

TOPICS FIRST PUBLISHED IN MAKKAH NEWSPAPER

An Essayist at the Seam of Two Worlds

*Selected Topics on Medicine, Money, and the Making of an
Industry*



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2023 – 2026 · 155 TOPICS



ABOUT THE AUTHOR

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Nabil Alhakamy is a professor at the Faculty of Pharmacy, King Abdulaziz University, and co-founder of several Saudi and U.S. ventures in health, pharmaceuticals, and biotechnology. He has spoken at TEDx on bringing pharmaceutical research into the public conversation.

He has written a weekly opinion column for Makkah Newspaper since 2023, in both Arabic and English, a rare position from which to watch one industry from three sides at once: the laboratory, the boardroom, and the regulator.

That vantage is what this book is made of.

Why Read This Book

Most writing about medicine tells you either how a drug works or what it costs. Rarely the same page. The science lives in journals the public cannot read; the money lives in filings the public does not open. Between them sits a gap where most of the important decisions actually get made.

These topics were written into that gap. They ask why a medicine that took twelve years to invent can lose its market in twelve months; why a sector that saves lives is valued below one that sells advertising; what it takes for a country to make its own medicine rather than buy it.

Nothing here requires a background in pharmacy or finance. Each piece was written for a newspaper reader, and each stands alone, open at any page. But read in sequence, they trace a single argument: that medicine is now inseparable from the capital, policy, and industrial capacity that carry it, and that a country which wants better health must build all four.

Contents

	PAGE	TOPICS
Part 1 Pharmaceuticals	5	37 topics
Read this section to understand why medicines cost what they cost, and why that number has more to do with patents, factories, and regulation than with chemistry.		
Part 2 Biotechnology	91	16 topics
Read this section to see where medicine is actually going, and to tell the genuine breakthroughs apart from the announcements.		
Part 3 Markets & Investment	125	36 topics
Read this section if you invest, allocate, or simply want to know who decides which cures get built, and on what evidence.		
Part 4 Business & Strategy	209	10 topics
Read this section for the ideas you can use on Monday morning, whatever industry you happen to work in.		
Part 5 Saudi Arabia	233	32 topics
Read this section for a practitioner's account of Vision 2030 in one sector, written from inside it, with the gaps left in.		
Part 6 Science & Technology	307	15 topics
Read this section for the technologies arriving in medicine next, explained without the jargon that usually guards them.		
Part 7 The Space Economy	341	9 topics
Read this section to watch a science turn into an economy, the same transition biotechnology is living through now.		

PART 1

Pharmaceuticals

37 TOPICS

A medicine is the most heavily engineered object most people will ever swallow, and the least understood. These topics follow one through its whole life: the decade of research before it exists, the patent that protects it, the price that decides who receives it, the regulator that permits it, the factory that reproduces it, and the cliff it falls from when its protection ends. Some pieces tell the story of a single molecule. Others take apart the machine that produces them all.

WHY READ THIS PART

Read this section to understand why medicines cost what they cost, and why that number has more to do with patents, factories, and regulation than with chemistry.

PHARMACEUTICALS · PART 1

In this part

NO.	TOPIC	PAGE	PUBLISHED
1	When Medicine Becomes a Silent Weapon	10	August 2026
2	Drug Protection Does Not Travel	12	July 2026
3	Active Ingredients and Key Starting Materials	14	July 2026
4	From Injection to Pill	16	June 2026
5	The US Health Secretary and the Fourteen Peptides	18	June 2026
6	Phase 3 Clinical Trials and the Profitability Test	21	May 2026
7	How a Painkiller Turned into a Massive Opioid Crisis	23	April 2026
8	Drug and Health Food Pricing Policies	26	April 2026
9	Social Responsibility in the Pharmaceutical Industry	29	January 2026
10	Pillars of Pharmaceutical Quality and Safety	31	January 2026
11	Opportunities in the Herbal and Natural Medicines Industry	33	December 2025
12	Comparing Global Pharmaceutical Markets	35	December 2025
13	The Story of a "Small Pill" That Transformed Pain Relief	37	December 2025
14	The Best-Selling Drugs in History	39	November 2025
15	The Most Widely Used Medications in History	41	October 2025
16	U.S. Drug Approvals Balancing Flexibility and Challenges	43	October 2025
17	Animal Testing, Human-Based Models, and Artificial Intelligence	45	September 2025
18	The Conflict Between Pharmaceutical Companies and U.S. Compounding Pharmacies	47	July 2025

PHARMACEUTICALS · PART 1

In this part

NO.	TOPIC	PAGE	PUBLISHED
19	India vs. China in the Global Pharmaceutical Industry Race	49	July 2025
20	Green Chemistry for Sustainable Pharmaceutical Industries	51	April 2025
21	The Growing Market for GLP-1 Drugs	54	December 2024
22	The Rapid Growth of the Anti-Obesity Drug Market	56	December 2024
23	Drug Development Through Virtual Trials	59	November 2024
24	Who Will Dominate the Future of Pharmaceutical Industries in 2030?	61	October 2024
25	How CDMOs are Leading the Pharmaceutical Market	63	September 2024
26	The "Hidden Engine" of the Pharmaceutical Industry	65	May 2024
27	Unlocking the Future of Medicine with AI's Revolution in Drug Development and Discovery	67	April 2024
28	Pharmacy of the World	69	March 2024
29	The Hunt of Big Pharma for Breakthrough Drugs	71	January 2024
30	Bracing for the Fall: Understanding the Patent Cliff's Impact on the Pharmaceutical Industry	74	December 2023
31	What is the priority, "Innovative Drugs " or "Generic Drugs"?	76	December 2023
32	What is the Virtual Pharmaceutical Companies?	78	September 2023
33	Why Investing in Orphan Drugs is Crucial?	80	September 2023
34	What is Pharmacoeconomics?	82	August 2023
35	The Pharmaceutical Industry is One of the Most Profitable Sectors Globally	85	July 2023

36 Australian Experience

87 July 2023

PHARMACEUTICALS · PART 1

In this part

NO.	TOPIC	PAGE	PUBLISHED
37	The Most Expensive Medicines Globally!	89	June 2023

PART 1 · TOPIC 1

When Medicine Becomes a Silent WeaponAugust 2026 · First published

The China Rx book opens with an idea that shakes the reader from the first line: China could bring an adversary to its knees without firing a missile or hacking a power grid; it would only need to cut off its medicine. The statement is shocking, but it captures the central argument of one of the most important books on drug security of the past decade.

Published in 2018 under the full title China Rx: Exposing the Risks of America's Dependence on China for Medicine, it was written by Rosemary Gibson, a healthcare-safety researcher, with Janardan Prasad Singh, a World Bank economist. It is an investigative account of how pharmaceutical manufacturing quietly migrated from the West to China over decades, until one country came to hold sensitive threads in the chain that sustains millions of lives.

Its key insight is a distinction often absent from public awareness: the medicine we take does not begin with the box, the pharmacy, or the hospital. It begins with the active pharmaceutical ingredient, the chemical compound that produces the real therapeutic effect. China has become a central supplier of many active ingredients, as well as the starting materials and intermediates used to make them. So the factory may be in America, Europe, or India, but the heart of the medicine may still originate in China, and the label rarely reveals that journey.

A few decades ago, the United States made essential medicines such as penicillin and vitamin C domestically. Today, components of common drugs, antibiotics, blood-pressure medicines, antidepressants, birth-control pills, and some cancer treatments are tied to cross-border supply chains in which China plays a central role.

The book warns of two linked risks. The first is strategic. When a country depends on a potential adversary for an indispensable good like medicine, it places part of its health security in that adversary's hands. The book offers a disturbing hypothetical: if conflict broke out in the South China Sea, wounded American soldiers could be treated with medicines whose origins depend on their geopolitical rival. At that point, medicine becomes a silent instrument of pressure; whoever controls the active ingredient can influence who is treated, when, and at what cost.

The second risk concerns quality and safety. The longer and more complex the chain, the harder it is to inspect and regulate. The 2008 heparin crisis, when contaminated batches of the anticoagulant reached the U.S. market and were linked to deaths, shows that dependence threatens not only availability but safety itself.

The story is familiar to anyone who follows industrial shifts. It began with prices too low to resist. Western and domestic manufacturers could not compete and shut production lines one after

another; expertise, trained workers, and the ability to restart vanished with them, turning a cost-cutting decision into strategic dependence on a single source. The COVID-19 pandemic, which followed the book's publication, proved the point: healthcare supply chains were far less resilient than assumed.

The book does not stop at diagnosis. It calls for transparency about the country of origin of active ingredients, stricter inspection of imports rather than reliance on paper documentation, a minimum level of domestic manufacturing for essential medicines, strategic stockpiles, and diversified supply sources. The goal is not isolation, but resilience enough to protect the health system in a crisis. Some critics find the book alarmist, and the exact extent of dependence is hard to measure, yet its core concern has become a major post-pandemic lesson.

If the United States, with all its industrial and regulatory power, worries about its dependence on foreign medicine, the lesson is even more urgent for the Arab world and the Gulf, which import most medicines and active ingredients. Drug security is not an economic luxury; it is part of national security. A country that cannot secure its essential medicines remains exposed to shocks it cannot control, such as a political crisis, a port closure, a price spike, or another state's export decision.

This is why Saudi Arabia's push toward local pharmaceutical manufacturing and partner diversification under Vision 2030 is more than industrial ambition; it is a safeguard for citizens' health in uncertain times. But real localization is not packaging boxes. It begins with understanding the whole chain: raw materials, intermediates, active ingredients, manufacturing, distribution, and regulation.

China Rx remains a powerful warning that medicine is not merely a commodity, and that when health is reduced to cost alone, it becomes a strategic weakness. Anyone who takes a pill should ask not only about its price but also about the long road it traveled: Who made its active ingredient? Who controls its supply? Can it be obtained in a crisis? Medicine is a treatment in a physician's hands, but it can become a silent weapon in the hands of whoever controls its earliest links.

PART 1 · TOPIC 2

Drug Protection Does Not Travel

July 2026 · First published

When we speak of protecting a new medicine, many assume it rests on a single patent. In reality, an innovative drug is usually protected by two locks. The first is the patent, granted by the intellectual property office to protect the molecule or invention itself. The second is regulatory exclusivity, granted by the medicines authority to protect the clinical data and scientific dossier that the innovator submits to win approval. Put simply, the patent protects the invention, while regulatory exclusivity protects the drug file.

What surprises many is that these locks are not designed the same way everywhere. Strong protection in the United States does not guarantee the same in Saudi Arabia; duration, scope, and application vary from one system to another.

In both countries, the standard patent term is generally twenty years from the filing date, administered by the USPTO in the United States and by SAIP in Saudi Arabia. The real difference comes afterward. In the United States, a company may obtain a patent term extension of up to five years to compensate for time lost during regulatory review, extending effective commercial protection well past launch. Saudi Arabia has traditionally relied on a flat twenty-year term without a clearly equivalent restoration mechanism, though similar tools are beginning to emerge. A U.S. patent can therefore deliver longer, more commercially useful protection, especially when development and review take years.

The most important difference is that patents are territorial. A U.S. patent gives its owner no automatic protection in Saudi Arabia; the Kingdom does not recognize “patents of origin” as standalone protection. To prevent competition locally, an innovator must file and obtain protection through SAIP. Filing only abroad can leave the Saudi market open, and once an invention is published anywhere, it may destroy novelty and make a late local filing nearly impossible. The rule is simple: protection does not travel with the molecule.

Regulatory exclusivity reveals an even sharper gap. In the United States, a new small-molecule drug typically receives five years of exclusivity, while biologics receive twelve years of data protection. Saudi Arabia is simpler: a minimum of five years for products based on new chemical substances, from the date of approval, and no separate longer period for biologics. So a biologic may enjoy twelve years of protection in America but only five in the Kingdom, a strategic factor affecting registration, pricing, partnerships, and market priorities.

Patents and exclusivity should not be confused. A drug may stay patent-protected after data exclusivity expires; conversely, a product may enjoy exclusivity even where its patent is weak or unregistered. Innovators use both together: the patent stops others from exploiting the invention,

while exclusivity stops the authority from relying on the innovator's data to approve a competitor for a set period.

The United States also runs a mature patent-linkage system through the Orange Book, connecting the regulator to patents on approved drugs so generics are not cleared while a valid listed patent blocks them. Saudi Arabia has only recently moved this way: a mechanism for handling patents during generic registration took effect on 1 January 2023, and the SFDA has begun building a patent-listing database in closer coordination with SAIP. The system is still maturing, but the direction is clearer than in earlier years, when copies were sometimes approved despite existing patents.

The Kingdom adds a dimension absent in the United States: incentives tied to local manufacturing. A biologic manufactured locally under license may benefit from price fixation for up to 7 years if all manufacturing phases are moved to Saudi Arabia. Protection here is linked not only to law and regulation but to drug security, technology transfer, localization, and Vision 2030. A company that sees the Kingdom only as a sales market misses much; one that treats it as a manufacturing partner finds deeper opportunities.

Three lessons follow. First, early local filing is a strategic necessity, not an option; global strength means little unless the patent is filed in Saudi Arabia. Second, Saudi exclusivity does not mirror American exclusivity, especially for biologics, so commercial assumptions cannot be imported from the U.S. Third, drug protection is no longer a purely legal battle; it spans intellectual property, registration, pricing, manufacturing, technology transfer, and partnerships.

The same medicine can enter two markets under two different rulebooks. Protection does not cross borders automatically: a U.S. patent will not protect the Saudi market, and twelve years of American exclusivity do not carry over. Any company that wants to protect its medicine must act early, file locally, and grasp the difference between protecting the invention and protecting the data. Strong science is essential, but so is a smart, local protection strategy.

PART 1 · TOPIC 3

Active Ingredients and Key Starting MaterialsJuly 2026 · First published

Every pill we swallow is the end of a long journey that began with raw chemicals bearing no resemblance to medicine. Between that start and the final tablet lies a precise chain of chemical, manufacturing, and regulatory transformations. At its center sit two terms many people confuse: the active pharmaceutical ingredient (API) and the key starting materials (KSMs). The distinction looks technical, but it shapes the price, quality, and security of medicine, and the extent to which our health depends on foreign supply. The real risk to drug security rarely shows in the finished tablet; it hides deep in the chain, where the story begins.

The API is the heart of the medicine, the chemical compound that produces the intended therapeutic effect in the body. When you take a painkiller, only a small part of the tablet is the active ingredient; the rest is inactive excipients. Those excipients do not treat the disease. They carry the active ingredient, improve its stability, impart the tablet's shape and taste, and help it dissolve and be absorbed. Because the API is the core, its manufacture is governed by strict standards, careful testing, and heavy oversight; any defect directly affects a medicine's effectiveness and safety.

Key starting materials are the first chemical building blocks from which the API is made, the starting point of the chain, where raw compounds enter reactors and, over several steps, become the active ingredient. They may not look connected to the finished drug, but they are its deep roots. A simple image helps: the KSMs are the roots, the API the fruit. Good fruit cannot grow from weak, contaminated, or unstable roots. Any defect in purity, source, method, or stability may reach the active ingredient and, in turn, the patient. Monitoring the beginning of the chain is no less important than inspecting its end.

Think of preparing a meal: raw ingredients like flour, oil, and spices are the starting materials; dough and sauce are the intermediates; the main dish is the active ingredient; plating and serving is the finished product, made once excipients are added. Every link depends on the one before it, and a medicine does not begin at the packaging factory; it begins with the first chemical used to make its active ingredient.

Three dimensions make this matter. The first is regulatory: authorities define the point where good manufacturing practice requirements begin. Set that line too far forward, and fewer steps face strict oversight, opening quality gaps; set it correctly, and oversight reaches deeper, where many risks begin. The second is safety: dangerous impurities often arise not at the API stage but in the starting materials or intermediates before it, small in quantity yet significant if toxic, hard to detect, or capable of accumulating. A safe medicine is built from the first step, not only the last.

The third dimension is strategic and economic, and the most serious. A country may believe it has achieved drug self-sufficiency because it makes the API locally, while importing all its key starting materials from a single foreign source. The dependence persists, hidden deep in the chain, more dangerous than visible dependence because it breeds false security. India is the clearest example: often called the pharmacy of the world and strong in API capacity, yet heavily reliant on China for many starting materials and intermediates. Self-sufficiency at the API level can still be incomplete if its roots are imported.

Whoever controls the beginning of the chain can influence its end. If key starting materials stop flowing, prices spike, or are disrupted by a pandemic, trade dispute, or political decision, even domestic API plants can halt. That is the deeper face of dependence: owning the factory without owning what feeds it. Real drug security is not achieved by packaging tablets locally, nor even by making APIs alone, but by understanding and securing the full chain as far as is realistic. This does not mean every country must make everything; full integration down to every KSM is costly and impractical. The goal is strategic resilience: identifying critical materials, diversifying suppliers, and creating alternatives for what cannot yet be made at home.

Any project to localize pharmaceutical manufacturing must therefore look beneath the surface. Packaging matters; finished-product manufacturing matters more; and API production is strategic, but the key starting materials reveal the true strength of the industrial base. The ambitions of Saudi Arabia and the wider region will reach their potential only if they extend from the fruit to the roots. A small tablet carries within it a global chain of science, industry, regulation, politics, and economics. Whoever owns the roots owns the fruit; whoever owns the beginning of the chain, in many ways, owns its end.

PART 1 · TOPIC 4

From Injection to PillJune 2026 · First published

Dear reader, over the past few years, obesity treatment has become closely tied to injections. Drugs such as Ozempic, Wegovy (Novo Nordisk), and Zepbound (Eli Lilly) reshaped obesity care, yet most remain weekly injections that require refrigeration, and for many patients, the fear of needles is a real barrier. Now, a new era is emerging with oral tablets. In late 2025, oral Wegovy became the first GLP-1 obesity treatment available in pill form. Then, on April 1, 2026, the U.S. Food and Drug Administration approved orforglipron, marketed as Foundayo (Eli Lilly). The change may look simple, but its impact on use, access, and adherence could be profound.

These developments are sequential and complementary. Oral Wegovy recorded more than 600,000 U.S. prescriptions within months, but it must be taken on an empty stomach with precise instructions on water and food. Foundayo arrived with a striking advantage: it is the only pill in its class that can be taken at any time of day, without food or drink restrictions, and it received accelerated approval under a new regulatory pathway designed to speed access to critical medicines.

For millions of patients, injections have been both a psychological and a practical obstacle. Eli Lilly notes that fewer than 1 in 10 people who could benefit from these medicines actually use them, due to limited access, complexity, or cost. A simple daily pill breaks down those barriers, simplifies distribution, and fits into daily life, expanding access, not just offering efficacy.

Dear reader, many of these medications are peptides, chains of amino acids that are fragile and break down in the stomach, which is why they were traditionally injected to preserve their structure. What is exciting is that scientists have developed formulations that partially protect the peptide and limit its breakdown, allowing some to be delivered as tablets, as with oral Wegovy.

Foundayo is different: not a peptide but a small chemical molecule. Small molecules can be manufactured in large quantities at lower cost, are easier to transport and distribute globally, and carry no food-related restrictions. The move from peptide to small molecule has freed the pill from many constraints.

In a clinical trial of more than 3,000 adults with obesity, those on the highest dose of Foundayo lost around 11 percent of their body weight over more than 16 months, compared with about 2 percent on placebo, according to results published in a leading medical journal. Cost starts at around 25 dollars per month for patients with insurance and is higher for those paying out of pocket. The medicine is distributed through home-delivery platforms that combine telemedicine with pharmacies and authorized retail channels.

Still, the picture is not without caution. Side effects appear broadly similar to those of injectables in the same class, nausea and gastrointestinal disturbances, plus warnings related to the thyroid gland. More importantly, weight may return after stopping treatment, making this a long-term commitment rather than a quick fix, and cost remains a burden for many. Some worry that obesity may be treated as a condition solved by a pill while the environment that created it is forgotten. These pills, dear reader, may reduce the effect, but they do not, by themselves, change the lifestyle that produced obesity.

It is no secret that our region is among those with the highest rates of obesity and diabetes in the world. The advantages of these pills are therefore significant: effective, relatively inexpensive, requiring no injections or refrigeration, and a potential therapeutic leap if properly regulated and made accessible. Yet the pill is a powerful tool only in the hands of someone using it within a healthier lifestyle, not a substitute for balanced nutrition, physical activity, good sleep, and reducing the daily factors that drive weight gain.

The transition from injection to pill remains a defining moment in the history of obesity treatment. It may reach millions of patients who were previously beyond its reach. But the real measure of success will not be the number of prescriptions written. It will be the long-term health of people, and our ability to turn this new tool into a bridge toward a better life, not a cover for an environment that continues to produce disease every day.

PART 1 • TOPIC 5

The US Health Secretary and the Fourteen Peptides

June 2026 · First published

Dear reader, in February 2026, during a conversation on one of the world's most widely followed podcasts, U.S. Health Secretary Robert F. Kennedy Jr. said he expected the Food and Drug Administration to reopen access to roughly fourteen peptides through trusted suppliers and under a more regulated framework. It was a short statement, but it landed heavily. It sparked excitement among advocates of alternative health and longevity medicine, while also raising serious concern among many physicians and scientists. What is the story behind these fourteen peptides? And why have they become a battleground between freedom of access and the requirements of scientific evidence?

In late 2023, the FDA moved nineteen peptides from Category 1 to Category 2 on its regulatory lists. Under the rules governing compounding, Category 1 covers substances that pharmacies are permitted to compound because they are recognized as reasonably safe and suitable for that purpose, whereas Category 2 covers substances flagged with significant safety concerns, which effectively bars pharmacies from compounding them until those concerns are resolved. This was not a cosmetic change. It effectively prevented compounding pharmacies from preparing these peptides for patients, citing unresolved safety concerns and a clear lack of scientific and clinical data. Dear reader, the compounding pharmacy is one that custom-prepares medications for individual patients by combining or altering ingredients to meet a specific prescription, rather than dispensing standard, mass-manufactured drugs. Now, the secretary is seeking to reverse that decision for about 14 of them, or some of them, returning them to a category that would allow licensed pharmacies to compound them by prescription, while others remain tied up in legal and regulatory disputes. It is important to note that the discussion is not about free sale on pharmacy shelves. It is about regulated access via a physician's prescription and through channels (compounding pharmacies) that are supposed to be trustworthy.

Let's discuss what a peptide is, which is a short chain of amino acids, smaller than a protein. Amino acids are the basic building blocks that link together like beads on a string to form these chains, and the difference between a peptide and a protein is mainly one of size: a chain is usually called a peptide when it is short (roughly up to 50 amino acids or less) and a protein when it is longer and folds into a larger, more complex structure. Many peptides are naturally produced by the human body and perform essential biological functions. Some peptides have also become well-established approved medicines, including several modern weight-loss drugs. But the peptides at the center of this debate are different. They are not approved medicines in the conventional sense, and they are often marketed for benefits that have not been sufficiently proven in clinical studies: tissue repair, anti-aging, faster recovery, immune enhancement, and longevity.

Among the best-known examples is BPC-157, promoted by some as a healing peptide for injuries, along with ipamorelin, MOTS-c, and others. Here lies the paradox: the word “peptide” can refer both to a life-saving medicine and to an experimental product that has not been adequately tested. The problem here, dear reader, therefore, is not that a substance is a peptide. The problem is the level of evidence supporting its use, and whether its safety and effectiveness in humans are clearly established.

The secretary’s position rests on an argument that may appear reasonable at first glance. He argues that the previous regulatory approach was too restrictive and that prohibition did not eliminate demand. Instead, it pushed people into black and gray markets across the internet and social media, where products of unknown source, concentration, and purity are sold without meaningful oversight. From this perspective, allowing these peptides to be compounded in licensed pharmacies under medical supervision may be safer than leaving consumers to an uncontrolled market where nobody truly knows what the products contain.

This position also fits within a broader political message focused on making America healthy again, expanding consumer choice, and reducing regulatory barriers that some believe deny people potentially useful therapeutic or preventive options. Yet this logic, attractive as it may sound, raises a fundamental question: is demand alone enough to reopen the door, or must clear scientific evidence first demonstrate that these products are safe and effective?

Many experts warn that the problem is not merely legal; it is scientific. These peptides lack rigorous clinical evidence proving their benefit and long-term safety. Specialists have noted that BPC-157, despite its popularity among people interested in recovery, fitness, and longevity, has not been studied in sufficiently robust human trials. Much of the available information comes from very small studies, limited observations, or sources that do not meet the evidentiary threshold needed for broad medical use.

Scientists fear that reclassification could give these products an official aura, leading the public to assume they are scientifically proven when they have not been properly tested. For that reason, the FDA has planned advisory committee sessions to review several of these peptides before making final decisions. That alone is an acknowledgment that the matter is not simple, and that opening the door requires a careful balance between access and safety.

At its core, this is a clash between two philosophies. The first emphasizes consumer freedom and rapid access to therapeutic options, especially if prohibition pushes people toward unsafe markets. The second insists that medicine must remain evidence-based, and that broad use of any substance must be preceded by clear proof of benefit and safety. Between these two positions lies a difficult gray zone. A total ban may drive people toward danger, while permissive access may give unproven products the appearance of legitimate treatment.

The real question, therefore, is not simply whether these peptides are legal or prohibited. The real question is whether they have been proven useful and safe. Medicine is not built on enthusiasm,

marketing promises, or isolated recovery stories. It is built on controlled studies, clear data, and long-term follow-up. The greatest warning remains that peptides sold under the label “for research purposes only” will continue to sit outside real medical oversight, making them the most dangerous category of all.

This may look like an American regulatory debate, but it is already knocking on our doors. The global wave of longevity, anti-aging treatments, experimental therapies, and biohacking has reached our region as well. Many of these same products are sold online, promoted in gray markets, and dressed in scientific language that often sounds convincing but remains incomplete. People may buy them out of hope, fear of disease, or the desire to remain young, without knowing their source, purity, dose, or risk.

The lesson is twofold. On one hand, we should not allow social media to become a medical clinic, nor should we inject or consume experimental substances simply because they are popular or endorsed by influencers. On the other hand, we need clear regulatory frameworks that distinguish between proven medicines and experimental products, and between genuine research and marketing disguised as science. Absence of regulation invites chaos; excessively rigid regulation may push people underground. The wise path is a transparent, safe, and evidence-driven route.

In the end, the story of the fourteen peptides reminds us that access to treatment is not an end in itself. It is a means that must be preceded by evidence. Reopening the door may improve safety by replacing black-market use with supervised medical access. But it may also send the wrong signal if the public interprets it as implicit scientific approval of products that have not yet been proven. The rule must remain clear: a door opened without evidence may let in benefit, but it may also let in harm. We should always ask not only whether something is available or permitted, but whether it has truly been shown to be safe and effective.

PART 1 · TOPIC 6

Phase 3 Clinical Trials and the Profitability TestMay 2026 · First published

Dear reader, in the world of drug development, you will often hear the phrase, “the results look promising.” But a truth many ignore is that a scientific promise does not automatically translate into a commercial opportunity worth tens or hundreds of millions of dollars. Today, Phase 3 clinical trials, the most expensive, longest, and most sensitive stage, have become something like a major investment gate. It is no longer enough that a drug works; it must also be profitable, sellable, and arrive at the right time in a crowded market.

Years ago, the decision to move into Phase 3 was built largely on one question: Do we have strong scientific evidence that the therapy is effective and safe? That question still matters, but it is no longer sufficient. Phase 3 is not just a larger scientific experiment; it is the step that sits right before pricing, regulatory negotiation, and head-to-head competition with products that may already exist, or may reach the market within months.

The first reason for this shift is cost. Phase 3 can require thousands of patients, multiple sites, long follow-up, and complex analyses. These are not just “research bills”; they are decisions like building a factory before confirming the product will sell. Investors and companies now ask: Does the expected return justify the risk? And is there a clear path to recovering the investment before the market changes its rules?

Then comes the bigger question: market size. You might have an excellent therapy for a very rare disease, or for a small subgroup within a common disease. Scientifically, that can be a major achievement. Commercially, it may set a low ceiling. That is why market assessment is now part of the Phase 3 decision: how many patients can realistically be reached? How many will actually receive therapy in accordance with clinical guidelines and insurance coverage? Can the commercial team build a distribution and marketing engine strong enough to generate meaningful sales? Many assets “succeed” medically but never find a large enough audience to sustain a business.

After-market size and competitive timing become just as critical. A drug may work, but if a stronger competitor is expected to hit the market 6–12 months earlier, or if multiple competitors are advancing in the same class, the commercial value can fall quickly. In that scenario, Phase 3 becomes a calculated gamble: do we truly have a chance to arrive early, or at least arrive with a clear advantage? Do we have real differentiation, or are we only a slightly improved version? Markets rarely reward “second place” unless it is clearly cheaper, easier to use, safer, or meaningfully better on outcomes that matter.

This leads to a very practical concept: the price corridor. In other words, within what price range can the drug be sold without triggering rejection from payers (insurers, government systems, private

hospitals), and without collapsing under pressure from cheaper alternatives? This question no longer waits until after Phase 3. It is asked early because pricing is not just an internal decision; it is tied to the clinical evidence you plan to present. If outcomes are not clearly superior, the market will push the price toward existing alternatives. And if manufacturing or operational costs are high, the project can become economically irrational even if it is scientifically successful.

Payer expectations have also changed. It is no longer enough to say, “the drug improves a lab marker,” or “the difference is statistically significant.” What matters today is whether it reduces hospitalizations. Does it prevent complications? Does it measurably improve quality of life? Does it save the healthcare system costs? That is why many companies redesign Phase 3 trials to prove a value that can actually be priced, not just general efficacy.

There is also a quiet but powerful factor: access and adoption. A therapy can be excellent yet difficult to use, requiring specialized infrastructure, advanced training, cold-chain logistics, operating room time, or intensive monitoring. Every extra step creates friction in the real world. Hospitals, physicians, and patients operate under time limits, budget constraints, and workflow realities. So, before entering Phase 3, practical questions arise early: will physicians be willing to change their habits? Does the current care pathway allow this therapy to be added smoothly? Are there logistical barriers that could kill uptake even after approval?

None of this means science has lost its value. On the contrary, science remains the necessary foundation. But Phase 3 funding now requires a convincing answer to a newer question: can this scientific success be turned into a product that earns revenue, reaches patients, becomes adopted in practice, and survives competition? Phase 3 is where the laboratory intersects with the market, and those who fail to read the market early often pay a massive price late.

If we summarize the entire picture in one sentence, Phase 3 is no longer a test of science alone, but a test of your ability to build a complete value story, a story that convinces the physician, the patient, the investor, and the party paying the bill. Without that story, even the best results can become a “success on paper” and a failure in reality.

PART 1 · TOPIC 7

How a Painkiller Turned into a Massive Opioid Crisis

April 2026 · First published

Dear reader, the story of Purdue Pharma and its drug OxyContin is one of the most painful chapters in modern medical history because it shows how a medicine that starts as a solution for pain can become the door to a massive wave of addiction and deaths across an entire country. The story begins in the mid-1990s, when Purdue launched OxyContin in the US market and presented it to doctors and patients as a strong, long-acting painkiller that could give continuous relief with a "low risk of addiction," according to the company's claims. That short phrase, "low risk of addiction", was the spark on which almost the entire marketing strategy was built, and time proved it to be misleading and dangerous.

OxyContin contains oxycodone, which belongs to the opioid family, medicines used to treat severe pain, such as cancer pain or pain after major surgery. The problem with these drugs, dear reader, is that they have two faces: on one side, they are very effective at relieving intense pain when other medicines don't work; on the other side, they carry a high risk of addiction, and high doses can suppress breathing and cause death. Purdue promoted OxyContin as a "controlled-release" tablet that releases the drug slowly over 12 hours and claimed that this slow release reduces the chance of addiction compared with fast-acting opioids. But there was no strong scientific evidence to support this claim in the way the company suggested.

At that time, the medical mood in the United States was shifting. Pain was being talked about as the "fifth vital sign," and hospitals and patient groups were putting more and more pressure on doctors to do something about pain and to make sure patients were not left suffering. In this environment, Purdue saw its opportunity. It built an army of sales representatives who visited doctors and clinics constantly, carrying brochures, giving "educational" talks, offering meals and small gifts, and repeating one message over and over: if OxyContin is used as prescribed, the risk of addiction is very low. Many doctors believed this message, thinking it was based on solid research, when in reality it was built on weak data and inappropriate sources.

The company did not stop at serious cases like cancer pain. It pushed hard to use OxyContin for common chronic pains: back pain, joint pain, and other orthopedic problems. This changed the drug's role from a heavy painkiller that should be used with extreme caution into a relatively "normal" option for long-term pain in large numbers of patients. The result was an explosion in prescriptions: millions of pills were being written every year, spreading into homes, pharmacies, and communities across America.

At first, everything looked official and legal: a doctor writes a prescription, a pharmacy dispenses the drug, and a well-known company stands behind the product. But over time, problems started to appear. Some patients developed tolerance, meaning their bodies no longer responded to the usual

dose, so they needed higher and higher doses to get the same relief. Others learned that if they crushed or dissolved the tablets, the slow-release mechanism disappeared and the pill turned into one big dose that produced an intense “rush” similar to heroin. As these tricks spread from person to person, OxyContin started to be widely abused. Pills were stolen from medicine cabinets at home, sold on the street, and shifted from being a prescription medicine into a street drug in some communities.

At the same time, the numbers began to climb: rising cases of addiction, more overdoses, more deaths linked to opioids, including OxyContin. Although warning signs were clear, many accuse Purdue of continuing for years to minimize the risks and to market the drug aggressively. Regulators such as the US Food and Drug Administration (FDA) were also not strict enough in the early years. The warnings on the drug’s label did not fully reflect the dangers of long-term use. Later on, the warnings were strengthened, but by then the damage had already spread.

The crisis grew into what is now called the opioid epidemic in the United States. Many people found themselves addicted to medicines prescribed initially by their own doctors for pain. When authorities and health agencies started tightening rules on opioid prescribing, some patients turned to the black market to get cheaper and more available alternatives like heroin. Then came fentanyl, a potent synthetic opioid, and overdose deaths shot up to tens of thousands per year. Today, fentanyl is the main cause of these deaths, but as many experts say, the starting point was the massive over-prescribing of prescription opioids, with OxyContin at the center.

Facing this harsh reality, Purdue Pharma and the Sackler family that owned it were hit by a wave of lawsuits from states, cities, Native American tribes, health institutions, and families of victims. Documents and investigations showed that the company had deliberately downplayed the risk of addiction and promoted an overly comforting and inaccurate image of the drug’s long-term safety. In 2007, a branch of the company and several top executives admitted, in a criminal settlement, to misleading marketing and paid hundreds of millions of dollars in fines. But that did not stop the lawsuits, which continued and grew bigger.

In 2019, under huge financial and legal pressure, Purdue filed for bankruptcy. The goal was not to shut down overnight, but to use bankruptcy law to consolidate thousands of cases into a single process and reach a global settlement, with billions of dollars directed to treatment programs, prevention efforts, and support for affected communities. Proposed plans included the Sackler family giving up ownership of the company and turning Purdue into a “public benefit” entity focused on addiction treatment and overdose reversal medicines, with profits going to communities rather than previous owners. Nevertheless, some parts of the deal, especially the terms that would protect the family from future lawsuits, sparked public anger. After negotiations and changes, a revised settlement worth billions of dollars was approved, though the moral debate around it continues.

Dear reader, if we want to summarize the lesson from this story, we can say it is a global warning about the moment when a patient is treated as a “market” and pain becomes a “business

opportunity.” When misleading marketing, pressure on doctors, weak early regulation, and people’s real need for relief all mix together, the result can be disastrous. The story of Purdue and OxyContin is not just a chapter in the history of one drug; it is a loud alarm for health systems everywhere about the danger of letting marketing drive treatment decisions without a real balance between the patient’s well-being and commercial profit.

PART 1 · TOPIC 8

Drug and Health Food Pricing Policies

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Dear reader, the pricing of medicines and health-related food products is not just a simple financial decision. It sits at the intersection of three sometimes conflicting interests: a patient who wants an affordable medicine, a pharmaceutical company that wants to recover its research and development costs and make a profit, and a government health system that must control spending to stay sustainable for decades. That's why pricing is one of the most sensitive issues in any health system, regardless of a country's culture or income level.

In Saudi Arabia, the Saudi Food and Drug Authority (SFDA), together with other government bodies, is responsible for regulating medicine prices. The basic philosophy is to prevent excessive prices while maintaining a healthy market that still attracts companies rather than pushing them away. Drug prices are not entirely left to free-market forces. Instead, a price range is set by comparing the drug's price in reference countries, considering whether it is an innovative drug or a generic, the type of disease it treats, and whether it is purchased in large volumes by the government (through centralized purchasing) or dispensed in the private sector. The idea is to keep prices controlled but not extreme, high enough to keep companies interested, but not so high as to harm patients and the health system.

In the United States, the situation is almost completely different. The drug market is largely driven by free-market dynamics, with only indirect government involvement through programs like Medicare and Medicaid, plus newer laws that allow limited price negotiation for certain medicines. The list prices you see on paper are among the highest in the world, but behind the scenes, there are many discounts and confidential agreements between drug companies, pharmacy benefit managers (PBMs), and insurance companies. The traditional American philosophy is to give market forces and innovation a lot of space, then try to "smooth the rough edges" with partial regulation, rather than having the state itself directly set prices as happens in much of Europe.

In Europe, most countries follow a more tightly government-regulated pricing model. Countries such as Germany, France, the UK, and Italy rely on specialized agencies to assess the added value of a new drug: does it offer a real benefit compared with existing treatments? If the answer is yes, they negotiate a price that reflects that value; if the added benefit is small, the allowed price is much lower, or the drug may not be reimbursed by public insurance at all. Many European states use a mix of external reference pricing (comparing their prices with those of other countries) and internal reference pricing (comparing with similar drugs in their own market), together with detailed negotiations and agreements based on usage volume or clinical outcomes. The result is often lower prices than in the US, but access to new drugs may be slower because the evaluation and negotiation process can take time.

In China, drug pricing is undergoing a major overhaul. The government uses centrally negotiated national reimbursement lists and organizes large tenders that push prices down in exchange for very high sales volumes. The logic is clear: “lower the price, and you get access to a market with hundreds of millions of patients.” This makes China attractive to companies despite the low price per pack, as the market size can offset the lower margins. At the same time, some medicines remain outside these national lists and can be sold at higher prices in the private sector, but the overall direction is strongly toward lower prices and wider coverage.

India is a special case, especially in generic medicines. There is a national list of essential drugs whose prices are strictly controlled, while a wider range of pricing is allowed for other products. Historically, India chose to support its local generics industry and to provide low-cost medicines to as many people as possible. That is why many Indian-made drugs are significantly cheaper than their equivalents in Western markets, whether used within India or exported abroad. On the other hand, imported innovative drugs usually have higher prices and are often the subject of special negotiations.

In Japan, pricing is closely regulated within a universal health insurance system that covers most of the population. The government sets official prices in a national reimbursement list and regularly reviews them. It sometimes applies automatic price cuts when generics become widely used or when the actual market price falls. Typically, Japan allows relatively higher prices for new drugs in the first few years to encourage innovation, then gradually reduces them later to protect the stability of the healthcare budget.

Outside these major players, models vary but usually revolve around similar tools: some countries rely mainly on external reference pricing, others on internal benchmarking, others on direct negotiation and confidential discounts, and lower-income countries often depend on pooled procurement and centralized tenders, sometimes supported by international organizations.

As for foods, supplements, and health-style nutrition products, prices in most countries are closer to free-market levels, with oversight focused on preventing monopolies or extreme price hikes during crises. In Saudi Arabia, for example, the government may intervene in the pricing of certain basic food items to protect consumers and ensure food security. At the same time, most other products are left to market competition within general regulatory limits.

Dear reader, the common thread in all these systems is the idea of “value for money.” The key question is no longer just “How much does the manufacturer want to earn?” but also “What real health value does this medicine deliver, and how much future cost does it save the health system?” Based on that, countries try to translate value into a price they can afford, given their budgets and market size. The differences in pricing policies between Saudi Arabia, the US, Europe, China, India, and Japan do not mean that one model is absolutely right and the others are wrong. Instead, each country is searching for its own balance between protecting patients, encouraging innovation, and controlling spending. Still, the global trend is slowly moving toward more transparency and a

stronger link between price and real value, so that medicines become a calculated health investment, not a random financial burden, and not an unlimited profit machine either.

PART 1 · TOPIC 9

Social Responsibility in the Pharmaceutical IndustryJanuary 2026 · First published

Dear reader, social responsibility in the pharmaceutical industry represents one of the most significant challenges companies face today. The urgent need to balance community obligations with profit-making is more pronounced than ever, primarily due to the direct impact pharmaceutical products have on people's lives and health. This makes ethical and social commitments essential criteria in assessing the overall success of pharmaceutical companies.

One primary area where pharmaceutical companies demonstrate social responsibility is ensuring essential medicines and treatments are available and affordable for everyone. According to reports from the World Health Organization, over 2 billion people worldwide still lack access to basic medications. Global pharmaceutical companies are actively addressing this gap through various initiatives, including providing medicines at reduced prices or even free of charge in developing countries and low-income regions.

Transparency and ethical conduct in manufacturing and marketing represent another crucial aspect of social responsibility in the pharmaceutical industry. Misleading or aggressive marketing practices continue to be a significant concern in this sector. Consequently, prominent industry leaders, such as Johnson & Johnson, Roche, and Pfizer, prioritize transparency by openly publishing the results of clinical trials and scientific research to maintain public trust and uphold ethical standards.

Furthermore, pharmaceutical companies make significant contributions to local communities through proactive and meaningful investments. For example, Johnson & Johnson dedicated over \$1.5 billion to social responsibility programs in 2023 alone, covering healthcare, education, and social welfare initiatives. Similarly, Novartis allocated approximately \$1.2 billion to similar initiatives in developing regions.

However, social responsibility in the pharmaceutical industry extends beyond financial contributions. Environmental sustainability has become a critical pillar within the industry's broader social responsibility framework. According to a 2024 report published by Forbes, over 80% of the largest pharmaceutical companies have committed to transparent and measurable carbon emission reduction goals by 2030, primarily by optimizing manufacturing processes and transitioning to cleaner energy sources.

Additionally, pharmaceutical companies have increased their efforts in medical research directed at rare or underserved diseases. IQVIA's recent report highlighted a notable 15% increase in investment in treatments for rare diseases between 2020 and 2024. This demonstrates a clear commitment to supporting medically marginalized groups.

Saudi pharmaceutical companies are also actively engaged in community service through various initiatives, including health awareness campaigns, environmental sustainability programs, and close collaboration with healthcare providers and governmental agencies. These companies frequently sponsor educational campaigns and medical conferences throughout the Kingdom, significantly enhancing public health awareness.

Moreover, these companies are committed to sustainability and environmental goals. For instance, Tabuk Pharmaceuticals partnered with Schneider Electric, aiming for carbon neutrality by 2025. On the social responsibility front, Saudi Pharmaceutical Industries and Medical Appliances Corporation (SPIMACO) donated medications valued at 11 million Saudi Riyals to support the Ministry of Health during the COVID-19 pandemic, in addition to ongoing support for charities such as the Disabled Children's Association.

Collaborations between pharmaceutical companies and official bodies have also intensified. The Tamer Group, for instance, partnered with King Abdulaziz University to establish a research chair aimed at converting scientific research into innovative medical products. Additionally, Al Nahdi Medical Company signed a memorandum of understanding with the Saudi Data and AI Authority (SDAIA) to support community health initiatives through the national "Ehsan" platform. These efforts underscore the commitment of leading Saudi companies, such as SPIMACO, Al Nahdi, and Tabuk Pharmaceuticals, to social responsibility, community engagement, and alignment with the Kingdom's Vision 2030 goals.

Despite these impressive initiatives, a significant challenge for pharmaceutical companies remains the delicate balance between fulfilling social responsibilities and meeting shareholders' expectations for profits. Yet, studies consistently indicate that firms integrating social responsibility into their core strategies tend to achieve more sustainable financial performance in the long run. According to McKinsey & Company's research, companies that prioritize social responsibility enjoy a 5-7% higher profitability compared to those that neglect these areas.

In conclusion, dear reader, the pharmaceutical industry's commitment to social responsibility remains essential for sustained growth and success. With increasing global awareness of the crucial role corporations play in promoting public health and environmental sustainability, pharmaceutical companies are expected to continue developing even more effective policies and programs. The ultimate challenge, however, remains finding the optimal balance between societal commitment and profitability, ensuring both sustainable economic success and meaningful, lasting community impact.

PART 1 · TOPIC 10

Pillars of Pharmaceutical Quality and SafetyJanuary 2026 · First published

Dear reader, the pharmaceutical industry plays a crucial role in protecting human health, which necessitates stringent standards to ensure the quality and safety of the drugs it manufactures. This has led to the establishment of "Good Manufacturing Practices" (GMP) and "Good Laboratory Practices" (GLP), structured methodologies governing each stage of pharmaceutical production and development. So, what are these standards, what is their history, and why are they so vital for the pharmaceutical industry?

The GMP standards first emerged in the United States in 1962, following the tragic Thalidomide incident. Thalidomide caused severe birth defects in thousands of children after their mothers used the drug during pregnancy. This catastrophic event prompted regulatory authorities, notably the U.S. Food and Drug Administration (FDA), to introduce rigorous standards aimed at ensuring the safety and quality of drug manufacturing processes.

As for the GLP standards, dear reader, these were introduced in the 1970s, specifically in 1978, when the FDA developed guidelines to regulate the quality of laboratory research and studies. These guidelines aim to guarantee the accuracy and reliability of results obtained from non-clinical drug testing.

GMP comprises principles and procedures that ensure pharmaceutical products are consistently produced to the highest quality standards. These practices encompass detailed regulations that cover every step of production, from receiving raw materials to manufacturing, packaging, and distributing the final product. GMP standards encompass cleanliness conditions, employee training, detailed documentation, and ensuring the final product consistently meets defined specifications, among other necessary pharmaceutical manufacturing steps.

GMP standards significantly reduce potential health risks by ensuring consistent, high-quality production for each batch of drugs. For example, a 2021 report by the World Health Organization (WHO) highlighted a substantial reduction in cases of drug contamination and counterfeiting in countries that rigorously implement GMP standards. This demonstrates the profound impact GMP has on patient safety.

Furthermore, dear reader, GLP constitutes rules governing laboratory operations and the conduct of safety studies for new drugs. The core purpose of GLP is to ensure the credibility and reliability of data generated from these studies, enabling regulators to make informed decisions about approving clinical trials based on this information.

The importance of GLP is immense because it ensures the integrity of data relied upon by researchers and regulatory bodies during the early stages of drug development. According to the European Medicines Agency (EMA), strict adherence to GLP has notably improved the accuracy of laboratory results, facilitating more confident and informed decisions when advancing drugs to clinical trial phases. This directly enhances the quality of drugs and patient safety.

Regulatory agencies such as the FDA and the Saudi Food and Drug Authority (SFDA) enforce these standards meticulously. For instance, in Saudi Arabia, the SFDA conducted over 300 inspections of pharmaceutical manufacturing sites in 2022, reflecting a significant increase in GMP compliance. Similarly, the EMA has reported notable improvements in laboratory reliability and reductions in drug rejection rates due to strict adherence to GLP standards.

In conclusion, dear reader, GMP and GLP standards are not merely regulatory protocols, but fundamental pillars that ensure pharmaceutical products maintain the highest quality and safety levels. As these standards continue to evolve, strict adherence remains crucial in safeguarding patient health and reinforcing public trust in pharmaceutical products worldwide.

PART 1 · TOPIC 11

Opportunities in the Herbal and Natural Medicines Industry

December 2025 · First published

Herbal and natural medicines, often referred to as traditional or complementary medicine, represent a therapeutic approach that utilizes plants and their active ingredients to promote health and treat diseases. This practice has deep historical roots spanning centuries and diverse civilizations. Even today, herbal medicines remain integral components of healthcare systems worldwide.

Herbal medicines typically derive their active ingredients from natural sources, such as herbs, roots, flowers, and seeds, which are used for various therapeutic and preventive purposes. According to the World Health Organization (WHO), approximately 80% of the global population relies on herbal medicine for at least some aspect of primary healthcare, particularly in developing countries, where herbal remedies can constitute up to 80% of accessible healthcare. The WHO further reports that around 88% of countries worldwide integrate traditional healing methods, including herbs and acupuncture, into their healthcare frameworks, underscoring the widespread acceptance and importance of this sector.

This broad acceptance has given rise to a booming global herbal medicine industry. Ancient traditions have evolved into commercialized modern products, ranging from herbal dietary supplements and plant-based pharmaceuticals to packaged traditional remedies. Driven by increased consumer demand and substantial research investment, the sector has rapidly become one of the fastest-growing segments in the global healthcare market.

Recent years have marked a significant shift in consumer preferences toward natural and herbal products. Growing awareness of the potential benefits of herbal medicines compared to synthetic pharmaceuticals has been fueled by a desire for healthier, more “natural” lifestyles. Younger generations, especially millennials and Gen Z, are pivotal drivers of this market growth. Data indicates that around 65% of consumers from these younger demographics regularly incorporate herbal remedies into their wellness routines. Furthermore, digital transformation plays a substantial role, with approximately 62% of consumers preferring to purchase herbal products online due to the ease of access and wider variety.

The global herbal medicine market has seen impressive growth, reaching approximately \$233 billion in 2024, with projections estimating it will reach around \$251 billion by 2025. Long-term forecasts remain optimistic, predicting the market will expand to approximately \$437 billion by 2032, reflecting a robust annual growth rate between 8% and 10%. Indeed, over recent years, this market has sustained annual growth of roughly 9-10%, positioning herbal and natural medicines prominently within the broader healthcare and pharmaceutical sectors.

Regionally, Europe and Asia dominate the global market landscape. Europe leads the market with a share of nearly 44% as of 2024, closely followed by the Asia-Pacific region, which commands over 40% due to the vast markets in China and India. North America trails slightly behind but remains a significant and influential market. For instance, the herbal supplements sector in the United States alone was valued at approximately \$9.6 billion in 2020, with around 22% of American adults regularly consuming herbal supplements. Similarly, Germany has developed a thriving market, valued at roughly €1.9 billion in 2020 for herbal medicinal products.

In Asia, China and India are prominent players driving substantial market activity. China's traditional herbal medicine sector alone reached a staggering \$55 billion in 2021. Meanwhile, Saudi Arabia has experienced significant growth in herbal medicines, driven by increasing health awareness and a shift in consumer preferences toward natural health products. The herbal and natural medicine market in Saudi Arabia reached approximately 3.9 billion Saudi Riyals in 2022 and is expected to grow steadily at an annual rate of around 7-9%, potentially exceeding 5.6 billion Saudi Riyals by 2028. The Saudi Food and Drug Authority (SFDA) reports thousands of officially registered herbal and natural products, alongside strengthened regulatory measures to ensure their safety, quality, and consumer confidence.

These figures underscore the fact that the herbal medicine industry is no longer confined to specific cultures or regions; it has evolved into a significant global economic phenomenon. Additionally, the diversity within this market is worth highlighting: herbal supplements (such as capsules, tablets, and tinctures derived from medicinal plants) currently represent the largest product category, accounting for over 60% of the overall market.

In conclusion, the herbal and natural medicine industry presents substantial growth opportunities, driven by shifts in consumer preferences, technological advancements, and strong market dynamics. As more people worldwide seek natural and safer alternatives for health management, this sector is likely to remain a cornerstone of the global pharmaceutical landscape for decades to come.

PART 1 · TOPIC 12

Comparing Global Pharmaceutical Markets

December 2025 · First published

Dear reader, pharmaceutical markets vary significantly across different regions, influenced by economic, regulatory, and healthcare factors. North America, particularly the United States, holds the largest share of global drug spending in terms of value. For instance, statistics from 2022 indicate that North America accounts for roughly 52% of global pharmaceutical sales, compared to about 22% for Europe. This disparity primarily stems from high medication prices in the U.S. and its healthcare system, which is heavily reliant on private insurance companies, allowing pharmaceutical corporations to generate substantial profits. In fact, in 2023, total worldwide revenues from blockbuster drugs (those generating billions annually) reached approximately \$511 billion, with the U.S. alone contributing about 58%, or \$298 billion.

These figures demonstrate the U.S. market's dominance as the primary driver of growth for the global pharmaceutical industry. Medications like HUMIRA, for example, derive most of their revenues from the American market, selling at significantly higher prices compared to other countries.

In Europe, despite a substantial population and robust scientific and industrial capabilities, the region's share in global pharmaceutical sales remains relatively minor due to stricter price regulations and government-controlled healthcare systems. Many European countries actively negotiate medication prices and enforce cost-containment policies, limiting revenue growth compared to the U.S., even though per capita drug consumption may be similar or higher. Moreover, the use of generic medications becomes more widespread in Europe once patents expire, further reducing the market share of higher-priced original brands. Nonetheless, Europe remains a critical market, accounting for over one-fifth of global sales, driven by an aging population and rising prevalence of chronic diseases.

Conversely, the Middle East and North Africa (MENA) region, while holding a relatively modest global share, is experiencing rapid growth. The area currently represents approximately 2-4% of the global pharmaceutical market, yet records annual growth rates of about 10%, notably outpacing the global average of 4-6%. This rapid expansion is fueled by demographic factors, such as increasing populations, rising life expectancy, and shifting lifestyle patterns leading to higher prevalence rates of chronic illnesses like heart disease, diabetes, and obesity.

Additionally, dear reader, Gulf Cooperation Council (GCC) nations, especially Saudi Arabia, have high healthcare spending capacities and a cultural preference for branded, imported medicines. In Saudi Arabia, for instance, roughly 85% of pharmaceuticals are imported, primarily well-known international brands. By contrast, other countries like Egypt heavily rely on domestic production, with generics comprising around 90% of their drug consumption.

These regional differences, particularly the varying preference between branded and generic medications along with divergent government pricing and subsidy policies, shape a diverse pharmaceutical landscape within the Middle East. With ongoing improvements in governmental healthcare infrastructure and escalating rates of chronic diseases, the importance of MENA markets as contributors to global pharmaceutical sales is expected to grow significantly in the coming years.

Turning to Asia, dear reader, we observe considerable differences between developed and developing countries. Japan, for instance, remains the second-largest single pharmaceutical market globally by value after the U.S., notable for high expenditure on advanced medications (although prices are regularly regulated downward). China, too, has emerged as a giant pharmaceutical market over the past two decades, quickly becoming one of the world's largest drug consumers as its healthcare system expands to meet the needs of over 1.4 billion people. Collectively, the Asia-Pacific region, including China, India, and Japan, accounts for about a quarter or more of global pharmaceutical sales, and this share is expected to keep increasing. Many Asian countries rely on domestic generic drug production for its cost-effectiveness; however, demand for innovative treatments is steadily rising, driven by growing incomes and enhanced healthcare access.

Thus, Asia has emerged as a crucial engine for the global pharmaceutical industry, leading in the number of medication doses distributed due to its massive population, as well as providing substantial revenue growth opportunities for pharmaceutical companies expanding into these rapidly evolving markets.

PART 1 · TOPIC 13

The Story of a "Small Pill" That Transformed Pain Relief

December 2025 · First published

Dear reader, "Paracetamol," also known as "Acetaminophen," is among the most widely used pain relievers and fever reducers worldwide. Although first synthesized by the American chemist Harmon Northrop Morse in 1878, its pain-relieving and fever-reducing qualities weren't identified until further studies by the German chemist Joseph von Mering in 1887. Von Mering experimented with the compound and discovered it had analgesic and antipyretic properties. Initially, however, it didn't gain immediate popularity because other drugs, particularly aspirin, dominated the market at the time. It wasn't until the mid-20th century, specifically the 1950s, that paracetamol became widely recognized as a safe and effective medication, leading pharmaceutical companies to market it under familiar brand names such as Panadol and Tylenol.

From a scientific perspective, paracetamol primarily affects the central nervous system by inhibiting certain enzymes responsible for producing compounds associated with pain and fever. Although its precise mechanism remains a subject of ongoing research, current medical consensus suggests it targets temperature-regulating centers in the hypothalamus while also influencing chemical messengers related to pain perception. Recent studies indicate that liver enzymes, specifically cytochrome enzymes, play a role in metabolizing paracetamol into relatively harmless by-products when consumed in recommended doses.

Statistically speaking, the World Health Organization lists paracetamol among its essential medicines recommended for inclusion in healthcare systems globally, due to its affordability and effectiveness in managing common symptoms. According to a 2021 report by IQVIA, a leading pharmaceutical market analysis company, global annual consumption of paracetamol surpasses 50 billion tablets. This number continues to rise significantly, particularly in regions such as Asia and Latin America, driven by increased health awareness and the medication's widespread availability at affordable prices. Moreover, paracetamol consistently ranks among the top-selling over-the-counter medications, further explaining its popularity across various age groups.

Despite its widespread usage, there are significant safety considerations regarding adherence to recommended dosages, typically not exceeding four grams daily for healthy adults. While paracetamol has an excellent reputation as a safe medication, overdose poses a serious risk to liver health. According to reports from the U.S. Food and Drug Administration (FDA), paracetamol overdose is a leading cause of acute liver failure in the United States, with over 50,000 annual poisoning cases linked to excessive intake. Health organizations continually emphasize that adhering strictly to recommended dosages significantly minimizes this risk. The main issue arises from accidental or intentional overdoses, often because paracetamol is included in numerous combination products.

Thus, consumer awareness about products containing paracetamol, such as cold and flu medicines or combination pain relievers, is crucial. Many individuals inadvertently exceed the safe daily dosage by consuming multiple medications containing paracetamol. Seniors and individuals with liver or kidney conditions should consult healthcare professionals before regular use to avoid potential health complications.

Despite these cautions, dear reader, paracetamol remains a cornerstone in modern medicine. It provides an effective solution for mild to moderate pain relief and fever reduction, typically without the gastrointestinal side effects associated with non-steroidal anti-inflammatory drugs (NSAIDs). Economically, a 2020 healthcare research group report from the Middle East noted that eight out of ten physicians recommend paracetamol as the first-line choice for relieving fever and minor aches, particularly for children and pregnant women, underscoring its deeply entrenched role in healthcare culture.

The story of paracetamol, dear reader, is one of remarkable transformation spanning more than a century, from its initial laboratory synthesis in the late 1800s to its widespread adoption starting in the 1950s, and ultimately to its current status as an essential global medicine. As long as awareness of proper dosage remains strong, this humble medication will continue to effectively and safely relieve pain and fever, sustaining its critical role in modern medical care.

PART 1 · TOPIC 14

The Best-Selling Drugs in History

November 2025 · First published

Dear reader, when we discuss the best-selling medications of all time, we're exploring more than just products with massive sales; we're highlighting milestones in the history of global medicine and healthcare. Over the past decades, numerous drugs have emerged to address critical health needs for millions worldwide, achieving unprecedented financial success and international reach thanks to their clinical effectiveness and sometimes groundbreaking marketing strategies and patents.

Throughout the history of pharmaceuticals, certain medications have achieved extraordinary sales, becoming major global successes. At the top of this list is the biologic drug HUMIRA® (adalimumab) by Abbvie. It holds the title of the best-selling drug of all time, having accumulated more than \$200 billion in sales over twenty years since its market launch. HUMIRA retained its dominance for nearly a decade, primarily due to its effectiveness in treating autoimmune diseases such as rheumatoid arthritis and psoriasis, combined with extended patent exclusivity.

However, starting in 2023, after its patent expiration, HUMIRA experienced a noticeable 32% decline in annual sales, to approximately \$14.4 billion, primarily due to the introduction of biosimilar alternatives into the market.

Another prominent example is KEYTRUDA® (pembrolizumab) by Merck, considered a rising star in pharmaceutical revenues. KEYTRUDA, used to treat various types of cancer, has become a cornerstone in oncology treatments, having secured over 40 distinct therapeutic approvals globally. Its sales soared dramatically in recent years, reaching \$25 billion in 2023, making it the top-selling medication globally that year. This upward trend continued, and in 2024, KEYTRUDA achieved around \$29.5 billion in revenues. At this pace, KEYTRUDA is expected to surpass HUMIRA's historical sales record soon, potentially becoming the highest-grossing drug ever.

Lipitor® (atorvastatin), produced by Pfizer, is another remarkable success story in the pharmaceutical world. It dominated sales during the first decade of the 2000s, generating approximately \$150 billion in cumulative sales by 2017. Lipitor's massive popularity resulted from its proven effectiveness in lowering cholesterol levels and reducing the risk of heart disease, paired with one of the most successful marketing strategies ever employed by the pharmaceutical industry. Reports indicate that during its first 14.5 years on the market, Lipitor generated approximately \$125 billion, driven by exceptional clinical outcomes and aggressive marketing campaigns that outperformed those of its competitors.

The list of the most lucrative medications also includes several other blockbuster treatments, each generating tens of billions in sales. For example, ENBREL (etanercept), indicated for rheumatoid arthritis, amassed roughly \$81 billion over its lifetime, while RITUXAN (rituximab), a key cancer

treatment, earned about \$82 billion cumulatively. Additionally, newer immunological treatments have also achieved substantial commercial success. Novartis's COSENTYX (secukinumab), prescribed for psoriasis and arthritis, reached nearly \$5 billion in revenues during 2023 alone, mainly benefiting from its effectiveness in treating common conditions.

Emerging medications for conditions like diabetes and obesity have also rapidly become commercial successes. OZEMPIC® (semaglutide) notably reached around \$14 billion in global revenues in 2023, rising to approximately \$16.9 billion in 2024, reflecting a yearly growth rate of about 26%, driven primarily by the increasing global prevalence of obesity and type 2 diabetes.

It's also important to note the remarkable sales achieved by vaccines during the COVID-19 pandemic. Pfizer-BioNTech's COVID-19 vaccine, Comirnaty®, recorded exceptional global revenues, totaling around \$37 billion in 2021 alone, making it the highest-selling drug worldwide that year, though this was a uniquely temporary phenomenon.

Ultimately, dear reader, these remarkable sales figures underscore more than mere commercial success; they represent groundbreaking achievements in global healthcare. These medications have shaped medical practice, improved patient outcomes, and addressed significant public health challenges, leaving an indelible mark on medical history and continuing to impact millions of lives worldwide.

PART 1 · TOPIC 15

The Most Widely Used Medications in History

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Dear reader, discussing the most widely used medications throughout history doesn't revolve only around drugs that generate massive revenues, but also includes those medications that have successfully reached vast numbers of people around the globe. Some drugs are taken daily by hundreds of millions due to their low cost, proven effectiveness, and widespread availability. These medications might not generate billions in revenue, but they unquestionably set enormous records in terms of annual doses and units consumed. Let's explore together some of these significant medications that have greatly enhanced the lives of millions worldwide.

In a previous article, we discussed "The Best-Selling Drugs in History," focusing primarily on revenue as a key measure. Today, however, we'll approach this from a different perspective, the number of units or doses consumed. Under this criterion, the medications that dominate the global market are typically low-cost essential drugs used to treat common conditions or widespread ailments.

Pain relievers and fever reducers available without prescription sit atop this list. Aspirin (acetylsalicylic acid) is a classic example, being one of the most commonly consumed medications worldwide for over a century. Annual global consumption of aspirin reaches approximately 40,000 metric tons, translating to roughly between 50 and 120 billion aspirin tablets every year. This astounding figure firmly places aspirin among the most extensively used medications globally, driven by its effectiveness in pain relief, fever reduction, and cardiovascular prevention, combined with affordability and widespread availability.

Similarly, dear reader, paracetamol (also known as Panadol or Tylenol) stands out among the most frequently used medications for pain relief and fever reduction. Market data indicates that global consumption of paracetamol's raw material reached approximately 145,000 metric tons in 2023. Theoretically, this represents hundreds of billions of individual doses annually. Paracetamol owes its popularity to its proven effectiveness, relative safety profile, and status as an affordable over-the-counter medication, making it a first-line choice for headaches and fever in adults and children worldwide.

Common antibiotics also feature prominently in global medication usage statistics, dear reader. Amoxicillin, a penicillin-type antibiotic, remains one of the most widely prescribed antibiotics worldwide for conditions such as respiratory infections, ear infections, and urinary tract infections. In the United States alone, amoxicillin was the number one prescribed antibiotic in 2023, accounting for approximately 18% of all antibiotic prescriptions that year. This extensive use translates to hundreds of millions of doses administered annually on a global scale, reflecting both the prevalence of common bacterial infections and amoxicillin's established role as a standard treatment for these

infections. Notably, amoxicillin is listed by the World Health Organization among essential medicines, alongside aspirin and paracetamol, highlighting its crucial role in primary healthcare.

Medications prescribed for widespread chronic diseases also achieve substantial usage numbers due to patients' need for daily, long-term treatment. Metformin, used to treat type 2 diabetes, stands out as one of the most frequently consumed drugs worldwide, with over 200 million individuals taking it daily to manage blood sugar levels. Similarly, medications to control blood pressure and cholesterol-lowering drugs such as statins (notably atorvastatin) are extensively prescribed and consumed daily by tens to hundreds of millions worldwide. These chronic-use medications typically don't command high prices per dose, especially once patent protections expire, making them available as low-cost generic drugs. Nonetheless, their cumulative global consumption is unparalleled due to the massive patient populations relying on these treatments continuously.

Thus, dear reader, the accurate measure of historical medication usage doesn't lie solely in revenue but rather in the sheer volume of doses consumed and the extensive patient populations that rely upon them. The medications we've highlighted here, ranging from aspirin and paracetamol to amoxicillin, metformin, and statins, represent essential healthcare products that significantly improve quality of life on a global scale, consistently fulfilling critical healthcare needs for billions worldwide.

PART 1 · TOPIC 16

U.S. Drug Approvals Balancing Flexibility and Challenges

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Dear reader, the U.S. Food and Drug Administration (FDA) plays a pivotal and continually evolving role in the approval process for new medications. The primary aim is to ensure both the efficacy and safety of pharmaceutical products offered to patients, particularly those facing severe or rare diseases. Recently, significant changes have occurred within the FDA under the leadership of the new Commissioner, Dr. Robert Califf, alongside the head of the Center for Biologics Evaluation and Research (CBER), Dr. Peter Marks.

A key direction of the current FDA administration is accelerating the approval process for new drugs that hold potential for significantly improving the lives of patients with complex and hard-to-treat conditions. Despite clear efforts to expedite approvals, a debate persists regarding these policies. Some argue, dear reader, that the FDA is becoming overly cautious, which could potentially slow down the availability of innovative treatments. Conversely, others express concern that excessive acceleration may lower quality standards, thereby pushing new drugs closer to dietary supplements in terms of effectiveness, a situation that generates significant anxiety among medical and industry professionals.

Guided by Commissioner Makary's vision, the FDA is striving to strike a balance between rapid approvals and rigorous safety standards. Although criticisms persist regarding the seriousness of the current administration in streamlining approvals, clear indications show the FDA is indeed adopting greater flexibility without compromising scientific rigor.

Reflecting this positive development, Tim Hunt, CEO of the Alliance for Regenerative Medicine, noted that alliance members have not experienced noticeable delays in approvals under Commissioner Makary's tenure. This perspective suggests that the new policies are indeed effective. Moreover, several leading pharmaceutical companies have acknowledged the positive improvements in communication with the FDA, emphasizing more transparent and more responsive approval procedures based directly on clinical trial data.

Dear reader, these shifts also underscore the FDA's increasing reliance on Real-World Data (RWD) to manage cases where extensive clinical trials are challenging, particularly in the treatment of rare diseases. This innovative approach, known as Bayesian analysis, enables decisions grounded in robust evidence drawn from even relatively minor datasets. This facilitates faster patient access to medications without sacrificing the necessary scientific precision.

A prime example showcasing this policy's success is the approval process for CAPLYTA®, a drug targeting autoimmune disorders. The FDA provided explicit guidance to expedite approval for this medication, reflecting positively on the efficiency and responsiveness of current practices.

Moreover, the FDA has increasingly adopted simplified pathways for other therapeutic products, significantly enhancing the overall approval process.

However, practically speaking, concerns persist among medical and industry professionals that excessively rapid approvals might undermine public confidence in pharmaceutical quality. Despite these apprehensions, the current administration, led by Dr. Makary and Dr. Prasad, remains committed to striking a careful balance between speed and quality. They repeatedly emphasize that patient safety remains an unwavering priority.

In conclusion, dear reader, the U.S. FDA is undergoing a significant transformation in its approach to drug approvals. By skillfully balancing flexibility with stringent safety standards, the administration is becoming better equipped and more adaptable to confront future challenges in healthcare and pharmaceuticals.

PART 1 · TOPIC 17

Animal Testing, Human-Based Models, and Artificial IntelligenceSeptember 2025 · First published

Dear reader, in a groundbreaking move, the U.S. Food and Drug Administration (FDA) recently announced significant changes to its policies concerning preclinical drug testing. The agency decided to gradually reduce animal testing, replacing it partly with advanced laboratory methods such as artificial intelligence (AI) and human-based models known as "organoids."

This decision marks a revolutionary shift toward more precise and effective methods for drug testing. According to the FDA's official statement, these new approaches provide results that are much closer to human biology and reality compared to traditional animal tests, which have long been subject to ethical and scientific criticisms.

Moreover, dear reader, the FDA indicated that these new tests would utilize sophisticated AI-driven computational models capable of simulating how antibodies distribute throughout the human body, accurately predicting potential side effects. The administration also highlighted that these computational models could deliver a precise analysis of drug substances, positioning them as an ideal alternative to traditional testing methods.

Additionally, the FDA clarified that pharmaceutical companies could employ human-based lab models such as "organ-on-a-chip" systems and organoids. These three-dimensional lab-grown models accurately replicate the functions of human organs, enabling researchers to study drug interactions with human organs precisely in controlled laboratory conditions. This approach enhances the reliability of results and significantly reduces errors stemming from traditional animal testing.

The FDA also announced plans to leverage real-world data and information collected globally to enhance its assessment capabilities regarding drug safety and efficacy. This will notably accelerate the approval processes for new medications and therapies.

In a statement, FDA Commissioner Marty Makary emphasized that this new approach represents significant ethical and health benefits. Makary stated, "By adopting AI-driven computational models, human-based laboratory testing, and real-world data from global studies, we can ensure safer and more effective treatments reach patients faster and at lower costs. This initiative represents a dual victory for public health and ethical standards."

Despite the significance of this change, dear reader, the FDA has not provided a detailed timeline for the complete elimination of animal testing. However, the administration clarified that this new policy would be implemented immediately and gradually.

This announcement follows many years of ethical debates surrounding animal testing, which has been traditionally considered essential despite ethical concerns and limitations regarding their applicability to humans. This policy shift responds to advancements in modern technology, providing more ethical and scientifically superior alternatives.

In conclusion, dear reader, this announcement by the FDA signifies a significant leap forward in medical and pharmaceutical research. It not only marks a victory for those advocating an end to animal testing but also represents a pivotal step toward employing innovative scientific techniques that ensure patient safety and uphold ethical standards in pharmaceutical research and industry.

PART 1 • TOPIC 18

The Conflict Between Pharmaceutical Companies and U.S. Compounding PharmaciesJuly 2025 • First published

Recently, the United States has witnessed an intense legal and commercial confrontation between major pharmaceutical companies and compounding pharmacies, pharmacies that specialize in creating customized medications based on individual patient prescriptions.

The crisis began when Eli Lilly, one of America's largest pharmaceutical corporations, issued a legal warning letter to the online pharmacy OrderlyMeds. Eli Lilly demanded an immediate halt to OrderlyMeds' sales of compounded medications similar to its popular weight-loss drug Zepbound, which contains the active ingredient tirzepatide, currently under patent protection.

OrderlyMeds, however, responded firmly and clearly, dismissing Eli Lilly's warning as "meaningless" and emphasizing its commitment to continuing to offer personalized healthcare solutions. The pharmacy argued its compounded medications were not exact replicas but uniquely customized formulations tailored to meet each patient's health requirements. In their statement, OrderlyMeds pledged to vigorously defend their right and the rights of patients to access customized healthcare. They accused major pharmaceutical companies of prioritizing profits over patient health.

On the other hand, Eli Lilly rejected these claims, maintaining through its spokesperson that the company would continue to pursue all available legal actions against what it describes as "unlawful practices." Eli Lilly has also urged regulatory and legal authorities to intervene and safeguard their commercial rights promptly.

Media reports suggest this conflict may escalate into a prolonged and complex legal battle, particularly if Eli Lilly decides to file lawsuits accusing compounding pharmacies of infringing on their patents. Legal experts indicate these lawsuits carry significant risks for pharmaceutical companies; losing such cases could jeopardize essential commercial rights and patents in the future.

Furthermore, the U.S. Food and Drug Administration (FDA) and federal courts have clearly stated that creating commercial replicas of tirzepatide is prohibited by law. Any attempts to market these compounded formulations as "personalized" or "customized" medications do not change the fact that such practices violate existing laws. Nonetheless, compounding pharmacies argue their products are distinct therapeutic preparations explicitly created at the request of doctors to address individual patient needs.

Additionally, other pharmacies such as "Hims & Hers" offer similar products and have a broad customer base but use different active ingredients, like semaglutide, found in popular medications such as Ozempic and Wegovy from Novo Nordisk.

In a related context, the FDA is currently facing challenges and administrative changes, with some observers noting instability due to recent leadership transitions in early 2025.

In conclusion, this ongoing dispute between large pharmaceutical corporations and compounding pharmacies highlights a broader conflict between innovation, intellectual property protection, and the need to provide affordable and personalized treatment options for patients. Consequently, regulatory and legal authorities face the critical task of striking a fair balance that safeguards innovation, promotes healthy competition, and ensures patients have access to effective, reasonably priced healthcare solutions.

PART 1 · TOPIC 19

India vs. China in the Global Pharmaceutical Industry Race

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Dear reader, India and China stand prominently among the world's largest pharmaceutical producers, each excelling in its unique strengths. India, famously dubbed the "Pharmacy of the World," specializes in manufacturing vast quantities of generic drugs, which are essentially affordable alternatives to original branded medications. On the other hand, China is swiftly establishing itself as a hub for innovative pharmaceutical development. In this article, we'll explore the differences between Indian and Chinese pharmaceuticals, covering aspects such as quality, price, competitiveness, manufacturing capabilities, technological advancements, and export activities. Additionally, we'll delve into the future potential, global expansion, innovation, partnerships, regulatory hurdles, and political challenges facing each country in this dynamic market.

Both India and China have significantly expanded their pharmaceutical production capabilities. India, notably, adheres rigorously to international quality standards, boasting the highest number of US FDA-approved pharmaceutical manufacturing sites, more than 370 compared to China's roughly 170 in 2023. This distinction underscores India's strong reputation and reliability in regulated markets. Meanwhile, China is rapidly improving its pharmaceutical quality standards, although it still lags slightly behind India in terms of international recognition. Technologically, China is investing heavily in advanced pharmaceutical technologies, including biotechnology. At the same time, India leverages its traditional strength in low-cost chemical manufacturing and gradually adopts new technologies to maintain its competitive edge.

Cost-wise, Indian and Chinese pharmaceuticals are renowned for their affordability on the global stage. However, India maintains a distinct advantage, with manufacturing costs about 20% lower than those in China. This significant cost difference has prompted global companies to adopt a "China+1" strategy, diversifying their supply chains by selecting India as an alternative manufacturing destination. Despite this, China continues to hold a substantial competitive advantage due to its abundant supply of active pharmaceutical ingredients (APIs) and strong industrial infrastructure. Remarkably, around 70% of the APIs used by Indian pharmaceutical manufacturers are imported from China. Thus, despite their competitive relationship, a significant interdependency remains within the global pharmaceutical supply chain. India excels in finished pharmaceutical products, offering competitive pricing, while China dominates in supplying essential raw materials.

India and China are major pharmaceutical exporters, although their export profiles differ significantly. In 2023, India's pharmaceutical exports reached approximately \$27 billion, considerably impacting markets such as North America and Europe. India accounts for around 20% of global generic drug exports and meets substantial pharmaceutical demands in significant markets, such as

approximately 40% of generic drugs in the U.S. Moreover, India stands as the world's leading supplier of essential vaccines, providing up to 60% of the vaccines used by developing countries.

Conversely, China's pharmaceutical exports saw a peak of approximately \$42 billion during the pandemic in 2021 but declined to around \$13 billion by 2023. China primarily exports raw materials and active pharmaceutical ingredients (APIs) essential for drug manufacturing worldwide, whereas its exports of finished pharmaceuticals remain limited compared to India's robust output. However, China's domestic pharmaceutical market remains vast, accounting for roughly 7% of the global market, thereby solidifying its position as a major player through its internal consumption.

Both India and China have ambitious plans for global expansion and innovation. India's pharmaceutical sector aims for significant growth by 2030, with a focus on research and development, the production of innovative drugs, and strengthening international partnerships. China, on the other hand, is heavily investing in pharmaceutical innovation, contributing to around 28% of global new drug development projects as of 2023. Chinese pharmaceutical companies have launched multiple innovative medications domestically, strongly backed by government support, while also seeking international collaborations to increase global presence, such as joint clinical research ventures. Despite their progress, India faces challenges in reducing its dependency on Chinese raw materials and improving quality control oversight. Meanwhile, China must earn global trust in the quality of its innovative drugs and overcome regulatory and political obstacles to achieve broader international acceptance.

In conclusion, dear reader, India and China complement each other as essential pillars of the global pharmaceutical market. India provides a critical supply of affordable generic medications and vaccines, while China contributes significant technological and research capabilities, driving pharmaceutical innovation. Their competitive dynamics enhance quality and cost-efficiency, whereas cooperation between their companies enriches the diversity and resilience of global pharmaceutical supply chains. As both nations continue to expand their pharmaceutical capabilities, they will remain pivotal in addressing global healthcare needs in the coming decades.

PART 1 · TOPIC 20

Green Chemistry for Sustainable Pharmaceutical IndustriesApril 2025 · First published

Dear reader, the pharmaceutical industry is currently undergoing a profound transformation, spurred by a growing global focus on environmental sustainability and the need to reduce the negative impacts of industrial processes. At the heart of this transformation lies green chemistry, a revolutionary concept that reimagines production processes to be safer and more environmentally friendly, all while maintaining the quality of pharmaceutical products and ensuring efficient manufacturing.

Green chemistry encompasses a set of principles and techniques designed to minimize or completely eliminate the use and generation of hazardous substances during chemical production. Its core ideas include the adoption of alternative, safer solvents, designing chemical reactions that require less energy, and producing minimal waste. Additionally, green chemistry emphasizes recycling materials and utilizing renewable resources. These approaches are no longer seen as optional extras; instead, they have become essential in light of increasing environmental pressures and international regulations that call for reduced emissions and responsible waste management.

In the realm of pharmaceuticals, integrating green chemistry principles is revolutionizing the manufacturing of medicinal compounds. Traditional processes often rely on harmful chemicals and toxic organic solvents, resulting in dangerous waste that is challenging to treat and dispose of. Today's innovations are focused on replacing these hazardous materials with safer, biodegradable alternatives. For instance, researchers are now experimenting with bio-based and water-based solvents as substitutes for conventional organic solvents. This not only reduces the emission of volatile organic compounds but also enhances the overall efficiency of the production process.

One breakthrough technology is the use of flow chemistry. Unlike traditional batch processes, flow chemistry involves carrying out chemical reactions in a continuous stream. This method allows for much better control over reaction conditions such as temperature, pressure, and reactant concentration. As a result, manufacturers can achieve higher conversion rates with significantly less waste, reduced energy consumption, and overall improved process safety. Such innovations are paving the way for faster and more flexible research and development, allowing laboratories to experiment with multiple reaction conditions swiftly and efficiently.

It isn't just the production process that benefits from green chemistry; the design of the pharmaceutical products themselves is evolving. In today's environmentally conscious world, it is increasingly important to create products that are easily biodegradable or recyclable. This shift towards environmentally responsible design involves considering the entire life cycle of a product, from manufacturing to disposal. For example, companies are now paying close attention to the packaging of drugs. Many have started to use eco-friendly materials derived from renewable

resources, which significantly reduce the amount of solid waste and lower the overall carbon footprint of their products.

Another key innovation is the integration of mathematical modeling and computational analysis in designing chemical reactions. These advanced tools allow scientists to simulate reactions in virtual environments to identify the optimal conditions that yield the desired outcome with minimal waste production. By using these techniques, researchers can fine-tune material and energy usage, which in turn lowers operational costs over the long term. The economic benefits are clear: reduced expenses combined with the environmental advantages make green chemistry a win-win strategy for sustainable pharmaceutical manufacturing.

From an environmental standpoint, reducing waste and harmful emissions is one of the primary goals of applying green chemistry. Less waste not only means a cleaner surrounding environment but also translates into better health conditions for workers in factories and laboratories. Minimizing exposure to toxic chemicals can significantly lower the health risks associated with traditional manufacturing practices. Moreover, reducing energy and water consumption during production has positive economic repercussions, especially given the rising costs of natural resources and the stringent environmental standards imposed in global markets.

The road to greener pharmaceutical manufacturing is not without its challenges. Transitioning to eco-friendly technologies often requires substantial initial investments in new infrastructure and cutting-edge equipment. Research and development in this field can be expensive, and companies must be willing to commit resources upfront. However, the long-term benefits far outweigh these initial costs. Embracing green chemistry not only improves the public image of pharmaceutical companies as socially and environmentally responsible entities but also opens up opportunities for collaboration with governmental bodies and international organizations dedicated to environmental protection.

In today's world, where environmental issues and regulatory pressures are on the rise, it is essential for pharmaceutical companies to adopt an integrated business model that combines technological innovation with environmental stewardship. Such a model requires seamless coordination among various departments, from research and development to production and distribution, to maximize efficiency and sustainability. Educational institutions and research centers also have a vital role to play; they must focus on training the next generation of scientists and engineers in modern green chemistry techniques and their practical applications. This collaborative effort across the industry will be crucial for realizing a sustainable future.

Green chemistry stands as a cornerstone for the future of sustainable pharmaceutical manufacturing. By redesigning production processes, optimizing product design, and embracing innovative technologies like flow chemistry and computational modeling, the pharmaceutical industry can significantly reduce its environmental impact. The shift toward green chemistry is not merely an environmental imperative but also a sound economic strategy, one that ensures the health

and safety of both the workforce and the broader community, while enhancing competitiveness in a global market that increasingly values sustainability.

As we look to the future, the continued integration of green chemistry into pharmaceutical manufacturing promises to redefine industrial practices, ensuring that progress in drug development goes hand in hand with a commitment to protecting our planet. The journey toward a greener, cleaner, and more sustainable industry is well underway, and the innovations emerging today will serve as the foundation for a healthier tomorrow.

PART 1 · TOPIC 21

The Growing Market for GLP-1 Drugs

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The pharmaceutical industry is undergoing a remarkable transformation, with GLP-1 modulators emerging as a groundbreaking innovation in modern medicine. Initially designed to treat type 2 diabetes, these drugs have extended their therapeutic reach to include obesity and other chronic conditions such as chronic kidney disease (CKD) and heart failure. With the dual benefits of improving blood sugar control and promoting weight loss, GLP-1 modulators have become a cornerstone in the management of chronic diseases. Projections through 2030 forecast significant growth in this drug class, underscoring its rising importance in global healthcare.

GLP-1 modulators, formally known as glucagon-like peptide-1 receptor agonists, function by enhancing insulin secretion, reducing glucagon release, and slowing gastric emptying. These mechanisms work synergistically to regulate blood glucose levels. Since the FDA's approval of the first GLP-1 modulator, exenatide, in 2005, the class has evolved significantly. Newer drugs such as liraglutide, semaglutide, and dulaglutide have set higher standards for efficacy and safety. Beyond diabetes, these medications have gained traction in treating obesity, with substantial weight-loss benefits distinguishing them from traditional therapies. Their growing popularity reflects their clinical effectiveness and their ability to address previously unmet medical needs.

Several key factors are driving the surge in demand for GLP-1 modulators. The global prevalence of diabetes and obesity has reached critical levels, affecting millions of people who require effective treatment options. With their dual-action capabilities, GLP-1 modulators are uniquely suited to meet this demand. Furthermore, their therapeutic scope continues to expand, with research exploring their potential in treating conditions like CKD, heart failure, and metabolic-associated steatohepatitis (MASH). These drugs also boast favorable safety profiles, patient-friendly delivery methods, such as once-weekly injections and oral formulations, and strong regulatory backing, which have collectively fueled their market growth. Expedited approvals and broadened indications have accelerated their adoption, further solidifying their position in the pharmaceutical landscape.

The competitive environment for GLP-1 modulators is vibrant and dynamic, with leading pharmaceutical companies like Novo Nordisk, Eli Lilly, and AstraZeneca driving the market forward. Novo Nordisk leads with its flagship products, Ozempic and Wegovy, which dominate the diabetes and obesity markets. Eli Lilly's Mounjaro (tirzepatide), a dual GLP-1/GIP agonist, has been heralded as a revolutionary development in both diabetes and weight management. AstraZeneca, while facing strong competition, continues to emphasize combination therapies to strengthen its portfolio. This intense competition fosters innovation, prompting the development of more advanced and accessible therapies. However, challenges such as affordability, regulatory complexity, and ensuring sustained patient adherence remain obstacles to widespread market penetration.

Despite these hurdles, the potential of GLP-1 modulators to revolutionize healthcare is enormous. By effectively managing chronic conditions like diabetes and obesity, these drugs can significantly reduce complications, improve patient outcomes, and ease the burden on healthcare systems. The expansion of their indications to include CKD and heart failure could yield considerable cost savings by slowing disease progression and reducing reliance on intensive treatments. Nonetheless, the high cost of these drugs underscores the need for collaboration among pharmaceutical companies, policymakers, and healthcare providers to ensure that they are accessible and affordable for all patients.

As the market for GLP-1 modulators continues to evolve, opportunities for innovation abound. Advances in drug delivery systems, such as oral formulations, promise greater convenience for patients and improved treatment adherence. Additionally, integrating digital health technologies can further enhance treatment outcomes by enabling real-time monitoring of patient progress and supporting long-term compliance. For pharmaceutical companies, success in this competitive landscape will hinge on addressing pricing challenges, fostering patient-centric solutions, and maintaining a commitment to innovation.

In summary, GLP-1 modulators are poised to redefine chronic disease management and reshape the future of healthcare. These drugs have already demonstrated their transformative impact in the treatment of diabetes and obesity and are now expanding their role to include other significant chronic conditions like CKD and MASH. Their profound impact on global healthcare systems offers hope to millions of patients while driving innovation and growth within the pharmaceutical industry. Through strategic collaboration and continued advancements, GLP-1 modulators are set to become a cornerstone of modern medicine, shaping a brighter future for healthcare worldwide.

PART 1 · TOPIC 22

The Rapid Growth of the Anti-Obesity Drug Market

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Obesity has emerged as one of the most pressing public health challenges globally, affecting over 650 million adults, according to the World Health Organization (WHO). Its associated comorbidities, such as diabetes, cardiovascular disease, and certain cancers, place a heavy burden on healthcare systems and societies. The increasing prevalence of obesity has amplified the demand for effective medical treatments, ushering in a new era of pharmaceutical innovation. The anti-obesity drug market is experiencing unprecedented growth, driven by groundbreaking medications that promise effective weight management and improved health outcomes.

Traditional approaches to weight management, including diet and exercise, have often proven insufficient, particularly for individuals with severe obesity. Many patients struggle with long-term weight maintenance, leading to a growing acknowledgment of the need for medical intervention. Anti-obesity drugs have emerged as a crucial solution, offering not only significant weight loss but also the management of obesity-related conditions like type 2 diabetes.

The pharmaceutical industry has responded to this urgent need by developing highly effective medications. The impressive revenue growth of leading anti-obesity drugs, including Ozempic, Rybelsus, Wegovy, Zepbound, and Mounjaro, from Q1 2018 to Q2 2024. These drugs represent a new frontier in obesity treatment, combining innovative mechanisms of action with clinical efficacy.

The rapid growth of the anti-obesity drug market is primarily fueled by a handful of medications that have redefined the landscape of obesity treatment. Each drug has unique attributes that contribute to its market performance:

Developed by Novo Nordisk, Ozempic was initially approved for managing type 2 diabetes. Its active ingredient, semaglutide, is a GLP-1 receptor agonist that helps regulate blood sugar levels. Clinical trials revealed a remarkable secondary benefit: substantial weight loss. This discovery transformed Ozempic into a dual-purpose medication, effective for both diabetes and obesity management. The drug's revenue growth has been exceptional. In Q1 2018, its revenue was modest, but by Q2 2024, Ozempic generated nearly \$3.5 billion in the US alone. This growth reflects its widespread adoption for weight management and diabetes control. While uptake in markets outside the US has been slower due to healthcare system differences, Ozempic remains a global leader in the anti-obesity space.

Rybelsus, the oral form of semaglutide, offers a less invasive alternative to injectable medications like Ozempic. Launched in 2019, it has gained traction among patients who prefer oral solutions. While its revenue is lower than Ozempic's, Rybelsus shows steady growth, driven by its accessibility and ease

of use. Its innovation has broadened the reach of semaglutide-based treatments, making weight management more appealing and feasible for a wider range of patients.

Wegovy, also developed by Novo Nordisk, is specifically approved for obesity treatment. Launched in mid-2021, it quickly became one of the most sought-after anti-obesity drugs. Unlike Ozempic and Rybelsus, Wegovy is exclusively marketed for weight loss, setting it apart in the market. Its efficacy in promoting significant weight loss has been validated by clinical trials, making it a preferred option for healthcare providers. Wegovy's revenue trajectory has been explosive, with US sales reaching approximately \$1.5 billion by Q2 2024. This growth underscores the increasing recognition of obesity as a serious medical condition that warrants targeted pharmaceutical intervention.

As a newer entrant to the market, Zepbound shows promising potential. While its revenue growth began in 2023 and remains in early stages, its upward trend indicates significant promise. Zepbound's presence reflects the expanding competitive landscape, with newer drugs continuing to diversify the options available for obesity management.

Developed by Eli Lilly, Mounjaro is a dual GLP-1/GIP agonist initially approved for type 2 diabetes. Its exceptional weight-loss benefits have made it a rising star in the anti-obesity market. By Q2 2024, Mounjaro's US revenue exceeded \$1 billion, highlighting its rapid adoption for weight management. Its success exemplifies the broader trend of repurposing diabetes drugs for obesity treatment.

The total market size for anti-obesity drugs, with revenues surpassing \$10 billion by Q2 2024.

The increasing prevalence of obesity has intensified the demand for effective treatments. The US, with its high obesity rates, accounts for a significant portion of the market. Shifting perceptions of obesity from a lifestyle issue to a complex medical condition have encouraged greater acceptance of pharmaceutical interventions.

Innovations like GLP-1 receptor agonists have revolutionized the obesity treatment landscape, offering highly effective solutions with manageable side effects.

Regulatory Approvals: Expedited approvals for drugs like Wegovy and broader indications for existing medications have expanded the market.

Increasing insurer willingness to cover obesity treatments has reduced financial barriers for patients.

High drug prices remain a significant barrier, even in high-income countries. Efforts to introduce generics and biosimilars could improve affordability and access. As chronic conditions, obesity and its comorbidities require long-term treatment. Ongoing research is essential to ensure sustained efficacy and safety. While the US dominates the market, adoption in lower-income regions remains limited. Addressing global inequities will require collaborative efforts to expand access.

At the same time, opportunities abound. Continued innovation in drug development promises more effective treatments with fewer side effects. Personalized medicine could enable tailored

interventions based on individual genetic and metabolic profiles. Expanded indications, including treatments for pre-diabetes and pediatric obesity, could further broaden the market.

The anti-obesity drug market is poised for continued expansion, driven by innovation and rising global demand. As new drugs enter the market and existing treatments improve, patients will have more options than ever for managing their weight. The pharmaceutical industry's investment in obesity research reflects a commitment to addressing one of the most pressing public health challenges of our time.

In conclusion, the rapid growth of the anti-obesity drug market represents a transformative moment in healthcare. Drugs like Ozempic, Wegovy, and Mounjaro have already revolutionized obesity treatment, offering hope to millions of patients. With continued innovation and global collaboration, the future of obesity treatment is bright, promising improved health outcomes and a better quality of life for individuals worldwide.

PART 1 · TOPIC 23**Drug Development Through Virtual Trials**

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Dear reader, traditional clinical trials require participants to visit specific locations, such as hospitals and research centers, multiple times throughout the trial period.

This intensive attendance can be burdensome for patients, especially those living far from these locations, reducing participant diversity and affecting data quality. Moreover, traditional trials rely on costly infrastructure, including medical equipment and trained personnel, contributing to the high cost of drug development and delaying their arrival to the market.

Based on modern concepts, virtual clinical trials are conducted entirely online, where evaluations and follow-ups are performed using advanced technologies such as wearable devices, health apps, and artificial intelligence.

The main goal of these trials is to enhance efficiency, reduce costs, and increase patient access to clinical research, particularly for those facing geographic or health-related barriers to participation.

While virtual trials can be helpful for many types of clinical research, specific trials that require intensive medical interventions may only partially be suitable for this approach.

Thanks to technological advancements, virtual trials have emerged as the long-awaited solution to overcome the challenges of traditional trials.

This approach expands the participant pool to include people worldwide, enhancing data diversity and speeding up data collection and analysis.

One key benefit of virtual trials is their efficiency. Pharmaceutical companies can shorten the duration of trials and accelerate the availability of medications by eliminating the need for in-person visits and physical infrastructure. This contributes significantly to meeting patient needs faster.

Additionally, virtual trials save a considerable portion of the high costs associated with traditional trials by reducing the need for on-site infrastructure and travel expenses, allowing companies to redirect these funds toward developing more innovative treatments.

Another advantage is expanded participant access; nearly anyone worldwide can participate in virtual trials, enhancing sample diversity and ensuring that medications are effective for all population groups.

Despite the numerous benefits of virtual trials, they are not without challenges. One such challenge is data security, as cybersecurity is a top priority to ensure personal information is protected from breaches.

Another challenge is patient engagement, requiring companies to provide continuous support and regular reminders and possibly offer incentives to ensure participant involvement and retention.

Furthermore, the implementation of virtual trials requires cooperation with health authorities to ensure compliance with legal and ethical standards.

During pandemics, such as the COVID-19 pandemic, virtual trials proved to be an ideal solution for continuing research without the need for risky gatherings.

This approach facilitated faster development of treatments and vaccines, ensuring their availability to broader populations.

With continuous technological advancement, virtual trials are expected to become integral to drug development.

Technologies like artificial intelligence and augmented reality will help improve trial efficiency and enhance interaction between researchers and participants.

Additionally, the scope of trials is likely to expand to more countries and regions, thereby increasing the inclusivity of studies.

Virtual trials are not just an enhancement of traditional trials; they represent a paradigm shift in the pharmaceutical industry.

As technology continues to evolve and collaboration between companies and regulatory bodies increases, these trials can lead to unprecedented medical achievements, making healthcare more inclusive and efficient and ultimately improving the lives of millions worldwide.

PART 1 · TOPIC 24

Who Will Dominate the Future of Pharmaceutical Industries in 2030?

October 2024 · First published

Dear reader, market forecasts for 2030 indicate a significant transformation in the global pharmaceutical landscape, with several leading companies, including Novo Nordisk and Eli Lilly, taking the spotlight. Data shows continued dominance for companies that have successfully expanded their pharmaceutical portfolios in high-growth, innovative therapeutic areas such as diabetes, obesity, immunology, and oncology. In this article, we will explore the trends driving the significant players in the industry and the factors contributing to their success.

Novo Nordisk and Eli Lilly are expected to lead global prescription drug sales by 2030. Both companies are projected to see substantial revenue growth thanks to their leadership in GLP-1 obesity drugs and other metabolic inhibitors. Novo Nordisk is expected to achieve a compound annual growth rate (CAGR) of 12% between 2023 and 2030, while Eli Lilly is also expected to reach a CAGR of 12%. This growth reflects the strategic focus on addressing the global obesity and diabetes epidemics, which has generated significant demand for effective and innovative treatments.

While Novo Nordisk and Eli Lilly are expected to lead the market, other major pharmaceutical companies will continue to play crucial roles. For instance, AbbVie is anticipated to maintain strong sales growth due to its robust immunology portfolio, which includes Skyrizi and Rinvoq. However, its growth rate, around 3% annually, is modest compared to the leading companies.

Additionally, despite some challenges, Johnson & Johnson and Merck & Co. are expected to remain key players in the global pharmaceutical landscape. Johnson & Johnson is forecasted to achieve a CAGR of 2.8%. These companies continue to lead in immunology and oncology, with flagship drugs like Keytruda by Merck and Stelara by Johnson & Johnson contributing significantly to their revenues. However, these companies face increasing competition from established players and emerging biotech firms, which may impact their market positions.

Sanofi, Roche, and AstraZeneca are also expected to grow moderately in the coming years, with CAGRs ranging from 3% to 5%. These companies are leaders in immunology and oncology. Sanofi is expected to see a slight increase in its ranking among top companies thanks to its strong immunology portfolio, including the leading drug Dupixent. Roche, a key player in oncology, is expected to maintain its position, though its growth rate of 3% suggests intense competition in the oncology sector. AstraZeneca is expected to achieve the highest growth rate among this group, with an estimated CAGR of 5%. The company's focus on oncology, respiratory, and cardiovascular treatments positions it well for future growth, especially with the rising demand for innovative cancer therapies.

While Pfizer and Novartis remain among the top 10 companies in global prescription drug sales, they face significant challenges in the coming years. Pfizer is expected to achieve a minimal growth rate of 0.17%, reflecting its reliance on COVID-19 vaccine and treatment sales, which are anticipated to decline as the pandemic subsides.

Dear reader, as the pharmaceutical industry evolves, the key to success will be staying ahead of trends in high-growth therapeutic areas, investing in innovation, and navigating a complex regulatory environment. Companies that can effectively execute these aspects are likely to be the industry's future leaders.

PART 1 · TOPIC 25

How CDMOs are Leading the Pharmaceutical MarketSeptember 2024 · First published

The pharmaceutical industry has witnessed profound growth and transformation over the past decade, with mergers and acquisitions (M&A) playing a pivotal role in reshaping the sector.

Among the various segments within this industry, contract development and manufacturing organizations (CDMOs) and pharmaceutical services are set to emerge as transformative forces by 2024.

In today's article, we will explore the trends driving M&A activities in the pharmaceutical sector, focusing on the transformative dominance of CDMOs.

We will also examine the key factors contributing to the rise of these sectors, their transformative impact on the broader market, and the transformative opportunities and challenges they present for the future.

Over the past decade, M&A activities in the pharmaceutical industry have evolved significantly.

While biotech and pharmaceutical companies have traditionally been the focus of these deals, recent years have seen a notable increase in transactions involving CDMOs and pharmaceutical service providers.

By 2024, these companies have become the primary targets for M&A, surpassing other sectors such as diagnostics, medical technology, and small to mid-sized biotech firms.

CDMOs provide contract services to pharmaceutical companies, including drug development, manufacturing, and production.

They play a critical role in the pharmaceutical supply chain, helping to bring new drugs to market efficiently.

Their services encompass various activities, including clinical trial management, regulatory support, and commercial marketing services.

CDMOs are crucial partners in helping pharmaceutical companies navigate the complex drug development and commercialization process.

Data indicates a sharp increase in M&A deals involving CDMOs and pharmaceutical services, especially since 2018.

The number of deals peaked in 2021, with over 260 transactions recorded.

Although there was a slight decline afterward, the sector remained dominant in pharmaceutical M&A in 2024, with nearly 82 deals involving CDMOs and pharmaceutical services.

This trend reflects the ongoing demand for these services and the importance of streamlining capabilities in this sector.

Several factors have contributed to the rise of CDMOs and pharmaceutical services in M&A activities.

One of the main drivers is the increasing reliance on outsourcing by pharmaceutical companies for drug development and manufacturing, allowing them to reduce costs and focus on core activities.

Additionally, the growing demand for biologics and advanced therapies has attracted acquisitions in these areas.

The COVID-19 pandemic also prompted companies to enhance supply chain resilience, leading to more acquisitions of CDMOs with a global presence.

Furthermore, complex regulatory challenges have heightened the value of companies with compliance and quality assurance expertise.

At the same time, digital transformation has made CDMOs offering innovative solutions, such as data analytics and AI-driven drug development, attractive acquisition targets.

The rising influence of CDMOs and pharmaceutical services in M&A reflects their growing importance as critical drivers of mergers and acquisitions in the life sciences sector.

These companies have become essential partners in the drug development process, and with increasing innovation and a focus on specialized capabilities, this growth is expected to continue reshaping the industry.

PART 1 · TOPIC 26

The "Hidden Engine" of the Pharmaceutical Industry

May 2024 · First published

The demand for innovative medical, pharmaceutical, and biotech products continues to rise, driving the constantly evolving pharmaceutical industry. This has led global pharmaceutical companies to increasingly rely on external organizations for support in their research, development, and production efforts. That's where Contract Development and Manufacturing Organizations (CDMOs) come in. These organizations offer comprehensive drug and medical product development and manufacturing services, making them indispensable to global pharmaceutical supply chains. In this article, we will take a closer look at what CDMOs are, their role in the pharmaceutical industry, their challenges, and their impact on drug development and production.

CDMOs are companies that provide manufacturing and development services for pharmaceutical companies. Their services include the development of efficient manufacturing processes that can achieve the desired quality of drugs at a minimal cost. They also handle the production of drugs in different forms, whether biological or chemical. Another crucial service CDMOs provide is quality analysis and testing, which ensures that the products are of high quality and safe to use, compliant with local and international standards. CDMOs also provide packaging and labeling solutions for the final products and offer clinical trial services by producing experimental batches of drugs used in clinical trials, contributing to clinical trial management. Additionally, they specialize in pharmaceutical formulation development services, which involve improving formulations to ensure drug efficacy and stability.

CDMOs offer pharmaceutical companies the opportunity to diversify their product lines without the need for significant infrastructure investment. They also provide the flexibility to manage changes in product demand, enabling companies to quickly adjust production volumes as per market needs.

While CDMOs offer a range of advantages, they also encounter various challenges. The CDMO industry is highly competitive, which creates price pressures and reduces profit margins. To maintain their market share, these companies must innovate and offer exceptional services. Additionally, regulatory requirements differ across markets, necessitating compliance with strict pharmaceutical production and distribution standards, which can be costly and complicated. Robust supply chains are required to obtain raw materials and essential components for drug manufacturing. Any disruptions in these supply chains can significantly impact manufacturing operations. Furthermore, with emerging technologies such as biomanufacturing, CDMOs must invest in modern technology and train their staff to keep up with the rapid advancements.

In Saudi Arabia, CDMOs can play a significant role in the growth of the pharmaceutical industry. As the country works towards the goals of Vision 2030, CDMOs can offer crucial support to local pharmaceutical companies by providing advanced drug development and manufacturing services.

Their expertise can help Saudi companies produce high-quality, innovative medications efficiently and cost-effectively. Additionally, CDMOs can help in the development of the local workforce's skills by providing training and technology transfer, ensuring a steady supply of skilled professionals. By leveraging CDMOs' global networks and regulatory expertise, Saudi pharmaceutical companies can navigate international markets more effectively, boosting exports and attracting foreign investment. This partnership will also encourage local production of essential drugs, reducing the country's reliance on imports and improving the resilience of the national healthcare system.

The CDMO industry is expected to witness continued growth and evolution in the upcoming years. This growth can be attributed to various factors, one of which is the increased demand for biological drugs. The sector is experiencing substantial growth, and many companies rely on CDMOs to develop and manufacture complex biological products such as antibodies and gene therapies.

PART 1 · TOPIC 27

Unlocking the Future of Medicine with AI's Revolution in Drug Development and Discovery

April 2024 · First published

The advent of Artificial Intelligence (AI) has revolutionized many industries, with the pharmaceutical sector standing out as one of the most significant beneficiaries. AI's applications in drug development and discovery are vast, ranging from speeding up the process of finding new drugs to personalizing treatments for patients. This article delves into how AI is transforming the landscape of drug development and discovery and its key applications, benefits, and future prospects.

At the core of AI's impact is its ability to accelerate the drug discovery process, which is traditionally time-consuming and costly. AI algorithms, particularly machine learning, and deep learning can analyze vast datasets faster than human researchers. This capability allows for the rapid identification of potential drug candidates by sifting through libraries of chemical compounds and predicting their effectiveness against specific diseases. For instance, AI models can simulate how a compound interacts with a biological target, such as a protein associated with a disease, to assess its potential as a therapeutic agent. This process, known as *in silico* drug discovery, significantly reduces the need for early-stage, lab-based experimental screening, saving time and resources.

AI is instrumental in advancing precision medicine, which aims to tailor treatments to individual patients based on their genetic makeup, lifestyle, and environment. AI can identify patterns and biomarkers that predict how patients will respond to specific treatments by analyzing large datasets from genomic sequencing, electronic health records, and biometric data. This not only helps in developing more effective drugs but also in avoiding adverse drug reactions. AI-driven tools are now being used to design personalized cancer therapies, where the treatment is based on the unique genetic mutations found in a patient's tumor.

Drug repurposing, the process of finding new uses for existing drugs, is another area where AI excels. Since the safety profile of these drugs is already well-understood, repurposing can bring treatments to market more quickly and at a lower cost than developing new drugs from scratch. AI algorithms can uncover hidden relationships between drugs and diseases, identifying potential new therapeutic applications. For example, AI has been used to identify existing drugs that could be repurposed to treat emerging diseases, such as finding medications that could potentially mitigate the effects of COVID-19.

Clinical trials are a critical but often bottleneck phase in drug development. AI can optimize trial design by identifying the most suitable candidates for a study, thereby improving clinical trial efficiency and success rates. Predictive models can analyze historical trial data and patient records to forecast trial outcomes, helping pharmaceutical companies decide which trials to pursue. AI can also monitor trial progress in real time, identifying issues early and suggesting corrective actions.

The cost of bringing a new drug to market is staggering, often exceeding \$1 billion. AI has the potential to significantly reduce these costs by making each phase of drug development more efficient. From early discovery through to clinical trials, AI-driven approaches can shorten timelines and decrease the need for expensive laboratory work and clinical studies. By improving success rates, AI also reduces the financial risk associated with drug development, making it feasible to invest in treatments for rare and neglected diseases.

Despite its potential, integrating AI into drug development is not without challenges. Data privacy and security are paramount, as AI systems rely on access to sensitive personal and health information. Ensuring the accuracy and reliability of AI predictions is another concern, as errors could lead to ineffective or unsafe drugs being developed. Moreover, ethical considerations around AI decision-making processes, including transparency and accountability, must be addressed to maintain public trust.

Looking ahead, AI's role in drug development and discovery is set to expand. Emerging technologies, such as generative adversarial networks (GANs) and reinforcement learning, offer new ways to design drugs and predict their interactions with the human body. Integrating AI with other technologies, like CRISPR for gene editing and nanotechnology for drug delivery, opens up exciting possibilities for creating innovative treatments.

AI's drug development and discovery applications represent a paradigm shift, offering the promise of faster, more efficient, and personalized medicine. While challenges remain, the potential benefits are immense, from accelerating the discovery of lifesaving drugs to making treatments more effective and accessible. As AI technologies continue to evolve, their integration into the pharmaceutical industry will undoubtedly lead to groundbreaking advances in healthcare.

PART 1 · TOPIC 28

Pharmacy of the World

March 2024 · First published

India's pharmaceutical and biotechnology sectors drive the pharmaceutical industries and manufacturing, attracting global investments. These sectors are booming in the rapidly evolving health landscape of the Asia-Pacific region. Here, we will explore India's growing impact in these sectors and highlight its advancements that set new standards for healthcare in the region.

India is often called the "pharmacy of the world," with its pharmaceutical sector significantly contributing to global healthcare. Meanwhile, despite its relative novelty, India's biotechnology sector has shown remarkable growth, driven by solid research and development capabilities.

The Indian pharmaceutical and biotechnology industries are crucial for meeting local healthcare needs and play a vital role in India's strategic position in the Asia-Pacific healthcare market.

India's pharmaceutical industry is renowned for its extensive production capabilities and cost-effectiveness, attracting significant foreign investments. The country's ability to produce high-quality generic medicines at attractive prices has made it a key player in global healthcare. This strength is further bolstered by a robust regulatory framework and government support to boost pharmaceutical exports.

The biotechnology sector in India is a new and emerging field of innovation focused on discovering new drugs, developing vaccines, and manufacturing biological products. India's talented scientists and researchers are driving the sector's growth, with an increasing number of investments being made in start-up biotech companies and research institutions. This growth is a clear indication of India's potential to become a leader in advanced healthcare solutions, not only in the Asia-Pacific region but on a global scale.

India's strategy to enhance its role in the pharmaceutical and biotechnology industries centers around developing its research and development infrastructure and fostering international collaboration. Government initiatives like the Biotechnology Industry Research Assistance Council (BIRAC) aim to support innovation and facilitate partnerships between Indian and global companies, including the United States, the most significant player globally in this field. These strategies enhance India's manufacturing and export capabilities, ensuring its pharmaceutical and biotechnological innovations reach broader global markets.

Despite its significant achievements, India's pharmaceutical and biotechnology sectors face challenges, including regulatory hurdles and the need for more substantial research and development infrastructure investments. Addressing these challenges is essential to maintain growth and its competitive edge in the global market.

Dear reader, Saudi Arabia's Vision 2030 aims to diversify its economy and improve its healthcare infrastructure. To achieve this, the country can greatly benefit from India's vast expertise in the pharmaceutical and biotechnology sectors. India's proven strategies for enhancing manufacturing and innovation, regulatory frameworks, and cost-competitive drug production can help Saudi Arabia accelerate the development of its pharmaceutical and biotechnology industries. To achieve this goal, collaborative projects that involve knowledge exchange programs, joint research initiatives, and investments in emerging biotech companies can be initiated.

Partnerships with Indian companies and other advanced countries in pharmaceuticals and biotechnology can help the Kingdom build a robust health system that can serve its local needs. In line with its national biotechnology strategy, this will also position Saudi Arabia as a hub for pharmaceutical and biotechnological innovations in the Middle East and globally.

PART 1 · TOPIC 29

The Hunt of Big Pharma for Breakthrough Drugs

January 2024 · First published

In the ever-evolving landscape of the pharmaceutical industry, a significant trend has emerged: Big Pharma's reliance on external sources for drug acquisition. This approach, primarily facilitated through mergers and acquisitions (M&A), is not just a business strategy but a necessity driven by the industry's intrinsic challenges and market dynamics. Let's explore this trend in more detail, backed by data and numbers highlighting its prevalence and impact.

The pharmaceutical industry's pivot towards external innovation between 2015 and 2021, as evidenced by the FDA's approval of 323 new drugs, reveals a strategic shift by Big Pharma to navigate the high-risk and costly landscape of drug development. A substantial 65% of these drugs were sourced from outside the top 20 biopharma companies, contrasting sharply with the 28% developed internally. This trend underscores Big Pharma's move to harness the faster pace of innovation and specialized expertise found in smaller biotech firms and startups, which often outpace more giant corporations in bringing groundbreaking therapies to market. By acquiring these external drugs and technologies, Big Pharma can diversify its portfolio, extend its patent life, and leverage novel therapeutic breakthroughs while mitigating in-house drug development's financial and scientific challenges. This strategy enables these pharmaceutical giants to maintain a competitive edge and ensure a continuous influx of innovative treatments in response to evolving healthcare demands.

The fiscal capacity of Big Pharma to engage in mergers and acquisitions (M&A) underscores a significant strategic shift towards external innovation, with the financial metrics from November 2023 painting a clear picture of this capability. The top 16 pharmaceutical companies boasted a "comfortable firepower," a term likely indicating the resources available for M&A without straining their balance sheets of \$521 billion. Beyond this, they had a "stretch firepower" of \$1.1 trillion, reflecting the maximum potential investment capacity, including resources that could be extended in a strategic stretch scenario. This impressive financial readiness underscores the industry's robustness in engaging in substantial acquisitions and highlights its strategic commitment to prioritizing external innovation as a growth lever. The sheer magnitude of these figures suggests a significant pool of resources earmarked for capturing innovative opportunities and securing competitive advantages through strategic deals.

Despite regulatory uncertainties that may affect the industry, 2023 stood out as a year when Big Pharma's biotech acquisition volume reached near-record levels. The transactions for that year, characterized by upfront payments ranging from \$50 million to a staggering \$50 billion, represent the breadth and depth of Big Pharma's investment in external innovation. This range of investment demonstrates the scale at which Big Pharma is willing to operate to secure promising new therapies

and technologies. Such financial undertakings indicate the industry's long-term vision to maintain a pipeline of innovative drugs that can sustain growth, counter patent cliffs, and meet the dynamic demands of the healthcare market. It's a testament to the proactive approach of these companies in navigating the complex landscape of drug development and market competition through strategic financial maneuvers.

The impending patent cliff presents a formidable challenge for the pharmaceutical industry, catalyzing the aggressive M&A activities we observe. Patents are the lifeblood of pharma companies, protecting their investments and securing exclusive rights to profit from their innovations. However, with patents expiring, a company's revenue can decline as generic competitors enter the market. The data projects a staggering loss of \$113 billion in revenue over the next five years due to these expiries. This looming financial impact underscores the urgency for Big Pharma to replenish its pipeline with new, patent-protected drugs. The race to acquire innovative compounds is about not just growth but survival, as each patent expiry threatens to erode the market share and revenue built over years of research and development.

In the shadow of this patent cliff, the pharmaceutical industry's strategic response is multifaceted, bolstering internal R&D efforts and seeking external opportunities through acquisitions. The \$113 billion figure quantifies the risk and is a stark reminder of the consequences of inaction. It's a precipice that could see market leaders become vulnerable to smaller, more agile competitors who can produce equivalent drugs at a fraction of the price once patent protection is lost. Therefore, securing new drugs with patent protection through acquisitions is a critical strategy, ensuring a continuous flow of innovative treatments into their product offerings and maintaining the revenue streams essential for long-term viability and sustained investment in future research endeavors.

As we gaze into the pharmaceutical industry's future, the trend of external acquisitions by Big Pharma is not merely continuing; it's gaining momentum. This escalation is fueled by a powerful combination of factors: substantial financial capability, intensifying market pressures, and relentless scientific advancements. As previously noted, the industry's financial muscle is robust, with top companies wielding a 'comfortable' and 'stretch' firepower totaling in the trillions of dollars, which positions them to pursue and secure high-value acquisitions. When aligned with the impetus to stay ahead in an aggressively competitive market, this financial money sets the stage for an even more dynamic and assertive M&A landscape. The need for innovation drives Big Pharma to seek the most promising new therapies and technologies, often found within biotech startups and smaller firms specializing in cutting-edge research.

Looking ahead, the convergence of these forces suggests a sustained or even heightened velocity in M&A activities. Scientific breakthroughs, particularly in gene editing, personalized medicine, and biologics, rapidly transform treatment paradigms and offer new growth opportunities. Big Pharma companies are poised to continue leveraging acquisitions as a strategic approach to bolster their pipelines, extend their market dominance, and navigate patent cliffs. The strategic imperatives of acquiring novel therapies and tapping into emerging markets are expected to compel Big Pharma to

maintain and potentially surpass the high levels of M&A activity witnessed in recent years. As such, the industry's future will likely be characterized by a proactive pursuit of external innovation, with M&A serving as a critical conduit for growth and adaptation in an ever-evolving healthcare landscape.

Saudi Arabia benefits significantly from the trends in Big Pharma's external acquisitions and the global shift towards innovation in the pharmaceutical industry. As a nation investing heavily in diversifying its economy beyond oil, the Kingdom could leverage several strategic advantages from the increasing M&A activity in the pharmaceutical sector. Firstly, with its substantial sovereign wealth funds, Saudi Arabia could invest in pharmaceutical companies and biotech startups worldwide. This investment strategy could yield significant returns as the value of innovative biotech companies often increases post-acquisition. By positioning itself as a key investor in the industry, Saudi Arabia could benefit financially while establishing a foothold in developing cutting-edge medical therapies. Secondly, Saudi Arabia has been expanding its healthcare infrastructure and investing in medical research to become a regional hub for healthcare excellence. By forming strategic alliances with big pharmaceutical companies looking for acquisition targets, Saudi Arabia can attract these companies to establish research and development centers within the kingdom. This would not only bring in expertise and create high-skilled jobs but also stimulate the growth of the domestic pharmaceutical industry.

Furthermore, with Vision 2030, Saudi Arabia aims to foster a more innovation-driven economy. The country could establish incubators and accelerators to support local biotech startups, making them attractive targets for future acquisitions by Big Pharma. This could boost the local economy, spur job creation in high-tech sectors, and facilitate knowledge and technology transfer. Additionally, by engaging in partnerships with Big Pharma, Saudi Arabia could negotiate to ensure access to the latest medications for its population. This could improve healthcare outcomes domestically and position the Kingdom as a leader in healthcare provision in the Middle East and North Africa (MENA) region.

Lastly, Saudi Arabia could benefit from the patent cliff by facilitating the creation of generic drug manufacturing within its borders. As patents expire, the opportunity to produce generic versions of high-demand medications presents a lucrative market. The Kingdom could attract manufacturers looking to produce these generics at a lower cost, which aligns with its goal to become a manufacturing and logistics hub.

In conclusion, Saudi Arabia can capitalize on the pharmaceutical industry's dynamics through strategic investments and partnerships and foster a local biotech ecosystem. These initiatives would align with the nation's broader economic goals and potentially transform Saudi Arabia into a critical player in the global pharmaceutical industry.

PART 1 • TOPIC 30

Bracing for the Fall: Understanding the Patent Cliff's Impact on the Pharmaceutical Industry

December 2023 · First published

Dear reader, the pharmaceutical industry stands on the precipice of innovation and profitability, with patents serving as both its shield and its "Achilles' heel." These legal instruments protect massive investments in drug development, ensuring that a new drug, often the result of billions of dollars and years of research, remains profitable for a time. Yet, the expiration of these patents, known colloquially as the "patent cliff," ushers in a period of vulnerability where generic manufacturers can produce equivalent drugs at a fraction of the price, causing original developers to face significant financial downturns.

Patents are the cornerstone of the pharmaceutical industry's economic model, granting up to two decades of exclusive rights to sell a new drug. The journey from concept to pharmacy shelf is long, risky, and costly, with only a small fraction of compounds ever making it to market. The patent period is critical; it is the window during which a company must not only recoup its investment but also fund future research. Without this system, the incentive to invest in potentially life-saving drugs would dwindle, leaving many medical needs unmet.

The "patent cliff" is an industry term for the steep decline in a drug's revenue as it loses patent protection. This occurs as "generics" (chemically identical copies of the drug) enter the market and offer the same therapeutic benefits at a lower cost. While this benefits consumers and healthcare providers, it means a rapid and often drastic loss of earnings for the original drug's manufacturer. Historical cases have shown losses amounting to billions of dollars within months of patent expiry.

For the innovator company, however, "the patent cliff" represents a steep drop in the drug's revenue stream. The exclusivity once provided by the patent, which allowed for controlled pricing, vanishes, and with it goes the ability to capitalize solely on the drug's market potential. The financial figures are stark; a blockbuster drug can see its revenue shrink by over 80% within the first year of its patent expiry. The brand-name drug, once the jewel in a company's crown, can quickly become just another option in a crowded marketplace.

For pharmaceutical giants, the patent cliff is a recurring threat. The reliance on a few blockbusters for the majority of revenue is a high-risk strategy. When these patents expire, the impact is seismic. Companies often resort to defensive strategies such as seeking new patents on minor reformulations or new therapeutic uses for the drug, sometimes criticized as 'evergreening.' However, such tactics provide only temporary relief and are increasingly scrutinized by regulators.

The rise of generic drugs post-patent-cliff is a transformative force in healthcare, driving down costs and expanding access to medicine. However, for every dollar the healthcare system saves, there is a

corresponding loss in the innovator company's revenue. The generic pharmaceutical industry thrives on this cliff but also faces its own challenges, such as rigorous approval processes and fierce price competition.

The impact is felt in the company's bottom line and reverberates through its entire ecosystem. Research and development budgets may be slashed, resulting in fewer innovative treatment options in the pipeline. Marketing strategies pivot drastically as efforts to retain market share intensify against the generic tide. Employment within the company can also be affected, with layoffs often seen as a necessary evil to balance the books.

Historical cases paint a grim picture of the patent cliff's impact. When the patent for a popular cholesterol drug (Lipitor) expired in 2011, its company (Pfizer) saw its sales drop from \$5 billion to \$2 billion in the span of one year. Another example is a famous antidepressant (Lexapro) that lost its patent protection in 2011, resulting in a 70% sales decline within two quarters for its company (Forest Laboratories). These are not isolated incidents but common narratives for pharmaceutical companies facing the inevitable patent expiration.

The descent into the "patent cliff" is thus a defining moment for pharmaceutical companies, a test of their resilience and adaptability. It's a phenomenon that has reshaped the industry's approach to drug development, marketing, and strategic planning. Companies must constantly innovate in their labs and business models to build a more sustainable future that can withstand the inevitable moment when a patent and the protection it affords expire.

In parallel, the industry is witnessing a wave of strategic mergers and acquisitions as companies seek to broaden their portfolios and hedge against losses from any drug's patent expiry. By acquiring companies with promising drug pipelines or merging with competitors to combine resources, pharmaceutical giants aim to create a more varied and resilient product range. This consolidation can lead to a more formidable market presence and a diversified risk profile. Beyond expanding their product lines, companies are doubling down on innovation, pouring resources into research and development to discover the next breakthrough drug. The goal is to continually populate the pipeline with new patents, which can provide a buffer of protection as older patents wane, thus smoothing out the potential revenue dips and maintaining a steady flow of market-leading treatments.

Finally, the patent system remains a double-edged sword for the pharmaceutical industry, a fundamental driver of innovation and a herald of financial uncertainty once patents expire. The industry's future hinges on its ability to navigate this patent cliff while committing to developing new and essential medicines. As the pharmaceutical landscape evolves, so must the strategies to sustain it, ensuring that the flow of medical breakthroughs continues unimpeded by the economic challenges posed by the patent life cycle.

PART 1 · TOPIC 31

What is the priority, "Innovative Drugs " or "Generic Drugs"?

December 2023 · First published

The uniqueness of the pharmaceutical market is evident in its central division into two categories: "innovative" drugs and "generic" drugs. The distinction lies in "industry" and "manufacturing". In today's article, we will delve into these two categories in more detail and focus on the importance of innovation in the pharmaceutical industry.

"Innovative drugs" represent modern medicines protected by intellectual property rights, and their protection usually lasts about 20 years from the drug's discovery. During this period, the company holding the patent was the only one authorized to manufacture and produce the drug. On the other hand, "generic drugs" are alternative copies of the original "innovative drugs" and are produced after the patent protection period expires. This raises a fundamental question: which is a priority, "innovative" or "generic" drugs? What about the concepts of "industry" and "manufacturing"?

Discovering and developing a new innovative drug comes at a hefty cost, often exceeding a billion US dollars, and typically takes more than ten years of research and development. This process also carries significant risks of failure. With these challenges, choosing between "innovative drugs" and "generic drugs" becomes crucial for pharmaceutical companies.

Having a defined period of patent protection incentivizes pharmaceutical companies to make massive investments in research, development, and innovation for drugs, whether they succeed or fail. Without patent protection, innovation and development processes might cease, potentially leading to exclusive monopolies by pharmaceutical companies for the treatment of many diseases. This highlights the delicate balance between encouraging innovation and ensuring easy drug access.

Unfortunately, there are no Arab "innovative" drugs at present. However, there is a vision and significant Saudi efforts to make substantial progress in this field shortly, thanks to solid support from our leadership. The concepts of "industry" and "manufacturing" are related to transforming natural resources and raw materials into final products. "Industry" encompasses a comprehensive design, development, production, manufacturing, distribution, and marketing process. Meanwhile, "manufacturing" is a specific part of this broader process, focusing on converting raw materials into final products through specific technical processes.

The concept of "industry" covers all processes from design to marketing, providing a comprehensive market overview and customer needs. It includes innovation and development processes and helps produce unique, advanced products that meet market demands. "Industry" allows companies to plan for the long term and make strategic decisions based on analysis and forecasts. It helps identify potential risks and manage them effectively.

In the end, when we look at the choice between "innovative" and "generic" drugs or between "innovative industry" and "generic drug manufacturing," it becomes clear that "innovative drugs" hold significant importance for several reasons. This includes discovering new treatments for stubborn diseases, support for innovation and development, and a substantial return on investment compared to the slim margins associated with "generic" drug manufacturing. Therefore, it is necessary to emphasize the importance of investing in "innovative drugs" rather than exclusively focusing on "manufacturing."

In today's interconnected global arena, no single country can produce all products independently, and there are complex linkages across various industries, including the pharmaceutical industry. "Manufacturing" focuses on transforming raw materials into ready-to-sell products, aiming to improve efficiency and reduce costs using advanced techniques and equipment, providing employment opportunities, and efficiently meeting demand.

In conclusion, "industry" and "manufacturing" are interconnected aspects of the same coin. "Industry" guides processes from design to marketing, providing a comprehensive market view and meeting customer needs, while "manufacturing" focuses on transforming raw materials into final products. Thus, they complement each other. We must consider industry, manufacturing, innovative drugs, and generic drugs as essential matters; they are a priority without exception.

PART 1 · TOPIC 32

What is the Virtual Pharmaceutical Companies?September 2023 · First published

Dear reader, our topic for today is virtual pharmaceutical companies, which heavily rely on external resources and partners for different stages of drug development, including research, clinical trials, and manufacturing.

The concept of virtual pharmaceutical companies is a recent addition to the pharmaceutical industry and came into existence in the 1990s as a response to the growing intricacy and expense of drug development. This business model is especially beneficial for small to medium-sized companies with insufficient resources to manage all facets of drug development in-house.

Companies that operate virtually usually concentrate on creating and promoting new and innovative medications, while depending heavily on external resources to handle tasks such as managing clinical trials, regulatory affairs, drug production and manufacturing, and other development-related activities. To accomplish this, they outsource these tasks to other companies, including contract research organizations (CROs) for clinical and preclinical studies, contract manufacturing organizations (CMOs) for drug production, and specialized regulatory affairs consultants for complex regulatory work. Compared to traditional pharmaceutical companies, virtual companies have lower overhead costs and smaller teams, which allows them to be more adaptable and focused on dealing with the various changes in drug development while concentrating on their key skills, such as drug discovery and development while outsourcing other functions to specialized external partners. This strategy can help speed up the drug development process and lower costs.

In contrast, traditional pharmaceutical companies often have in-house research and development departments and comprehensive manufacturing and distribution capabilities. They have different advantages related to resources and infrastructure. Drug development within traditional pharmaceutical companies can be very expensive, requiring significant investment in infrastructure, facilities, and employees.

Dear reader, although virtual pharmaceutical companies offer many advantages, there are also some challenges to consider. Managing a network of external partners can be complex and requires strong project management skills. Additionally, virtual pharmaceutical companies may face difficulty in attracting funding from investors who prefer to invest in established traditional pharmaceutical companies with in-house research and development and manufacturing capabilities.

There are some possible drawbacks to this approach when it comes to cost and efficiency. For instance, outsourcing various parts of the drug development process could complicate project management and coordination, which may result in delays and higher costs. Moreover, depending on third-party partners for drug development could also raise the risks and uncertainties involved in

the process since virtual companies may have less oversight of the work done by their external partners, potentially affecting the quality and consistency of the outcome.

Alternatively, the conventional pharmaceutical company approach offers greater management over the drug development process, potentially enhancing communication and coordination between various departments. However, this model may be less versatile and able to adjust to changes in the drug development system, resulting in higher costs due to the requirement for internal resources and extensive infrastructure.

Here, dear reader, we mention examples of virtual pharmaceutical companies:

Alnylam Pharmaceuticals: It is a biotech company that focuses on developing RNAi injectable therapies for rare genetic diseases, and the company's market value is estimated at around \$ 27 billion.

Cytokinetics: It is a biotech company that focuses on developing treatments for heart and muscle-related diseases, and the company's market value is estimated at around \$ 3.2 billion.

Arvinas: It is a biotech company that focuses on developing small-molecule drugs to treat cancer and other diseases, and the company's market value is estimated at around \$ 1.3 billion.

The choice between the virtual and traditional models for research and development within a company depends on a variety of factors, including the company's resources and expertise, the nature of the drugs being developed, market competition, cost, experience, flexibility, and other factors. Companies must evaluate market competition, resources, and the capabilities of their competitors.

PART 1 · TOPIC 33

Why Investing in Orphan Drugs is Crucial?

September 2023 · First published

Dear reader, it is crucial to understand what orphan drugs are before delving into the question posed in the title of this article. These drugs are specifically designed to treat rare diseases with limited information and high associated development costs. Cystic fibrosis and Angelman syndrome are a few examples of rare diseases, with an incidence rate of 1 in 15,000 people.

According to the US Food and Drug Administration (FDA), an orphan drug is a medication or biological product that is developed to cure a rare disease or condition. Such diseases or conditions are defined as affecting less than 200,000 people in the United States. Since orphan drugs are limited to a small number of patients, pharmaceutical companies may not have significant financial incentives to research and develop them.

On the other hand, according to the European Medicines Agency (EMA), orphan drugs are drugs that aim to treat rare diseases or chronic diseases that are serious, life-threatening, or affect less than 10,000 individuals in the European Union.

According to the Saudi Food and Drug Authority (SFDA), a rare disease is defined as any condition that affects only one out of every 2,000 individuals.

There are approximately 8,000 rare diseases worldwide, with symptoms typically manifesting during infancy and childhood. Genetic disorders are the primary cause of these conditions, which can be fatal, with mortality rates reaching up to 50%.

The percentage of approved drugs to treat these diseases ranges from 5%.

Like other drugs, orphan drugs undergo the same regulatory development process, and pharmaceutical companies can seek orphan drug designation. Various countries provide financial benefits for registering these drugs, such as tax exemptions for clinical research expenses and the possibility of up to 7 years of additional exclusivity in the market if the drug is approved.

Dear reader, let us ponder on today's question, "Why should we invest in orphan drugs?" There are multiple compelling reasons to contemplate investing in such drugs.

1. **Unmet medical need:** Investing in orphan drugs can help meet this need and provide new novel treatment options for patients with these rare conditions.
2. **Regulatory incentives:** Regulatory agencies offer various incentives to encourage investment in orphan drugs. These incentives help offset the expenses of developing drugs for rare diseases and make it financially feasible for investors to participate in this sector.

3. Stimulating market potential: Even though rare diseases only impact a small portion of the population, the overall number of individuals affected by these diseases is significant and is expected to grow as more rare diseases are identified and diagnostic methods improve. As a result, there is a substantial demand for orphan drugs in the marketplace.

4. Social responsibility: Investing in orphan drugs can be considered a responsible social investment, as it can help build trust and confidence with patients and healthcare providers.

5. Scientific innovation: When it comes to developing drugs for rare diseases, innovative drug discovery and development approaches are often necessary. This can result in scientific breakthroughs that have implications beyond just treating the specific targeted disease. For instance, drugs created for rare genetic diseases can help uncover the underlying reasons for these conditions, leading to new findings related to more common diseases.

Before investing in this field, it is crucial to evaluate the potential risks and challenges involved, such as the high cost and complexity of drug development, regulatory approval hurdles, pricing, market accessibility, and intense competition. Taking these factors into consideration can help make informed investment decisions.

Finally, the development of orphan drugs has become an important area for the pharmaceutical industry in recent years, as pharmaceutical companies are looking for innovative ways to treat these rare diseases.

PART 1 · TOPIC 34

What is Pharmacoeconomics?

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Pharmacoeconomics is a highly specialized area within the broader field of health economics. Its primary focus is on analyzing the affordability and effectiveness of pharmaceuticals and medical interventions. This involves applying a range of economic principles and methodologies to assess the overall value and impact of healthcare interventions, including drugs, devices, and procedures. By examining key metrics such as cost-effectiveness, cost-benefit analysis, and health-related quality of life, pharmacoeconomics helps healthcare providers, and policymakers make informed decisions about which interventions are most likely to deliver the greatest benefits to patients while also being cost-effective and sustainable over the long term. Overall, pharmacoeconomics plays a vital role in ensuring that healthcare resources are allocated in the most efficient and effective way possible, ultimately improving patient outcomes and quality of life.

The field of pharmacoeconomics analysis is focused on identifying the most effective and efficient means of achieving a desired health outcome. This is done by conducting a comprehensive assessment of the costs and benefits associated with various treatments. The process involves a thorough examination of the expenses related to the intervention, including any drug and administrative costs, as well as any medical expenses that may arise as a result of the treatment, such as hospitalization or additional doctor visits. In addition to these costs, the analysis also takes into account the benefits of the intervention, which may include improved health outcomes, enhanced quality of life, and increased productivity. By comparing the costs and benefits of different treatment options, pharmacoeconomics analysis aims to identify the best course of action to achieve optimal health outcomes while minimizing costs and maximizing value.

Pharmacoeconomics is a newly developed field of study that originated in the 1980s. Michael Drummond, a health economist in the United Kingdom, coined the term "pharmacoeconomics" in 1987. However, the foundation of pharmacoeconomics can be traced back to the early 1960s, when health economists started utilizing economic principles to make decisions regarding healthcare.

The development of pharmacoeconomics was driven by the increasing cost of healthcare and the need to make informed decisions about how to allocate limited resources. The field initially focused on evaluating the cost-effectiveness of pharmaceuticals but has since expanded to include other healthcare interventions, such as medical devices and surgical procedures.

Pharmacoeconomics can be used to inform decision-making by healthcare providers, insurers, and policymakers, who use the information to determine which treatments to cover and at what price. It is an important tool for ensuring that healthcare resources are used efficiently and effectively.

In the early days of pharmacoeconomics, the methods used were relatively simple, and the focus was on cost-effectiveness analysis (CEA). However, as the field has grown, more sophisticated methods have been developed, including cost-utility analysis (CUA) and cost-benefit analysis (CBA).

Pharmacoeconomics commonly uses Cost-effectiveness analysis (CEA) to compare the costs and benefits of different interventions. This entails calculating the cost per unit of effectiveness, such as the cost per life-year gained or the cost per symptom-free day.

Cost-utility analysis (CUA), on the other hand, is a type of CEA that compares the costs and benefits of interventions by calculating the cost per quality-adjusted life-year (QALY) gained. QALYs measure the quantity and quality of life gained from an intervention for a more comprehensive evaluation of the value of healthcare interventions.

Cost-benefit analysis (CBA) compares the costs and benefits of interventions in monetary terms. This method assigns a dollar value to the benefits gained from the intervention, such as increased productivity or reduced healthcare costs, to determine whether the intervention is economically justifiable.

It can be designed to address different research questions, depending on the goals of the analysis. For example, a study may evaluate the cost-effectiveness of a new drug compared to an existing one, or it may assess the cost-effectiveness of a drug in a specific patient population or clinical setting.

Moreover, it can also be used to inform healthcare policymaking, such as policymakers may use the data to make decisions about drug formularies, price regulation, and reimbursement policies. The data can also be used to inform clinical practice guidelines and treatment protocols.

Pharmacoeconomic analysis can be challenging due to the complexity of healthcare interventions and the variability of patient populations. For example, different patient populations may respond differently to the same treatment, and the costs of healthcare interventions can vary widely depending on the setting in which they are delivered. Therefore, it is important for pharmacoeconomic studies to consider the potential sources of variability and uncertainty in the analysis.

Pharmacoeconomic studies have resulted in several cost-saving examples. Here are a few:

One study evaluated the cost-effectiveness of using a once-daily extended-release formulation of a medication for the treatment of attention-deficit/hyperactivity disorder (ADHD) compared to traditional immediate-release formulations. The study found that the extended-release formulation was more cost-effective, resulting in potential cost savings of up to \$1,300 per patient per year.

Another study evaluated the cost-effectiveness of using a new drug for the treatment of heart failure with reduced ejection fraction. The study found that the new drug was more cost-effective than existing therapies, resulting in potential cost savings of up to \$4,500 per patient per year.

Another study evaluated the cost-effectiveness of using a new medication for the treatment of hepatitis C compared to older, less effective therapies. The study found that the new medication was more cost-effective, resulting in potential cost savings of up to \$1.2 billion over a 20-year period.

These are just a few examples of how pharmacoeconomic studies can inform healthcare decision-making and result in cost savings.

Dear reader, pharmacoeconomics is an interdisciplinary field that draws on principles and methods from economics, epidemiology, statistics, and clinical medicine. As such, it requires collaboration between healthcare professionals, economists, statisticians, and other experts to ensure that the analysis is rigorous and accurate.

PART 1 · TOPIC 35**The Pharmaceutical Industry is One of the Most Profitable Sectors Globally**July 2023 · First published

The pharmaceutical industry is highly profitable and plays a significant role in the global economy, particularly in the industrial and healthcare fields. It is a strategic industry that requires short, medium, and long-term strategies to support and foster growth. This sector is part of the knowledge-based economy, which relies on innovative technology and knowledge. To promote its growth, the industry requires proper support, infrastructure, and an attractive investment environment.

The pharmaceutical industry is certainly a major player in the global economy, particularly in the healthcare field. It's clear that there is a significant demand for innovative drugs and treatments, and top companies like Johnson & Johnson, Pfizer, and Roche have managed to generate impressive revenue, more than \$ 48 billion in annual revenue, through their investments in research and development. It's exciting to see what the future holds for these companies as they continue to meet the needs of patients around the world.

Dear reader, when it comes to the pharmaceutical industry, there are several key factors that must be carefully considered to ensure profitability and ongoing success. Some of these factors include research and development costs, patent protection, compliance with regulations, pricing strategies, market demand, and other key considerations. Successfully managing these factors can lead to increased profits and sustainable growth for pharmaceutical companies, while failing to address them can result in financial losses and decreased market share for these companies.

One of the biggest challenges facing pharmaceutical companies today is the high cost of research, development, and innovation. With the emergence of new technologies and stricter regulatory demands, companies are investing more time and money in developing new drugs, which raises healthcare costs and puts pressure on pharmaceutical companies to find new ways to innovate and stay competitive. Pharmaceutical companies spend tens of billions annually on research, development, and innovation. According to recent financial statistics, the cost of research, development, and innovation constitutes a large share of the budgets and expenses of pharmaceutical companies, with an estimated average cost of around 10 billion Saudi riyals per drug.

The United States is the dominant player in the pharmaceutical industry, with "Johnson & Johnson" and "Pfizer" among the largest pharmaceutical companies in the United States. The United States alone accounts for about 40% of global spending on drugs in 2021. China has emerged as the second-largest market, owning about 12% of the market share. The Chinese pharmaceutical market is characterized by a large number of consumers, while the US pharmaceutical market is characterized by quality and high prices compared to other countries.

In addition, intellectual property protection and patents play a critical role in the pharmaceutical industry, where the usual patent lasts for 20 years from the date of filing. Compliance with regulations and legislation from regulatory bodies and sectors such as the FDA is also necessary for pharmaceutical companies, as non-compliance can lead to hefty fines and legal proceedings. Pricing strategies must also be carefully considered to achieve a balance between profitability and an appropriate price for patients.

Understanding market demand and adapting to variables is crucial for sustainable growth and success for these companies. By effectively managing these key factors, pharmaceutical companies can increase profits and maintain a strong position in these competitive and changing industries, where pharmaceutical and biotech industries' profits worldwide reached about \$ 1.44 trillion in 2021.

Dear reader, the increasing demand for personalized medicine is another important factor shaping the pharmaceutical industry. Consumers are increasingly seeking treatments designed specifically for their individual needs, including gene and cell therapies, which is driving companies to invest in new research and development strategies. In 2021, the global personalized medicine market was valued at \$ 2.1 trillion, and it is expected to reach \$ 5.6 trillion by 2030.

Despite these challenges, the pharmaceutical industries remain an important and highly profitable sector in the global economy. With the right strategies and a strong focus on innovation, companies can continue to evolve and succeed in this dynamic and constantly changing market.

In conclusion, dear reader, as we look to the future, technologies such as artificial intelligence, machine learning, and 3D printing are promising in identifying new drug targets and developing more effective treatments, revolutionizing the pharmaceutical industry. Keeping up with these emerging trends is vital for pharmaceutical companies to maintain profitability in rapidly evolving pharmaceutical industries.

PART 1 · TOPIC 36**Australian Experience**July 2023 · First published

Dear Reader! I wanted to touch base with you about Australian clinical trials. I recently had a chat with a colleague from an American-Australian company who was impressed by one of my articles on the subject. He shared some interesting insights on why clinical trials in Australia are so beneficial compared to other countries. As someone who's worked in this field for a while now, both in Saudi Arabia and the United States, I'm excited to share some of the most important information on the topic. Let's dive in!

Clinical trials are an essential part of medical research, as they help us understand the safety and effectiveness of new treatments. These experiments are conducted on volunteers and can be used to diagnose or prevent specific diseases. Before clinical trials can begin, preclinical trials are conducted in the lab and on animals to ensure the treatment is safe and effective. Only after these tests are completed and approved by the authorities can clinical trials on humans begin. It's important to note that these trials are conducted with the utmost care and consideration for the well-being of all involved.

Clinical trials are divided into four main stages:

The first clinical phase focuses on studying the safety of the treatment and is often conducted on healthy volunteers and, in some exceptional cases, on some patients, such as cancer patients. The number of volunteers ranges between 10 to 100 and lasts for months.

The second clinical phase focuses on studying the effectiveness of the treatment and the study of side effects and is conducted on volunteer patients, and their number ranges between 100 to 300 and lasts from one to two years.

The third phase focuses on a wider study of the effectiveness of treatment, side effects, and safety on a broader scale where the number of volunteers ranges between 1000 to 3000 and lasts from one to 4 years and may be in a number of hospitals and countries. This phase is considered the last phase before approval of the treatment by the concerned authorities and its availability in the markets.

The fourth phase comes after the approval of the treatment and its availability in the markets and aims to study the effectiveness and safety of the drug in the long run.

Let us return, dear reader, to the advantages of conducting clinical research for biotechnology and pharmaceuticals in Australia. As my American friend mentioned, many benefits are available to small biotechnology startups that come to Australia to conduct trials in the early stages. This is due to the careful and considerate manner in which clinical trials are conducted in Australia, with the well-being

of all involved as a top priority. Additionally, Australia has a strong and supportive regulatory environment that encourages innovation and growth in the biotechnology industry.

The most important of these features that distinguish Australia:

1. The speed of obtaining the necessary approvals from the relevant authorities to start clinical trials, as there is no need to get official permission, which saves time and money, as there are ethical review committees that take only five weeks, which is a very big incentive for emerging pharmaceutical companies.
2. Clinical trials in Australia are characterized by quality. All previous tests and data established in different countries, such as the US Food and Drug Administration and the European Medicines Agency, are accepted. There is no need to redo them, which saves money and time as well.
3. Australia is characterized by providing a 43.5% cash discount by the Australian government on all clinical trials, which provides a large amount of capital and reduces financial risks for startups and venture capital companies. It is a major attraction for these companies from outside Australia.
4. There is a big difference in currency exchange rates between most countries and Australia, which makes the total costs lower.

Clinical trials in Australia are within reach of all small startups from various countries of the world.

It seems that Australia could be a more affordable option for conducting clinical trials. However, it's important to prioritize the quality of work and accuracy of data analysis, so it may be worth considering the potential trade-offs before making a final decision.

At the end of this article, dear reader, what about clinical trials in Saudi Arabia, especially in the early stages (Phases 1 and 2)? We can answer this question in an upcoming article...

PART 1 · TOPIC 37

The Most Expensive Medicines Globally!

June 2023 · First published

Dear reader, it is no secret that the global pharmaceutical market is a very large market, reaching billions of dollars annually. In this article, we will review the three most expensive medicines in the world and rank them according to the cost of treatment for one year for each medicine. The pricing of medicines has always been a controversial issue among many parties.

To start our article today, let us first ask a question before we review the most expensive medicines globally, which is why some medicines are very expensive. The pricing of drugs depends on many factors, the most important of which are the cost of research, development, and innovation, which may cost billions of dollars and may take many years just to approve the drug by the relevant authorities. Another factor is the size of the targeted pharmaceutical market. For example, suppose the number of patients with a certain disease around the world is about 10,000 compared to another disease where the number of patients around the world exceeds 10 million patients. In that case, it will greatly affect the drug price. Other factors include whether there is competition from other alternative drugs for the same disease, and we may discuss many other factors in a separate article in the future.

If it is a specialized drug, a gene therapy, or a biological drug, it will be one of the most expensive drugs today. Gene therapies, for example, are unique in that they only need to be taken once for life-threatening diseases and can result in complete healing.

Now, let us review the three most expensive medicines in the world, starting with "Zolgensma" (onasemnogene abeparvovec-xioi)," which ranks third as the most expensive drug in the world with a total cost of approximately \$2.125 million per patient. It is a life-saving gene therapy drug that was approved by the US Food and Drug Administration (FDA) in 2019 to treat Spinal Muscular Atrophy (SMA). This rare genetic motor neuron disease causes breathing and swallowing problems in children. Most children with SMA do not survive their early childhood due to the inability to breathe. This drug is given as a one-time intravenous (IV) dose, as it works by replacing or correcting the defective or missing gene for motor neuron 1 (SMN1) cells.

The second most expensive drug in the world is "Zynteglo" (betibeglogene autotemcel or beti-cel), with a total cost of approximately \$2.8 million per patient. It was approved by the US FDA in 2022 as a gene therapy treatment for adult and pediatric patients with Beta-Thalassemia. This genetic blood disorder is one of the main types of Thalassemia. It is classified as anemia, where red blood cell counts or hemoglobin levels fall below normal levels in the body. Patients need regular red blood cell transfusions in blood transfusion procedures, and their life depends on it if left untreated. The process is long; patients usually undergo transfusions every two to five weeks.

The most expensive drug in the world is "Skysona" (elivaldogene autotemcel or eli-cel), with a total cost that exceeds \$3 million per patient. It was approved by the US FDA in 2022 as the first treatment for slowing the progression of neurological degeneration in patients aged 4 to 17 who suffer from early active cerebral adrenoleukodystrophy (CALD), also known as "brain adrenal gland degeneration." CALD is a rare and deadly genetic disease that primarily affects young patients, and the death rate due to this disease reaches half of the patients who do not receive treatment within five years of the onset of symptoms. "Skysona" is produced from the patient's stem cells and modified to contain a copy of the functional ALDP protein gene. The treatment is given in a single dose only.

Finally, access to medication is crucial for the well-being of people, and governments play a vital role in ensuring that they are available to everyone. It's heartening to see that the Saudi government is committed to this cause and is working towards providing the latest drugs to its citizens and residents for free, regardless of the cost or price. Such efforts will go a long way in improving the quality of life of people and helping them lead healthier and happier lives.

PART 2

Biotechnology

16 TOPICS

For most of history medicine was something we found. Biotechnology is medicine we write. Since the first genetically engineered insulin was approved in 1982, the tools have compounded: genomics, cell and gene therapy, mRNA, the microbiome, bioprinting, vaccines tailored to a single patient. These topics follow that frontier as it moves, what each new capability makes possible, what it does not yet do, and how long the distance usually is between a striking result and a treatment anyone can actually receive.

WHY READ THIS PART

Read this section to see where medicine is actually going, and to tell the genuine breakthroughs apart from the announcements.

BIOTECHNOLOGY · PART 2

In this part

NO.	TOPIC	PAGE	PUBLISHED
1	Why is Biotechnology Moving Toward Big Numbers	93	May 2026
2	Collaboration is the Fuel for the Next Generation of Biotech Innovation in the USA	95	April 2026
3	The Biotech Race Between the United States and China	97	March 2026
4	Personalized Vaccines and Preventive Medicine	99	May 2025
5	The 3D Bioprinting Revolution	101	May 2025
6	Metabolomics	103	April 2025
7	The Hidden World Within Our Bodies	105	March 2025
8	Biotech Companies Outside the United States	107	February 2025
9	The Growth of China's Biotechnology Giant	109	January 2025
10	How Life Sciences, Pharmaceuticals, and Biotechnology are Shaping our Future	111	December 2024
11	The Backbone of Biotechnology Development	113	December 2024
12	Biotech Cities!	115	May 2024
13	What is the Ecosystem of the Pharmaceutical and Biotechnology Industries?	117	September 2023
14	My Preferred Color is "Red"... What is Your Favorite Color?	119	August 2023
15	Some of the Biotechnology History	121	August 2023
16	The Beginning of Biotechnology Companies	123	June 2023

PART 2 · TOPIC 1

Why is Biotechnology Moving Toward Big Numbers

May 2026 · First published

Dear reader, the pharmaceutical and biotechnology industries are undergoing a clear shift toward innovation. After years in which the spotlight was largely on rare diseases, oncology, and narrowly defined indications, areas where high per-patient prices can be justified, and clinical trials are often more manageable, a new wave is bringing common, high-prevalence diseases back to the center of attention. This does not mean specialized innovation is fading. Rather, it adds a new layer that redefines where the greatest scientific and commercial value is created, especially when the health impact can be broad at a population level.

We can understand this shift through two interconnected lenses. The first is the evolution of the therapeutic toolbox itself. The industry is no longer dominated by traditional small molecules; today's therapeutic portfolio is far more diverse. Historically, small molecules accounted for the majority of blockbuster sales at major pharmaceutical companies, but that dominance has gradually declined with the rise of biologics such as antibodies, proteins, and peptides, followed by newer categories like multispecific therapies, cell and gene therapies, and beyond. This is not just a change in labels. It reflects a world where competition increasingly requires new capabilities: advanced biomanufacturing, cold-chain logistics, sterile fill-finish, autoinjector devices, complex purification, and long-term clinical monitoring that relies on biomarkers and real-world data. In other words, innovation has become an integrated system, not just a single molecule.

The second lens, dear reader, is the changing shape of the market. Over the past decades, sales of drugs targeting small patient populations grew dramatically, and the market peaks were often built on products serving fewer patients but generating high revenue per patient. What is new is that this trend has begun to reverse. Broad, high-prevalence indications are once again climbing into the list of top-selling therapies, driven especially by the explosion of obesity, diabetes, and weight-management treatments such as the GLP-1 class, and by expanding markets tied to cardiometabolic risk. At the same time, large segments of immunology and inflammation, covering relatively common conditions, are moving toward earlier treatment, prevention of complications, and improved adherence, further strengthening the business case for population-scale impact.

Commercially and from a regulatory standpoint, moving into "big indications" imposes completely different rules. In rare diseases, demonstrating strong efficacy in a small cohort with a clear reimbursement pathway may be sufficient. In common diseases, the bar is higher: long-term safety across potentially millions of users, proof of effect on "hard" outcomes such as reducing cardiovascular events or preventing complications, durability of benefit over time, and a clear plan to manage side effects, improve adherence, and reduce discontinuation. Budget impact also becomes decisive. Payers may accept a high price for a rare treatment because patient numbers are limited,

but they become far more price-sensitive when the same therapy could be prescribed at scale. That pushes companies toward strategies such as tiered pricing, outcomes-based agreements, launching in defined eligibility subgroups before expanding, and linking therapy to digital monitoring and behavioral interventions to maximize real-world outcomes.

Operationally, this shift demands a different innovation infrastructure: improving tolerability and safety for long-term use, designing trials that balance precision (biomarkers) with realism (studies closer to daily practice), and building resilient supply chains that can meet massive demand without interruption. It also requires close collaboration with healthcare systems to ensure rational use and to prevent uncontrolled expansion or off-label overuse, because unmanaged scale can create financial and clinical strain rather than solve the underlying problem.

For healthcare systems in our region, this wave presents both a major opportunity and a clear challenge. The opportunity is that common diseases such as obesity, diabetes, cardiometabolic conditions, and parts of immunology represent a heavy burden on quality of life and national budgets. Therapies with true population-level impact can meaningfully reduce complications and improve people's lives. The challenge is that successful adoption requires deliberate policy: clear eligibility criteria, follow-up protocols, dispensing pathways, provider training, real-world outcomes measurement, and strong data governance. Broad innovation without management can become budget depletion rather than a health investment.

The takeaway, dear reader, is not that "innovation is only moving toward obesity." It is that the industry is rebalancing between high-value specialized innovation and high-impact population-scale innovation. As this happens, the rules of competition will change: having a powerful therapeutic platform is no longer enough. The winners will be those who combine the platform with scalable manufacturing, credible access and reimbursement strategy, long-term real-world evidence, and effective partnerships with health systems, because that is what it takes to lead the era of "innovation for big numbers."

PART 2 · TOPIC 2

Collaboration is the Fuel for the Next Generation of Biotech Innovation in the USA

April 2026 · First published

In the United States, the biotech industry is going through a delicate moment: company valuations have dropped, investors are more careful with their money, and start-ups are finding it harder to raise capital, so people are realizing that competition alone is no longer enough to drive growth and that the next generation of life-science innovation will depend on collaboration and strong networks, not on isolated companies fighting alone.

This idea came through clearly in recent meetings and events in Washington, D.C., where investors, university leaders, big-pharma executives, and policy experts gathered to ask a basic question: What does America need to build a new life-science ecosystem that can keep leading the world? One major topic was the geographic concentration of innovation in just a few states, especially California and Massachusetts, while many other regions with good universities, hospitals, and talented people remain at the edge of the map; to fix this, the federal government launched programs such as the regional tech hubs under the CHIPS and Science Act to channel funding into places like Richmond, Baltimore, and other cities, trying to turn them into new centers for biotech and advanced industries, based on the belief that America's long-term strength depends on spreading innovation across the country instead of keeping it locked in a few zip codes.

Another big theme was the role of universities as the main source of new scientific discoveries in life sciences, and the problem that too few of those discoveries turn into real companies and products: research funding on campuses has grown sharply over the past years, but the number of spin-outs and licenses has not kept up, so some states have created programs like "Lab2Launch," which align technology-transfer rules across major research universities and make it easier and faster for a scientist to launch a start-up, sending a clear message that if the U.S. wants to stay ahead in drugs and biotech, it needs far more attempts to turn ideas from the lab into businesses in the market. A

t the local level, the goal is no longer to "trap" a start-up in the city where it was born, but to build an environment that makes founders actually want to stay, and that comes from seemingly simple things with big impact: a tight, supportive community, regular meetups, and open communication channels between scientists, entrepreneurs, and investors; the CvilleBioHub example shows this well, as a single monthly event that has run for about ten years helped create a dense web of trust and collaboration among dozens of companies in one region, making it a magnet for talent and funding.

The discussions also pushed for a broader definition of "talent" in the biotech ecosystem: it is not only about top scientists or CEOs, but also about an entire layer of mid-level experts, project managers, regulatory specialists, data people, who connect the lab, the rules, the money, and the

daily execution, and with the rise of remote work a new model has appeared in which senior leaders split their time across several start-ups as “fractional” executives, giving young companies high-level expertise at a manageable cost, a flexibility that is especially important in emerging regions outside the traditional coastal hubs.

Large global pharma companies also play a key role, because when giants like Eli Lilly, AstraZeneca, or Merck put major manufacturing plants or R&D sites in a region, they don’t just bring factories and jobs; they become magnets for skilled workers, create local supply chains, and open doors to partnerships with start-ups and universities, and when they invest billions in advanced manufacturing in a given state, they are effectively declaring that this place is a reliable address for production and innovation, around which new start-ups, training programs, and joint research projects tend to grow. Although competition between cities, states, and companies is normal in a market economy, experience shows that cooperation is what keeps growth going over time: areas like the Washington–Maryland–Virginia corridor offer an example of “smart collaboration,” with shared lab spaces, joint workforce programs, and aligned investment strategies, while still allowing each sub-region to specialize in what it does best instead of trying to win in everything, a mix of specialization and collaboration that gives each area a clear advantage and links them into a stronger regional ecosystem. Successful stories in states like Texas highlight how integrated, long-term programs, funding infrastructure, attracting top scientists, backing clinical trials, and supporting product development under one vision, can transform a local scene, and they remind us that America’s biotech leadership did not appear by accident, but grew out of conscious choices: laws that support innovation, tax incentives, and targeted funding programs; to protect that lead today, the country needs to keep investing in these policies, not cut innovation budgets in the name of short-term savings.

In the end, this whole picture shows that life-science innovation is no longer the project of any single player, but of a full system that connects universities, investors, start-ups, big pharma, and governments; real value is created when all of them act as partners in a long-term shared effort instead of isolated rivals, and the real question is no longer whether the United States will build the next generation of life-science ecosystems, but how it will do it, through smart collaboration that opens doors for everyone, or through scattered competition that weakens everyone, while current signs strongly suggest that collaboration is turning into the most important competitive advantage in the global race for biotech innovation.

PART 2 · TOPIC 3

The Biotech Race Between the United States and China

March 2026 · First published

Dear reader, imagine that today's great-power competition is no longer only about tanks, planes, and missiles, but also about genes, medical data, vaccines, and advanced biological drugs. This is what American politician Todd Tiaht discusses in his article, in which he describes the relationship between the United States and China as a fierce race to control biotechnology and warns that Washington could lose this race if it adopts the wrong economic policies, especially on drug pricing.

He focuses on a policy being debated in the US called the Most Favored Nation (MFN) pricing rule. On the surface, the idea looks fair and straightforward: link US drug prices to prices in other countries, usually European ones. In other words, if Germany or France pays less for the same medicine, why should American patients pay more? At first glance, that sounds reasonable, but Tiaht argues that this kind of policy may hurt America's ability to innovate more than it helps patients in the long run.

He explains that developing a new drug is neither easy nor cheap; it can take more than ten years and require investments of billions of dollars, with a high risk of failure at every research and clinical stage. Because of this, the whole sector depends heavily on investors' willingness to take risks. If the government then imposes strict price controls, the expected return on that risk declines, and investors become less willing to fund pharma and biotech companies. The final result, he warns, is fewer new medicines and slower innovation, even if we don't feel that impact immediately, but only after many years.

At the same time, the article reminds us that China is moving in the opposite direction. Beijing has declared biotech a "strategic emerging industry" and has poured billions of dollars into research cities, genome centers, and state-backed drug firms. According to the figures he cites, China now accounts for a growing share of global drug development activity and even surpasses the US in some measures of registered clinical trials. This shows that China does not want to remain just a factory producing drugs invented elsewhere; it wants to become a leading center of pharmaceutical innovation itself.

Tiaht also highlights a key risk in global drug supply chains: China already dominates production of active pharmaceutical ingredients (APIs) and basic chemicals used to make antibiotics and many generic drugs worldwide. If the US also loses its lead in innovative and biological medicines, it could end up depending on a strategic rival for both manufacturing and innovation. That dependence becomes dangerous in times of crisis, pandemics, health emergencies, or biological threats, when access to drugs and vaccines is not only a commercial or medical issue but a national security one.

The writer then turns to America's European allies. He argues that countries like Germany, the UK, and France have benefited for decades from drug innovation funded mainly by the US market, while using strict pricing systems that keep their own medicine prices lower than US prices. In other words, European patients enjoy drugs that were often paid for, in R&D terms, by American investors and taxpayers, but their health systems pay less. Tiahrt believes this imbalance needs to be fixed, but not by copying European price controls inside the US. Instead, he calls for trade and diplomatic negotiations that push these countries to bear a greater share of the costs of global innovation, without strangling the American research and development engine.

Domestically, he warns that an MFN-style pricing system could put tens of thousands of high-skilled jobs in the pharma and biotech sectors at risk and scare off venture capital from start-ups working on cutting-edge science. In his view, every new drug developed in an American lab is not only a scientific achievement or a profit opportunity; it is also part of the US strategic toolbox against diseases, pandemics, and biological threats, and a contributor to economic growth and exports.

In the end, he does not deny that high drug prices in the US are a real and painful problem, and that many patients suffer under heavy bills. But he sees tying US prices to foreign prices as "the wrong solution to a real problem." Instead, he calls for reforms that improve the efficiency of the health system, review the role of middlemen and distribution chains, increase transparency in discounts and negotiations, and strengthen real competition, so the burden on patients is reduced without weakening investment in R&D.

The deeper message of the article is that scientific innovation in the twenty-first century has become a form of national defense. The country that leads the world in genomics, vaccines, and advanced therapies will be in a stronger position to protect its people and to enhance its economic and political influence. For that reason, Tiahrt warns that any policy that weakens America's innovation capacity, even if it is marketed as a popular move to cut prices, could open the door for China to take the lead in this critical race, a race that Washington believes it simply cannot afford to lose.

PART 2 · TOPIC 4

Personalized Vaccines and Preventive MedicineMay 2025 · First published

Dear reader, in the world of modern medicine, scientists and researchers are constantly striving to develop new and effective ways to combat diseases and improve human health. One of the remarkable innovations in this field is "personalized vaccines," which aim to provide health solutions specifically tailored to an individual's genetic needs. This technology is part of the broader concept of preventive medicine, which focuses on preventing diseases before they occur, rather than treating them after infection. In this article, we will explore the concept of personalized vaccines, their impact on preventive medicine, and the benefits and challenges associated with them.

Personalized vaccines are a type of vaccine that is designed specifically for each individual based on their genetic analysis. The goal of these vaccines is to provide effective protection against diseases by targeting the causative agents in a way that matches the genetic makeup of each person. For example, immune system responses can vary between individuals due to genetic differences, meaning that traditional vaccines may be more or less effective depending on an individual's genetic condition.

These vaccines rely on a deep understanding of the human genome and leverage advancements in genetics and immunology. By analyzing an individual's DNA, scientists can identify genetic factors that may make a person more susceptible to certain diseases, allowing them to design a vaccine targeted specifically at those diseases.

The development of personalized vaccines depends on analyzing human genes and understanding how they interact with microbes or viruses that cause diseases. By comprehending the human genome, scientists can identify genetic variations that affect immune system responses.

For instance, some individuals may have specific gene copies that make them more susceptible to certain diseases or more responsive to certain vaccines. On the other hand, others may require a vaccine that contains different components or formulations. One of the modern techniques used in developing personalized vaccines is "gene therapy," which aims to modify or repair an individual's genes to enhance their immune response. These techniques can be used to design vaccines that target individuals with specific genes that may make them more susceptible to diseases like cancer or autoimmune disorders.

The major benefit of personalized vaccines lies in their ability to offer more effective protection against diseases. Since the vaccine is designed based on an individual's genetic traits, it increases the chances of its effectiveness. Rather than relying on traditional vaccines, which may work well for some individuals but not for others, personalized vaccines allow for an optimal immune response tailored to the individual.

Additionally, personalized vaccines contribute to the prevention of chronic diseases that may be linked to genetic factors. For instance, vaccines can be specifically designed for individuals with a family history of breast cancer or colon cancer, significantly reducing the chances of developing these diseases.

Another benefit of personalized vaccines is their potential to minimize negative side effects. Since the vaccine will be designed according to the genetic needs of the body, the risk of undesirable reactions is reduced.

Despite the many benefits of personalized vaccines, there are several challenges that may arise in the future. One of the most prominent challenges is cost. Developing a personalized vaccine requires costly genetic analysis and can take a long time, which significantly increases the price of the vaccine. Therefore, solutions need to be found to reduce these costs and achieve a balance between quality and cost.

Furthermore, there is still much scientific research that needs to be completed in genetics and immunology to fully understand how to design effective vaccines based on genetic differences among individuals. Although significant progress has been made in this field, applying this knowledge to real-world medical practice requires more time and effort.

Despite the challenges, the future looks promising for personalized vaccines and preventive medicine. As technology continues to advance, we may see a breakthrough in this area, where personalized vaccines become more common and affordable. In the future, it may be possible to integrate these vaccines into personalized healthcare programs, allowing individuals to prevent diseases more effectively. These vaccines are expected to play a significant role in combating chronic diseases like cancer and cardiovascular diseases, which are closely related to genetics. Additionally, they will contribute to improving the health of the elderly, as personalized vaccines could be designed to boost the immune system in age groups that are more vulnerable to diseases.

In conclusion, personalized vaccines represent one of the leading medical innovations that could revolutionize preventive medicine in the future. By tailoring treatments to each individual's genetic makeup, significant health benefits can be achieved, including more effective disease prevention and reduced side effects. However, there are challenges that need to be overcome, such as cost and ethical concerns. Despite these challenges, ongoing research and technological advancements indicate that personalized vaccines could become an integral part of healthcare in the near future, helping improve the health of individuals and communities.

PART 2 · TOPIC 5

The 3D Bioprinting RevolutionMay 2025 · First published

Dear reader, 3D bioprinting stands out as one of the most remarkable innovations in modern medical science. It carries the promise of transforming organ transplants and treating numerous diseases that have long posed challenges to traditional medicine. In this article, we will explore the latest developments in bioprinting techniques, discuss the obstacles that researchers face, and envision how this technology might redefine organ transplantation and provide new solutions to complex medical problems.

At its core, 3D bioprinting uses advanced printing devices built on sophisticated three-dimensional modeling techniques. These machines work by depositing layers of live cells mixed with supportive materials, often referred to as "bio-inks." These bio-inks are typically made up of biocompatible polymers that serve as scaffolds, allowing cells to grow and form tissues that mimic the structure and function of natural organs. Using this innovative method, scientists can construct intricate tissue structures designed to replace or regenerate damaged parts of the human body.

Recent years have witnessed significant progress in bioprinting technology. Researchers have successfully printed primitive tissues such as skin and cartilage. Early experiments have even ventured into the creation of more complex organs like livers and hearts. The success of these endeavors relies heavily on the precision with which live cells are distributed within the printed structures. This meticulous placement allows the cells to grow and integrate, eventually forming tissues that can function harmoniously within the body once implanted. Advances in material science and stem cell research have played crucial roles in enhancing this technology. Scientists have developed new formulations of bio-ink that not only keep the cells alive but also guide their growth in the proper directions. Moreover, sophisticated sensing and monitoring techniques during the printing process have significantly improved the quality of the printed tissue, ensuring its compatibility with the target biological system.

Despite these impressive achievements, 3D bioprinting still faces several challenges that limit its widespread application in organ transplantation. One of the primary issues is ensuring that the printed cells receive a constant supply of oxygen and nutrients. Even when tissue is printed successfully, the cells within require a well-developed vascular network to survive and thrive. Researchers are actively working on solutions, such as integrating microscopic channels within the printed tissue to simulate natural blood vessels, which could help overcome this critical hurdle.

Another significant challenge lies in accurately replicating the complex architecture of natural organs. Although current technologies offer high precision, reproducing the intricate structural details of living organs remains a formidable task. Achieving a balance between the flexibility and mechanical strength of the tissue requires perfect coordination between different cell types and the supporting

material. Additionally, bioprinting raises substantial ethical and regulatory questions. The testing of printed organs on human subjects, for example, might necessitate long-term clinical trials to ensure their safety and efficacy. This, in turn, calls for the development of comprehensive regulatory frameworks that safeguard patient rights and well-being.

The cost of bioprinting equipment and materials is also a major consideration. Producing printed tissues and organs demands significant investments in research and development. However, as this technology integrates with smart manufacturing systems, there is hope that production costs will decrease over time, making bioprinting more accessible in the long run.

Preliminary experiments suggest that this technology could have a profound impact on the future of medicine, particularly in the field of organ transplantation. Imagine a future where each patient receives a tailor-made organ grown from their own cells. Such a breakthrough would dramatically reduce the risk of organ rejection and improve surgical outcomes. It could also help alleviate the long waiting lists that currently result in the loss of many lives due to the shortage of donor organs.

Beyond transplantation, 3D bioprinting is poised to revolutionize medical research. Printed organs provide a controlled and precise environment for studying disease progression and testing new drugs. With these lab-created tissues, scientists can directly observe the effects of treatments without relying on animal testing or early-phase human trials. Furthermore, the ability to print complex tissues like hearts and livers opens up exciting new possibilities for treating chronic diseases that have, until now, resisted conventional therapies. Future advancements may even include the integration of gene editing or the incorporation of specific growth factors to further enhance the adaptability and functionality of the printed tissues within a patient's body.

In light of these challenges, the road ahead remains both promising and demanding. The journey toward fully functional, bioprinted organs requires continued research, collaboration, and innovation. As technological advancements accelerate and investments in this field grow, we may soon witness a dramatic transformation in how organ diseases are treated and managed. This progress could lead to the development of cutting-edge therapeutic solutions that not only extend lives but also offer a higher quality of life to patients around the globe.

Ultimately, 3D bioprinting is not just another technological breakthrough, it represents a genuine revolution in medicine. Its potential to create patient-specific organs and revolutionize both clinical treatment and medical research makes it one of the most exciting developments in modern healthcare. While significant challenges remain, the ongoing efforts of scientists, engineers, and clinicians provide a hopeful glimpse into a future where healthcare is more personalized, effective, and accessible.

Dear reader, as we stand on the cusp of this new era in medical science, it is important to recognize both the vast potential and the considerable hurdles that lie ahead. With perseverance and continued innovation, the promise of 3D bioprinting may well become a reality that changes the very fabric of healthcare, offering new hope to countless patients worldwide.

PART 2 · TOPIC 6

Metabolomics

April 2025 · First published

Dear reader, the term “metabolomics” refers to the study of the broad spectrum of small biological molecules known as “metabolites,” including amino acids, fatty acids, sugars, nucleotides, vitamins, and other compounds produced by metabolic reactions within a living organism. The importance of this field lies in its ability to create what is called a “metabolic profile” of an organism under certain conditions, such as specific health or disease states, age, diet, and lifestyle. Metabolomics forms a key link in the chain of sciences known collectively as the “omics,” which also includes genomics, proteomics, and transcriptomics. Together, these disciplines enable an integrated understanding of biological processes; through genetic, proteomic, and metabolic analyses, it becomes possible to track health or disease pathways and detect any imbalances in the biochemical reactions within cells and tissues.

Over the past few years, metabolomics has advanced rapidly in tandem with notable progress in spectroscopic techniques such as mass spectrometry (MS) and nuclear magnetic resonance (NMR), as well as breakthroughs in bioinformatics and biostatistics. Researchers and physicians use these tools to accurately measure metabolite concentrations, aiding in the early detection of metabolic disturbances that may result from complex diseases like cancer, heart disease, diabetes, or neurological disorders. By comparing the metabolic profile in samples from healthy individuals to those taken from patients with various conditions, significant differences emerge in their chemical composition and metabolite levels. These differences help identify “biomarkers” that accelerate diagnosis, assess treatment effectiveness, and develop more effective preventive strategies.

On a practical level, metabolomics opens up a broad avenue for discovering biomarkers that can be employed for early diagnosis and monitoring disease progression. For instance, analyzing blood or urine samples can reveal changes in metabolic byproducts before the appearance of clinical symptoms, providing doctors with a valuable opportunity for earlier preventive or therapeutic intervention. In addition, metabolomics deepens our understanding of disease mechanisms by accurately mapping out disrupted metabolic pathways, including any excesses or deficiencies in key metabolites. This approach aids in creating customized treatment plans that align with a patient's genetic and metabolic characteristics. Its impact is particularly evident in the growing adoption of “personalized medicine,” where metabolic profiling helps determine the most suitable therapies or dietary programs for each person.

In Saudi Arabia, the future of metabolomics looks very promising, especially with the country's growing focus on advancing healthcare, scientific research, and modern agriculture as part of Vision 2030. The emphasis on fostering innovation in healthcare and transitioning to a diversified, knowledge-based economy makes metabolomics a strategic avenue of investment to accelerate

the achievement of national goals. Many Saudi universities and research centers are establishing cutting-edge facilities for bioinformatics and spectroscopic analysis, providing the foundation to conduct metabolomics studies on a wide range of individuals. The aim is to obtain a more precise understanding of local health and metabolic characteristics, allowing researchers to identify potential hereditary diseases or chronic conditions that may be common in specific areas or age groups. Such research paves the way for the creation of more effective, tailored preventive and therapeutic strategies.

Moreover, developing metabolomics research in Saudi Arabia will allow labs and healthcare institutions to discover local biomarkers linked to prevalent diseases such as diabetes and cardiovascular disorders, which show high rates of incidence, as well as rarer genetic conditions. This represents a valuable opportunity to strengthen partnerships between the public and private sectors, as well as with global pharmaceutical companies seeking deeper insights into regional markets and the development of drugs tailored to the area's genetic and metabolic makeup.

In conclusion, dear reader, it is important to note that carrying out metabolomics projects entails tackling several challenges, foremost among them the significant cost of establishing the required infrastructure, from advanced spectroscopic instruments and high-efficiency chromatographic systems to education programs and specialized universities capable of graduating a workforce skilled in biochemistry, biostatistics, and information technology. Legislative considerations in medical research also need attention, as it is critical to protect individual data privacy and ensure the safe, responsible use of such data for research or development endeavors. Nevertheless, these challenges need not stand in the way of Saudi Arabia's research ambitions if official efforts, partnerships with international scientific centers, and the training of a new generation of specialized researchers come together to drive this field forward.

PART 2 · TOPIC 7

The Hidden World Within Our Bodies

March 2025 · First published

Dear reader, many people imagine that our bodies belong solely to us. In reality, however, we carry within us countless organisms that inhabit and coexist in every part of our being, from the skin all the way to the intestines, including bacteria, fungi, viruses, and more, collectively known as the microbiome. Modern scientific research has begun to reveal a fundamental role these organisms play in shaping both our health and our susceptibility to disease.

Ever since the launch of the Human Genome Project, attention turned to decoding human DNA under the assumption that uncovering our genetic secrets would lead to a better understanding of diseases and the development of groundbreaking treatments. However, dear reader, scientists soon noticed limitations in explaining the immense complexity of the human body with just a limited number of genes. When recent studies shed light on the bacterial genes that accompany us, the results were astonishing: one study conducted at Harvard University in 2019 found around 46 million bacterial genes in only a few samples taken from the mouth and intestines. Comparing these numbers to the overall human genome, the microbial gene count in our bodies may exceed the number of stars in the visible universe, a finding that raises profound questions about our relationship with these microscopic creatures.

The word “microbes” might conjure up images of organisms that must be eradicated, but reality is far more intricate. The bacteria living in our bodies are neither identical nor uniform in their functions; rather, they comprise different strains that play important roles in digesting food, producing certain vitamins, and strengthening the immune system. However, when this balance is disturbed, they may become implicated in diseases such as gum inflammation, inflammatory bowel diseases, and even autoimmune disorders like type 2 diabetes.

It is striking that while the rate of infectious diseases has been declining in recent decades, thanks to medical advances, vaccinations, and antibiotics, there has been a marked increase in chronic illnesses, such as diabetes, autoimmune diseases, and inflammatory bowel conditions. This, dear reader, has prompted researchers to focus on the close connection between the microbiome and these ailments, proposing a hypothesis that the extensive use of antibiotics, combined with modern lifestyles characterized by processed foods, sedentary habits, and psychological stress, has led to a microbial imbalance in many individuals.

This hypothesis gains even more significance when we learn that a large portion of our immune system resides in the gut, which is home to the majority of the microbes in our bodies. The interplay between the immune system and the intestinal microbes indicates a mutual relationship: microbes train the immune system to distinguish between what is helpful and what is harmful, while immune cells develop specialized mechanisms to handle foreign organisms without harming beneficial ones.

However, dear reader, when a disruption known as “dysbiosis” occurs, where the microbiome’s balance is disturbed, our bodies become less capable of regulating immune responses, potentially leading to issues ranging from mild digestive problems to severe and chronic autoimmune conditions.

A new trend has emerged in healthcare, viewing the microbiome as a core element of any treatment or prevention plan. This approach goes beyond using antibiotics to suppress microbes, instead focusing on maintaining their balance. Doctors now advise against overprescribing antibiotics except when absolutely necessary, recommend increasing intake of fiber-rich fruits and vegetables, and encourage the use of “probiotics” to support and restore beneficial bacteria in the gut.

In the long run, research envisions a future shaped by genetic engineering and genome sequencing techniques, where it may become possible to treat illnesses by precisely modifying the microbiome or by designing “smart” bacteria that can combat certain complex diseases such as cancerous tumors or chronic inflammatory disorders. Analyzing the microbiome might even become as routine as measuring blood pressure or blood sugar, allowing healthcare providers to determine an ideal diet or necessary supplements based on the test results.

In conclusion, dear reader, we should reflect on our relationship with this hidden world within us. The next chapter in fighting diseases may not lie in “destroying” bacteria, but rather in coming to a mutual understanding with them. It could well turn out that genuine health hinges on a delicate mix of factors that govern our dietary habits and lifestyle, and on the reciprocal bond between our immune system and the microbes that dwell in our bodies. Ultimately, we may discover that our current scientific understanding is just one step along a long path toward deeper insight into the nature of human life and its capacity to coexist in harmony with the vast microbial community that may very well determine our health or illness.

PART 2 · TOPIC 8

Biotech Companies Outside the United StatesFebruary 2025 · First published

The biotechnology industry is at the forefront of innovation, shaping the future of healthcare, agriculture, and environmental protection. However, this industry faces significant challenges outside the United States, particularly in regions like Europe, the United Kingdom, Asia, and Australia, where gaps in funding, infrastructure, and talent development hinder the growth of biotech companies.

Biotech companies outside the U.S. struggle to secure the necessary funding to compete with their American counterparts. The U.S., especially hubs like Boston and San Francisco, has successfully built robust ecosystems supported by venture capital, favorable tax policies, and a culture that embraces risk. In contrast, regions like Europe and Asia often lack the capital required to support biotech firms, resulting in the absence of economies of scale that facilitate the development of critical infrastructure.

For instance, the biotech hub in Cambridge, UK, faces a severe shortage of laboratory and research space. According to estimates by the UK-based firm Bidwells, there is a demand for over 1 million square feet of lab space, while only 10,000 square feet are currently available. This infrastructural shortfall adds to the complexity of funding challenges.

Another major issue is the brain drain to the U.S., driven by disparities in salaries and job opportunities. A biotech PhD graduate in the UK earns approximately \$50,000 annually, compared to over \$70,000 in the U.S. The gap widens significantly for experienced executives, who receive substantially higher salaries in the U.S., along with additional stock options and more favorable tax systems. This brain drain weakens local industries and makes it difficult for non-U.S. companies to build experienced leadership teams.

Unlike the U.S., where a unified market fosters collaboration and innovation, biotech companies in Europe face fragmented ecosystems. Each country has its own regulations, legal frameworks, and tax policies, creating a complex and often inefficient environment for startups. Moreover, the lack of specialized professionals, such as lawyers, accountants, and investment bankers with biotech expertise, exacerbates these challenges.

British and European investors traditionally favor established, revenue-generating companies over startups. This conservative approach limits the flow of venture capital into high-risk sectors like biotechnology. For example, UK pension funds, which manage billions of pounds in assets, are hesitant to invest in innovative projects, unlike their U.S. counterparts. These obstacles reflect cultural and structural barriers to biotech investments outside the U.S.

In light of these challenges, many biotech companies outside the U.S. seek to list on American stock exchanges to secure funding. Between 2018 and 2021, more than 20 European biotech companies and several Australian firms went public on the Nasdaq. However, listing on the U.S. market is not a straightforward solution. It requires significant resources and often results in the complete relocation of operations to the U.S. Consequently, the profits, jobs, and intellectual property that could benefit the companies' home countries are instead absorbed by the U.S. economy.

Overcoming these challenges requires fundamental structural changes. Governments, investors, and industry stakeholders must collaborate to create supportive ecosystems. This includes improving funding mechanisms, developing infrastructure, and harmonizing regulations to foster innovation. While the challenges are substantial, there is reason for optimism. Targeted efforts and increased awareness of these structural issues can lead to tangible progress, paving the way for a more balanced and globally competitive biotech industry.

PART 2 · TOPIC 9

The Growth of China's Biotechnology Giant

January 2025 · First published

China's biotechnology sector is undergoing a critical transformation, marked by significant challenges and promising opportunities. Experts highlight a complex picture of this industry: while concerns remain about the sustainability of startups and their ability to tackle current challenges, strong evidence suggests that China is poised to emerge as a global powerhouse in biotechnology.

One of the clearest indicators of China's progress in biotechnology is the increasing scale and quality of international partnerships, particularly with major Western companies. Over the past few years, China has signed more than 20 major deals between its biotech startups and Western firms, each involving initial payments exceeding \$100 million. These agreements are not just financial investments but a testament to growing global recognition of Chinese biotech startups' capabilities in drug discovery and development.

These partnerships span a wide array of fields, including the development of innovative drugs and advanced therapies like immunological treatments and protein technology innovations. This progress marks a turning point for China, as local startups increasingly become trusted partners for global companies seeking to leverage China's research and development expertise. For instance, several Chinese companies are now introducing innovative drugs that make a tangible impact in the market, reinforcing China's position as a global biotechnology hub.

In addition to partnerships, the sector is witnessing rapid expansion in the production lines of innovative therapies. These include immunological drugs and cancer treatments, positioning China as a critical player in addressing global diseases. Furthermore, a new generation of Chinese entrepreneurs and researchers is focusing on innovation, utilizing cutting-edge technologies in biotechnology. This young cohort is driven by a clear vision for substantial progress, placing China at the forefront of transformative changes in the sector.

Despite these achievements, the path forward is not without significant challenges. Among the most pressing is the limited flow of investment capital, which has placed many startups in difficult positions. Chinese companies also struggle with insufficient international collaboration relative to the size of their market, limiting opportunities for knowledge exchange and access to global markets.

Nevertheless, several long-term factors support the sector's growth. These include a shift towards innovation, as many companies focus on developing improved "innovative" drugs and gradually transition to producing world-class pharmaceutical products. Regulatory reforms are also playing a key role, with the Chinese National Medical Products Administration streamlining approval processes to accelerate development and innovation. By 2030, China's population over 60 years old is projected to exceed 400 million, driving demand for advanced treatments. Additionally, rising

disposable incomes are enhancing the population's ability to afford modern therapies, while low operational costs make China an attractive destination for both domestic and international investments.

China is not merely catching up to the West; it is building its own identity in innovation. Cities like Shenzhen, which serves as a hub for biotech innovation, and a younger generation of innovators focused on advanced technologies position China to become a leading global biotechnology force.

To maximize its potential, China must strengthen intellectual property protections and establish more inclusive partnerships with global companies. Building a culture of innovation and entrepreneurship among younger generations will ensure sustained growth and development in the sector.

China's biotechnology sector is a living example of how challenges can be turned into opportunities for growth. Through international partnerships, regulatory reforms, and a focus on innovation, China is well-positioned to become a major player in the future of global healthcare. Despite the obstacles, the sector demonstrates immense resilience and creativity, making it one of the most promising industries in the years ahead.

PART 2 · TOPIC 10

How Life Sciences, Pharmaceuticals, and Biotechnology are Shaping our FutureDecember 2024 · First published

Dear reader, in today's rapidly evolving world of science and innovation, the terms "life sciences," "pharmaceuticals," and "biotechnology" are often used interchangeably. However, each field represents a distinct scope of research and development. Understanding these differences is crucial, especially as these sectors collectively drive progress in healthcare, environmental sustainability, and industry.

Life sciences form the backbone of biological understanding, encompassing disciplines like ecology, genetics, and molecular biology. Life science researchers seek to understand biological processes, from single-cell organisms to complex human body systems, providing insights that enhance progress in healthcare, agriculture, and the environment.

In contrast, pharmaceuticals focus on developing, producing, and distributing medicines for disease treatment or prevention. Unlike life sciences' heavy research focus, the pharmaceutical sector is heavily regulated by bodies like the FDA and EMA. Key areas include drug discovery, clinical trials, and regulatory compliance, ensuring medicine safety and efficacy before reaching patients. In this way, pharmaceuticals directly impact public health by providing solutions to urgent medical needs.

Biotechnology represents a dynamic field where biological systems are harnessed to develop products or processes with broad applications in healthcare, agriculture, and industry. It bridges life sciences and technology, leveraging biological knowledge and genetics to solve practical problems. Biotechnology fields like genetic engineering, synthetic biology, and bioinformatics have led to important innovations, from insulin production to biofuel development. Its versatility enables various applications, including medical biotechnology focusing on diagnostics and personalized medicine; agricultural biotechnology enhancing crop productivity and resistance; and industrial biotechnology contributing to sustainable production methods. Biotech specialists work in diverse areas like laboratory research and biological engineering, developing products through biological system manipulation.

Pharmaceuticals often intersect with biotechnology, especially in biologics, where drugs are manufactured from biological sources. This intersection has created a collaborative environment, with many biotech companies partnering with pharmaceutical companies to navigate clinical trials and regulatory approvals. For example, antibodies used in cancer and immune disease treatment are biotech products but classify as pharmaceuticals after approval. The emergence of biologics has blurred the lines between these fields, uniting them in their shared goal of advancing healthcare. This partnership highlights the growing reliance on biotechnology for developing innovative treatments, especially for chronic and rare diseases.

Dear reader, these fields together contribute to modern healthcare. Life sciences provide the research foundation for discoveries supporting pharmaceuticals and biotechnology. Pharmaceutical companies transform these discoveries into treatments improving public health advancement, while biotech innovations extend into healthcare, agriculture, and environmental sustainability.

As technology, especially deep tech, continues to advance, the boundaries between life sciences, pharmaceuticals, and biotechnology will likely fade. The rise of AI, big data, and personalized medicine promises increased collaboration and integration among these fields, accelerating drug discovery and developing more effective treatments.

PART 2 · TOPIC 11

The Backbone of Biotechnology Development

December 2024 · First published

The biotechnology and life sciences sectors have become promising fields, playing a crucial role in addressing global challenges such as innovation in healthcare, achieving agricultural sustainability, and protecting the environment. At the core of these advancements lie research services and tools, which form the backbone of scientific discoveries and innovations. These include laboratory equipment, bioinformatics platforms, contract research organizations (CROs), and centralized facilities offering advanced technologies like CRISPR and 3D printing, among others. Their role extends beyond providing technical support; they serve as enablers of an interconnected ecosystem that fosters collaboration between academia, industry, and government to drive progress.

Research services and tools play a pivotal role in accelerating innovation, lowering market entry barriers, and building local expertise. By simplifying complex processes, they allow researchers to focus on discovery rather than operational challenges. This facilitation helps level the playing field for small companies and academic institutions, enabling them to compete in advanced fields. Furthermore, these services bridge the gap between academic discoveries and marketable products, supporting innovation and contributing to the development of skilled professionals trained in cutting-edge technologies. These contributions not only advance local innovation but also attract global partnerships and investments, positioning countries as competitive hubs in the biotechnology sector.

Emerging markets in the biotechnology sector, seeking to establish or expand their capabilities, must prioritize investing in research services and tools. Challenges such as limited infrastructure, insufficient funding, and a lack of qualified professionals can be addressed through government support, fostering international partnerships, offering specialized educational programs, and encouraging local entrepreneurship. These measures help create an environment conducive to innovation, enabling countries to achieve national goals such as improving healthcare, ensuring food security, and diversifying the economy.

While research services companies and biotechnology startups coexist within the same ecosystem, their roles and business models differ significantly. Research services companies focus on empowering other organizations by providing tools, technologies, and expertise, operating on a B2B model with lower risks and diversified revenue streams. Conversely, biotechnology startups aim to develop specific innovative products or solutions, often relying on venture capital and grants due to their high-risk, high-reward nature. The synergy between these two types of entities creates a productive cycle, where startups depend on service providers to meet critical R&D needs, while successful startups drive demand for more advanced tools and services.

This interdependence highlights the importance of strengthening the relationship between research services and biotechnology startups. Governments and policymakers play a vital role in fostering this dynamic, as a thriving ecosystem relies on seamless integration between these components. Research services and tools lay the foundation for scientific breakthroughs, while startups translate these breakthroughs into marketable innovations. Together, they form the pillars of a robust biotechnology landscape.

In conclusion, developing a strong biotechnology ecosystem requires a comprehensive approach that emphasizes the importance of research services and tools. These components enable innovation, support business operations, and build the expertise necessary to address national and global challenges. Differentiating the roles of research service providers and biotechnology startups while fostering their collaboration is crucial for creating a dynamic and self-sustaining system. By prioritizing investments in research infrastructure and strengthening partnerships, countries can unlock the transformative potential of biotechnology to drive economic growth, enhance global competitiveness, and improve quality of life.

PART 2 · TOPIC 12

Biotech Cities!May 2024 · First published

The world is experiencing rapid advancements in science and technology, and biotechnology is emerging as a crucial area with the potential to revolutionize how we deal with health, agricultural, industrial, and environmental challenges. Many cities across the globe are now focusing on innovation and sustainable solutions and have become leading centers in biotechnology. These cities benefit from strong ecosystems, including prestigious companies and research institutions, strategic partnerships between the industrial and academic sectors, and significant government support.

In today's world where sustainability is becoming increasingly important, major cities are taking the lead in "biotechnology" by investing in research and development. This emphasis on "biotechnology" is necessary to protect the environment and create new opportunities for innovation and growth. Looking forward, it's clear that progress in this field will continue to be driven by these global centers, which are now the frontrunners in the pursuit of innovation and development.

The San Francisco Bay Area is a hub of biotechnological innovation, owing to the presence of prominent research institutes such as the University of California, Berkeley, and Stanford University, along with leading biotech companies and venture capitalists. The collaborative environment here fosters continuous innovation and development.

Boston, located in the United States, is a significant worldwide hub for biotechnology, primarily due to its extensive focus on research and development. The city is home to prestigious universities such as MIT and Harvard, which collaborate closely with the industrial, technological, and health sectors to speed up innovation. The city also attracts significant investments in scientific research and development, making it a vital center for biotechnology startups and giants.

Cambridge, in the United Kingdom, is one of the most prominent European centers in "biotechnology." It combines a rich history in education and innovation with a thriving ecosystem for startups and research institutions. The University of Cambridge, with its global reputation in scientific research, is the heart of this tech city. The area surrounding the university, known as the "Cambridge Triangle," hosts a vast network of startups, research labs, and institutions focusing on biotechnology, making it a magnet for scientists and researchers worldwide.

With its national strategy for science and technology and business-friendly policies, Singapore has successfully established itself as a major biotechnology hub in Asia. The Singaporean government invests heavily in research and development and offers incentives for startups, contributing to a

thriving innovation environment. Additionally, Singapore attracts global talents with its excellent education system and high quality of life.

Zurich, in Switzerland, is not only one of the most attractive cities to live in the world but also an important center for biotechnology, especially in innovative pharmaceuticals. The advanced research infrastructure, including institutes like ETH Zurich and strong support from the industrial sector, provide the foundation for a vibrant environment for innovation and development.

With a bold vision and strategic investment, New York City in the United States emerged as a global center for biotechnology. With opportunities spanning therapeutic areas such as oncology, cardiovascular diseases, neurology, endocrinology, and more, New York City proves to be fertile ground for developing and innovating treatments, devices, vaccines, digital health tools, and sustainability solutions. The city has seen a 59% increase in jobs in the healthcare and biotechnology sector over the past decade, with a fourfold increase in the number of companies from 2019 to the end of 2023 and over 4 million square feet of advanced specialized laboratories. New York City currently secures over \$1.1 billion in public investment to create more than 40,000 jobs, aiming to grow the biotechnology and healthcare field in the city to 1,000 companies and opening 10 million square feet of advanced specialized laboratories.

Looking to the future, new cities are expected to emerge as global centers for biotechnology, with a particular focus on "Neom" and "Riyadh," among other Saudi cities that align with the national biotechnology strategy launched by His Royal Highness Prince Mohammed bin Salman. This strategy reflects the kingdom's ambitious goal to transform the country into a leading global center in biotechnology through massive investments, advanced infrastructure development, and attracting international talents and skills. In line with Vision 2030, the Kingdom of Saudi Arabia aims to enhance its position at the forefront of innovative countries in biotechnology, contributing to diversifying its economy and improving the quality of life for its people. These developments signal the beginning of a new era of innovation and growth in the biotechnology sector globally, positioning Saudi Arabia as a key player in the field.

PART 2 · TOPIC 13

What is the Ecosystem of the Pharmaceutical and Biotechnology Industries?

September 2023 · First published

The pharmaceutical and biotechnology industries operate as a sophisticated network composed of numerous institutions, companies, centers, individuals, resources, and others working collaboratively to develop and advance biotechnology products and services. This article delves into the essential components of this intricate ecosystem.

Let's start by focusing on pharmaceutical and biotech startups and companies, as they are expected to be significant drivers of progress in these fields. These companies specialize in developing advanced medications, therapies, and medical devices that have the potential to improve overall quality of life and reduce disease prevalence.

Academic research and development institutions play an indispensable role in the pharmaceutical and biotechnology industries. Without universities and other research institutions, achieving scientific breakthroughs that bridge the gap between research, manufacturing, and commercial marketing would be very hard. These companies must work closely with researchers and scientists from academic and research institutions to develop innovative technologies and treatments that will revolutionize these industries.

Another important ecosystem component includes specialized government agencies like the National Institutes of Health (NIH) and innovation institutions for research and development, which provide crucial financial support for system development. Additionally, the Food and Drug Administration (FDA) plays a vital role in regulatory oversight for the pharmaceutical and biotechnology industries.

Investors are crucial in providing financial support and funding for the growth of emerging companies in this field. They seek out companies with strong intellectual property portfolios, experienced management teams, and clear commercial marketing strategies. Investment banks also play a significant role in offering financial services to these companies, including help with mergers and acquisitions, other strategic deals, and accessing new markets to achieve their growth goals.

The pharmaceutical and biotechnology industries rely on various service providers, such as Contract Manufacturing Organizations (CMOs), to manufacture their products on a large scale. These organizations offer specialized services like process development, expansion, and commercial manufacturing. Additionally, Contract Research Organizations (CROs) support regulatory compliance and clinical trial management while protecting intellectual property. Contract Research and Manufacturing organizations (CRAMs) offer integrated services to emerging pharmaceutical and biotech companies, including drug discovery, development, and more.

Pharmaceutical and biotech companies value the protection of their ideas and methods through intellectual property rights. Patent attorneys and experts in intellectual property can aid these companies in obtaining and defending patents, ensuring their viability and legality, and protecting their intellectual property rights against infringement.

Technology transfer offices are also vital in connecting academia and research institutions to industry. By identifying promising technologies, negotiating licensing agreements, and providing support for commercial marketing efforts, technology transfer offices facilitate the transfer of technology from academic and research institutions to the industry sector.

The pharmaceutical and biotechnology industries rely heavily on patients, health insurance companies, hospitals, clinics, and medical practices. These end-users play an essential role in the ecosystem by utilizing and providing feedback on various medical and pharmaceutical products. In particular, healthcare providers can offer valuable insights into the effectiveness and usability of new products.

The ecosystem benefits greatly from the involvement of scientific and medical societies, as they offer a platform for collaboration and the exchange of scientific information. Additionally, research ethics committees play a crucial role in ensuring that clinical trials and other research activities are conducted in an ethical and responsible manner.

Dear reader, we've discussed the significant components of the pharmaceutical and biotechnology industries ecosystem in this article. However, covering all of them in one article can be challenging.

To sum up, the Kingdom of Saudi Arabia is making tremendous strides in all aspects of its ecosystem, thanks to the guidance of our wise leaders. The aim is to nurture and domesticate these industries within the country, positioning ourselves as a top global hub for these sectors.

PART 2 · TOPIC 14

My Preferred Color is "Red"... What is Your Favorite Color?August 2023 · First published

Hello, reader. Today's article will focus on the various colors of biotechnology, such as red, green, white, blue, and gray. Being well-versed in pharmaceuticals and biotech industries, I am particularly fond of the color "red." However, before we delve into its importance, it is essential to acknowledge the significant advancements in biotechnology studies. These breakthroughs have brought about a deeper understanding of genetics, microbiology, biochemistry, and other sciences, which have opened up new avenues for scientific research in all fields.

Let's revisit the "red color" and the reasons why it is my preferred color in biotechnology.

Red biotechnology is an exciting field that is focused on developing medical and pharmaceutical products. It has been associated with discovering and developing new treatments for various diseases, personalized medicine, and gene therapies. The advancements in this field have significantly improved healthcare outcomes and quality of life for many patients. With the development of diagnostic tools and treatments for a wide range of diseases (e.g., cancer), diagnosing and preventing these conditions has greatly improved. Personally, I find the scientific and practical aspects of "red biotechnology" fascinating, which is why it's one of my favorite topics to learn about.

There are many other colors in biotechnology, including:

Green biotechnology has been an important focus in the agricultural and environmental sectors. The development of genetically modified crops that are resistant to pests or require less water, as well as the use of green biotechnology to improve soil health and develop sustainable and environmentally friendly biofuels, has had a positive impact on the world. This has helped to increase food security and reduce hunger in many parts of the world.

White biotechnology is an important area that focuses on industrial processes. It involves the production of chemicals and other products, such as enzymes and biofuels, in a more sustainable and environmentally friendly way. Additionally, white biotechnology can also involve the development of new materials, such as biodegradable plastics and other materials used in various industrial processes. By utilizing white biotechnology, industries can reduce their environmental impact and operate more efficiently, leading to a more sustainable future for our planet.

Blue biotechnology is a fascinating field that concentrates on exploring marine and aquatic systems. This field is concerned with discovering and developing innovative treatments and technologies that are derived from marine organisms. Additionally, the study of marine systems and biodiversity is a

crucial aspect of blue biotechnology. It is exciting to see how this area of research is advancing and how it can lead to new discoveries and solutions that benefit both humans and the environment.

Gray biotechnology focuses on environmental conservation and biodiversity by removing pollutants using microorganisms and plants to isolate and dispose of various substances such as heavy metals, hydrocarbons, and others. Biotechnology has been used to find sustainable and environmentally friendly solutions, such as biodegradable plastics and biofuels, which can help reduce our reliance on polluting materials and minimize their negative impact on the environment.

It's important to keep in mind that the various fields and colors within biotechnology are often closely related, and their research can overlap in many different ways. Defining the boundaries of these areas can be challenging, and different experts may use different terminology or definitions.

In conclusion, dear reader, what is your favorite color in the field of biotechnology?

PART 2 · TOPIC 15

Some of the Biotechnology HistoryAugust 2023 · First published

Biotechnology has had a significant impact on various industries, including medicine, agriculture, and industrial technology. Its development has been remarkable, and it has led to numerous scientific breakthroughs. The use of living organisms and biological processes has enabled the creation of new products and technologies, which have revolutionized the way we approach problem-solving. It's exciting to see how biotechnology will continue to shape the world in the future.

Biotechnology has had a huge impact on various fields, including medicine, agriculture, industry, and the environment. In medicine, it has helped in developing new treatments for various diseases, including cancer, diabetes, and rare genetic diseases. Biotech has also contributed to the development of vaccines and personalized medicine. In agriculture, biotechnology has led to the creation of genetically modified crops that are more resistant to pests and diseases, which has increased food production while reducing the use of harmful chemicals. Biotech has also significantly improved industrial processes, such as the production of chemicals, fuels, and materials, in a more environmentally friendly way. Finally, biotechnology has been used to develop new techniques for cleaning up contaminated soil and water, which helps to keep our environment clean and healthy.

It's no secret that biotechnology has a significant impact on the global economy, with a market size of over \$ 0.7 trillion in 2020. This industry includes a wide range of companies, from small start-ups to large multinational corporations, and is characterized by a high level of innovation and investment in research and development. The continued evolution of biotechnology offers many exciting opportunities for new discoveries and inventions, particularly in the areas of research and development that will be focused on in the coming years.

And now, we will mention some of the main achievements that have occurred in the field of biotechnology over the past few decades:

In 1953, James Watson and Francis Crick made a groundbreaking discovery of DNA's structure. This discovery laid the foundation for understanding the genetic code and how it can be manipulated. The first-ever genetic engineering experiment was conducted in 1973, where DNA from different living organisms was combined to create new genetic structures.

The year 1982 was a momentous year for the field of genetic engineering, as it marked the approval of human insulin as the first-ever genetically engineered drug. This groundbreaking achievement not only paved the way for the development of innovative drugs and treatments but also ushered in a new era of biotechnology, which was spearheaded by the American biotech company Genentech. The discovery of genetically engineered drugs has since then revolutionized the medical industry,

providing novel treatments for previously incurable diseases and improving the overall quality of life for millions of people worldwide.

In the year 1990, the Human Genome Project was initiated with the ambitious goal of mapping the entire human genome. The main objective of this project was to create a comprehensive genetic blueprint of human beings, which would aid researchers in comprehending the root causes of various genetic disorders. The project involved extensive research and analysis, and after more than a decade of dedicated efforts, it was successfully completed in the year 2003.

In the year 2012, a group of scientists successfully utilized gene editing techniques to create the very first genetically modified human embryo. This significant achievement sparked a new level of hope for the prevention of genetic diseases, as it demonstrated the potential for altering an individual's genetic makeup in a way that could eliminate the risk of certain illnesses.

It is important to note that the COVID-19 vaccine, which was developed in 2020, utilized advanced technologies like mRNA. This revolutionary approach to vaccine development represents a significant breakthrough in the field. The use of mRNA allows the vaccine to provide immunity against the virus by instructing cells to produce a harmless protein that triggers an immune response. This method provides a safe and effective way to protect against COVID-19.

These achievements represent some of the main achievements in the field of biotechnology over the past few decades. With the continued development of these technologies in general, we will see more inventions and progress in the field of biotechnology in the coming years.

PART 2 · TOPIC 16

The Beginning of Biotechnology Companies

June 2023 · First published

Dear reader, you may have heard a lot about the term "biotechnology," which is a fascinating field that combines natural sciences and engineering to use living organisms or parts of them to develop innovative products and technologies. It's amazing to think that biological processes have been used for over six thousand years to develop food products that are beneficial to humans, such as bread and cheese, and preserve other food products, such as milk. It's exciting to see how biotechnology is advancing and how it will continue to impact our lives in positive ways.

You may also have heard another term, "biotech," which is an abbreviation for the word "biotechnology." Although the technical meaning of the term is "technology based on living organisms or living cells," the term "biotech" is usually used to refer to a start-up company that uses bioscience to develop new drugs or products. This word can also be used to refer to the industry itself.

Did you know that the biotechnology industry started with a company called "Genentech" in 1976? It was founded by Robert Swanson, a venture capitalist, and Dr. Herbert Boyer, a biochemist, with the goal of using genetic engineering technology to create new drug products. One of their earliest successes was the development of human insulin, which was approved by the US Food and Drug Administration in 1982 and transformed diabetes treatment. Over the years, the company has introduced many innovative treatments, including the first monoclonal antibody therapy approved for cancer treatment.

Back in 1978, just two years after its founding, Genentech discovered an innovative way to use recombinant DNA technology to prepare the first human insulin. They accomplished this by utilizing the A and B insulin chains expressed in *E. coli* bacteria. This breakthrough was significant for developing biotechnology companies as a promising science and investment. The production of insulin by bacteria allowed the production of large quantities of insulin with consistent quality, which was crucial as the lack of insulin could lead to the death of many diabetes patients. Before Genentech's discovery, insulin was extracted from the pancreas of cows and pigs, which sometimes caused allergic reactions that could threaten the lives of patients. Before this groundbreaking discovery, people with diabetes had a significantly shorter lifespan. However, thanks to Genentech's innovative production of insulin, there is now almost no difference between a person with diabetes and a healthy person. It's incredible to see how much of an impact one discovery can have on the world.

It's fascinating to learn that Genentech's discovery of human insulin in 1982 marked the beginning of biotechnology companies that have brought hundreds of new and innovative drugs to global markets, benefiting patients around the world. This discovery was a game-changer for the medical

industry. The success story of Genentech has inspired many other biotechnology companies to emerge and use genetic engineering, molecular biology, and other technologies to develop drugs, vaccines, and other products that can help improve human health and well-being.

In conclusion, it's amazing how much progress has been made since the discovery of recombinant DNA technology and the development of the first human insulin. Biotechnology companies are now involved in so many different fields, from genetic engineering to bioinformatics, and they are constantly developing new treatments for diseases and finding ways to improve agricultural productivity and address environmental challenges. It's clear that biotechnology has become an essential part of modern medicine and will continue to shape the future of healthcare and other industries.

PART 3

Markets & Investment

36 TOPICS

No medicine reaches a patient without someone first deciding to fund it. That decision is made in markets, by venture funds, public offerings, acquisitions, and indices most readers never see. These topics look at the sector as capital sees it: what a biotech company is worth before it has a product, why the largest pharmaceutical firms are valued below companies that sell advertising, when the IPO window opens and closes, and how a trillion-dollar industry can still fail to fund the medicine it most needs.

WHY READ THIS PART

Read this section if you invest, allocate, or simply want to know who decides which cures get built, and on what evidence.

MARKETS & INVESTMENT · PART 3

In this part

NO.	TOPIC	PAGE	PUBLISHED
1	A Trillion Dollars Waiting to Be Spent	129	February 2026
2	More Than \$9 Trillion Under the Microscope	131	January 2026
3	Promising Global Investments in Oncology Drugs	133	November 2025
4	Scarcity and Opportunity Amid Biotech's Tough Times	135	June 2025
5	Catalyzing Transformation in the Healthcare World	137	February 2025
6	Structural Barriers in the Global Biotech Ecosystem	140	February 2025
7	The Beginning of "Mega Deals" for the Chinese Biotech Giant	142	January 2025
8	The Secrets Behind the Efficiency of Global Biotech Markets	144	January 2025
9	Chasing the" Big Biotech Sharks"	146	January 2025
10	The Hidden Challenges in Biotech Investments	148	January 2025
11	Beyond Traditional Metrics in Biotechnology	150	November 2024
12	Investment is the Cornerstone of This Sector	152	November 2024
13	Venture Capital Deals in the Biopharmaceutical Sector	154	November 2024
14	The Rise of IPOs in the Biotechnology Sector	156	October 2024
15	The Rise and Challenges of Survival in the Pharmaceutical Industry	158	October 2024
16	Driving Growth in the Global Pharmaceutical Market	160	October 2024
17	Global Shifts in Biopharma Venture Investments	162	September 2024
18	Biotechnology Transformations and the Rise of Immunology	164	September 2024

MARKETS & INVESTMENT · PART 3

In this part

NO.	TOPIC	PAGE	PUBLISHED
19	Dealmakers in the Pharmaceutical Industries	167	August 2024
20	Why Are Pharma and Biotech Not in the Big 7?	171	July 2024
21	The Big 5	174	July 2024
22	Gross Profit Margins between “Branded” and “Generic” Pharmaceutical and Biotech Companies	176	July 2024
23	Biotech Market Shifts and Capturing Golden Opportunities	179	June 2024
24	Inside the XBI Index	181	June 2024
25	Exploring the Challenges of Biotech Stock Investment	183	May 2024
26	The Titans of Biotech Stock Investment	185	May 2024
27	The Trillion-Dollar Gap Between “Tech Giants” and “Big Pharma”	187	March 2024
28	Unveiling the Hidden Innovators: The Heroes Behind the Scenes	189	March 2024
29	Can We Benefit from the ‘Rising Stars’ in Pharma and Biotechnology?	191	February 2024
30	Biotech Boom 2024 with IPO Revival and Saudi Arabia’s Global Leadership Ascent	193	February 2024
31	How Smaller VC Funds are Outshining the Industry Giants	195	January 2024
32	Biotech’s Steady Growth Despite Economic Hurdles	198	January 2024
33	The Titans Merge: a Look at the Largest M&A Deals in Pharma and Biotech History	200	December 2023
34	Invest in Biotech!	203	July 2023

35	More than \$7 Trillion!	205	June 2023
36	Investing in Biotechnology	207	June 2023

PART 3 · TOPIC 1

A Trillion Dollars Waiting to Be Spent

February 2026 · First published

Dear reader, imagine that the 18 biggest pharmaceutical companies in the world are today sitting on huge “financial firepower” that is reserved mainly for buying other companies or entering very large deals. The numbers suggest that if these companies were to use their maximum borrowing and investment capacity, they could deploy around 1.2 trillion dollars in deals, on top of more than 500 billion dollars they can comfortably spend without putting their balance sheets under serious risk. This is not just “extra cash”; it may signal the beginning of a new wave of mergers and acquisitions that could reshape the global pharma industry over the next few years.

The idea of “financial firepower” is built on a simple question: how far can a company safely borrow to finance new deals without entering a dangerous financial zone? Analysts measure this by comparing a company’s debt to its annual operating profit (before interest, taxes, and other items). They usually see a level of about three times profit as a “comfortable” and safe level that keeps a good credit rating, this is called the comfortable firepower. If the company is willing to go up to five times its profit in debt, it moves into what is called stretched firepower, a higher-risk position that it may accept to grab rare, big opportunities. When we add up these capacities across the largest pharma players, we reach that headline number: 1.2 trillion dollars of potential deal-making power.

At the top of the list are companies like Johnson & Johnson, Roche, Merck, and Novo Nordisk. Each of these has a comfortable capacity estimated at roughly 58–63 billion dollars, rising to about 113–119 billion dollars if they use the stretched scenario. These firms have very strong balance sheets and diversified businesses across prescription drugs, vaccines, medical devices, and consumer health products, which gives them considerable freedom to choose where to invest. A company that can add tens of billions in debt and still stay in a safe financial range can realistically buy an entire mid-sized company, acquire late-stage or marketed drugs, or sign huge licensing deals for innovative assets without shaking investor confidence.

Right behind them is a powerful group of companies like Novartis, Eli Lilly, AbbVie, Pfizer, AstraZeneca, and Sanofi, with stretched firepower between 70 and 92 billion dollars, and comfortable levels between roughly 20 and 45 billion. This group faces strong pressure from what is often called the “patent cliff”, many of its best-selling drugs will soon lose patent protection and face competition from generics and biosimilars, especially in areas such as cancer, immunology, and cardiovascular disease. Their big question is: how do we keep revenues growing? Developing a drug from scratch can take 10 or more years, so the faster route is often to acquire biotech companies with drugs in late-stage clinical trials, or to invest in promising platform technologies in gene therapy, cell therapy, or AI-driven drug discovery.

Even with all this financial power, it does not mean these companies will spend recklessly. Today's financial environment is more challenging: interest rates are higher, banks and regulators are stricter, and investors punish bad deals quickly. Some companies have a reputation for being naturally conservative, preferring to keep wide safety buffers in case of surprises such as major legal cases, drug safety crises, or new pandemics. Others, like AstraZeneca in the past, have shown they are willing to take on more debt if they see a transformational acquisition that can reshape their portfolio and open new growth areas.

On the other side of the table, many small biotech start-ups face the exact opposite situation: they struggle to raise money from venture funds and capital markets, while big pharma players sit on hundreds of billions of dollars ready to be deployed. This mismatch creates pressure and often pushes smaller companies to accept acquisition or partnership offers on terms that may not be ideal, just to survive. Here, large pharma uses its strength to be selective: they can buy assets that fill clear gaps in their portfolio, strengthen existing franchises, or give them a strong position in hot fields such as GLP-1 obesity drugs, anti-aging and longevity therapies, and advanced gene and cell therapies.

Some experts worry that a large wave of acquisitions could concentrate too much innovation in the hands of a small number of big companies. That could reduce competition in the long term and change the mindset of many young biotechs, leading them to focus mainly on a "quick exit" through a sale rather than building strong, independent companies that grow over time. There is also a risk that, if big pharma relies too heavily on acquisitions rather than investing in its own internal R&D, it may weaken its deep innovation culture over time. Because of this, regulators in the US, Europe, and elsewhere will have to carefully balance two goals: encouraging investment and deal-making on the one hand, and protecting competition and patient interests on the other, when reviewing large transactions.

In the end, dear reader, this trillion-plus in available firepower is more than a flashy number. It tells us that the pharma industry is entering a phase where balance sheets themselves become strategic weapons. The companies that use this financial power wisely, choosing the right acquisitions and partnerships that add real scientific and commercial value, are likely to lead the market in the next decade. Those who hesitate or bet on the wrong deals may find themselves left behind in a landscape reshaped by megatransactions, new technologies, and shifting expectations from patients, payers, and regulators worldwide.

PART 3 · TOPIC 2

More Than \$9 Trillion Under the Microscope

January 2026 · First published

The global life sciences sector is huge, worth about 9.9 trillion dollars, which is close to the size of some major countries' economies. This number includes everything from drug makers and medical device companies to biotech firms, research labs, and digital health platforms. In this big world, commercial pharmaceutical companies hold the largest share, valued at a little over 6 trillion dollars.

After them come medical device companies, valued at more than 1.8 trillion dollars, followed by life science tools companies, which provide lab equipment, chemicals, and research services, valued at around half a trillion dollars. Around these big groups, we also find CDMOs that manufacture drugs for others, companies that produce active pharmaceutical ingredients (APIs), diagnostics companies that make tests and instruments, firms that sell over-the-counter medicines directly to consumers, specialized pharma service providers, and finally healthcare IT companies, which are still small in total value but growing very quickly.

Over the last week, biotech was the biggest loser among these groups. This is not surprising if we remember how biotech works: many of these companies spend huge sums on research and clinical trials for years without having a product on the market yet. When financial markets are nervous or interest rates are high, investors become less willing to wait many years for a potential payoff, so they sell part of their holdings in early- and mid-stage biotech companies. As a result, share prices fall, not because the science suddenly became worse or the projects stopped working, but simply because the appetite for risk has changed. A similar story is happening in the life science tools sector. These companies sell machines, kits, and services to universities, hospitals, and pharma labs. During the COVID-19 pandemic, they experienced a major boom as governments and research centers spent heavily on testing and vaccine development. Once the pandemic peak passed, budgets started to return to normal. Universities faced cost pressure, some pharma companies postponed buying new machines or reduced the number of research projects, and spending on tools became more cautious.

That made these companies' revenue more sensitive to the ups and downs of research funding and their stock prices more volatile, which explains why they also dropped sharply last week, along with biotech. On the other side, healthcare IT companies had a positive week. While other parts of the sector were flat or down, digital health stocks moved up. This reflects a growing belief that digitalization in healthcare is not a passing fashion but a long-term shift. Companies that build electronic medical record systems, clinical data analysis platforms, or artificial intelligence tools for diagnosis and hospital management typically use a subscription-based business model with long-term contracts. They are less dependent on the success of a single drug or device, and they often

need less capital than a company that is trying to invent a completely new medicine. Because of this, they can look safer and more attractive to investors when the overall market is uncertain.

Indeed, the total value of healthcare IT is still only in the tens of billions, much smaller than the trillions in pharma and devices, but it is growing fast, and with the worldwide interest in medical AI and telemedicine, it could become one of the fastest-expanding parts of the life sciences space in the coming years. Between the high-risk biotech names and the fast-growing health IT firms, commercial pharma and pharma services sit in a quieter middle zone. Big drug companies have well-known portfolios of medicines, relatively stable sales, and cash flows that analysts can predict with some confidence.

They benefit from steady demand for treatments of chronic diseases such as diabetes, high blood pressure, and cancer. For this reason, their stock prices usually move slowly, and they are seen as defensive holdings that investors like to keep when markets are unstable. That is exactly what happened last week: their performance was almost flat. They did not rise sharply like healthcare IT, but they also did not fall hard like biotech and tools.

Pharma services firms, including contract research organizations and market-access or marketing consultants, depend on the budgets of pharma and biotech clients. When those clients hesitate to increase spending, demand for services does not disappear but grows more slowly, so the shares of service providers also tend to show neutral or mild moves in such periods. In the end, this figure of 9.9 trillion dollars is more than just a huge number; it is a mirror of how science and money interact. It shows us which areas investors see as risky, which they see as safe, and where they expect the strongest growth in the future. By watching how value flows from biotech to digital health, from tools to big pharma, we get a clearer picture of how the future of medical innovation is being reshaped and where the next wave of progress in treatments and technologies is likely to start.

PART 3 · TOPIC 3**Promising Global Investments in Oncology Drugs**November 2025 · First published

Dear reader, oncology medications occupy a prominent position in the global pharmaceutical industry, representing one of the largest and fastest-growing areas in terms of both revenue and innovation. Recent market data demonstrates that oncology drugs will continue to lead the pharmaceutical industry in future growth.

According to the 2024 report published by Evaluate Omnium, oncology medications are recognized as the largest segment among high-growth pharmaceuticals. The report projects a compound annual growth rate (CAGR) of 10% to 12% for oncology drugs from 2023 to 2030, which is among the highest growth rates in the pharmaceutical sector. This robust growth reflects an increasing global demand for oncology treatments driven by rising cancer incidence rates, particularly due to the aging global population and expanding elderly demographic groups worldwide.

Regarding the major global pharmaceutical companies, Merck (MSD) leads the sector. Merck's revenues from its immunotherapy drug Keytruda reached approximately \$28 billion in 2023 and rose to around \$32 billion in 2024. Although a slight decline to roughly \$25 billion is anticipated by 2030, Merck remains firmly positioned as one of the leading players in the oncology field.

Roche, another major pharmaceutical company focused on targeted oncology drugs, also achieved significant revenues with its drug Perjeta, generating about \$25 billion in 2023, increasing to around \$26.15 billion in 2024, and expected to reach approximately \$23.90 billion by 2030.

Bristol Myers Squibb ranks third with its immunotherapy drug Opdivo, recording impressive sales of about \$26.50 billion in 2023, around \$24.80 billion in 2024, and projected to reach approximately \$18.20 billion in 2030.

Similarly, AstraZeneca continues to achieve remarkable success through its targeted oncology medication Tagrisso. The company's revenues from Tagrisso reached \$17.20 billion in 2023 and grew to \$22.35 billion in 2024, with expectations to reach approximately \$29.50 billion by 2030.

Johnson & Johnson also stands out significantly with Darzalex, a drug targeting B-cell cancers. Darzalex revenues are anticipated to reach \$36.80 billion by 2030, a significant increase from the \$17.70 billion reported in 2023.

Other major players also show considerable success. Novartis with Kisqali, Pfizer with Ibrance, Amgen with Kyprolis, Lilly with Verzenio, and Astellas with XTANDI have all demonstrated rising revenues, underscoring extensive industry interest and substantial investments in oncology drug development.

This substantial growth, dear reader, is primarily driven by several critical factors, including an ongoing rise in global cancer incidence rates, a trend expected to continue as populations age. Additionally, significant technological and medical advancements have paved the way for the development of more effective and safer treatments, such as immunotherapies and targeted therapies. These innovative treatments accurately target cancer cells while minimizing side effects.

In conclusion, dear reader, the oncology drugs market remains a focal point for pharmaceutical companies and investors alike. This sector is expected to witness further significant growth and expansion in the coming years, driven by technological innovations, increased global demand, and the growing necessity for effective therapeutic solutions that serve millions of cancer patients worldwide.

PART 3 · TOPIC 4

Scarcity and Opportunity Amid Biotech's Tough TimesJune 2025 · First published

Dear reader, 2025 hasn't been an entirely bright year for the U.S. stock market. IPO opportunities have dried up, the FDA is experiencing considerable turmoil, and significant budget cuts have hit the National Institutes of Health (NIH). At first glance, these conditions might seem disheartening for investors and entrepreneurs alike. However, upon closer examination of this challenging environment, unique and valuable opportunities emerge, particularly for startups in the biotechnology sector.

In a recent article from April 2025, Bruce Booth at LifeSciVC presents an insightful take on the current market landscape. Booth argues that challenging economic conditions aren't necessarily obstacles but rather ideal conditions to kickstart innovative biotech ventures. The key lies in the scarcity of newly founded biotech startups, which translates into less competition for vital resources, such as funding, talent, and scientific expertise.

Recent data from Pitchbook supports this viewpoint, showing that the first quarter of 2025 recorded the lowest rate of new biotech startups in the U.S. in at least ten years. This marks a steep drop, approximately 70%, compared to the peak seen in early 2021, when the market was booming and investments flowed freely into the sector.

From an economic perspective, biotech startups heavily rely on the interplay between supply and demand for venture capital. When market optimism is high, as it was in early 2021, startups flood the market. At that peak, over 170 new biotech companies received initial funding. However, when market optimism wanes, both demand and the influx of new startups decline significantly, a trend that is visible today.

But here's the silver lining: Booth emphasizes that this reduced rate of startup formation shouldn't be viewed negatively. Instead, venture capital firms like Atlas Venture perceive it as a prime opportunity to concentrate on high-quality investments rather than quantity. During market surges, intense competition for funding, talent, and even patient recruitment makes it difficult for new startups to stand out or thrive. Conversely, under current conditions, new startups have distinct advantages, such as easier access to resources and the ability to attract exceptional scientific talent who might now be more readily available due to reduced competition.

Dear reader, for early-stage investors, this situation represents a golden opportunity. Investors can secure larger equity stakes under more favorable terms, increasing their potential gains significantly when market conditions inevitably rebound.

To summarize, the current environment highlights three critical elements for successful venture-backed startups: robust science, exceptional talent, and adequate capital. Surprisingly, these elements are now more readily available than they were during times when startups proliferated rapidly.

In closing, dear reader, despite the challenges of 2025, this period could mark a turning point for biotech. By emphasizing quality, innovation, and rigorous scientific foundations, entrepreneurs and investors can create resilient companies that are capable of achieving significant scientific and medical breakthroughs. Therefore, 2025 may be a transformative year for the biotechnology sector if its players capitalize on current circumstances wisely and strategically.

PART 3 · TOPIC 5**Catalyzing Transformation in the Healthcare World**February 2025 · First published

Dear reader, the global healthcare sector has witnessed a rising wave of mergers and acquisitions (M&A) in recent decades, driven by various factors ranging from technological advancements and demographic shifts to growing demand for medical services. These deals, which sometimes result in major consolidations between large pharmaceutical companies, reputable hospitals, or even international health insurance providers, emerge as healthcare institutions seek to improve efficiency, optimize expenses, and strengthen their competitive edge in a market defined by financial and innovative challenges.

Generally, a merger refers to the union of two or more companies into an entirely new entity, whereas an acquisition involves one company purchasing a controlling stake in another, thus bringing it under its administrative and legal umbrella. In the healthcare context, such initiatives can unlock significant opportunities to expand service offerings, reduce costs, and stimulate research and development activities; however, they may also raise concerns about monopolies, reduced competition, and increased prices. Consequently, the healthcare sector finds itself in a continual balancing act between the benefits and the pitfalls of these transactions.

One of the primary drivers behind these mergers and acquisitions is the ongoing need to channel massive investments into research, development, and innovation. Pharmaceutical manufacturing and medical device technologies necessitate extensive spending on clinical trials and prolonged studies to verify product effectiveness and safety, an obligation that imposes considerable pressure on smaller companies lacking the financial or technical resources for large-scale research and development.

Herein lies the role of a merger or acquisition: it provides an avenue for companies to pool resources, laboratories, and expertise, aligning research efforts and distributing financial risks. This collective approach accelerates high-impact projects in the biomedical arena, particularly those focused on complex diseases such as cancer and genetic disorders that conventional treatments struggle to address. Moreover, large companies can leverage these alliances to achieve economies of scale by consolidating supply chains, manufacturing, and distribution processes, leading to lower final costs. In theory, these cost savings might translate into reduced prices for products and services, thereby benefiting patients without compromising the quality of care.

Turning to the Saudi landscape, the sector exhibits robust momentum for several reasons, notably comprehensive reforms in the healthcare system aligned with Saudi Vision 2030. This vision aims to bring about a qualitative leap in the standards and efficiency of healthcare services and to bolster private-sector engagement in the national economy, including the healthcare field. In recent years,

there has been a notable trend toward privatizing certain government hospitals and medical centers to improve resource management and patient experiences.

This shift has opened doors for further mergers and acquisitions among both local and international companies, particularly those specializing in digital healthcare technologies or medical supplies, many of which view the Saudi market as fertile ground given its strong demand and stable economic conditions. Indicative of the importance of these deals in the Kingdom is the growing role of the private sector in healthcare delivery, along with incentives to establish large medical conglomerates that operate multiple hospitals, specialty clinics, and pharmacies, drawing on extensive networks of suppliers and insurance providers.

Another key aspect lies in the contribution of mergers and acquisitions to strengthening research and development capabilities within Saudi Arabia. Local companies aspiring to boost their medical and pharmaceutical research find opportunities in partnerships with global firms, allowing them to acquire technological expertise and share research funding.

This direction aligns with national goals centered on forging a knowledge-based economy, expanding local research expertise, and positioning Saudi Arabia as a regional hub for healthcare innovation. With rising awareness of advanced health technologies, ranging from robotic surgery and artificial intelligence-based diagnostics to genomics and bioinformatics, these deals could gain momentum, as such fields demand significant investments and specialized skills that can be difficult to assemble without organizational collaboration or synergy.

In terms of the significance of mergers and acquisitions for the development of the healthcare sector in the Kingdom, creating larger and more comprehensive entities serves to enhance competitiveness in the local market, stimulating companies to deliver better services at more competitive prices. However, as major companies merge, regulatory authorities may harbor concerns over diminished competition. Regulatory bodies such as the General Authority for Competition and healthcare oversight organizations thus play a crucial role in maintaining market balance and curbing the misuse of dominant positions at the expense of consumers.

In another perspective, these transactions facilitate the transfer of modern technology into the country and raise the skill levels of human resources through training and qualification programs commonly associated with M&A. They also help build more integrated supply chains by standardizing purchasing, storage, and distribution processes, thereby enabling more efficient provision of medicines and medical supplies while reducing logistical errors and supply chain vulnerabilities.

Ultimately, mergers and acquisitions represent a key pillar in the evolution of global healthcare and in Saudi Arabia in particular. The increase in these transactions is not a transient phenomenon but rather a reflection of contemporary trends driven by healthcare challenges in the 21st century, demographic changes, longer lifespans, the mounting financial responsibilities on governments to provide healthcare, and the race to develop novel drugs and devices in tandem with ever-evolving

diseases and treatment methods. While these processes hold vast potential to accelerate innovation and elevate service integration, effective governance and regulation remain the core safeguard against potential abuses, ensuring accessible and affordable healthcare for all.

In the Saudi context, fostering a conducive regulatory environment and promoting strategic partnerships may pave the way to achieving the ambitious goals of Vision 2030, aspiring to a highly developed and diversified healthcare system that meets the needs of citizens and residents efficiently and sustainably in tandem with the Kingdom's overarching development trajectory.

PART 3 · TOPIC 6**Structural Barriers in the Global Biotech Ecosystem**February 2025 · First published

The biotechnology industry serves as a cornerstone of modern innovation, offering solutions to some of the most pressing challenges in healthcare and beyond. However, despite its importance, the industry faces significant obstacles, particularly for smaller companies. These challenges stem from market inefficiencies, behavioral biases in investment decisions, and structural barriers in global financing systems. This article explores these challenges and their impact on the growth of the global biotech sector.

The biotech market challenges traditional economic theories that suggest lower prices attract more buyers. In an ideal market, small biotech startups with a market value of \$200 - 300 million, backed by promising science and future commercial potential, should be attractive to investors. However, in reality, these companies struggle to secure funding compared to larger companies with market valuations of \$1 billion or more. This counterintuitive trend highlights a major issue.

Behavioral economics sheds light on this phenomenon. Investors often exhibit biases that make them more comfortable investing in larger, well-known companies, even if smaller companies have stronger fundamentals. This tendency underscores how psychological factors influence market outcomes. Rather than basing decisions purely on economic fundamentals, investors lean toward perceived safety and familiarity, creating inefficiencies in the market.

For the biotech sector, these inefficiencies manifest as smaller companies suffering from undervaluation and insufficient investment, despite their promising scientific and commercial prospects.

In addition to this challenge, the biotech sector is plagued by systemic structural barriers. U.S.-based biotech companies disproportionately benefit from a concentration of specialized investors, advanced infrastructure, and integrated hubs like Boston and San Francisco. These regions have achieved the "critical mass" necessary to sustain a continuous cycle of innovation and investment.

Outside the U.S., biotech companies face a starkly different reality.

Regions like Europe, Asia, and Australia lack the institutional support and critical mass required to drive growth. Local investors in these areas are often generalists who lack the expertise or risk appetite to invest in early-stage biotech ventures. Furthermore, these companies struggle to attract specialized U.S. investors, who typically focus on domestic opportunities or firms already listed on major stock exchanges.

This dynamic creates a "funding gap" for companies outside the U.S., particularly those too large to rely on seed funding but not yet developed enough to attract substantial institutional investment.

This gap hinders growth and limits the ability of these companies to scale and compete globally.

The consequences of this funding gap extend beyond mere capital shortages, affecting the broader development of the biotech industry outside the U.S. Without adequate funding, companies cannot build the infrastructure or attract the talent needed to drive innovation. Regions lacking integrated biotech ecosystems also miss out on the economies of scale that enable U.S. hubs to thrive.

For example, biotech companies in Europe, the UK, and Australia often face challenges in attracting top scientific and managerial talent. Limited financial resources force these companies to compete globally for the same talent pool, placing them at a disadvantage. This further entrenches the dominance of U.S. biotech hubs and deepens the global disparity in the biotech landscape.

Behavioral finance provides a framework for understanding why these challenges persist. Research indicates that investors often favor larger, more established companies, leading to inflated valuations for large U.S. biotech firms and undervaluation for smaller international companies. This bias is not necessarily rational but reflects greater psychological comfort with familiar brands and markets.

Addressing the challenges facing the global biotech sector requires a multifaceted approach. Stakeholders in regions outside the U.S. must prioritize the development of biotech hubs capable of competing with existing ecosystems. This includes investing in infrastructure, fostering collaboration between academia and industry, and creating incentives for specialized investors to support startups.

Targeted initiatives can also help reduce behavioral biases among investors. By promoting a deeper understanding of biotech fundamentals and highlighting the long-term potential of smaller companies, stakeholders can encourage more rational investment decisions and reduce reliance on geographical and size-based biases.

International partnerships can play a crucial role in bridging the funding gap. By connecting smaller biotech companies with global networks of investors and resources, these partnerships can provide the support needed for expansion and success in an increasingly competitive market.

The global biotech sector holds immense potential to transform healthcare and improve quality of life. However, market inefficiencies, structural barriers, and behavioral biases continue to constrain its growth, particularly for smaller companies outside the U.S. Overcoming these challenges requires coordinated efforts to create a fairer investment landscape, build robust global biotech ecosystems, and address the psychological factors influencing investment decisions.

PART 3 · TOPIC 7

The Beginning of "Mega Deals" for the Chinese Biotech Giant

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Dear reader, China's biotechnology sector has rapidly emerged as one of the fastest-growing industries, with Chinese players becoming key contributors to the global market through local innovation and international partnerships. A clear testament to this is the series of major international deals signed by Chinese biotech companies with leading global pharmaceutical firms, each involving upfront payments exceeding \$100 million. These agreements mark a significant turning point for China's biotech sector and highlight its growing stature as a strong competitor on the global stage.

The list of deals includes 23 international agreements signed by Chinese biotech startups with major global pharmaceutical companies, such as AstraZeneca, Merck, and Roche. These deals underscore the increasing confidence in the ability of Chinese companies to deliver innovative technologies on par with their Western counterparts.

For example, Chinese company Gracell Biotechnologies signed a deal with AstraZeneca worth \$1 billion upfront, one of the largest deals in the list. The agreement included the acquisition of the Chinese CAR-T platform, with the total deal amounting to \$1.2 billion. This transaction is not just a financial investment, but a reflection of the tremendous progress made by Chinese startups in developing advanced technologies for treating complex diseases like cancer.

These deals also highlight the diverse range of technical assets and targeted innovations offered by Chinese companies, showcasing their ability to provide innovative solutions addressing a wide spectrum of medical challenges. For instance, Regor Therapeutics secured an \$850 million deal with Roche for the acquisition of the advanced CDKx platform. In the field of advanced immunotherapy, Curon Biopharmaceutical signed a \$700 million agreement with Merck to develop T-cell engager technology. Similarly, BeiGene played a key role in agreements with Novartis and Bristol-Myers Squibb (BMS), licensing PD1 and TIGIT therapies with upfront payments of \$300 million and \$263 million, respectively. These deals vividly demonstrate the positioning of Chinese companies as major players in developing cutting-edge technologies that address critical medical challenges.

These major international agreements signify a radical transformation in China's position on the global biotechnology map, reflecting a profound impact on the industry. One of the most significant effects is the support for local innovation; Chinese companies are no longer solely reliant on imported technology but are now capable of delivering their own innovations that attract global companies. Additionally, the substantial financial investments, with upfront payments exceeding \$100 million, indicate a high level of international recognition and trust in Chinese capabilities, trust built through years of investment in research and development. Furthermore, these partnerships have facilitated Chinese companies' expansion into global markets. No longer confined to the

domestic market, they are now actively involved in developing and marketing drugs internationally, strengthening their integration into the global healthcare system.

Several factors have contributed to the success of China's biotech sector and its rise to prominence. Key among them is government support and regulatory reforms, which, despite the challenges, have streamlined research operations and empowered local companies to enter international markets. Accelerated local innovation has also played a crucial role, driven by a new generation of researchers and entrepreneurs in China focused on advanced technologies like immunotherapies and genetic engineering. Moreover, China's competitive advantage in operational costs makes it an attractive destination for research and development investments, significantly bolstering its position as a global force in biotechnology.

With these trends continuing, the future of China's biotech sector looks brighter than ever. The collaboration with global giants such as AstraZeneca, Merck, and Roche provide Chinese companies with enhanced expertise and access to advanced markets. Additionally, China's focus on fostering innovation and integrating with the global healthcare system further strengthens its prospects of becoming a global hub for biotech innovation.

The international mega-deals signed by Chinese biotech companies serve as a clear indicator of China's transformation into a major force in this field. These deals are not merely financial transactions but a testament to the growing global acknowledgment of China's potential and its ability to innovate. As this momentum continues, the future of China's biotech sector appears more promising than ever, combining local innovation and international partnerships to achieve sustainable success on the global stage.

PART 3 · TOPIC 8

The Secrets Behind the Efficiency of Global Biotech MarketsJanuary 2025 · First published

The biotechnology sector faces significant challenges in achieving efficiency within global financial markets. A recurring observation highlights a substantial gap in the valuation of companies operating in this sector across different regions, underscoring structural barriers to the global allocation of capital and raising numerous questions.

Typically, companies in the biotechnology field with comparable assets and intellectual property are valued significantly lower in the UK, Europe, and Australia compared to their counterparts in the United States. For instance, a U.S.-based company listed on the Nasdaq stock exchange might be valued at \$1 billion, while a British company with similar assets and therapeutic focus might not exceed a valuation of \$200 million.

This disparity becomes even more pronounced in Australia, where the market suffers from a lack of "capital depth", a shortage of investors willing to fund high-risk ventures compared to Europe or the U.S.

Such valuation gaps highlight what can be considered an arbitrage opportunity, where investors could exploit this discrepancy by purchasing shares in undervalued companies in less efficient markets. However, the persistence of these gaps raises questions about why such discrepancies are not corrected by market participants.

The "Efficient Market Hypothesis" assumes that market participants process all available information to determine the correct prices for assets. According to this theory, clear valuation gaps, such as those in the biotech sector, should attract investors to buy undervalued assets and sell overvalued ones, leading to a convergence of prices toward their intrinsic values.

However, applying this hypothesis in the biotech sector encounters numerous obstacles that limit its real-world effectiveness. Among the most notable challenges are regional capital constraints, where investors face regulatory, cultural, and logistical hurdles that hinder their ability to move capital across borders. Additionally, investment institutions often prefer larger markets like the U.S. due to their liquidity and relative stability.

Risk perception and market maturity also play a critical role in shaping investment decisions. Smaller markets in Europe or Australia often lack the investor confidence and specialized knowledge present in the U.S., leading to lower valuations. Furthermore, the biotech sector itself faces structural challenges, such as high failure rates and long development cycles, making it inherently risky. As a result, investors in smaller markets often demand higher risk premiums, further pressuring valuations and limiting the ability to attract capital necessary for growth and innovation.

While the Efficient Market Hypothesis provides an appealing theoretical framework, its assumptions frequently collapse in practice, especially in specialized, high-risk sectors like biotechnology. The global market in this sector remains far from efficient, with local conditions and investor behavior heavily influencing capital allocation instead of relying on unified global principles.

These challenges significantly impact the growth and innovation potential of biotech companies in regions with weaker capital ecosystems. Companies in markets like the UK and Australia may struggle to secure sufficient funding, limiting their ability to compete globally. In contrast, U.S. companies benefit from a stronger investment ecosystem that supports high-risk ventures.

For professional investors, these inefficiencies present both a challenge and an opportunity. Investments in undervalued assets in smaller markets could yield substantial returns, provided investors have the patience and expertise to navigate the dynamics of local markets.

For policymakers in regions like Europe and Australia, addressing structural issues to attract more investment into the biotech sector is crucial. This could involve expanding networks of specialized investors, improving market liquidity, and offering incentives to mitigate the risks associated with investing in this sector.

The biotech sector demonstrates the complexities of achieving market efficiency in practice. While the Efficient Market Hypothesis serves as a theoretical benchmark, real-world constraints such as local capital barriers, risk perceptions, and structural challenges create significant inefficiencies. To unlock its full potential, investors and policymakers must acknowledge these challenges and work to address them, ensuring a more equitable distribution of resources and opportunities across global markets.

PART 3 · TOPIC 9

Chasing the "Big Biotech Sharks"

January 2025 · First published

Dear reader, biotech investments in the United States face unique challenges, chief among them the issue of "massive capital." This problem arises when large investment funds in this sector struggle to effectively allocate enormous sums of money across a limited number of opportunities. As a result, they are compelled to focus on larger, more established companies, leaving smaller startups overlooked.

When managing billions of dollars in capital, say, \$3 billion, large funds face practical constraints on the number of startups they can include in their portfolios. Typically, these funds limit their investments to around 50 companies to ensure each is closely monitored. With this capped number of investments, the average amount allocated per company rises significantly, often reaching \$60 million per company.

This mathematical inevitability forces large funds to concentrate on more stable, well-established companies, engaging in what is known as "chasing the big biotech sharks," rather than pursuing smaller, riskier opportunities. Smaller biotech startups, particularly those outside the U.S. with low daily trading volumes, often fall outside the scope of these large investment funds. For instance, investing in a small company in Europe or Australia with daily trading volumes of just \$0.5 million becomes neither practical nor appealing for these massive funds.

Large funds may occasionally support smaller startups or IPOs with smaller allocations, such as \$30 million, but this presents additional challenges. Firstly, such an investment may result in the fund owning an excessively large stake in the small company, which can complicate the company's growth and the fund's future exit strategy. Secondly, selling off this stake later could take months, even under favorable market conditions.

Moreover, resource and efficiency challenges further complicate the situation. Conducting due diligence for a small company requires nearly the same effort and time as for a larger, more established firm. This makes the return on investment (ROI) in terms of time and resources less attractive when comparing small companies to large ones.

From a purely financial perspective, investing \$100 million in a U.S. company with a \$10 billion valuation is often preferred over a similar investment in a small company. Larger companies' stability, liquidity, and established market presence reduce risks associated with geography, time zones, currency fluctuations, and operational complexities. While small companies may promise higher returns, the risks and inefficiencies tied to such investments often render them unjustifiable for large funds.

For example, a small company may experience a significant surge in stock value following a major investment. However, for a fund managing billions of dollars, the potential gains may not justify the time and resources required for evaluation, monitoring, and crafting an exit strategy.

The "massive capital" problem highlights a structural imbalance in the biotech investment ecosystem. While large funds play a vital role in driving industry growth, their focus on big players limits funding opportunities for innovative startups. This dynamic can stifle the growth and progress of smaller biotech companies, particularly those operating in niche markets or outside major economic hubs, making it harder for them to secure the capital needed to develop groundbreaking treatments.

PART 3 · TOPIC 10

The Hidden Challenges in Biotech InvestmentsJanuary 2025 · First published

Dear reader, investing in the biotechnology sector is one of the most attractive opportunities in today's global market, given the immense potential this industry offers in therapeutic advancements and medical innovation. However, this sector faces significant and complex challenges that make investing in it far from straightforward, especially for specialized analysts and investors. Among the most notable challenges are human resource issues and the complexities of managing large-scale capital. Let us delve deeper into these challenges, focusing on the largest global biotech market: the United States.

The U.S. biotechnology sector is massive and intricate, featuring hundreds of publicly listed companies alongside thousands of private firms operating domestically and internationally. This sheer volume of companies makes it exceptionally challenging for investors to track all available investment opportunities.

For investors and analysts specializing in venture capital and investment firms in the U.S., priority is often given to publicly listed local startups due to the overwhelming amount of data that must be analyzed. For example, a fund manager based in New York or San Francisco needs to track hundreds of startups operating across various therapeutic areas and offering diverse products. This requires an in-depth understanding of each startup's developments, including quarterly updates, clinical trials, market trends, and other key factors.

An investment portfolio in this space often contains more than 50 startups, sometimes significantly more, depending on the fund's size and focus. These venture capital and investment firms require companies to provide periodic reports, up to four times a year, in addition to immediate updates for critical developments. This creates a heavy workload for analysts and fund managers, who must maintain comprehensive knowledge of all details, including market competition and emerging innovations.

In addition, investors must monitor major global pharmaceutical companies such as Novartis (Switzerland), Takeda (Japan), and AstraZeneca (UK). This requires keeping an eye on international competitors and innovations across different markets, further adding to the demands on their time and effort.

The biotech sector is one of the most capital-intensive industries. Startups require continuous funding to support research, clinical trials, and new product launches. For instance, in 2020 alone, the U.S. saw 78 biotech IPOs. Each IPO requires detailed analysis by investors to determine its investment potential.

Furthermore, small startups face significant challenges in gaining access to major investors. Analysts and investors often focus on large pharmaceutical companies with market capitalizations exceeding \$10 billion, or even \$5 billion in some cases, to minimize the burden of tracking numerous companies. By applying the Pareto Principle, investors can concentrate on the 20% of companies that generate 80% of returns, helping them manage their portfolios more efficiently.

However, this industry's reliance on capital places substantial pressure on small and medium-sized companies, which are often the most innovative. Many American venture capital investors prefer to avoid these startups due to high risks, time zone differences, tax complications, and other factors.

Dear reader, global expansion is another significant challenge for small biotech firms. Despite potentially revolutionary innovations, gaining access to international investors requires significant effort and time. Small companies operating outside the U.S. often struggle to attract the attention of American investors, who tend to focus on domestic markets and larger corporations.

These challenges heavily influence the nature of biotech investments. While the sector offers immense opportunities for growth and innovation, the excessive focus on large startups often leaves smaller companies struggling to secure funding.

On the other hand, the heavy reliance on capital remains a critical determinant of success in this sector. Startups that can secure sufficient and continuous funding are better positioned to survive and thrive, while smaller firms face greater challenges in accessing the same resources.

Investing in the biotechnology sector is a complex challenge requiring a mix of strategic focus, thorough analysis, and efficient resource management. Human resource limitations and the complexities of managing large-scale capital are among the most significant barriers to investing in this industry. As the market expands, investors must adopt innovative tools and methods to analyze and capitalize on opportunities. For smaller companies, building a strong presence, enhancing transparency, and maintaining effective communication with investors will be essential to securing funding and driving continued innovation.

PART 3 · TOPIC 11

Beyond Traditional Metrics in Biotechnology

November 2024 · First published

Dear reader, the biotechnology sector is one of the most significant and strategic fields in our modern era, contributing to the development of innovative solutions to improve public health, address environmental challenges, and drive industrial innovation. However, biotechnology companies, especially startups, face considerable challenges in attracting the necessary investments to support their research and growth. In this article, we will explore these challenges, focusing on their causes and their impact on this critical sector.

Biotechnology startups often struggle to secure the funding needed to cover the high costs of developing their products, particularly during the early stages. These companies frequently rely on local markets to obtain the necessary capital. For instance, biotechnology startups in the UK heavily depend on local investors to fund research and clinical trials.

This reliance on local markets places additional pressure on small companies, as local markets may be limited or lack the incentives to encourage investment in a sector that requires significant capital. This challenge is not exclusive to the UK but is shared by many developed countries, such as France, Germany, Australia, and South Korea. As a result, biotechnology startups face similar global challenges.

Investors in biotechnology startups often diversify their portfolios across various sectors, making them non-specialists in biotechnology. These "generalist investors" aim to build portfolios that span multiple industries, including biotechnology, retail, and traditional manufacturing. However, their lack of expertise in the biotechnology field makes them hesitant to invest in startups due to the sector's complexity. For these investors, sectors like software or retail seem less risky and more straightforward compared to a technical field requiring in-depth scientific understanding.

One of the primary challenges for investors lies in the difficulty of evaluating biotechnology companies compared to other industries. Traditional companies rely on clear financial metrics, such as the price-to-earnings (P/E) ratio or return on investment (ROI), to determine their value. In contrast, biotechnology startups require more complex valuation criteria, as they are often in early development stages and may not generate revenue for several years.

For example, a company working on developing a drug for a specific disease in its early stages would have its valuation based on the likelihood of the product's success and its future market impact. If the drug has a 10%-15% success probability and a projected market value of \$6 billion in the future, investors might estimate the company's current value at around \$400 million. This type of complex valuation often causes investors to hesitate before making decisions in this field.

Given the high-risk nature of biotechnology companies, diversification in investment portfolios is essential to mitigate potential losses. Many companies in this sector may fail at various stages of development, such as clinical trials or commercial marketing. Therefore, investment portfolios are typically diversified across numerous companies to offset losses from one company with potential successes from others.

However, this diversification requires a significant commitment from fund managers and a readiness for long-term investments, which may not be feasible for many investors. As a result, the biotechnology sector remains less attractive compared to other industries.

The UK serves as a clear example of the challenges biotechnology companies face in attracting investments. Among the top 50 investment firms in the UK, only six have notable investments in the life sciences sector, and even these investments tend to be limited and inconsistent. This lack of investor interest makes it difficult for biotechnology companies in the UK to achieve the necessary growth and expand their operations.

To address these challenges, clear strategies are needed to enhance investment in biotechnology companies. These strategies include offering financial and regulatory incentives, such as tax breaks and support programs that encourage investors to enter this sector. Strengthening partnerships between the public and private sectors can also provide a more stable investment environment. Awareness campaigns highlighting the significant opportunities in biotechnology may attract more investors. Additionally, focusing on supporting research infrastructure in biotechnology could draw more international investments.

By implementing these strategies, governments and private sectors can help overcome the barriers facing biotechnology startups, paving the way for innovation and sustainable growth in this vital field.

PART 3 · TOPIC 12

Investment is the Cornerstone of This Sector

November 2024 · First published

Dear reader, the biotechnology sector is one of the most promising fields for innovation and economic growth worldwide. Its strength lies in transforming scientific discoveries into tangible products that improve people's lives and generate substantial economic returns. However, bringing these innovations to market is a long and challenging journey that requires vast resources and significant investments, often reaching hundreds of millions of dollars. Developing new drugs, for example, involves multiple stages, including the preclinical stage and three clinical stages, each of which comes with unique financial and regulatory challenges. This reality highlights the importance of investment in biotechnology, as no scientific discovery can transform into an approved product without the necessary funding.

Biotechnology startups work to develop new products by following a systematic pathway that begins with the preclinical phase. During this stage, extensive research is conducted to ensure the safety and effectiveness of chemical or biological compounds before testing them on humans. Next, clinical trials commence, divided into three phases: Phase I focuses on the safety of the drug and determining the appropriate dosage, while Phase II evaluates the drug's effectiveness in a small group of patients. Phase III involves broader testing to achieve statistically significant results. Only after successfully completing these stages can the drug receive regulatory approval and enter the market. However, failure at any stage could result in years of wasted effort and depleted financial resources.

Although the development of medical devices or other biotechnological innovations may require less investment compared to pharmaceuticals, it still heavily depends on funding to transition from research to commercialization. The costs associated with conducting clinical trials, obtaining regulatory approvals, and building manufacturing capabilities make it clear that investment is the cornerstone of this sector. Nevertheless, securing this funding presents a significant challenge for many entrepreneurs in the biotechnology field.

The journey to secure investment typically begins with seed funding, often provided by high-net-worth individuals or "angel investors." This funding is used to establish the company, hire essential personnel, and initiate early-stage research. As the company progresses, it seeks additional funding from venture capital firms to support costly stages such as clinical trials and regulatory processes. However, for most biotechnology companies, the funding requirements for late-stage development and commercial marketing are so high that they eventually need to go public through an Initial Public Offering (IPO) to attract broader investor interest.

Despite its importance, investment in biotechnology faces considerable challenges in regions outside the United States. Structural and historical factors make investment markets in Europe and

other parts of the world less efficient compared to the U.S. One prominent challenge is the fragmentation of markets. Investment markets in Europe, for instance, are distributed across multiple countries and financial exchanges, making it difficult for startups to access the substantial capital they need.

Additionally, the nature of investors poses another challenge. In many regions outside the United States, investors lack specialization in biotechnology, often focusing on general investments rather than sector-specific projects. Furthermore, many biotechnology startups are too small to capture the attention of large, specialized investors. This combination of fragmented markets, a lack of specialized investors, and the small size of companies leads to inefficiencies that hinder the sector's growth.

The inefficiency of investment markets in regions outside the U.S. has far-reaching implications. Promising scientific innovations often struggle to secure the funding necessary to advance to practical applications. This presents a significant problem given the capital-intensive nature of biotechnology development. Without adequate funding, many scientific discoveries remain confined to laboratories, unable to achieve their potential benefits for society and the economy.

In conclusion, the biotechnology sector is a testament to the power of science and innovation in driving economic growth and improving people's lives. However, the path to success is not without obstacles. Investment is the backbone of biotechnology development, and securing it requires addressing structural, cultural, and regulatory challenges. By adopting a proactive and integrated approach, regions around the world can position themselves as global leaders in biotechnology, ensuring that scientific discoveries are transformed into tangible benefits for society and substantial economic returns.

PART 3 · TOPIC 13**Venture Capital Deals in the Biopharmaceutical Sector**November 2024 · First published

The global biopharmaceutical sector has undergone significant changes in venture capital (VC) deals over the past several years. In 2024, the industry faces a new landscape, reflecting recovery from the downturn experienced in 2023 and a rebalancing from the surge seen during the pandemic. This article explores trends in biopharmaceutical VC deals from 2000 to 2024, focusing on the current market dynamics.

Since 2000, the biopharmaceutical sector has seen a steady increase in VC deals. The early 2000s were characterized by modest investment levels, with annual totals between \$1 billion and \$3 billion. During this period, investors were cautiously optimistic, recognizing the potential of biopharmaceutical companies but remaining wary of the risks associated with early-stage biotech ventures.

In the mid-2000s, VC deals grew gradually, reaching \$6 billion by 2007. This growth was driven by advancements in biotechnology, particularly in fields such as genomics and personalized medicine. However, the 2008 global financial crisis led to a temporary decline in investment, with deal volumes dropping to \$4 billion in 2008 and 2009.

Despite this setback, the biopharmaceutical sector experienced a recovery in the 2010s, with consistent year-over-year increases in VC deals. By 2014, annual deal volumes had reached \$8 billion, reflecting growing confidence in the sector's ability to deliver innovative treatments. This upward trend continued throughout the decade, culminating in a significant surge in 2020 when the COVID-19 pandemic brought unprecedented attention and investment to the biopharmaceutical industry.

The years 2020 and 2021 marked a significant turning point for the sector. The pandemic highlighted the critical importance of innovation in biopharmaceuticals, leading to a boom in VC deals. In 2020, deal volumes reached \$37 billion, more than double the total from the previous year. This growth was driven by the urgent need for vaccines, treatments, and diagnostics, along with a broader recognition of biopharmaceuticals' role in addressing global health challenges.

In 2021, this investment frenzy peaked, with total VC deals reaching \$70 billion. Investors were eager to capitalize on technological advances like mRNA, gene editing, and other cutting-edge biotech fields. The success of companies like Moderna and BioNTech boosted confidence in the sector, leading to record valuations and substantial funding rounds.

As the world began to recover from the pandemic, the biopharmaceutical sector entered a period of adjustment. The extraordinary investment levels of 2020 and 2021 could have been more

sustainable, resulting in a decline in VC deals in 2022. Deal volumes fell to \$50 billion, signaling a return to more stable investment levels. This decline continued into 2023, with annual deal volumes dropping to \$34 billion.

However, 2024 has seen a partial recovery, with VC deals reaching an annual total of \$41 billion. While this is still below the pandemic peak, it represents a significant improvement from the lows in 2023. This recovery indicates the sector's resilience and ability to adapt to changing market conditions.

The partial recovery in 2024 can be attributed to several key trends. One of the most important is the continued focus on therapeutic areas such as oncology, immunology, and neuroscience. These fields, which have dominated the initial public offering (IPO) market, also attract significant VC investment. Companies demonstrating progress in these areas are well-positioned to secure funding.

Despite the recovery in VC deals, biopharmaceutical companies still face many challenges in 2024. One of the biggest challenges is increased competition. With numerous companies vying for investment, those that stand out through innovation, execution, and strategic partnerships will have a clear advantage.

As we move through 2024, the biopharmaceutical sector is in a more stable, yet still dynamic, growth phase. The recovery in VC deals from the lows in 2023 is a positive sign, indicating that investors remain confident in the sector's long-term prospects. However, the decline from the pandemic peak serves as a reminder that the market is still adjusting to the new normal.

Biopharmaceutical companies' key to success in this environment lies in focusing on innovation, strategic execution, and overcoming regulatory and market challenges. Companies that rise to these challenges will find numerous opportunities for growth and investment.

PART 3 · TOPIC 14

The Rise of IPOs in the Biotechnology SectorOctober 2024 · First published

The biotechnology sector, a beacon of pharmaceutical innovation, not only drives scientific research but also significantly contributes to economic growth.

The resurgence of Initial Public Offerings (IPOs) in 2024 is a testament to this, bringing about notable changes in capital market behavior.

In this article, we will delve into the rise of biotechnology IPOs in the United States in 2024, shedding light on the trends and therapeutic areas that are piquing the interest of investors.

Statistics reveal a significant increase in the total number of global IPOs in 2024 compared to 2023. This rise is particularly pronounced in the U.S. biotechnology sector, which is bouncing back from a period of stagnation.

The growth we are witnessing underscores the resilience of the biotech sector, driven by innovations in fields such as oncology, immunology, and neuroscience.

Dear reader, this resurgence in IPO activity is likely the result of several factors, including the maturation of critical companies, favorable market conditions, and renewed investor confidence.

Annual data for 2024 indicates that this trend is not just a temporary spike but a sign of a sustainable recovery in the sector's ability to attract significant capital.

One notable trend is the dominance of areas like oncology, immunology, and neuroscience in recent IPOs.

The relative stability of oncology-related transactions between 2021 and 2023 highlights the continued appeal of this field.

However, other areas, such as treatments for eye diseases, urology, and gastrointestinal disorders, have seen a significant decline in IPO activity in 2024.

The revival of biotech IPOs can also be attributed to a more favorable economic environment. After the challenging years of 2022 and 2023, marked by rising interest rates and economic uncertainty, 2024 has brought greater stability to global markets.

This stability has provided a more conducive environment for IPOs, particularly in sectors like biotechnology that require long-term investments and significant capital costs.

Data from 2024 suggests that the biotech IPO market is entering a new era, with a focus on high-value therapeutic areas and a more discerning investor base.

For companies in this sector, this presents both opportunities and challenges. Companies that can adapt to shifting market dynamics and continue to innovate are well-positioned to succeed in this evolving landscape.

As the year unfolds, it will be crucial to closely monitor whether these trends persist and how they will impact the broader biotechnology sector.

The revival of IPO activity in 2024 is a positive signal for the industry, but it also underscores the need for companies to remain agile and focused in an increasingly competitive market. Your active engagement in this process is key.

PART 3 · TOPIC 15

The Rise and Challenges of Survival in the Pharmaceutical IndustryOctober 2024 · First published

Dear reader, in 2024, the pharmaceutical industry has undergone significant transformations due to rapid advancements in drug therapies and ongoing challenges.

In this article, we will review the performance of some of the largest companies in this sector, where the landscape varies between companies experiencing substantial growth and others struggling under changing pressures.

We will highlight how these companies' values have evolved and what the numbers reflect about the industry's future.

As of the third quarter of 2024, several pharmaceutical companies have emerged thanks to their significant success in launching new products, executing strategic acquisitions, and capitalizing on the growing demand for advanced treatments such as anti-obesity drugs.

Eli Lilly leads the scene with a 62% increase in its market value this year, driven by its remarkable success in developing obesity medications, making it a leader in this rapidly expanding market.

With its strong financial performance and clear strategy, the company has solidified its position at the forefront of the industry.

Novo Nordisk, a leader in obesity and diabetes treatments, saw a 39% rise in enterprise value this year, strengthening its position as one of the top companies in this field due to continuous innovation and strong market demand. Similarly, Boston Scientific achieved a 32% growth, fueled by strong global demand for advanced medical devices.

Intuitive Surgical, known for its "da Vinci" robotic systems, saw a 36% increase following the success of its "da Vinci 5" system. Amgen also experienced impressive growth of 29%, driven by its focus on pharmaceutical innovations and biosimilars.

On the other hand, some pharmaceutical companies faced challenges in 2024. Johnson & Johnson saw a slight decline due to challenges in its oncology sector and legal issues, negatively impacting its overall performance. Bristol-Myers Squibb experienced a 4.6% decline due to intense competition in the cancer treatment market.

Abbott also faced a 5% decrease, affected by mixed performance in its diagnostics and medical device sectors. Medtronic struggled to maintain growth amid fierce competition, resulting in a 7% drop in its market value. Gilead Sciences was the most affected, with a 9% decline in value due to significant challenges in the oncology treatment sector.

Conversely, some companies managed to remain stable despite the challenges. Sanofi achieved a slight increase of 0.3%, benefiting from its focus on specialized care and vaccines.

Roche saw a slight decline of 1%, impacted by pressures in the oncology sector, but its diverse portfolio and robust pipeline in research and development helped minimize losses. Danaher's value rose 7%, driven by stable performance in its diagnostics and biotechnology sectors.

The year 2024 was characterized by several key trends, most notably the increasing focus on obesity treatments, which contributed to the success of companies like Eli Lilly and Novo Nordisk.

Obesity is one of the world's most considerable health challenges, attracting significant attention from healthcare providers and investors. Additionally, innovation in surgical technologies has seen tremendous progress, with Intuitive Surgical driving demand for less invasive surgical procedures.

However, despite this progress, the cancer treatment sector remains a significant challenge for many companies, including Johnson & Johnson, Bristol-Myers Squibb, and Gilead Sciences.

The complexity of developing effective cancer treatments and intense competition have made it difficult for these companies to maintain market leadership.

As the pharmaceutical and biotech sectors continue to evolve, companies that focus on innovation and adapt to changing market dynamics will be positioned for success.

At the same time, those struggling to keep up may face more significant challenges. The future success will likely depend on trends in obesity treatments, surgical innovations, and finding practical solutions for cancer treatment.

Companies' ability to execute successful acquisitions and deliver innovative solutions will be significant in achieving growth in 2025 and beyond.

As this dynamic sector develops, innovation and adaptability will remain the keys to success and leadership in this rapidly changing field.

PART 3 · TOPIC 16

Driving Growth in the Global Pharmaceutical Market

October 2024 · First published

In 2024, stock markets revealed distinctive patterns in the performance of pharmaceutical companies based on their market capitalization. According to data, small-cap and large-cap companies outperformed their mid-cap counterparts. This article will explore the reasons behind this trend and its impact on investors.

Small-cap companies with market values under \$100 million saw strong growth in 2024, achieving over a 10% increase. Many of these smaller pharmaceutical companies focus on innovative technologies, whether in developing new drugs, medical devices, or biotech advancements. These companies attract investors due to their potential to revolutionize healthcare and create new markets.

Small companies are often attractive acquisition targets for larger firms looking to expand their portfolios. The rise in mergers and acquisitions in 2024 likely contributed to the increased stock prices of smaller companies as investors anticipate broad buyouts.

These small companies often operate in niche markets, allowing them to capitalize on specific trends or unmet needs in the healthcare sector. Focusing on specialized markets can lead to significant gains when these companies achieve breakthroughs.

On the other hand, large-cap companies with market values exceeding \$100 billion also had a standout year, with gains nearing 16%. This impressive growth was mainly driven by industry giants like Novo Nordisk and Eli Lilly, which have been at the forefront of major trends in the pharmaceutical industry. Both companies made significant strides in developing and marketing obesity and diabetes treatments. These advancements improved patient outcomes and led to substantial revenue growth, boosting investor confidence and raising stock prices.

Large-cap companies benefit from their global presence and strong market positions. They are better equipped to navigate regulatory challenges, quickly expand product lines, and leverage their vast resources to dominate key markets. Due to their financial stability, these companies are also seen as safer investments. During economic uncertainty, investors tend to favor these firms over the more volatile small-cap companies.

Despite their size, many large-cap companies continue to invest heavily in research and development, driving innovation across their product pipelines. Their ability to consistently innovate keeps them competitive and attractive to investors.

While small and large companies thrived in 2024, mid-cap companies, with market values between \$100 million and \$10 billion, faced challenges. Some reported negative returns, with a slight decline

of -2.6%, and companies valued between \$1 billion and \$10 billion experienced a minor decrease of -1.0%. These mid-cap firms often compete directly with nimble small companies and resource-rich large corporations, which can pressure their market share and limit growth opportunities.

Mid-cap companies may have been overvalued heading into 2024, leading to price corrections as investors reassessed their growth expectations. While mergers and acquisitions can boost small companies' stock prices, mid-cap firms may need help. They are often less attractive acquisition targets than smaller companies and may face difficulties competing with larger firms in strategic takeovers.

Operational challenges may also limit the ability of mid-cap companies to scale effectively. Issues like expanding into new markets, managing supply chains, or executing complex research and development initiatives can hinder growth.

Companies with market capitalizations between \$10 billion and \$100 billion saw modest growth of 2.3% in 2024. These firms benefit from a combination of stability and growth potential, but they need to gain the explosive growth seen in small-cap companies or the scale advantages of large-cap firms.

The data suggests that investors gravitate towards companies at either end of the market capitalization spectrum—those with very small or tremendous values. This polarization reflects broader market dynamics, where innovation, risk appetite, and financial stability influence investment decisions.

PART 3 · TOPIC 17

Global Shifts in Biopharma Venture InvestmentsSeptember 2024 · First published

Dear reader, in the last decade, there have been significant fluctuations in biopharma venture activity across various countries and regions.

As we move into 2024, the global biopharma funding landscape presents a combination of opportunities and challenges in the United States, Europe, China, and Japan.

This article seeks to offer a summary of venture capital activity in advanced nations from 2010 to 2024, focusing on the trends influencing the global market.

The United States has been the main center for biopharma venture funding, experiencing significant growth over the past decade.

In 2010, \$2.5 billion was raised, which then increased to \$30.2 billion in 2021.

This substantial rise was fueled by the growing demand for innovation in biopharma, particularly during the COVID-19 pandemic, which prompted the development of vaccines and therapeutic platforms. However, the market saw a decline in 2022 and 2023 as investors reevaluated risks.

By 2024, the total funding dropped to \$11.0 billion year-to-date, accompanied by a decrease in funding rounds.

This decrease reflects a more cautious investment environment, where investors prioritize quality and focus on companies with strong scientific foundations and clear market potential.

In Europe, funding for biopharma ventures has shown moderate growth compared to the U.S. Total funding increased from \$0.9 billion in 2010 to \$3.9 billion in 2020.

The pandemic pushed the sector to a peak of \$6.3 billion in 2021. However, there was a decline in 2022 and 2023, with funding dropping to \$2.2 billion in 2024 year-to-date. This indicates a shift towards more selective investment in high-potential companies.

Europe continues to attract venture capital, focusing on sustainability, digital health, and innovative platforms, albeit at a slower pace.

From 2017 to 2021, China's biopharma sector experienced a significant increase in venture activity, with funding rising from \$0.8 billion in 2017 to \$6.2 billion in 2021.

This growth was attributed to China's initiatives to promote biopharma innovation and nurture domestic pharmaceutical companies.

However, the sector encountered a sharp decline in 2022 and 2023, with funding decreasing to \$0.7 billion in 2024 year-to-date. This decline reflects the challenges facing China's biopharma sector, including regulatory obstacles, geopolitical tensions, and a more cautious investment climate.

Despite these challenges, China remains a significant player in the global biopharma landscape, with potential for future growth.

Biopharma venture activity has been characterized by volatility in Japan over the past decade. Total funding fluctuated between \$9 million in 2014 and \$88 million in 2018, reflecting the unique market dynamics in the region.

Japan saw a resurgence in activity in 2021, with \$88 million raised due to increased interest in innovative therapies and digital health platforms.

However, Japan also experienced a decline in 2022 and 2023, with funding dropping to \$38 million in 2024 year-to-date.

Despite this volatility, Japan continues to attract venture capital, particularly in niche areas such as regenerative medicine, gene therapy, and personalized healthcare.

While the United States remains the dominant force, other regions like Europe, China, and Japan play crucial roles in driving biopharma innovation.

The decline in venture activity across all regions since the pandemic peak underscores the importance of strategic investments and the need for companies to offer clear value propositions.

Investors have become more selective, focusing on companies with strong scientific foundations, clear regulatory pathways, and robust business models.

As we progress into 2024, the global biopharma venture landscape presents both opportunities and challenges.

The decrease in investment activity since the peak of the pandemic reflects a more cautious environment. However, the continued focus on innovation, digital health, and sustainability offers promising growth opportunities.

For companies and investors, staying informed about regional trends and adapting to changing market dynamics will be crucial for success in this competitive sector.

PART 3 · TOPIC 18

Biotechnology Transformations and the Rise of ImmunologySeptember 2024 · First published

Dear Reader, the biotechnology sector is experiencing rapid developments, with shifts in investment trends.

Previously, oncology was a primary focus for attracting investments, but in 2023, these investments declined while interest in immunology and immunotherapies surged.

As we enter 2024, immunology has emerged as a key area for attracting investments, while oncology is beginning to regain some of its former momentum.

In this article, we will explore the investment trends and the factors influencing these changes.

During 2023, investment in the oncology sector decreased for several key reasons.

First, the oncology drug market reached a saturation point, with many companies fiercely competing for attention and funding.

This saturation made it difficult for startups, especially those without strong clinical data or a unique approach, to secure the necessary investments to support their projects. Additionally, the oncology drug industry faces significant clinical and regulatory challenges.

The process of developing cancer treatments is extremely complex and time-consuming, and with high failure rates in clinical trials, investors have become more cautious, turning their attention to more stable and less risky areas.

At the beginning of 2024, the oncology sector saw a noticeable rebound in investments after the decline of the previous year.

This resurgence is attributed to several pivotal factors.

First, significant progress has been made in oncology research, particularly in the areas of immunotherapies and targeted therapies.

These research breakthroughs, along with advancements in personalized medicine, have rekindled investor interest in supporting companies that offer innovative technologies and promising clinical data.

Second, regulatory bodies have played an important role in boosting investor confidence.

The U.S. Food and Drug Administration (FDA) and other regulatory agencies have introduced expedited pathways for approving new oncology treatments, facilitating faster market entry.

This regulatory support has restored investor confidence in the ability of oncology companies to achieve positive and successful outcomes.

Third, strategic partnerships continue to grow, with major pharmaceutical companies still viewing the oncology sector as an attractive investment field.

These partnerships, whether in the form of acquisitions or strategic collaborations, offer lucrative exit opportunities for investors, making investments in this sector more appealing.

Dear Reader, while oncology has historically dominated venture capital, immunology has emerged as one of the most promising fields in recent years.

The COVID-19 pandemic highlighted the importance of modulating the immune system to combat diseases, sparking interest in investments in immunology-related research and development.

Investments in immunology have seen significant growth due to several factors.

First, the pandemic-driven interest increased awareness of the potential of immunology.

The success of vaccines and treatments targeting the immune system during the pandemic showcased the field's ability to deliver effective solutions, attracting more investments.

Second, technological advancements in immunology, such as CRISPR and CAR-T cell therapy, have opened up vast new horizons in the field. These advanced technologies have attracted venture capital as investors seek to capitalize on the next wave of immunological discoveries. Third, immunology's role extends across a wide range of disease conditions, including infectious, chronic, and autoimmune diseases.

These broad applications have made immunology an attractive field for investors looking to achieve substantial returns by diversifying their investments across multiple areas.

The shift in venture capital from oncology to immunology in 2023, followed by the rebound in oncology in 2024, reflects the dynamic nature of the investment landscape in the biopharmaceutical industry.

While oncology remains one of the largest investment areas due to its high potential returns, it continues to be fraught with challenges that require a clear strategy and market differentiation.

Conversely, immunology offers emerging opportunities in a less saturated market with significant growth potential.

To succeed in this changing investment landscape, biotechnology companies need to embrace innovation and differentiation, focusing on leveraging strategic partnerships to stay competitive.

By concentrating on these strategies, companies in both oncology and immunology can position themselves for sustainable growth and long-term success.

The transformations witnessed in the biotechnology industry in recent years indicate a promising but challenging future.

As technologies continue to evolve and new fields emerge, staying informed about these changes will be crucial for both companies and investors.

The ability to adapt to these transformations and respond quickly will be key to achieving success in this growing and complex sector.

PART 3 · TOPIC 19**Dealmakers in the Pharmaceutical Industries**August 2024 · First published

Dear reader, the pharmaceutical industry is experiencing significant changes in 2024, with several leading companies driving mergers, acquisitions, and strategic partnerships.

These actions are part of complex strategies to enhance innovation, expand global market presence, and develop new treatments to address unmet medical needs.

In this article, we will explore the key players in this field, including Novartis, Merck, AbbVie, and Novo Nordisk, and analyze their strategies and their impact on the global pharmaceutical industry.

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This year, certain companies have emerged as powerful deal-makers, driving major changes in the pharmaceutical field.

Their moves focus on bolstering their research and development (R&D) capabilities through partnerships and acquiring other companies to strengthen their competitive positions.

Novartis is considered one of the leading companies because it is continuously expanding its operations through research and development partnerships and acquisitions.

In 2024, Novartis has been involved in five R&D partnerships and four mergers and acquisitions, which puts it at the forefront of industry changes.

One key factor that sets Novartis apart is its strong focus on innovation and the expansion of its pharmaceutical portfolio.

This is supported by substantial upfront payments totaling \$4.2 billion and overall deal values reaching \$15.9 billion.

Meanwhile, Merck, operating as MSD outside North America, takes a different approach by strengthening its presence through significant acquisitions.

In 2024, Merck completed seven mergers and acquisitions and entered into two research partnerships.

The company's strategy is focused on expanding its pharmaceutical portfolio in crucial areas such as oncology, vaccines, and infectious diseases.

With significant upfront investments amounting to \$2 billion, Merck's total deal value reaches \$3.7 billion, reflecting its commitment to reinforcing its market position through acquisitions of new companies and assets.

These acquisitions aim to enhance its portfolio and innovation capacity to keep pace with the competition.

AbbVie is strategically focused on acquiring innovative treatments and expanding its presence in specialized therapeutic areas such as immunology and oncology.

In 2024, AbbVie completed six mergers and acquisitions with a total value of \$7.9 billion.

These deals include upfront payments of \$1.1 billion, showing the company's dedication to investing in new technologies to address challenges resulting from the expiration of patents on some of its essential drugs.

Through these moves, AbbVie aims to ensure continued growth and expand its customer base by focusing on therapies that address unmet medical needs, a crucial direction to maintain its competitive edge amidst intense competition.

Novo Nordisk, a leader in the treatment of diabetes and obesity, is continuously improving its portfolio by making several deals focused on innovating the treatment of metabolic diseases.

In 2024, Novo Nordisk entered into seven R&D partnerships and one merger.

These actions aim to enhance its innovation capabilities and keep up with the increasing demand for new treatments. Novo Nordisk's upfront payments totaled \$3.4 billion, while the overall value of its deals reached \$3.8 billion.

These investments reflect the company's commitment to tackling global health challenges related to diabetes and obesity, focusing on delivering innovative solutions.

There is another noteworthy company, Johnson & Johnson, that actively operates through its Janssen Pharmaceuticals division in the fields of research, development, and mergers and acquisitions.

In 2024, the company engaged in four R&D partnerships and three mergers and acquisitions, with upfront payments totaling \$4.1 billion.

Johnson & Johnson's total deal value reached \$10.7 billion, with a specific focus on expanding its portfolio in critical therapeutic areas such as oncology, immunology, and neuroscience.

Through these actions, the company aims to bolster its global market position and introduce new therapeutic solutions that contribute to improved healthcare outcomes.

AstraZeneca is concentrating on precision medicine by engaging in four mergers and acquisitions in 2024.

The company's goal is to reinforce its presence in specific therapeutic areas such as oncology, cardiovascular, and respiratory diseases, thereby enhancing its competitive capabilities.

AstraZeneca's upfront payments amounted to \$2.8 billion, and the total value of its deals reached \$6.4 billion.

The company prioritizes strategic acquisitions that improve its market position and support growth in key therapeutic areas.

In 2024, Eli Lilly has been active in making deals, having entered into six R&D partnerships and one merger.

The company's strategy is focused on expanding its portfolio in therapeutic areas like diabetes, oncology, and neuroscience, demonstrating its dedication to developing advanced treatments that cater to the needs of patients in these fields.

Eli Lilly made upfront payments totaling \$3.2 billion, and the overall value of its deals reached \$7.9 billion.

With these investments, the company aims to strengthen its sustainable growth and tackle the challenges presented by competitive markets.

Roche, together with its subsidiaries Genentech and Chugai, remains at the forefront of innovation and specialized treatments.

In 2024, the company entered into five R&D partnerships and three mergers and acquisitions, with upfront payments totaling \$6.6 billion.

Roche's total deal value reached \$12.7 billion, showcasing its commitment to innovation and expansion of its portfolio in critical areas such as oncology, neuroscience, and personalized medicine.

The company continues to invest in advanced technologies to address global health challenges and achieve sustainable success.

Data indicates that the key trends driving pharmaceutical deals 2024 include a focus on research partnerships and mergers and acquisitions in specific therapeutic areas.

Leading companies invest heavily in innovation and advanced technologies to meet increasing medical needs and strengthen their global market positions.

Oncology, immunology, and neuroscience remain areas of significant interest, and this trend is expected to continue in the coming years.

Moreover, companies' focus on digital transformation and the use of big data in drug development reflects a new direction toward improving patient outcomes and accelerating drug development processes.

The leading dealmakers in the pharmaceutical industry for 2024, such as Novartis, Merck, AbbVie, and Novo Nordisk, show a strong commitment to enhancing innovation and expanding their portfolios to address global health challenges.

Through strategies combining research partnerships and strategic acquisitions, these companies are shaping the pharmaceutical industry's future, paving the way for new and innovative treatments that meet the needs of millions of patients worldwide.

PART 3 · TOPIC 20

Why Are Pharma and Biotech Not in the Big 7?July 2024 · First published

In the rapidly evolving world of technology, a few companies have risen to dominate the industry, shaping the future of innovation and driving the global economy. Known as the "Big 7," these tech titans include Apple Inc., Microsoft Corporation, Alphabet Inc., Amazon.com, Inc., Meta Platforms, Inc., NVIDIA Corporation, and Tesla, Inc. While some of these companies are renowned for their physical products, a significant portion of their value and influence comes from their intangible assets and services. This article delves into the impact and strategies of these companies, highlighting their reliance on intangible products and explaining why pharmaceutical, or biotech companies are not part of this elite group.

The Big 7 tech companies primarily derive their value from intangible assets such as software, cloud services, digital advertising, artificial intelligence, and data analytics. These assets provide scalability, recurring revenue, and high-profit margins, allowing these companies to maintain their market dominance and profitability.

Apple generates a significant portion of its revenue from services such as the App Store, Apple Music, iCloud, and Apple TV+, contributing over \$75 billion in 2023. Integrating hardware and software ensures a loyal customer base and recurring revenue.

Microsoft has shifted to being a cloud-first company. It now offers Windows and Office subscription-based services, known as Windows 365 and Microsoft 365, respectively. In 2023 the company made \$75 billion from its Azure cloud platform. Additionally, its focus on intangible assets is evident through acquisitions and investments in AI.

Alphabet (Google) dominates digital advertising with Google Ads and holds significant intangible assets like Android, Google Search, YouTube, and Google Cloud. It monetizes user data for targeted advertising, with YouTube and Google Cloud being key revenue drivers.

Amazon profits significantly from Amazon Web Services (AWS), the leading cloud infrastructure provider, alongside its e-commerce platform. AWS and Prime membership offer intangible benefits and enhance customer loyalty and spending.

Meta, formerly known as Facebook, primarily generates revenue from digital advertising on platforms such as Facebook, Instagram, WhatsApp, and Messenger. The company's focus on new digital experiences is emphasized by its initiatives in the metaverse and acquisitions like Oculus.

NVIDIA is renowned for its GPUs, crucial for gaming and AI. The company's value is also evident in its software and services, like the CUDA platform. Its investments in AI research and cloud-based services underscore its emphasis on intangible assets.

Tesla's value extends beyond electric vehicles, including software such as Autopilot and Full Self-Driving features, with continuous over-the-air updates. Its energy division also relies on intangible products like energy management software.

Pharmaceutical and biotech companies operate on fundamentally different business models than the Big 7 tech giants. Their value proposition lies in developing, approving, and commercializing new drugs and therapies. These processes are highly regulated, capital-intensive, and involve long development cycles, with substantial risks at every stage, from research and development to regulatory approval and market acceptance.

In contrast, tech companies, mainly the Big 7, thrive on rapid innovation cycles, scalability of digital products, and lower regulatory burdens. Once a software product or digital service is developed, it can be distributed to millions of users at minimal incremental cost, unlike the manufacturing and distribution of physical drugs. This difference in business models makes it challenging for pharmaceutical and biotech companies to achieve the same scalability and profitability as tech companies focused on intangible assets.

Pharmaceutical and biotech companies must navigate a complex regulatory environment, requiring extensive clinical trials and approvals from agencies like the FDA (Food and Drug Administration). These processes are time-consuming and expensive, with a high rate of failure. The rigorous testing and approval process is necessary to ensure the safety and efficacy of new drugs and therapies. Still, bringing a product to market requires significant time and cost.

Tech companies, on the other hand, often face fewer regulatory hurdles, especially in the early stages of product development. While there are regulations concerning data privacy, cybersecurity, and competition, the path to market for digital products and services is generally faster and less expensive. This regulatory landscape allows tech companies to innovate more quickly and bring new products and services to market with greater agility.

The profitability dynamics in the tech sector are distinct from those in the pharmaceutical and biotech sectors. Intangible assets in tech offer higher profit margins and scalability compared to the tangible, product-based revenue streams of pharma and biotech firms. For instance, cloud services, digital advertising, and software subscriptions provide recurring revenue with relatively low operating costs, enabling tech companies to achieve high profitability.

In contrast, pharmaceutical and biotech companies face high costs associated with research and development, clinical trials, and regulatory compliance. The time to market for new drugs can span several years, and the risk of failure is significant. Even after a drug is approved, manufacturing and distribution costs can further erode profit margins. While successful drugs can generate substantial revenue, the overall business model is less scalable and more vulnerable to regulatory and market uncertainties.

The strategic focus of the Big 7 tech companies is on leveraging intangible assets to drive growth and maintain competitive advantages. This focus is reflected in their market valuations, investor perceptions, and overall business strategies. Investors value the scalability, recurring revenue, and high margins associated with intangible products, contributing to their high market capitalization.

Pharmaceutical and biotech companies, while crucial to healthcare and innovation, operate in a market where the business dynamics are perceived as more volatile and less scalable. The high-risk, high-reward nature of drug development and regulatory challenges make it difficult for these companies to achieve the same level of market dominance and investor confidence as the Big 7 tech companies.

In conclusion, the absence of pharmaceutical and biotech companies among the "Big 7" tech giants can be attributed to the fundamental differences in business models, focus on intangible assets, regulatory challenges, and market dynamics. The tech giants' success is largely driven by their ability to leverage intangible products and services, creating scalable and highly profitable business models that differ significantly from those in the pharmaceutical and biotech sectors. The strategic focus on software, cloud services, digital advertising, artificial intelligence, and data analytics has enabled these companies to achieve unparalleled market dominance and financial success, underscoring the growing importance of intangible assets in the modern economy.

PART 3 · TOPIC 21**The Big 5**July 2024 · First published

Dear reader, in the rapidly evolving world of technology, a few companies have risen to dominate the industry, shaping the future of innovation and driving the global economy. These tech titans are known as the "Big 5," including Microsoft Corporation, Apple Inc., NVIDIA Corporation, Alphabet Inc., and Amazon.com, Inc. Despite some having physical products, most of their value and influence come from their intangible assets and services. This article delves into the impact and strategies of these companies, emphasizing their reliance on intangible products and the knowledge economy.

Microsoft was the largest company in the world by market capitalization at the time this article was written, competing with Apple Inc. and NVIDIA Corporation, with a market capitalization of approximately \$3.47 trillion. It is a prime example of the shift towards intangible assets. The company's success relies heavily on its software products and cloud computing services. Microsoft's Azure cloud platform, along with subscription-based services like Windows 365 and Microsoft 365, provide stable, recurring revenue streams. Additionally, Microsoft's ventures into artificial intelligence and acquisitions like LinkedIn have strengthened its intangible asset portfolio, showcasing its dominance in the tech world without heavy reliance on manufacturing.

With a market cap of about \$3.45 trillion, Apple is renowned for its hardware products like the iPhone, iPad, and Mac computers. However, a significant portion of Apple's revenue comes from its services sector, including the App Store, Apple Music, iCloud, and Apple TV+. These services generated over \$75 billion in 2023, highlighting the importance of intangible products in Apple's business model. The seamless integration of its hardware with software services has created a loyal customer base, driving recurring revenue and reinforcing Apple's market position.

NVIDIA, valued at around \$3.15 trillion, has transformed from a graphics processing unit (GPU) manufacturer into a leader in the knowledge economy. Its GPUs are essential for gaming, artificial intelligence, and high-performance computing. The real value lies in NVIDIA's software platforms like CUDA, which enable developers to utilize its hardware for various applications, from deep learning to scientific simulations. NVIDIA's strategic focus on AI research and development and cloud-based AI services underscores its reliance on intangible assets to drive growth and innovation.

Alphabet, the parent company of Google, has a market cap of approximately \$2.34 trillion. It is a dominant force in digital advertising, with Google Ads generating most of its revenue. Alphabet's other intangible assets include the Android operating system, Google Search, YouTube, and the Google Cloud Platform. Its vast data processing capabilities and ability to monetize user data through targeted advertising are key drivers of its success. Alphabet's investments in futuristic technologies like autonomous vehicles (Waymo) and life sciences (Verily) further highlight its commitment to the knowledge economy.

Amazon, with a market capitalization of \$2.07 trillion, is widely known for its vast e-commerce platform. However, its most profitable segment is Amazon Web Services (AWS), which is the leading provider of cloud infrastructure. AWS offers a broad range of cloud-based services, such as computing power, storage, and databases, to businesses globally. Amazon's Prime membership program and its investments in artificial intelligence and digital content significantly contribute to its revenue. These intangible assets drive customer loyalty and overall spending on the platform.

The Big 5 companies exemplify the modern business trend of leveraging intangible assets to drive growth and maintain competitive advantages. Their strategic focus on services, software, and digital platforms offers scalable and recurring revenue streams, setting them apart from traditional manufacturing-based companies.

The success of the Big 5 tech companies offers several key lessons for the industry. Emphasizing innovation through continuous investment in research and development, especially in emerging technologies like artificial intelligence and cloud computing, is essential for maintaining a competitive edge. Diversifying revenue streams by relying on a mix of products and services, particularly those that provide recurring revenue, helps stabilize and grow a company's financial performance. Leveraging data and user insights to drive targeted advertising and personalized services can significantly enhance customer engagement and profitability. Investing in intangible assets, such as building strong intellectual property portfolios and focusing on software, platforms, and services, can create significant long-term value. Lastly, companies must be agile and willing to adapt their business models to align with market demands and technological advancements. These strategies underscore the importance of intangible assets and the knowledge economy in driving sustained growth and innovation.

The ascendancy of the Big 5 tech companies underscores the growing significance of intangible assets in today's economy. These companies have adeptly integrated intangible products into their core business models, from cloud services and digital advertising to artificial intelligence and software ecosystems. This strategic shift enhances their market positions and ensures long-term sustainability and growth in a rapidly changing technological landscape. Their success is a testament to the pivotal role of intellectual property and the knowledge economy in driving innovation and economic value.

PART 3 · TOPIC 22

**Gross Profit Margins
between “Branded” and “Generic” Pharmaceutical and
Biotech Companies**July 2024 · First published

Dear reader, the pharmaceutical industry is a complex and highly competitive sector, distinguished by significant differences in the financial metrics of branded and generic drug companies. One of the most telling metrics in this context is the gross profit margin, which measures the percentage of revenue that exceeds the cost of goods sold (COGS).

This metric provides crucial insights into how efficiently a company produces its goods and indicates the profitability of its core operations. Today, we explore the distinct gross profit margins of branded and generic drug companies, shedding light on the underlying factors contributing to these differences.

Branded drug companies, or innovative or originator pharmaceutical companies, are responsible for developing new drugs. These companies invest heavily in research and development (R&D) to discover, develop, and bring to market novel medications. The process is arduous and expensive, often taking years and costing billions of dollars. However, once a new drug is approved by regulatory bodies such as the FDA, the company is granted a period of market exclusivity through patents. This exclusivity allows the company to sell the drug without competition, thereby setting high prices to recoup the extensive R&D costs and generate significant profits.

According to industry reports, the gross profit margin for branded drug manufacturers is notably high, averaging around 80%. This high margin is primarily due to the premium pricing power of market exclusivity. During the patent-protected period, branded drug companies can charge significantly more for their medications than generics, ensuring substantial profit margins. The exclusivity period is crucial for these companies as it allows them to maximize their return on investment (ROI) before generic competitors enter the market.

On the other hand, generic drug companies focus on manufacturing and selling versions of drugs that are no longer protected by patents. These companies do not bear the exact high R&D costs as branded drug manufacturers because they replicate existing drugs rather than develop new ones. The cost structure of generic drug companies is significantly different, primarily focusing on manufacturing efficiency and cost control.

The gross profit margin for generic drug manufacturers is nearly half that of branded companies, averaging around 40%. Despite the lower margins, generic drug companies benefit from reduced regulatory and development costs. Once a drug's patent expires, generic manufacturers can produce and sell the drug at a fraction of the original cost, offering significant savings to consumers.

and healthcare systems. The lower prices of generics translate to lower margins, but the high sales volume often compensates for this, allowing generic companies to maintain profitability.

Several factors contribute to the differences in gross profit margins between branded and generic drug companies. Branded drug companies invest heavily in R&D, significantly impacting their cost structure. The high investment in developing new drugs and conducting clinical trials is reflected in their higher prices, resulting in higher gross profit margins. In contrast, generic drug companies bypass much of the R&D expense, focusing instead on manufacturing efficiency.

The regulatory approval process for branded drugs is rigorous and costly, involving multiple phases of clinical trials to ensure safety and efficacy. Generic drugs, however, only need to demonstrate bioequivalence to the branded drug and maybe other minor tests, a much more straightforward and less expensive process. This difference in regulatory requirements contributes to the lower cost COGS for generic manufacturers.

The period of market exclusivity granted to branded drugs allows these companies to set high prices without competition. This exclusivity is critical for recovering R&D investments and achieving high-profit margins. Once the exclusivity period ends, generic manufacturers enter the market, offering lower-priced alternatives that reduce the pricing power of branded drugs.

Generic drug companies often benefit from economies of scale due to the high production and sales volume. By optimizing production processes and leveraging large-scale manufacturing, generic companies can reduce per-unit costs, maintaining profitability even with lower margins.

Lastly, the competition in the generic drug market is intense, with multiple manufacturers producing the same drug once patents expire. This competitive environment drives down prices and margins. Branded drug companies, however, face less direct competition during their exclusivity period, allowing them to maintain higher margins.

The distinct gross profit margins of branded and generic drug companies have several implications for the pharmaceutical industry and healthcare systems. Branded drugs' high-profit margins incentivize innovation and the development of new treatments, which is vital for addressing unmet medical needs. However, the high cost of branded drugs can limit access for some patients. With their lower prices, generic drugs enhance access to medications, contributing to broader public health benefits.

The introduction of generics significantly reduces healthcare costs by providing affordable alternatives to expensive branded drugs. This cost-saving potential is crucial for managing healthcare budgets and ensuring sustainable medication access.

Policymakers must balance the need to incentivize innovation to ensure affordable medication access. Regulatory frameworks that support both the development of new drugs and the timely entry of generics into the market are essential for achieving this balance.

The pharmaceutical market is characterized by dynamic interactions between branded and generic drug companies. The entry of generics impacts the revenue streams of branded companies, influencing their strategies and investment decisions. Conversely, the availability of generics drives competition and price reductions, benefiting consumers.

In summary, the gross profit margins of branded and generic drug companies reflect the distinct business models and cost structures inherent to each pharmaceutical industry segment. Branded drug companies achieve high margins through innovation, market exclusivity, and premium pricing, while generic companies focus on cost efficiency and high-volume production to maintain profitability. Understanding these differences is crucial for stakeholders across the healthcare system, from policymakers and payers to patients and providers, as they navigate the complexities of drug pricing and access.

PART 3 · TOPIC 23

Biotech Market Shifts and Capturing Golden Opportunities

June 2024 · First published

The biotech sector has always attracted investors due to its potential for high returns driven by healthcare innovation and breakthroughs. However, since the COVID-19 pandemic pushed the industry to unprecedented highs, some investors are now uncertain about the current state of the market. The good news is that there are still plenty of investment opportunities in the biotech sector, with prices currently lower than their pandemic-era highs and new technological innovations emerging. This comprehensive overview will explore why the biotech market is an excellent investment option over the next two years.

The COVID-19 pandemic caused an unprecedented surge in the biotech industry, as vaccine and diagnostic development companies caught the attention of investors, and their valuations skyrocketed. However, after the initial surge, the market corrected itself, and previously valued stocks experienced a considerable decline. This correction has allowed investors to buy into innovative companies at more attractive prices.

The COVID-19 pandemic poured billions into the biotech sector, accelerating research and development. As a result, many biotech companies now possess robust pipelines, and some technologies previously in their infancy have matured rapidly. For instance:

mRNA Technology: Moderna and BioNTech/Pfizer have successfully established mRNA vaccines as a credible platform, attracting significant investments into similar approaches for other diseases.

Gene Editing and CRISPR: Companies like CRISPR Therapeutics, Editas Medicine, and Intellia Therapeutics are developing new therapies using cutting-edge gene-editing technologies.

Cell and Gene Therapy: CAR-T cell therapy and other personalized medicine are gaining traction, with several biotech firms focusing on oncology and rare genetic diseases.

The urgency created by the pandemic led to expedited regulatory pathways, which appear to be continuing. The U.S. Food and Drug Administration (FDA) and the European Medicines Agency (EMA) have maintained streamlined approval processes for innovative treatments. This favorable regulatory environment encourages companies to pursue ambitious projects and seek approvals faster.

The pandemic exposed vulnerabilities in the global healthcare infrastructure and heightened interest in pandemic preparedness and emerging infectious diseases. This focus has translated into increased investments in vaccines, antiviral drugs, and diagnostic technologies. New vaccines targeting infectious diseases like RSV, flu, and emerging pathogens are gaining attention, while oral antiviral drugs aimed at COVID-19 and other viruses have become a priority for pharmaceutical

companies. Moreover, rapid and accurate diagnostic tests are crucial for early detection and containment, further driving investment in advanced diagnostic technologies.

Pharmaceutical companies are increasingly turning to biotech firms to bolster their pipelines. This has resulted in strategic acquisitions and collaborations, particularly in niche areas like oncology, rare diseases, and neurology. Some notable examples include:

Pfizer's acquisition of Trillium Therapeutics to strengthen its oncology pipeline.

Merck's (MSD) acquisition of Acceleron Pharma to expand its cardiovascular portfolio.

Biogen's collaboration with Denali Therapeutics on neurodegenerative diseases.

Precision medicine is gradually shifting the healthcare paradigm toward personalized and targeted treatments. Biotech companies specializing in biomarkers, companion diagnostics, and targeted therapies benefit from this shift. Growth in this area is driven by an increasing genetic understanding of diseases, improvements in sequencing technology, and a rising demand for personalized healthcare solutions.

The aging global population and increasing prevalence of chronic diseases drive demand for innovative therapies. Biotech companies focusing on age-related diseases such as cancer, Alzheimer's, and cardiovascular conditions are poised for long-term growth. Moreover, rising healthcare spending and access to better healthcare in emerging markets contribute to expanding the biotech industry.

Investors increasingly consider environmental, social, and governance (ESG) criteria when making investment decisions. The biotech sector is a good fit for ESG investment strategies as it has the potential to solve global health challenges. Companies involved in developing treatments for rare diseases, improving vaccine access, or working on solutions for global health crises have the potential to attract impact investors.

The biotech sector is uniquely positioned to offer significant investment opportunities in the coming years. Several factors, such as technological advancements, favorable regulatory environments, strategic collaborations, and growing market needs, make this an exciting time for investors. Although the biotech sector is inherently risky due to the nature of drug development, investors who conduct thorough due diligence can find biotech stocks with the potential to deliver substantial returns.

Investing in the biotech industry can be very lucrative but requires careful consideration and attention to detail. Diversification is essential, as is a clear understanding of each company's pipeline and market potential. To achieve success in biotech investment, it is important to select companies with strong innovation pipelines and growth potential carefully. By doing so, investors can take advantage of current market dynamics and ride the wave of a fascinating and potentially profitable sector.

PART 3 · TOPIC 24**Inside the XBI Index**

June 2024 · First published

The biotechnology industry is a dynamic and rapidly evolving sector known for its innovation and potential to transform healthcare, agriculture, and other fields. Investors seeking to capitalize on these advancements often look to specific indices that track the performance of biotechnology companies. One such index is the S&P Biotechnology Select Industry Index (XBI). Today, the article aims to comprehensively understand the XBI Index, covering its composition, methodology, benefits, challenges, and role in biotechnology investment strategies.

The S&P Biotechnology Select Industry Index, or the XBI Index, stands out among other biotech indices due to its unique features. It is a market-cap-weighted index that mirrors the performance of the biotechnology sub-industry within the U.S. equity market. The index's composition includes companies involved in biopharmaceuticals and biotechnology products' research, development, manufacturing, and commercialization. This comprehensive representation of the biotech sector makes it a popular benchmark for biotech-focused exchange-traded funds (ETFs), such as the SPDR S&P Biotech ETF (ticker symbol: XBI), which closely tracks the index's performance.

S&P Dow Jones Indices manages the XBI Index and employs a unique methodology that distinguishes it from other biotechnology indices. Companies must be listed on a U.S. exchange and classified under the Global Industry Classification Standard (GICS) Biotechnology Sub-Industry. They must also meet specific size and liquidity criteria, including minimum market capitalization and trading volume thresholds. The XBI Index uses a modified equal-weighting approach to ensure the biotech industry giants do not overshadow smaller companies. Each constituent is initially given an equal weight, but adjustments are made to reflect liquidity factors. Rebalancing occurs quarterly to maintain the equal-weight balance, and constituents may be added or removed based on changes in eligibility criteria or corporate actions like mergers, acquisitions, or bankruptcies.

The XBI Index covers various companies, from early-stage biotech startups to established biopharmaceutical firms, providing comprehensive exposure to the biotechnology sector. As biotechnology is inherently driven by innovation, the index comprises companies involved in cutting-edge research areas such as gene therapy, oncology, CRISPR gene editing, and personalized medicine. Due to the nature of the biotechnology industry, the XBI Index tends to be more volatile than broader market indices. Regulatory decisions, clinical trial results, and market sentiment can cause significant fluctuations in constituent stocks. Additionally, the index generally includes companies focused on high-growth segments of the biotech market, often prioritizing research and development over profitability.

Investing in the XBI Index is not just about the risks; it also offers several benefits. It provides diversified exposure to the biotechnology industry by holding a wide range of companies across

different stages of development and therapeutic areas. The modified equal-weight methodology prevents concentration risk by ensuring no single company can disproportionately impact the index's performance. Moreover, investors gain exposure to innovative companies at the forefront of medical and technological advancements, offering the potential for significant returns. The XBI Index serves as a valuable benchmark for the biotechnology sector, allowing investors to assess the performance of biotech-focused funds and individual stocks. ETFs that track the XBI Index, like the SPDR S&P Biotech ETF, offer high liquidity, enabling investors to buy and sell shares efficiently.

Despite these benefits, investing in the XBI Index presents challenges and risks. The biotechnology sector is inherently volatile due to its reliance on clinical trial outcomes, regulatory approvals, and market sentiment. This volatility can result in significant price swings for the XBI Index. Changes in healthcare regulations, pricing policies, and drug approval processes can significantly impact the profitability and valuation of biotech companies in the index. Although the index aims for equal weighting, it often includes a higher proportion of more minor, speculative companies. These firms are more susceptible to market fluctuations and business challenges than established biotech giants. Biotech companies face intense competition and rapid technological changes, and a breakthrough by one firm can render a competitor's product or technology obsolete, impacting their stock prices. Additionally, investor sentiment plays a crucial role in the biotech sector, and positive or negative news can significantly influence valuations, sometimes leading to overvaluation or undervaluation of constituent stocks.

The XBI Index is often compared to other biotech indices, such as the NASDAQ Biotechnology Index (NBI) and the NYSE Arca Biotechnology Index (BTK). The NBI is a market-cap-weighted index that includes the largest and most liquid biotechnology and pharmaceutical companies listed on the NASDAQ exchange. However, it is heavily weighted towards large-cap biotech firms, leading to a concentration of risk in fewer companies. The BTK is a price-weighted index that includes biopharmaceutical companies listed on the NYSE, but it consists of fewer companies (approximately 30) and emphasizes large-cap stocks. The XBI Index, on the other hand, uses a modified equal-weight index with a broader representation of the biotechnology sector, balancing exposure between large and small biotech firms.

For investors with a high-risk tolerance and a long-term investment horizon, the XBI Index can be an excellent way to gain exposure to the innovations and growth potential within the biotech industry. Understanding its composition, methodology, and risks involved is crucial for making informed investment decisions and harnessing this index's opportunities.

PART 3 · TOPIC 25**Exploring the Challenges of Biotech Stock Investment**May 2024 · First published

Dear reader, the biotechnology industry is widely known as one of the most dynamic and innovative sectors in the global economy. Due to its crucial role in developing new treatments, medical discoveries, and advanced health technologies, it presents significant investment opportunities. However, many investors hesitate to invest in the biotech market despite its appeal. What are the reasons behind this hesitation?

Investors often need help comprehending the advanced technology and scientific innovations in biotechnology. Developments such as gene therapies, CRISPR gene editing, and mRNA technology require specialized technical knowledge that is not easily accessible. It is crucial for investors to carefully evaluate each company based on its technologies, product pipeline, and prospects. However, many investors need help understanding the details of clinical trial phases, regulatory approvals, and the technology involved, which makes investing in the sector a significant challenge.

The biotech market is known for its high level of volatility in comparison to other sectors. The prices of companies' stocks are often influenced by unexpected developments such as regulatory approvals, clinical trial results, and even rumors surrounding the effectiveness of treatments. Sometimes, a single clinical trial result can cause a significant rise or fall in stock value. This volatility can make many investors feel insecure and prefer more stable sectors.

Biotechnology drug development is a lengthy, intricate, and expensive affair. Clinical research can take several years and require substantial investments before drugs can be sold. Even after all these efforts, companies may need help obtaining regulatory approvals or achieving sales. This added risk often discourages many investors from investing in this sector.

Biotech companies heavily rely on innovation for their success, which leads to intense competition from major industry players and other startups vying to capture market share through novel discoveries. This competition can reduce company profits or even force them out of the market entirely. Additionally, mergers and acquisitions can unexpectedly and rapidly alter the industry landscape.

Regulatory bodies like the U.S. Food and Drug Administration (FDA) or the European Medicines Agency (EMA) must approve any new drug or treatment. These regulatory processes are pretty complex and time-consuming, sometimes resulting in the rejection of drugs even after years of development and testing. This creates uncertainty regarding a company's success in bringing its products to market, which prompts investors to avoid the sector.

Many investors need to learn how to evaluate biotech companies. Different from other sectors, financial analyst reports in this area are not frequently available and are usually complex due to their dependence on scientific and technical data. More unambiguous information is needed to assess companies' financial performance, which introduces additional uncertainty.

The fear of failure in biotechnology is a genuine concern. Research shows that many drugs fail to make it through clinical trials or achieve the expected financial results after approval. This fear creates a psychological barrier for potential investors who may feel the risk does not justify the possible returns.

Biotech companies usually garner significant investments and are typically well-funded. However, for the average investor, purchasing shares in these firms may require substantial amounts of money they cannot afford. Moreover, specialized biotech investment funds generally charge higher-than-average management fees, which may make investing in them less appealing. Despite its challenges, the biotech sector provides attractive investment opportunities for those who can comprehend it properly. Investors with sufficient technical knowledge, market risk analysis abilities, and good diversification strategies can earn significant returns in this sector. However, the inherent complexity, volatility, and regulatory hurdles often make many investors hesitate. Therefore, investors must conduct in-depth research and seek the advice of financial experts before making any investment decisions in the biotech market.

The biotech sector is complex and carries associated risks. As a result, many investors prefer to stick to traditional industries, such as real estate, finance, and energy. These sectors are known for their relative stability and are often considered safer than biotech.

Numerous investors have attempted to invest in biotechnology and suffered losses due to their inability to assess companies accurately or due to sharp market fluctuations. These personal experiences have led to a negative perception of the sector, discouraging them from returning.

Despite these challenges, the biotech sector continues to offer tremendous investment opportunities for those who can understand it correctly. Investors with sufficient technical knowledge, the ability to analyze market risks, and good diversification can reap substantial rewards in this sector. However, the challenges related to complexity, volatility, and regulation cause many to refrain from investing. Therefore, investors must conduct thorough research and consult financial experts before investing in the biotech market.

PART 3 · TOPIC 26

The Titans of Biotech Stock Investment

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Biotechnology has become an attractive investment opportunity due to its rapid medical and healthcare advancements. BlackRock and Vanguard are leading this trend, which holds many biotech stocks together. Each manages over \$100 billion in biotechnology investments, which gives them significant influence in the sector. According to CapitalIQ data, let's take a closer look at these two investment giants and their role in shaping the biotech investment landscape.

As per the latest data, BlackRock and Vanguard are the biggest owners of biotech stocks, managing \$114.8 billion and \$114.7 billion, respectively. Together, they have holdings worth over \$229 billion, significantly influencing the biotech sector's dynamics.

BlackRock, the world's largest asset manager, heavily relies on index funds to shape its investment strategy, thereby establishing itself as a dominant player in the market. In the biotech sector, the firm primarily invests through index funds, particularly those that track broad indices such as the Russell 3000. Its biotech portfolio is also significantly diversified through the firm's quantitative funds, which employ data-driven strategies to maximize returns. Furthermore, BlackRock prioritizes environmental, social, and governance (ESG) factors in its investment decisions, which align with the global sustainability trend.

BlackRock has a unique investment strategy that helps to stabilize the biotech sector. They do this by systematically buying and holding stocks in key indices. This strategy is known as passive investment. It ensures consistent liquidity even when the market conditions are fluctuating. BlackRock has invested heavily in numerous biotech companies and plays a significant role in corporate governance. They often advocate for sustainable business practices to ensure the industry grows sustainably and ethically.

BlackRock holds significant stakes in large pharmaceutical companies with biotech divisions, such as AbbVie, Amgen, and Gilead Sciences. The firm also invests in smaller, emerging biotech firms, providing much-needed capital for innovation.

With \$114.7 billion in biotech stocks, Vanguard closely follows BlackRock's investment strategy. Known for pioneering low-cost index investing, Vanguard trails only BlackRock in this sector.

Vanguard is known for its biotech investments, primarily focused on broad-market indices such as the S&P 500 and the Russell 3000. The firm's dedication to low-cost investing attracts retail and institutional investors, making its biotech funds highly popular. Additionally, Vanguard's long-term perspective is well-suited to the lengthy innovation timelines associated with biotech.

Index funds from BlackRock and Vanguard stabilize the biotech market, reducing volatility through consistent investment flows. Vanguard's significant biotech holdings allow for advocacy of long-term value creation in corporate governance.

Vanguard invests in biotech, with holdings in renowned pharmaceutical firms such as Pfizer, Moderna, and Regeneron Pharmaceuticals. It also supports innovative biotech startups working towards the next wave of healthcare breakthroughs.

Their investment strategy is passive, which provides stability to the biotech market and offers consistent liquidity even during market fluctuations.

Both firms emphasize strong corporate governance and ESG principles, advocating for responsible business practices in biotech companies. Their investments in emerging biotech firms provide vital funding for research and development, fueling the next generation of medical innovations.

Biotech investments have great growth potential but come with unique challenges. Biotech stocks are highly volatile and can react strongly to clinical trial results, regulatory approvals, or rumors. While index funds offer stability, specialist funds can take advantage of specific trends for higher returns. Innovation is crucial for biotech success, and funds must identify cutting-edge technologies like CRISPR, mRNA technology, and gene therapies. This requires specialized knowledge and expertise. Regulatory approvals from the FDA and EMA significantly affect biotech company valuations. Funds with expertise in navigating these regulatory landscapes are better positioned to mitigate these risks. The lengthy and costly drug development process requires a long-term investment horizon. Investors must be prepared for a long wait before returns materialize.

The development of high-tech industries and economic diversification are crucial for Saudi Arabia's progress. Saudi investors can establish specialized biotech research hubs or funds within the country to achieve this. This will help attract global talent, encourage innovation, and promote knowledge transfer. Ultimately, this will position Saudi Arabia as a regional leader in biotech investments and healthcare innovation.

PART 3 · TOPIC 27

The Trillion-Dollar Gap Between “Tech Giants” and “Big Pharma”

March 2024 · First published

The current economy has seen “giant tech companies” like Apple, Microsoft, Nvidia, and Amazon reach a valuation of between one to three trillion dollars. However, “the pharmaceutical sector” has yet to achieve this milestone despite its crucial role in healthcare. This gap highlights the need to examine the unique challenges and opportunities in the pharmaceutical industry. These include the lengthy and expensive drug development process, strict regulatory landscape, market constraints, and the impact of patent expirations on revenue.

“The tech industry” enjoys more flexible regulations and greater scalability, unlike the pharmaceutical sector, which has to deal with strict approval processes and market fragmentation, limiting its rapid expansion. Moreover, unlike “tech companies”, pharmaceutical companies face intense competition from generic drugs after patent expirations. This competition restricts their ability to maintain long-term high revenue streams, even though they cannot continuously diversify and innovate.

Pharmaceutical companies can find new growth opportunities by collaborating with “tech companies” that leverage digital health and biotech innovations, such as artificial intelligence and data analytics.

In August 2018, Apple achieved a market valuation of one trillion dollars in just 42 years since its inception, after years of research and development. Generating such enormous revenues required overcoming numerous challenges related to development and regulation. Apple's success is largely attributed to its innovative products such as the iPhone. In the first quarter of 2021 alone, the company's revenues surpassed 111 billion dollars. In contrast, according to a study by the Tufts Center for the Study of Drug Development, Pfizer, one of the world's largest pharmaceutical companies, has an average drug development timeline of 10 years and costs approximately 2.6 billion dollars.

The pharmaceutical industry has the potential to surpass trillion-dollar market valuations, outperforming even “tech giants”. This is due to their unique advantages and significant contributions to healthcare. Their success is driven by factors such as developing successful drugs that generate substantial revenues, patent protections ensuring extended profitability, and the growing global demand for pharmaceuticals driven by demographic changes. The pharmaceutical industry's resilience to economic fluctuations and advances in biotechnology and personalized medicine enhance its valuation prospects. In addition, strategic mergers and acquisitions play a crucial role in increasing these companies' market value and efficiency. Furthermore, pharmaceutical companies' contributions to global health save lives and add significant economic value, enhancing

their potential for higher profitability and valuation compared to the "technology sector," which operates differently in terms of the product lifecycle and market dynamics.

When comparing "pharmaceutical giants" to "tech giants," it becomes apparent that they differ significantly in terms of innovation speed, market dynamics, regulatory environments, scalability, and social impact. These factors affect their ability to reach trillion-dollar valuations and profitability. "Tech companies" are known for their fast-paced innovation and global expansion at lower costs. This leads to high valuations, but they also face challenges such as market volatility and regulatory scrutiny. On the other hand, "the pharmaceutical sector" has a slower, patent-protected innovation cycle, which ensures long-term revenue with high-profit margins and market resilience. Despite facing more significant regulatory barriers, the pharmaceutical industry's business model is designed to withstand such challenges.

PART 3 · TOPIC 28

Unveiling the Hidden Innovators: The Heroes Behind the Scenes

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Dear Reader, we often overlook the unsung heroes behind the curtain, the brilliant minds fueling giants like Amazon, Apple, Meta, Microsoft, Moderna, and others. We are dazzled and inspired by the founders of these innovative companies. Yet, behind every great success story is an essential, albeit "invisible," supporter: the "Venture Capital Funds." These funds play a subtle but equally vital role as the founders in the journey of these innovative companies. They are the "unseen" architects of innovation whose investments transform numerous startups from modest beginnings into today's corporate giants.

Venture Capital Funds are at the heart of the startup ecosystem in all fields without exception. Their role extends beyond financial assistance; they provide guidance and insights from deep market experience and a vast network of contacts in technology, industry, and commerce. They offer critical support in the early stages of a company when looming risks are a defining characteristic of startups. These funds bet on their belief in the startup teams' potential and innovative ideas.

Success in the startup world is a high-risk adventure. Behind every "Tech Giant" today are the success stories of Venture Capital Funds that saw the future and potential in these companies in their early "startup" days. Companies like Amazon, Google, and Moderna would have remained mere ideas without Venture Capital Funds and the confidence of early investors. These investors bet on these startups and creative ideas, paving the way for their immense successes.

Dear Reader, let us highlight some notable cases where the heroes of Venture Capital Funds shaped the future through their investments:

In 1978, Don Valentine and his investment firm, Sequoia Capital, invested nearly \$150,000 in Apple. This was a critical investment with significant future benefits, attracting more investors to Apple's table and undoubtedly contributing to the company's later success.

In 1999, Kleiner Perkins, in collaboration with Sequoia Capital, invested \$25 million in Google, then a small startup with an emerging search engine. This early investment massively expanded Google's operations, with Kleiner Perkins' expertise and network playing a crucial role in guiding Google's growth to its current dominant level.

Dear Reader, we will also mention some key scenarios where Venture Capital Funds played a fundamental role in the success of "Biotech companies." For example:

Flagship Pioneering invested in the innovative biotech company Moderna, which specializes in mRNA technology. Flagship's continuous support was crucial for Moderna in building its mRNA

platform. It played a decisive role in the rapid development of the COVID-19 vaccine, demonstrating how venture capital drives leading medical research globally.

Third Rock Ventures, specializing in healthcare investments, invested in the emerging pharmaceutical company Bluebird Bio, specializing in developing gene therapies. This investment and support were crucial in developing innovative gene therapies for rare genetic diseases and cancer.

In conclusion, dear esteemed reader, we must remember that behind the successes of entrepreneurs in technology and beyond stand heroic figures behind the curtain from Venture Capital Funds, fundamentally supporting these successes.

PART 3 · TOPIC 29

Can We Benefit from the 'Rising Stars' in Pharma and Biotechnology?

February 2024 · First published

Dear Reader, amidst the significant global transformations witnessed following the COVID-19 pandemic, the significance of pharmaceutical and biotechnological industries as key areas of innovation and investment has been highlighted. New opportunities and challenges emerge in this context, necessitating exploration and assessment of their global impact. 2023 marked a crossroads for these industries, with notable declines observed in China and Germany.

The market value decreased by 10% in China due to regulatory and economic challenges. On the other hand, the German marketsaw a modest decline of about 2%, reflecting diverse impacts at a global level.

Conversely, the United States, Japan, Switzerland, and France demonstrated remarkable resilience and stability. These countries benefited from advanced infrastructure and intensive investments in research and development, leading to significant innovations in this field. Similarly, Italy, South Korea, and Australia experienced increasing growth rates between 4% and 7%.

Countries like the Netherlands, Sweden, Belgium, Spain, and India emerged as rising stars in this domain, registering growth between 20% and 35%. This notable growth is attributed to long-term investments in innovation and the expansion of sectors related to biotechnology and pharmaceuticals.

With its strong base in generic drug manufacturing and significant advancements in vaccine production, India is an exemplary model in leveraging the post-pandemic period. The Indian government's supportive stance towards biotechnology and digital health startups has significantly bolstered the sector. For Saudi Arabia, India's model can inspire, especially with Vision 2030 focusing on healthcare as a critical sector.

Saudi Arabia can exploit local talents and encourage innovation through supportive policies, contributing to developing its pharmaceutical manufacturing capabilities. By adopting an approach similar to India's, the Kingdom can enhance its leadership in healthcare and biotechnology.

Denmark has distinguished itself with a unique market strength, supported by drug export and development and a robust startup ecosystem. This diversity in global performance underscores the importance of demographic shifts, the spread of chronic diseases, advances in personalized medicine, digital health, and more. These trends and experiences allow Saudi Arabia to gain new insights and develop effective strategies to bolster its healthcare sector. Focusing on investment in research and development, encouraging public-private partnerships, and supporting life sciences

education is crucial. Moreover, concentrating on healthcare manufacturing and developing a startup ecosystem will contribute to significant long-term growth.

In light of Vision 2030 and the presence of a distinguished and high-quality national strategy for biotechnology launched by His Royal Highness Prince Mohammed bin Salman bin Abdulaziz Al Saud, Crown Prince, the Kingdom stands on the brink of a significant transformation in the healthcare sector, benefiting from leading global trends. The increasing investment in research and development emerges as a critical cornerstone for achieving this transformation, as innovation and technological advancement in healthcare are crucial factors in enhancing the quality of healthcare services and products.

Furthermore, focusing on healthcare manufacturing is a strategic step towards self-sufficiency and opening new export opportunities. Developing this sector will achieve economic growth and enhance the Kingdom's innovation and global competitiveness capabilities.

Finally, developing an integrated ecosystem for healthcare startups will profoundly impact creativity and innovation. This environment, encouraging entrepreneurship and supporting small and medium-sized companies' growth, will create a favorable climate for exchanging new ideas and developing innovative health solutions. With this approach, Saudi Arabia is steadily progressing towards realizing its Vision 2030, reaffirming its active and influential role in the global healthcare sector.

PART 3 · TOPIC 30

Biotech Boom 2024 with IPO Revival and Saudi Arabia's Global Leadership Ascent

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The biotechnology industry is constantly changing, and that includes Initial Public Offerings (IPOs). This is especially true for the biotech sector, which plays a crucial role in advancing medical and scientific research. As we approach 2024, the biotech IPO market is expected to be a key factor in rejuvenating this critical industry.

The biotech sector experienced a significant increase in IPO activities after March 2020. This growth is detailed in "The Biotech Boom: 2020 IPO Overview" report by the BioMarket Trends Institute, which states that over 100 biotech companies went public in 2020, raising more than \$20 billion. However, this positive trend suffered a setback due to the Federal Reserve's interest rate hikes. By 2022, there was a noticeable decline in both the number and total capital of biotech IPOs, highlighting the sector's susceptibility to economic fluctuations.

The IPO sector's valuation trends have shifted in recent years. According to Biotech Valuations Inc.'s comprehensive analysis titled "The 2023 Biotech IPO Landscape," the average IPO size in 2023 has fallen to around \$75 million, compared to previous years' averages of over \$100 million. Additionally, over 60% of biotech IPOs in 2022 traded below their initial offering prices, indicating an increase in investor caution.

The monetary policies of the Federal Reserve, particularly the interest rate hikes, have had a significant impact on the dynamics of biotech IPOs. This report discusses how these hikes, although necessary for economic stability, have reduced investor interest in the high-risk, high-reward nature of biotech investments. As a result, IPO activity in the industry has declined. However, there was a market rebound in late 2023, although it did not reach the peak levels observed after the COVID-19 pandemic.

The current economic environment has led to emerging trends in the biotech sector. Investors now gravitate toward biotech firms with lower-risk profiles or those nearing commercialization. Additionally, mergers and acquisitions (M&A) are increasingly seen as viable alternatives to IPOs for capital-seeking startups. The market is now divided into companies with robust data and clear commercial paths and those needing help to secure funding.

Biotech IPO valuations are on a downward trend, indicating a cautious market stance. Many of the recent IPOs have been struggling to maintain their offering prices, which is in contrast to the significant post-IPO surges seen earlier. This suggests that investors are now being more cautious and scrutinizing the market more carefully.

According to experts, the biotech IPO market seems to be cautiously optimistic as we look ahead to 2024. With the market adjusting to the new interest rate environment and evolving investor behavior, there is an expectation of a moderate resurgence in biotech IPOs. The success of these IPOs will likely depend on demonstrating clear clinical progress and commercial viability, in line with the changing post-pandemic investor preferences.

Dear reader, the biotechnology sector is globally and nationally promising, with Saudi Arabia showing keen interest in this sector. The greatest incentive for this interest is the launch of the "National Biotechnology Strategy" by His Royal Highness Prince Mohammed bin Salman bin Abdulaziz Al Saud, Crown Prince and Prime Minister. Saudi Arabia strategically invests in the biotechnology sector to diversify its economy away from oil, in line with Vision 2030. Through its significant sovereign wealth funds, such as the Public Investment Fund (PIF), the Kingdom strategically invests in promising biotech companies, focusing on medium and low-risk projects with high potential. This approach aligns with the global shift in investor preferences post-pandemic.

The Kingdom is also developing state-of-the-art "science and technology parks" to foster innovation and attract global companies in the biotechnology field. Saudi Arabia's investments are not limited to financial aspects but also include building a comprehensive biotechnology ecosystem encompassing research, development, manufacturing, and marketing. This comprehensive strategy aims to transform Saudi Arabia into a global hub for biotechnology and healthcare innovation by 2040.

In conclusion, the Kingdom's multifaceted strategies in transferring "deep technology," including biotechnology, through investments in global "initial public offerings" markets, could lead to significant economic returns and solidify Saudi Arabia's position as a global innovator in the biotech field.

PART 3 · TOPIC 31

How Smaller VC Funds are Outshining the Industry Giants

January 2024 · First published

In the ever-evolving world of biotechnology, a notable trend is transforming the venture capital (VC) landscape. Smaller VC funds are steadily eclipsing their larger counterparts, marking a pivotal shift in funding patterns within the sector. This change, highlighted in recent studies, reflects a growing preference for the agility and specialized knowledge smaller funds offer.

Traditionally, the biotech industry has been under the financial wing of giant VC funds, known for their vast resources and extensive networks. However, emerging data indicates a significant shift towards smaller funds, demonstrating higher returns and more successful project outcomes. This shift is reshaping investment strategies and signaling a broader change in how biotech innovations are funded and brought to the forefront.

Small VC Funds in Biotech, typically managing assets under \$100 million to \$500 million, are considered nimbler. The upper limit of this range can vary based on market dynamics and industry definitions. These funds are often oriented towards early-stage companies and niche areas within biotech, offering seed or Series A funding to startups with potentially disruptive technologies. Small VC funds are valued for their agility and ability to make swift investment decisions. They often provide closer, more personalized support to their portfolio companies and are known for taking risks on innovative, high-potential technologies.

On the other hand, giant VC funds manage substantial capital, typically over \$500 million to several billion dollars. These funds may have a more diverse investment portfolio, extending from early-stage to more established biotech firms, and often participate in larger, later-stage funding rounds. With more extensive capital resources, giant VC funds can support prolonged development cycles and invest in multiple funding rounds for the same company. Their expansive networks and resources are crucial for navigating regulatory landscapes, marketing, and scaling operations.

The fund size significantly influences the investment approach, risk tolerance, and the type of companies each fund attracts in biotech, where the journey from research to marketable products is complex and costly. The strategic decisions made by VC funds, whether small or large, directly impact the direction and success of the startups they back in this dynamic industry.

Giant VC funds, known for their substantial capital reserves, extensive networks, and experienced management teams, have been the cornerstone for biotech startups needing significant funding and strategic guidance. They have provided the muscle and means to propel groundbreaking research from the lab to the market.

Yet, a detailed examination of the evolving market dynamics within the biotech sector suggests an emerging, contrasting narrative. Smaller VC funds, once considered the underdogs, are increasingly showing a capability to compete with and often surpass their larger counterparts, especially in terms of return on investment and successful project exits. This shift indicates a changing landscape in biotech financing, where agility, specialized knowledge, and a targeted approach to investment seem to be paying off more effectively than the traditional might of large-scale capital.

Several factors contribute to this shift. Firstly, smaller VC funds often exhibit more agility and flexibility. In the rapidly evolving biotech sector, where innovation cycles are short, and competition is fierce, this agility allows smaller funds to seize opportunities more quickly and pivot as needed.

Specialized knowledge is another significant factor. Smaller funds often focus on niche areas within biotech, enabling them to develop deep expertise and better assess the potential of emerging technologies and startups. This specialization often translates into more strategic investments and a higher success rate.

This trend has profound implications for the biotech industry. Startups may find more receptive audiences among smaller, more specialized funds. This could lead to a more diverse range of innovations receiving funding. This trend poses a challenge for the larger VC funds: adapt or risk continued underperformance. This adaptation could involve developing specialized teams within their larger structures or rethinking their investment strategies to become more agile.

The future of VC funding in biotech is one where size does not inherently equate to success. As smaller VC funds continue to carve out their niches and deliver impressive returns, the pressure on larger funds to evolve and rethink their strategies will only intensify. This competitive dynamic bodes well for the biotech sector, potentially leading to a more vibrant and diverse landscape of funded innovation.

The venture capital (VC) landscape is witnessing a significant shift, with smaller VC funds outperforming their larger counterparts for various reasons. A study by "Invesco" has highlighted the difficulties giant funds face in achieving high "venture-type" returns, mainly because most exit outcomes occur at relatively modest valuations, making it challenging for giant funds to generate substantial returns from these exits. Contrary to the perceived benefits of scale, brand, and experience, smaller VC funds have demonstrated better performance, suggesting that the advantages associated with larger funds do not necessarily translate into higher returns.

Moreover, the impact of fund size on returns is notable. Smaller funds can achieve higher overall returns from just one highly successful investment, a feat less attainable for larger funds as the impact of a single successful investment diminishes with the increased capital they raise. This dynamic reduces giant funds' ability to affect overall returns significantly. Regarding risk and return considerations, investing in giant funds, often considered safer, poses a higher risk with lower returns. In contrast, smaller seed funds offer better returns with a lower risk of earning less than the

invested amount. This trend suggests that smaller funds in venture capital may present a more attractive option for investors seeking lower risk and higher potential returns.

These insights indicate a notable shift in the venture capital landscape, where the agility of smaller funds and their ability to capitalize on specific, high-potential investments make them increasingly competitive against larger, more established funds.

Santé's examination of over 1,300 funds from 1978 reveals that larger venture funds (over \$750 million) have a lower success rate, with only 17% exceeding 2.5 times their paid-in capital value after costs. Conversely, smaller funds (below \$350 million) show a 25% success rate, suggesting they're about 50% more effective than larger ones in achieving similar returns.

Revere's research, a platform for evaluating early-stage venture firms, highlights that small venture capital funds outperform their larger counterparts. This is evident in comparing total value to paid-in capital ratios, where small funds in Revere's group exceed those in larger funds, both in the median and top-quartile categories.

The performance gap widens when considering cumulative internal rates of return (IRR). Giant funds average a 9.7% IRR, while smaller ones achieve a notably higher average of 17.4%, as reported by Santé.

These findings underscore a shift in the venture capital sector, where smaller, more nimble funds with a focused approach are proving more effective and competitive than giant funds.

PART 3 · TOPIC 32

Biotech's Steady Growth Despite Economic Hurdles

January 2024 · First published

Dear readers! Let's dive into the strength of the biotech market, which has repeatedly shown that it can handle the rollercoaster ride of the world economy. Today, we will explore how biotech has managed to stay strong through the ups and downs and why it looks set to continue this path.

In the world of healthcare, biotech is a byword for constant innovation. Its unique economic role comes from its knack for surviving and flourishing during tough economic times. This toughness is all about biotech's never-ending innovation, ability to change with the times, and its crucial work in tackling big health problems worldwide.

The real test of biotech's toughness shows up when the economy takes a hit. While other industries buckle under the pressure of recessions, biotech tends to stand firm. The 2008 financial crisis was a perfect case, with biotech drawing in investment when other markets were on shaky ground, thanks to the ongoing need for new healthcare solutions.

In the early 2000s, investors started flocking to biotech following significant discoveries from the human genome project. Even as other markets fell, biotech saw a boom, with more venture capital and many companies going public for the first time.

When the 2008 financial storm hit, the NASDAQ Biotechnology Index didn't wobble as much as other big market indexes like the S&P 500. Moreover, biotech didn't just recover after the dust settled—it soared. From 2009 to 2015, the index jumped over 300%, far outpacing the S&P 500 and marking a time of impressive growth and energy for the industry.

Biotech's resilience is anchored in several core factors: Central to its endurance is a culture of innovation that propels the industry by continually producing new medical treatments, maintaining investor interest, and advancing healthcare. The sector's financial health is bolstered by various funding sources, including venture capital, government grants, and strategic partnerships, collectively fuel ongoing research and development efforts. Additionally, the industry benefits from demographic shifts and evolving health trends, such as an increasing elderly population and a higher incidence of chronic illnesses, ensuring consistent demand for biotech innovations. Furthermore, the industry is supported by a regulatory framework that encourages growth and stability, allowing it to thrive over the long term.

Biotech's ability to stay tough is likely to keep going. The COVID-19 pandemic, while a massive challenge, also showed how vital biotech is when dealing with health crises. The industry's quick work in making vaccines and treatments showed its ability to innovate in a pinch.

Cutting-edge tech like CRISPR gene editing, personalized medicine, and AI in drug discovery are revolutionizing biotech. These advances are leading to new treatments and drawing in money and strategic partnerships, adding even more strength to the industry.

We're seeing more partnerships between small biotech firms and big pharma, which helps with innovation and financial strength. There's also a noticeable rise in companies going public and getting venture capital, showing high confidence in biotech's growth.

Government policies and regulations have a significant impact on biotech's resilience. As governments worldwide get behind the sector, we're seeing more supportive policies, funding for research, and streamlined processes for getting new treatments approved.

Taking all this into account, biotech's past ability to withstand economic troubles is a vital sign of its crucial place in the economy and bright future outlook. As health challenges evolve, biotech's importance only grows. Investors and those involved in the industry can be confident in biotech's proven track record of managing economic uncertainty and its dedication to ongoing innovation. With a mix of scientific advances, diverse funding, and flexible business tactics, biotech is well-equipped to keep up its growth and resilience in the years ahead.

PART 3 · TOPIC 33

The Titans Merge: a Look at the Largest M&A Deals in Pharma and Biotech History

December 2023 · First published

Dear reader, in the intricate dance of global commerce, few movements are as impactful as the mergers and acquisitions in the pharmaceutical and biotechnology sectors. Often running into billions, these deals shape corporate strategies and have far-reaching implications for healthcare innovation and market competition. Here, we delve into some of the most monumental M&A deals in pharma and biotech history, exploring their scale, rationale, and the ripples they have created in the industry.

The pharma and biotech industries are characterized by a relentless pursuit of innovation amidst fierce competition. In these sectors, where research and development are as crucial as market dominance, M&A activities are not just strategies but necessities. These mergers and acquisitions allow companies to diversify portfolios, enter unexplored markets, and access cutting-edge research and technologies. They are instrumental in shaping the industries, driving them towards new heights of medical and technological advancements.

The pharmaceutical industry is notoriously dependent on patents to protect its investments in drug development. However, when patents expire, a phenomenon known as the "patent cliff" occurs. Companies face significant revenue losses as generic manufacturers enter the market. M&A strategies are crucial in these situations, allowing companies to diversify their product portfolios and reduce reliance on any drug or therapeutic area.

M&A enables companies to rapidly expand their geographical footprint and gain access to new markets. This is particularly vital for reaching emerging markets with growing healthcare needs. By merging with or acquiring companies in different regions, pharma and biotech firms can overcome regulatory hurdles, gain local market insights, and establish a presence in these new territories more efficiently than they could on their own.

Mergers often lead to economies of scale, where the merged entity can operate more efficiently and at lower costs than the individual companies could separately. This efficiency is critical in an industry where production, marketing, and distribution costs are high. Furthermore, M&A can lead to economies of scope, where companies can cross-sell products and leverage complementary strengths, such as combining drug development expertise with advanced distribution networks.

The healthcare landscape continually evolves with new medical needs and trends, such as personalized medicine and digital health technologies. Companies often use M&A to adapt swiftly to these changes, acquiring capabilities and technologies that align with emerging healthcare paradigms.

The history of M&A in pharma and biotech is as old as the industries. In the early days, these deals were primarily driven by the need to consolidate market positions and streamline operations. However, as the sectors evolved, so did the nature of these acquisitions. The late 20th and early 21st centuries witnessed a surge in mega-mergers, spurred by the need for large pharma companies to fill gaps in their product pipelines and capitalize on emerging biotech innovations. Here are some examples: Pfizer and Warner-Lambert (2000): This \$90 billion deal remains one of the most significant in the industry. Pfizer's acquisition of Warner-Lambert allowed it to gain control of the lucrative cholesterol drug Lipitor, which became one of the best-selling pharmaceuticals in history.

Glaxo Wellcome and SmithKline Beecham (2000): The union of these two companies, forming GlaxoSmithKline, was valued at around \$76 billion. It combined Glaxo's strengths in respiratory and anti-infective drugs with SmithKline's expertise in vaccines and consumer healthcare.

Sanofi and Aventis (2004): This merger, valued at about \$65 billion, was a strategic move to create a European pharmaceutical powerhouse. The resulting entity, Sanofi-Aventis, became one of the world's largest pharmaceutical companies by revenue and R&D spending.

Merck and Schering-Plough (2009): Valued at \$41 billion, this merger was part of Merck's strategy to diversify its portfolio and enhance its pipeline in the wake of patent expirations for some of its key drugs.

Actavis and Allergan (2015): This \$70.5 billion deal was significant for combining Actavis's generic drug portfolio with Allergan's specialty pharmaceuticals, particularly in ophthalmology and neurology.

This year, 2023, the value of mergers and acquisitions in the pharmaceutical and life sciences sector reached more than \$220 billion, according to a recent report by PwC. For the upcoming year, the projected value is estimated to be more than \$225 billion.

The future of mergers and acquisitions (M&A) in the pharmaceutical and biotechnology sectors is poised to be significantly influenced by advancements in precision medicine, biotechnology, and digital health. As personalized treatments gain prominence, big pharma is expected to increasingly merge with or acquire biotech firms specializing in targeted therapies and gene editing technologies. Concurrently, integrating digital health technologies like AI and big data analytics will become crucial, driving pharma companies to seek M&A opportunities that bolster their capabilities in these areas. This trend will facilitate more efficient drug development, enhanced clinical trials, and improved patient care strategies.

The global expansion into emerging markets will likely shape the M&A landscape as companies strive to meet diverse healthcare needs and navigate unique regulatory environments. This expansion will be complemented by cross-sector collaborations extending beyond traditional boundaries, including partnerships with technology firms and other non-traditional players. Future M&A activities must also consider evolving regulatory oversight, ethical concerns, especially in

biotech, and a growing emphasis on environmental, social, and governance (ESG) principles. These factors will collectively guide the strategic direction of M&A, making them a tool for growth and innovation and a means to address global healthcare challenges and uphold sustainability.

The M&A deals in the pharma and biotech sectors represent more than just financial transactions; they signify shifts in healthcare paradigms, research focus, and market dynamics. As the industry continues to evolve, these mergers and acquisitions will undoubtedly play a pivotal role in shaping its future, impacting everything from drug prices to the availability of innovative therapies. Understanding these deals provides a window into the complex and ever-changing world of pharmaceuticals and biotechnology.

PART 3 · TOPIC 34**Invest in Biotech!**July 2023 · First published

Dear reader, if you're seeking to broaden your portfolio, investing in biotechnology, also known as "biotech," is a thrilling opportunity worth considering. It's important to keep in mind several key factors when making investments in this field, such as the possibility of groundbreaking innovations, the regulatory landscape, and the financial stability of the companies involved. By considering these factors, investors can make informed decisions that may lead to significant returns.

Mergers and acquisitions are a crucial factor in the pharmaceutical and biotech industries. Biotech companies are often sought after by larger pharmaceutical and biotech companies to acquire innovative drugs and technologies in the discovery and development stages before they are approved and marketed. Investors can benefit from these activities as they can create financial gains and increase stock prices. In the first quarter of 2023, the total value of mergers and acquisitions in the United States alone exceeded \$70 billion, which is more than double the value of deals in the same period last year, 2022. Surprisingly, while mergers and acquisitions activity has declined in all other areas, it has increased in the healthcare industry, particularly in pharma and biotech.

It's important for investors to keep an eye on changes in healthcare policies, as they can have a significant impact on the success of biotech companies. For instance, alterations in patent laws or legal requirements can make it harder for these companies to bring their new products to market. It's crucial to stay informed about these changes in order to make informed investment decisions.

Investors must closely monitor clinical trial results, as they can have a significant impact on the success of emerging biotech companies. Positive results can cause a surge in stock prices, while negative results can lead to a substantial decrease. It is imperative to closely study and monitor these results and understand their potential impact on investments. If necessary, investors should also consider hiring specialized consultants in this field to make informed investment decisions. Additionally, any changes in healthcare policies can significantly affect the success of biotech companies. Thus, it is crucial to stay up to date on any alterations in patent laws or legal requirements that may impact these companies' ability to launch new products.

When investing in pharmaceutical and biotech industries, competition must be a significant consideration. This sector is highly competitive, with numerous companies and startups competing for market share in specific therapeutic areas. As an investor, evaluating potential investments' competition is crucial, including factors such as intellectual property strength, technology uniqueness, team strength, and financial situation. By doing so, you can better understand new competitors' ability to disrupt market positions and make informed investment decisions with confidence.

Dear reader, it is not hidden that the pharmaceutical and biotech industries are subject to multiple geopolitical risks, such as trade tensions, tariffs, and political instability. These risks can affect the ability of emerging companies to operate in some markets or access key resources.

Licensing agreements with other companies or academic institutions can make or break the revenue generation and overall value of biotech companies. Therefore, it is crucial to thoroughly examine the terms and potential impact of such agreements before entering them. This is a crucial step in securing the long-term success of your company and its products.

Generally, investing in the biotech industry can be a complex and dynamic investment area that requires careful consideration of many factors. Staying abreast of industry developments and trends is important, and working with consultants who can help you identify risks and opportunities in this exciting and rewarding sector. Certainly, we can delve deeper into the pharma and biotech investment climate of Saudi Arabia and examine the challenges as well as opportunities that accompany it.

PART 3 · TOPIC 35

More than \$7 Trillion!

June 2023 · First published

It's interesting to note that the pharmaceutical and biotechnology industries worldwide have seen a significant profit rise in recent years, with the largest 2,300 pharmaceutical companies generating a profit of \$1.44 trillion in 2021 alone, based on Trroeya Report. The global pharmaceutical market size in 2021 exceeded \$7 trillion, and it's expected to continue to grow at a compound annual growth rate of over 16% through 2020. The increase in demand for healthcare products and services due to aging demographics, chronic diseases such as cancer, diabetes, and heart diseases, and new treatment options like gene therapy is driving this growth. Additionally, the increasing investment in research and development by pharmaceutical and biotechnology companies is contributing to the expansion of these industries.

It's incredible how much these industries impact the world economy and job market. The innovative ideas that are being developed in these fields are truly amazing, and I'm excited to see what the future holds. With the expected growth in the pharmaceutical and biotechnology industries, there will be even more opportunities to improve the health and well-being of people all over the world. It's truly inspiring to see how science and technology can make such a positive impact on society.

It's interesting to consider how much money goes into developing a new drug. It can cost billions of dollars because of the extensive research and development process. However, the pharmaceutical and biotechnology sectors are essential parts of the economy and provide valuable opportunities for employment and financial growth. It's exciting to think about the potential future of these industries, especially given the factors mentioned earlier.

The pharmaceutical market in Saudi Arabia is booming, with an estimated worth of over \$8 billion. Experts predict that this industry will continue to grow at a CAGR of 9.6% during the forecast period (2022 to 2032). What's driving this growth? Several factors including increased government and private investment in healthcare, a growing population, a rise in chronic diseases, and higher demand for new and high-quality pharmaceutical products and services. The pharmaceutical industry is a crucial player in Saudi Arabia's economy, and it's one of the key targets of Vision 2030. By creating new markets and generating billions of riyals in exports, this industry is helping to employ thousands of people and drive innovation.

The Saudi government is doing a lot to support different industries in the kingdom. They are increasing spending on healthcare and providing excellent medical services to citizens. They are also investing more in research and development, improving the business environment, and making licensing procedures easier. Additionally, they are helping new pharmaceutical companies register in the kingdom. These efforts will go a long way in helping these industries grow and thrive.

The Saudi pharmaceutical market is expected to continue growing and expanding in the near and distant future, thanks to a conducive legislative and regulatory environment. This presents an excellent opportunity for investors, as well as pharmaceutical and biotechnology companies, to invest in and expand their operations in this promising market.

PART 3 · TOPIC 36

Investing in BiotechnologyJune 2023 · First published

Dear reader, in today's article, we will discuss investing in biotechnology. As an investor or entrepreneur, you may be interested in this field for several reasons, including the high potential for high financial returns. Biotech companies can often develop innovative drugs and treatments that improve the quality of life, which can lead to substantial profits for investors if successful.

As the world's population continues to grow and demographics shift towards aging, we're seeing a surge in demand for biotech products. This demand for new drugs and treatments is an attractive reason to invest in biotech. Additionally, innovation is a driving force behind biotechnology investment, as it supports the development of new products and allows us to reap the benefits of these advancements.

Investors often consider diversifying their portfolios and investing in biotechnology companies can be a great way to do so. This sector isn't necessarily affected by general economic trends, which makes it more attractive to some investors. However, it's important to note that investing in biotech can be risky if you don't study investment opportunities well. As you gain more knowledge about the market, you'll be able to take on less risk. Many companies in this sector fail to launch their products or face regulatory issues, so it's important to research companies thoroughly before investing.

Dear reader, I would like to mention some additional points to consider when investing in biotechnology. It's true that this sector can be a great way to diversify your portfolio, but it's important to note that discovering and developing biotech products takes a long time. Developing a new drug or treatment can take many years, which requires significant investment. Additionally, biotech companies usually have high research and development costs due to the complexity of the discovery and development stages. This can make it difficult for small companies to compete with larger companies with more resources. As with any investment, it's essential to research and thoroughly evaluate the opportunities before deciding.

One thing that sets these companies apart is their reliance on patents and other forms of intellectual property protection to safeguard their products from competition. These protections can last up to 20 years but are sometimes foolproof. Competitors can sometimes find ways to bypass them.

It's essential to keep in mind that investing in this sector can be pretty volatile, as the stocks of these companies tend to fluctuate significantly during the drug discovery and development stages. This is particularly true during clinical and preclinical trials, as well as regulatory approvals and updates. It's not uncommon for investors to react strongly to news related to these factors, so it's essential to stay informed and make decisions based on carefully analyzing all available information.

All of these factors can create significant opportunities for massive gains, but they also carry real risks. Investing in biotechnology can be a complex but advantageous field from an investment perspective, where returns can reach tens or hundreds of times the initial investment. However, conducting thorough research and evaluating potential risks and rewards for each investment opportunity is significant. It is essential to seek advice from a specialized investment advisor in the pharmaceutical and biotechnology industries and obtain guidance on making informed investment decisions.

PART 4

Business & Strategy

10 TOPICS

This section steps back from any one industry to ask how businesses and the people inside them actually decide. Why the most profitable parts of a value chain sit at its two ends and not its middle. How a free product becomes a paid one. Why we overvalue what we already own. What separates an investor who compounds for decades from one who is merely early. These are the shortest topics in the book and often the most portable, the reasoning transfers well beyond medicine.

WHY READ THIS PART

Read this section for the ideas you can use on Monday morning, whatever industry you happen to work in.

BUSINESS & STRATEGY · PART 4

In this part

NO.	TOPIC	PAGE	PUBLISHED
1	The Cheap Price Trap	211	August 2026
2	Think and Grow Rich	213	July 2026
3	Rohn, Who Taught Us to Work on Ourselves	215	July 2026
4	Hims & Hers, AI and the Clinic of the Future	217	June 2026
5	The Endowment Effect	220	February 2025
6	Lessons From Bloomberg	222	August 2024
7	Why does Buffett's Strategy prevail over Graham's?	225	July 2024
8	Mastering Speed and Strategy in the Business World and Beyond	227	February 2024
9	The Freemium Business Model: Balancing Free and Premium for Success	229	November 2023
10	What is the Reason Behind the Constant Smile of the World's Largest Company?	231	October 2023

PART 4 · TOPIC 1

The Cheap Price TrapAugust 2026 · First published

Dear reader, when a Chinese product appears at half the price of its rivals, or less, the reaction is instant: what a bargain. The consumer is pleased, the trader is pleased, and the market looks abundant and affordable. Yet behind that attractive price, there can lie a long-term strategy aimed not merely at selling a product, but at dominating an entire market. The story does not end with the low price; it begins there. What looks like a gift to the consumer may later become a strategic bill paid by countries, industries, and societies.

In economics, this is known as predatory pricing, or dumping. A company or a state-backed sector enters a global market at extremely low prices, sometimes below the real cost of production, accepting losses for years, not out of ignorance, but as an investment in future control. Local competitors in Europe, America, or elsewhere cannot survive such a flood: they must cover labor, regulation, and capital costs, while the subsidized rival sells at a loss indefinitely. Over time, factories close, market share erodes, and expertise drains away. When competitors weaken, the second chapter opens: the issue is no longer price but influence. The dominant party can then raise prices, control quantities, delay supply, or wield it as political leverage.

Three factors make this possible in China's case. The first is massive direct and indirect government support, which makes short-term losses bearable when a sector is treated as a strategic project rather than ordinary commerce. The second is enormous scale, vast manufacturing capacity, and deep supply chains that lower unit cost as volume grows. The third is patience: Western firms are judged every quarter by investors, while China can plan in years and decades. The battle is often between a company chasing next quarter's profit and a state pursuing future dominance.

The clearest example is solar panels. Germany, Japan, and the United States once led the field. Then low-priced Chinese panels arrived, Western firms collapsed, factories closed, and jobs vanished. Today, China controls much of the global solar manufacturing chain, exceeding 80% at some stages, leaving the world reliant on a single source for a key clean-energy component. The more serious case is rare earth elements, used in smartphones, electric vehicles, turbines, and advanced weapons. China built a dominant position in refining and processing, and during a political dispute with Japan, it restricted exports, shaking entire industries. Here, control becomes geopolitical: whoever controls the start of the chain can pressure its end.

The same pattern recurs in pharmaceuticals, steel, LED lighting, telecom equipment, and now electric vehicles: low prices, rising market share, weakened competitors, and a dependence hard to escape. The danger falls not only on rival companies but on importing countries. When the domestic industry disappears, so do jobs, expertise, local suppliers, and the ability to rebuild. What is destroyed in ten years may take twenty to restore. A nation then depends on one supplier that can

raise prices, delay shipments, or tie supply to politics. In a crisis, memories of low prices offer little comfort; the question becomes whether the product can be obtained at all.

Still, fairness requires balance. Not every inexpensive Chinese product is a conspiracy, and not every low price is dumping. China has genuine advantages, strong infrastructure, a large workforce, deep supplier networks, and vast economies of scale. Often, the lower price reflects real efficiency. Consumers worldwide, especially in developing countries, have benefited: phones, appliances, and solar solutions have become affordable to millions. Even economists disagree on how easily predatory pricing can be proven; sometimes prices stay low because competition endures, or because of genuine innovation. The picture is neither wholly dark nor wholly innocent.

Wisdom, then, lies not in rejecting every cheap product but in reading beyond the price. The smart question is not only what this costs today, but what it will cost tomorrow if we depend on it alone. For emerging economies, the lesson is clear: real value lies in resilience, diversified sourcing, and the ability to produce locally when necessary. This does not mean making everything at home, only identifying sensitive sectors, preserving industrial knowledge, and refusing to let a low price today destroy a strategic option needed tomorrow. Industrial security is no less vital than food, medicine, or defense. A low price can be a blessing when it springs from efficiency, and a trap when it is bait. Markets should be judged not by today's price, but by tomorrow's capacity.

PART 4 · TOPIC 2

Think and Grow Rich

July 2026 · First published

Few books cross an entire century and remain present in bookstores and on lists of the most influential works. *Think and Grow Rich* by Napoleon Hill, published in 1937 in the aftermath of the Great Depression, is one of them. It arrived when people were searching for hope amid economic devastation and for a formula that could restore their belief that life might rise again. Hill presented it as the result of more than twenty years of studying hundreds of America's most successful men. Since then, it has sold over 100 million copies and become the spiritual father of much of the personal development literature that followed. Yet a question lingers: is it timeless wisdom, or a formula that inflates promise by mixing action with illusion?

The book rests on one bold principle: thoughts are things. Whatever the mind can conceive and believe, Hill argues, it can achieve. Wealth does not begin in the bank; it begins in the mind, with a clear, burning desire that, joined to belief, persistence, and planning, becomes tangible reality. But Hill is not describing a passing wish. He means an organized obsession with a defined purpose, one that dominates thought, directs energy, and pushes the individual to build and revise plans until the goal is reached. An idea, for him, is a seed that needs belief, work, decision, and patience before it bears fruit. That is part of the book's enduring power: it tells people in moments of weakness that the starting point is not money or circumstance, but clarity of desire and strength of inner direction.

Hill summarized his philosophy in thirteen steps: definite desire, faith, autosuggestion, specialized knowledge, imagination, organized planning, decisiveness, and persistence. Among his most influential ideas is the mastermind, the practice of surrounding oneself with harmonious minds that support, challenge, and multiply one's ability to think and execute. He later enters stranger territory, writing about the subconscious, the sixth sense, and the transmutation of sexual energy into creative force. These chapters give the book its distinctive character, blending psychology, belief, intuition, and financial success into a single framework.

Behind the money-focused title lies practical wisdom that has not aged. Clarity of purpose is essential: a person who does not know what they want scatters their energy and stays busy without advancing. Persistence in the face of repeated failure is indispensable, since real success rarely comes on the first attempt; the book usefully reminds readers that failure is a test of desire, not the end of the road. Written planning turns a dream into an executable project because desire alone creates no wealth without deadlines, steps, review, and revision. And the mastermind concept holds: no one succeeds entirely alone, and we all need people who review us, support us, and open doors we cannot see.

Fairness requires examination, too. Hill's own biography has been widely debated; historians question several claims, including his account of meeting Andrew Carnegie, for which documentary

evidence is thin, and he was criticized in his lifetime over credibility and business conduct. This does not make the book false, but the intelligent reader should not treat it as scripture or science. It is a mixture of wisdom, experience, marketing, exaggeration, and motivational language that often speaks more to hope than to evidence.

Its greatest flaw is exaggerating the power of positive thinking, at times implying that poverty and failure are merely the product of weak thought. Reality is more complex: environment, education, health, luck, relationships, and the time and place of one's birth are not fully under our control. The book also falls into survivorship bias, extracting principles from those who reached the top while ignoring the thousands who followed similar principles and failed. The claim that belief alone turns thought into wealth does not survive scrutiny; if it did, humanity's wishes would have enriched everyone.

The best way to read *Think and Grow Rich* is to take its mental tools, not its myths: clarity, persistence, planning, specialized knowledge, and wise association. Leave behind the suggestion that the universe will reorganize itself because you wished intensely enough. Read as a product of its time, written as America rebuilt confidence after the collapse, it still moves the reader from wishing to action. Thoughts may begin wealth, but they become wealth only when they descend from the mind to the ground and are tested in a reality that flatters no one.

PART 4 · TOPIC 3

Rohn, Who Taught Us to Work on OurselvesJuly 2026 · First published

In the crowded world of personal development, where many promise fast wealth and instant transformation, one man stood out with a calm voice and simple language. Jim Rohn — often called the philosopher of business and the teacher of a generation of self-development leaders, including Tony Robbins — changed the rules without exaggeration or false promises. He did not sell illusion or promise miracles from outside. His single, heavy idea was that changing your life begins with changing yourself first. He moved the language of success away from temporary excitement toward daily discipline, and away from waiting for opportunities toward becoming the person capable of seizing them.

Rohn was born in 1930 to a modest farming family and began as a young store employee. By twenty-five he was burdened by debt and discouraged. The turning point came in 1955, when he met businessman Earl Shoaff, his mentor for six years. Shoaff did not teach him to work longer hours, but to think differently, take responsibility, and understand that external results begin with internal change. Within a few years Rohn became a millionaire before thirty-one. He later lost his fortune and rebuilt it, easier the second time, he said, not because conditions improved but because he now knew the way. The lesson: money is not the beginning but the result; wealth is less about what you own than who you become.

Rohn's message was captured in one motto: "Work harder on yourself than you do on your job." Income, he believed, rarely exceeds the level of personal development; to raise your income, first raise your skills, knowledge, discipline, and character. He built his philosophy on a simple chain: philosophy creates attitude, attitude drives activity, and activity produces results. The way you think about life is the first seed from which everything grows. So he focused not on results alone but on their roots, asking not only "How much do you earn?" but "Who have you become?"

He left behind sayings that became proverbs. A person is the average of the five people closest to them, not a precise formula, but a reminder that association shapes ambition, behavior, and expectation. Discipline is the bridge between goals and achievement; dreams alone do not produce results unless they become organized daily action. Everyone must choose between two pains: the light, temporary pain of discipline, or the heavy, lasting pain of regret. He advised people not to wish that things were easier but that they were better, not for fewer problems but for more skills. In his lecture *The Seasons of Life*, he taught that we cannot cancel winter or prevent change, but we can prepare and learn to adjust our sails when the winds shift.

Rohn distinguished two kinds of education: formal education, which earns a living, and self-education, which can make a fortune. He did not dismiss formal schooling but believed that anyone who stops learning after graduation freezes their future. Success, he said with striking simplicity, is a

few simple disciplines practiced every day; failure is a few errors in judgment repeated every day. Both are the result of accumulation, not sudden luck. He was not a seller of magical formulas: do small correct things daily, and their effect appears over time. Read a little, discipline yourself, choose better company, watch your thoughts, build your skills, and do not run from responsibility.

His words remain alive after his death in 2009 because they rest on deep human principles, responsibility, discipline, learning, choice, and accumulation, rather than a passing trend. His influence spread through those he taught, especially Tony Robbins, making him a central link in the modern language of personal development. Still, fairness requires reading him with awareness. The simplicity that is his strength can become a weakness when stretched too far. Saying a person is responsible for their life does not mean circumstances, luck, and opportunity do not matter. His background in direct sales has made some critics wary of using personal responsibility to ignore social and economic conditions. Yet these reservations do not erase his core message; they place it in context.

Discipline does not guarantee success, but improves the odds; self-education does not erase environment but offers better tools; good company does not solve every problem, but guards against silent decline. Rohn's philosophy is not an absolute promise but a practical invitation to own what can be owned: the self, habits, thoughts, and behavior. He remains proof that the deepest wisdom is often the simplest, that a person is a project built day by day, and working on the self is among the highest-return investments in life. If one lesson endures, let it be his: "do not wait for the sea to become calm; learn how to adjust your sail."

PART 4 · TOPIC 4

Hims & Hers, AI and the Clinic of the FutureJune 2026 · First published

Dear reader, in only a few years, an American startup evolved from a simple platform selling hair-loss treatments into one of the most prominent models in global digital health. That company is Hims & Hers, founded in 2017. It expanded rapidly, with 2025 revenue exceeding two and a third billion dollars, growth approaching 60%, and more than 2.5 million subscribers. Yet the most important story is not only in the numbers. It lies in the major bet the company is making on its future: artificial intelligence.

Hims & Hers is a direct-to-consumer healthcare platform built on a simple but powerful idea: moving a large part of routine medical care from the clinic to the phone. Through the platform, users can connect with licensed clinicians online, receive digital prescriptions, and have medication delivered to their doorstep by a cloud pharmacy.

The company covers multiple areas, including sexual health, hair loss, hormones, weight loss, dermatology, and mental health. It has also recently added at-home laboratory testing. Since its founding, the platform has conducted more than fifty million medical consultations and expanded across the United States, Canada, the United Kingdom, and several European markets. At its core, the idea is to make healthcare easier, faster, more private, and increasingly personalized to everyone's needs.

In 2025, the company made it clear that its future would be built around artificial intelligence. This was not simply a marketing slogan. It was a strategic message, reinforced by the appointment of Mo Elshenawy as chief technology officer. Elshenawy, formerly the chief technology officer of Cruise, the autonomous vehicle company, brings more than twenty years of experience in artificial intelligence and large-scale technical infrastructure.

The company then sent an even stronger signal to the market by raising approximately 870 million dollars through convertible notes, with proceeds allocated to developing AI tools, building data infrastructure, and improving personalized treatment algorithms. The declared vision is to connect all parts of the care journey into a single continuous chain: from data collection to understanding the condition to proposing the treatment pathway to prescribing medication, delivering it, and monitoring outcomes.

What makes the Hims & Hers story important is that its AI strategy extends beyond public statements. It is beginning to turn into practical tools. One of the most prominent is MedMatch, a system that uses machine learning to help guide patients toward the treatment pathway most appropriate for their condition. The company aims to broaden the system and improve its accuracy so it can support more personalized treatment decisions over time.

The company has also developed an AI agent to interpret lab results. This tool can read a user's biomarkers and present personalized health insights in clear, accessible language. Importantly, the company says this tool does not diagnose disease, does not replace the physician, and does not draw answers from the open internet. Instead, it relies on a dedicated medical knowledge base developed with specialists, while maintaining the company's stated commitment to protecting user privacy.

Here lies the delicate point: in this model, AI is not presented as a replacement for the doctor, but as an assisting layer between data and medical decision-making. Used well, it may save time, reduce confusion, and better align care with patient needs.

The secret of the strategy is not the application alone. It lies in what can be called the data flywheel. As the number of subscribers grows, the company accumulates larger volumes of health, behavioral, and treatment data. As the data grows, AI models become more capable of personalization and prediction. As personalization improves, the platform becomes more attractive to new users. The wheel then turns faster: more users, more data, better algorithms, more personalized experiences, and faster growth.

Vertical integration strengthens this flywheel. The company does not stop at telehealth consultation. It brings together the clinician, the prescription, the pharmacy, at-home lab testing, and delivery. This integration gives it greater control over user experience, quality, and cost, while also feeding the model with data at every step of the care journey. Hims & Hers is therefore not merely building a consultation platform; it is trying to build a relatively closed digital health ecosystem centered around the user from the first question to the final dose.

The company does not appear satisfied with its domestic market. In 2026, it is moving into new therapeutic categories and expanding globally through acquisitions and growth in Europe, Australia, and Canada. It has also announced an ambitious 2030 goal: at least 6.5 billion dollars in annual revenue.

On June 2, 2026, Hims & Hers announced the completion of its acquisition of Eucalyptus, the Australian company behind brands such as Juniper, Pilot, and Kin. This expanded its presence across Australia, Canada, Germany, Japan, and the United Kingdom, and marked its official entry into the Australian market, following earlier acquisitions of ZAVA and Livewell and a growing presence in parts of Europe.

The larger dream of its founder, Andrew Dudum, is to make Hims & Hers the leading global platform in consumer health: a platform that enables every person to access care designed for them, wherever they are, through a mix of artificial intelligence, local medical expertise, and digital convenience. It is an appealing vision because it promises to shift healthcare from a system that waits for patients in clinics to one that reaches them through their phones and homes.

The road, however, is not free of risk. The company faces growing regulatory scrutiny, especially after controversy surrounding weight-loss medications and the end of its partnership with Novo Nordisk. Introducing AI into medicine also raises difficult questions. Will algorithmic recommendations always be accurate and safe? Who bears responsibility when something goes wrong? How will highly sensitive health data be protected? Does the user always know when they are interacting with a clinician, an AI system, or content shaped by commercial incentives?

AI-powered personalization may sometimes be real care. At other times, it may become advanced marketing dressed in the language of science. Distinguishing between the two is not easy. It is a shared responsibility among the company, the clinician, the user, and regulators. Medicine is not built on speed alone, nor on access alone. It is built on trust, safety, transparency, and evidence.

To be fair, the promise is significant. Digital platforms can close genuine gaps in access to care, particularly for routine conditions, chronic follow-up, and ongoing management. Yet they may also create new gaps if the medical relationship becomes a fast consumer experience, or if treatment decisions are driven by algorithms whose limits patients do not understand.

In the end, Hims & Hers offers a clear window into one possible form of tomorrow's medicine: digital, proactive, personalized, guided by algorithms, and powered by data from millions of users. But the success of this model will not be measured only by subscriber growth or revenue. It will be measured by its ability to earn trust, protect patients, and deliver safe care, rather than by merely providing an attractive technology experience.

In our region, where gaps in access to care remain significant, this model could represent an opportunity for a major leap if it is well-regulated and adapted locally. But the most important condition is that we remember that behind every data point is a human being, and behind every algorithmic recommendation is a decision that may affect health and life. The digital clinic may be the future of medicine, but it must remain a clinic first, not a smart store wearing a doctor's coat.

PART 4 · TOPIC 5

The Endowment EffectFebruary 2025 · First published

Dear reader, the concept of the endowment effect suggests that people view the value of what they own as being at least equal to, if not greater than, what they originally paid, regardless of the economic downturn. This idea aligns with the “loss aversion” phenomenon, made popular by Daniel Kahneman and Amos Tversky, which indicates that people feel the pain of losing something far more intensely than the pleasure of a gain of equal value. Thus, property owners tend to hold on to their real estate and refuse to acknowledge a drop in its market value, often procrastinating in the hope that prices will rise again.

The real estate market provides one of the most tangible examples of this phenomenon. For many, buying property is not just an investment decision but an emotional one as well, blending personal considerations with financial ones. An owner associates a home with family memories or makes renovations they believe add value, additions that may not carry significant weight from a buyer's perspective. So, when economic circumstances change and prices begin to fall, it becomes difficult for the owner to accept that the actual value of the property has dropped below what they paid or what they believed was a “fair” price.

Because of these psychological factors, real estate price corrections slow down. The prospective buyer, who follows economic indicators and sees the property's fair price as lower, stands opposite the owner who insists on a much higher price due to the “endowment effect.” This gap between supply and demand leads to a market standstill, causing fewer deals to occur and properties to remain unsold for longer periods. Instead of a gradual price decrease and a swift market adjustment, a “freeze” persists until a number of owners, who may be forced by urgent financial needs or changing family circumstances, cut their prices noticeably, causing property values to drop abruptly and affecting other prices in the area.

To understand the psychological roots of this phenomenon, we can look at several associated biases. One of the most prominent is confirmation bias, where the owner constantly searches for information that reinforces the belief that the property value must go up or that real estate is “never sick and never dies,” all while dismissing negative indicators or downplaying their importance.

There is also status quo bias, which leads people to prefer maintaining their current situation rather than taking the risk of lowering their price. Emotional attachment and fond memories tied to the home, along with personal designs or modifications, further increase the owner's insistence on a certain price.

By contrast, in financial markets, professional traders have learned to handle assets without becoming emotionally attached. They rely on automatic sell orders called stop-loss at

predetermined price points, selling quickly without hesitation and moving on to better opportunities, rather than clinging to a losing investment in the hope it will rebound. While property differs from stocks in several respects (such as the size of the investment and the difficulty of selling), the principles of risk management and realistic number-crunching can mitigate the endowment effect and facilitate better decision-making.

In conclusion, dear reader, the endowment effect is a deep-seated psychological bias that can push property owners to cling to outdated valuations that no longer match the current economic realities, negatively affecting market activity and delaying price corrections. Nonetheless, awareness of this bias, along with sound financial policies and appraisal procedures that accurately reflect market conditions, can help reduce its impact. Only then can we reconcile psychological factors with financial returns, achieving wiser, more objective decisions in one of the most significant investment arenas for many people.

PART 4 · TOPIC 6

Lessons From BloombergAugust 2024 · First published

Dear reader, Mike Bloomberg's journey to becoming one of the world's most successful entrepreneurs and philanthropists is a compelling story of resilience and learning from failure. Before he founded Bloomberg L.P. and built a global media and financial services empire, Bloomberg faced significant professional setbacks, including being fired.

After graduating from Harvard Business School in 1966, Bloomberg began his career at Salomon Brothers, a leading Wall Street investment bank. He started in the firm's entry-level position, handling stock and bond certificates. Through hard work and determination, he climbed the ranks to become a partner at the firm by 1972. However, in 1981, after 15 years with Salomon Brothers, Bloomberg faced a major career setback. The firm was acquired by "Phibro Corporation," and Bloomberg was let go during the reorganization. At the time, he was leading the firm's information systems division. Being fired from Salomon Brothers was a significant blow and a turning point in his life.

After facing this setback, Bloomberg didn't let it defeat him. Instead, he saw it as an opportunity to pursue his entrepreneurial vision. With the severance package he received from Salomon Brothers, he decided to start his own company. Bloomberg's experience at Salomon Brothers had given him valuable insights into the financial industry's need for reliable and accessible data. He realized that traders, analysts, and financial professionals required real-time financial data to make informed decisions. This realization led to the founding of Innovative Market Systems (IMS), later named Bloomberg L.P.

In 1981, Bloomberg and his team developed the IMS, an innovative computer system that provided financial professionals with real-time market data, financial analytics, and other tools. The system revolutionized how financial information was consumed and processed on Wall Street. Initially, it was challenging to convince firms to adopt the new technology.

However, Bloomberg's perseverance and belief in the product paid off. The Market Master terminal quickly gained traction, and Bloomberg L.P. proliferated. By leveraging technology and data, Bloomberg L.P. became a leading financial information and analytics provider.

Mike Bloomberg's journey serves as a clear example of how setbacks can be transformed into opportunities for growth and success. His time at Salomon Brothers provided him with important lessons in resilience, vision, adaptability, and perseverance. Bloomberg's ability to bounce back from being fired and use that experience as motivation to start his own business illustrates the significance of resilience in the face of failure.

Identifying a gap in the market and envisioning a solution that utilized his expertise and experience allowed him to create a product that transformed the financial industry. His willingness to adapt and innovate was crucial to his success, even when faced with significant obstacles. The establishment of Bloomberg L.P. demanded persistent effort and determination, particularly in the early days when the product was not widely accepted.

Modern society often celebrates success stories while disregarding the failures that usually come before them. This selective focus can create a distorted view that success is the standard and failure is uncommon.

However, Bloomberg's assertion challenges this idea by suggesting that never experiencing failure is a lack of character. This implies that a life without failure also lacks growth, learning, and real achievement.

Failure is an integral part of the learning process. It provides invaluable lessons that success cannot teach. When we fail, we must confront our limitations, reassess our strategies, and develop resilience. Each failure becomes a steppingstone, guiding us toward better decisions and more refined approaches in the future.

In this sense, failure is not an endpoint but a crucial component of a continuous improvement journey.

The true importance of failure is determined by our response to it. According to Bloomberg, what we take away from failure and how we use that understanding truly counts.

This viewpoint redirects our attention from the failure itself to our subsequent actions. It encourages us to adopt a growth mindset, where setbacks are seen as chances for growth rather than impassable obstacles.

Bloomberg's statement concludes that our responses to failure define who we are. This idea aligns with the concept of character-building through adversity.

Facing and overcoming challenges strengthens our character, fosters empathy, and builds resilience. Through this process, we develop the fortitude to tackle future obstacles with greater confidence and competence.

Several successful individuals and organizations demonstrate that failure is often a stepping stone to success. For example, Thomas Edison famously commented on his many attempts to create the electric light bulb, stating, "I have not failed. I've just found 10,000 ways that won't work." Each failure brought him closer to his ultimate success. Similarly, companies like SpaceX have embraced failure as a crucial part of their innovation process, using each setback as a learning opportunity to refine their technology and strategies.

Finally, Mike Bloomberg's professional journey shows that failure is not the end but rather a step toward success. His ability to learn from setbacks and turn them into opportunities has made him a prominent figure in the business world. Bloomberg's story illustrates how resilience, vision, adaptability, and perseverance can lead to remarkable achievements.

By recognizing that failure is essential to growth and focusing on the lessons it imparts, we can transform our failures into catalysts for personal and collective improvement. Ultimately, not the absence of failure defines us, but rather our ability to learn, adapt, and thrive in the face of it.

PART 4 · TOPIC 7

Why does Buffett's Strategy prevail over Graham's?July 2024 · First published

Warren Buffett, often called the "Oracle of Omaha," is renowned for his exceptional investment acumen and long-term success. His investment philosophy has been shaped significantly by his mentor, Benjamin Graham, widely recognized as the father of value investing. While Buffett's approach shares many core principles with Graham's, it has evolved into a more nuanced and comprehensive strategy. Today, we will delve into the key differences between Buffett's long-term investment strategy and Graham's principles, highlighting why Buffett's approach has proven superior.

Benjamin Graham's investment philosophy is based on value investing, which involves buying undervalued stocks with strong fundamentals. Graham's key principles include investing in stocks that are trading below their intrinsic value, calculated based on a company's earnings, assets, and dividends. He also introduced the concept of a margin of safety, which involves purchasing securities at a significant discount to their intrinsic value to reduce risk. Graham recommended defensive investing, advising investors to focus on stable, established companies with consistent earnings and dividends to minimize exposure to market volatility. Additionally, he heavily relied on quantitative analysis, using financial ratios and metrics to identify undervalued stocks.

While deeply influenced by Benjamin Graham's teachings, Buffett developed a distinct investment philosophy. Critical elements of Buffett's strategy include a focus on quality, where he emphasizes the importance of strong competitive advantages, excellent management, and potential for long-term growth. Unlike Graham, who primarily relied on quantitative metrics, Buffett seeks companies with sustainable competitive advantages or "economic moats," such as brand recognition, patents, cost advantages, or network effects.

Buffett is also known for his long-term investment perspective. He famously states that his favorite holding period is forever. This approach allows him to benefit from the compounding of returns over time. Additionally, he places significant importance on the quality and integrity of a company's management team, believing that strong leadership is crucial for long-term success.

Dear reader, Warren Buffett's investment philosophy has several key principles. He emphasizes quality and durability, focusing on high-quality businesses with sustainable competitive advantages that can withstand economic downturns and generate consistent returns over the long term. This approach reduces the risk of permanent capital loss.

Warren Buffett's long-term investment approach allows him to take advantage of compound growth, endure market fluctuations, and profit from the expansion of his investments over many years. He also emphasizes the significance of effective management and governance. This ensures that the

companies he invests in are guided by capable management teams who can navigate challenges and seize opportunities, thus minimizing the risks associated with poor management decisions.

Investing in companies with durable competitive advantages, or "economic moats," protects market competition. These moats help maintain profitability and market share, contributing to long-term growth. Buffett's adaptability and learning ability have been crucial to his success. While he started with a strict Graham-like approach, he has evolved to incorporate elements emphasizing quality and growth, leading to better overall performance.

Buffett's investment in Coca-Cola exemplifies his strategy. Despite its high price-to-earnings ratio at the time of purchase, Coca-Cola had a strong brand, a global presence, and a dominant market position, which provided a substantial economic moat. Over the years, this investment has yielded significant returns, showcasing the effectiveness of Buffett's focus on quality and long-term growth.

Another notable example is Buffett's investment in Apple. Initially skeptical about technology stocks, Buffett recognized Apple's strong brand, loyal customer base, and innovative product line. This investment has become one of Berkshire Hathaway's most profitable holdings, illustrating Buffett's ability to adapt and identify high-quality companies even in sectors he once avoided.

While Benjamin Graham's principles laid the foundation for value investing, Warren Buffett's approach has proven to be more effective in today's investment landscape. By emphasizing the quality of businesses, maintaining a long-term perspective, and focusing on strong management and economic moats, Buffett's strategy mitigates risk and capitalizes on growth opportunities. His success demonstrates that a refined approach to value investing, which balances quantitative analysis with qualitative insights, can yield superior long-term results. Therefore, Buffett's investment strategy stands as a testament to the power of patience, discipline, and a keen eye for enduring business value.

PART 4 · TOPIC 8**Mastering Speed and Strategy in the Business World and Beyond**February 2024 · First published

In an era characterized by rapid changes and intensifying economic competition, two main concepts emerge as crucial factors for success in the business world: speed and strategy. Our era, witnessing the convergence of tremendous technological progress with volatile and swift market transformations, poses unique challenges that require companies and organizations to make quick and effective decisions to stay competitive.

Speed in the business world is more than just a competitive edge; it's necessary for survival. Time is a precious resource that cannot be overlooked in a dynamic and ever-changing environment. The adage "time is money" accurately embodies our current reality, where every moment of delay could mean a missed opportunity or a lost competitive advantage. Responding quickly to market changes enables companies and organizations to adapt and evolve faster than their competitors.

However, more is needed for decisions to be merely fast; they must also be thoughtful and strategic. In this context, the importance of strategic wisdom as a complement to speed becomes apparent. Strategy means having a deep understanding of the market, anticipating changes, and developing plans to achieve short-, medium-, and long-term goals. Companies and organizations that combine speed in execution with precision in planning can surpass competitors and lead the markets.

Dear reader, sometimes hesitation or delay in making decisions can be more damaging than making imperfect decisions. Speed in today's entrepreneurial world can be likened to the momentum a plane needs for takeoff. For a plane to take off and fly, it must gain enough speed without stopping; otherwise, it may not take off or might even risk crashing. Just as a plane needs continual speed to take off, companies and organizations must make quick and decisive decisions to succeed. Delay in decision-making can be like losing momentum in a plane's takeoff, exposing the company to the risk of missing valuable opportunities and reducing its ability to compete effectively in the market. However, speed without accuracy is like a plane flying without a destination. The speed must be coupled with strategy and sound planning. Quick and well-thought-out decisions mean responding flexibly and efficiently to market changes and competitor movements, allowing the company to soar high and outperform its rivals. Ultimately, for companies to succeed in the contemporary market, their strategies must mimic a plane's takeoff process: moving quickly and steadily while maintaining the right direction and steering towards set goals.

Also, dear reader, the business world can be compared to a boxing match to understand the importance of speed and agility in this field. In boxing, a boxer must make quick and precise decisions with little time for thought or hesitation. This dynamic is precisely what companies and organizations face today. In the boxing ring, speed and adaptability are keys to success. A boxer needs a quick assessment of the situation, with the ability to move and respond effectively to any

move from their opponent. Delay in response or decision can lead to losing points or even defeat. As a boxer requires speed and agility, companies and organizations must apply the same principles. Successful companies and organizations act quickly and effectively, responding intelligently and agilely to market changes and competitor movements. Quickly adapting to new situations and making wise decisions in record time is vital in today's business. In both boxing and business, strategy plays a central role. While decisions must be fast, they must also be based on straightforward tactics and a well-thought-out plan. Companies that successfully balance speed with strategy can more effectively face challenges and exploit opportunities.

Hesitation or delay in decision-making can lead to various risks. Slowness in action often means losing the advantage in emerging markets or new technologies. Competitors who are quick in decision-making can capture significant market shares, leaving slower companies behind. Despite the importance of speed, the significance of making the right decision should be noticed. Decision-making processes should be streamlined and quick, depending on a culture of flexibility and agility in companies, led by guiding teams with clear instructions and giving them the confidence to be effective level.

PART 4 · TOPIC 9**The Freemium Business Model: Balancing Free and Premium for Success**

November 2023 · First published

In today's ever-evolving digital landscape, businesses constantly search for innovative ways to reach a global audience. The freemium business model has emerged as a popular strategy for achieving this objective. Blending the words "free" and "premium," this model offers a unique approach to delivering products and services. This piece will delve into the specifics of the freemium business model, including its advantages, challenges, and tips for successful implementation.

The freemium business model involves offering a product or service with a basic version available for free and providing advanced or premium features that require payment. The primary objective is to entice a broad range of users with free options and then convert some of these users into paying customers by offering superior features or services.

Offering a complimentary version enables businesses to reach a substantial audience swiftly. Users are more inclined to explore a product or service when there is no initial financial commitment, facilitating rapid user acquisition.

Freemium models encourage users to engage more deeply with the product. This heightened engagement can increase customer retention rates as users acclimate to the service.

Once users become accustomed to the free version and appreciate its value, they may be more inclined to upgrade to the premium version to access additional features or benefits. Freemium models generate recurring revenue from users who opt for premium features. This income helps sustain the business.

Striking the optimal equilibrium between free and premium offerings can be challenging. Offering too much for free can limit revenue potential, whereas offering too little may discourage potential users.

As the user base expands, so does the demand for customer support. Managing the cost of providing support to free users and premium customers can be complex. The conversion of free users into paying customers is not guaranteed and can fluctuate significantly based on industry and the product or service offered. In fiercely competitive markets, attracting users to the freemium model can be challenging due to the presence of comparable free alternatives.

Ensure that the free version offers distinct value to users. It should be compelling enough to entice a broad user base. Skillfully segment your user base. Gain insights into their preferences and needs to tailor premium offerings that cater to diverse user groups.

Continuously update and improve both the free and premium versions based on user feedback and shifts in market dynamics. Communicate the advantages of upgrading to the premium version. Emphasize the additional features, enhanced functionality, or improved support premium users will enjoy. Extend time-limited trials of premium features to free users, allowing them to experience the value firsthand before making a purchase decision. Implement robust analytics to monitor user behavior, conversion rates, and engagement levels. Leverage this data to refine your freemium strategy.

Numerous successful companies have embraced the freemium business model with remarkable success. Prominent examples include:

Spotify: The music streaming giant provides free, ad-supported access to its extensive music library while enticing users with premium features such as offline listening and an ad-free experience.

Dropbox or Google Drive: The cloud storage service offers limited complimentary storage space, encouraging users to upgrade for expanded storage capacity and advanced features.

The freemium business model has emerged as a potent strategy for many companies striving to expand their user base and generate revenue. By presenting a compelling free version and thoughtfully crafting premium offerings, businesses can tap into a broad audience while monetizing a portion of their user base. Although challenges persist, meticulous planning, ongoing improvement, and effective communication can facilitate the successful adoption and flourishing of the freemium model. In a landscape where technology and consumer behavior continue to evolve, the freemium model remains a valuable tool in the toolkit of contemporary businesses.

PART 4 · TOPIC 10

What is the Reason Behind the Constant Smile of the World's Largest Company?October 2023 · First published

Dear reader, I hope you are always smiling, just like the largest company in the world, Apple Inc.

The "Smile Curve" is a fundamental concept elucidating value distribution across various stages of a product's lifecycle or supply chain. While not exclusively associated with Apple company, it is imperative to comprehend how companies like Apple manage their production processes and focus on different aspects of their products.

The Smile Curve is a graph that resembles a smile in shape, hence the name. It shows the different stages of the supply chain or production process on the horizontal axis and the value added at each stage on the vertical axis.

Here is a breakdown of the stages that are typically included in the Smile Curve:

The Research and Development (R&D) phase is located at the leftmost end of the curve. It's where companies create initial concepts, designs, and innovations. Investing in R&D helps them develop new technologies, designs, and features that make their products unique. This stage adds significant value to the product, although it may not generate revenue immediately.

Design and Branding: The next stage involves designing the product's aesthetics, user experience, and overall brand identity. This includes creating user interfaces, physical designs, packaging, and marketing materials. Design and branding contribute to a product's perceived value and can command premium pricing.

Manufacturing and Assembly: We reach the manufacturing and assembly phase as we progress down the curve. This is where the actual product is created, often requiring complex procedures and unique pieces. Although this stage can be expensive, it usually adds less value to the end product's market worth than the previous stages.

Distribution and Marketing: After production, the product must be distributed to the market through logistics, transportation, and retail channels. Marketing efforts to raise awareness and demand for the product are also included.

Sales and Support: The sales and customer support stages become essential after selling the product. Offering after-sales support, addressing customer inquiries, and ensuring a smooth purchasing experience can enhance customer satisfaction and loyalty.

End-of-Life and Recycling: In the Smile Curve, the last stages focus on what happens to the product at the end of its life. This involves responsibly disposing of, recycling, or refurbishing the product to

promote sustainability and environmental responsibility. Although this phase may not result in immediate revenue, companies must address their products' impact on the environment.

Dear reader, when it comes to companies like Apple that make consumer electronics, the Smile Curve theory can help clarify why Apple outsources its hardware manufacturing while emphasizing design, branding, and customer experience. Apple excels in its design innovation, software development, and brand loyalty. By outsourcing manufacturing, Apple can use its resources most efficiently and focus on the stages where it can provide the greatest value.

Apple differentiates itself from competitors by focusing on design and innovation. The company's dedication to delivering high-quality design and user experience fosters customer loyalty and justifies premium pricing. Apple benefits from efficient production processes and advanced manufacturing technologies by outsourcing manufacturing to specialized partners. Apple can quickly pivot production in response to market changes, reducing exposure to operational and supply chain risks. By collaborating with manufacturers in various regions, Apple can effectively meet the global demand for its products.

It is essential to recognize that the Smile Curve's fundamental principles hold, but the idea has developed in response to changing technologies and business methods. Improvements have influenced how businesses approach various stages of the curve in automation, digital technologies, and supply chain management. As industries evolve, the significance and worth of each stage may change.

In summary, the Smile Curve illustrates how companies like Apple strategically position themselves along different stages of a product's lifecycle to maximize their strengths, differentiate their offerings, and provide customer value.

PART 5

Saudi Arabia

32 TOPICS

A country that imports most of its medicine has outsourced part of its security. These topics follow Saudi Arabia's attempt to change that: the regulator maturing into a global reference, the university laboratories learning to produce companies and not only papers, the hospitals, the clinical trials that must be run here for the results to apply here, the sovereign capital, and the people. Written from inside the effort, they are neither promotional nor dismissive, they mark what has genuinely been built and what still has not.

WHY READ THIS PART

Read this section for a practitioner's account of Vision 2030 in one sector, written from inside it, with the gaps left in.

SAUDI ARABIA · PART 5

In this part

NO.	TOPIC	PAGE	PUBLISHED
1	Wadi Jeddah Innovation Hub	238	June 2026
2	Saudi NIH	240	March 2026
3	The Story of How the Pharmaceutical Industry Grew in Saudi Arabia	242	February 2026
4	The Story of the First Pharmacy in Saudi Arabia	245	February 2026
5	Saudi FDA Between Innovation and Generic Drugs	247	February 2026
6	Why Localizing Clinical Trials in Saudi Arabia Has Become a Health and Economic Necessity	249	January 2026
7	Leading Causes of Death in Saudi Arabia	251	October 2025
8	Hevolution is Pioneering the Future of Health and Longevity	253	October 2025
9	King Faisal Specialist Hospital Leading the Future of Saudi Healthcare with an Integrated Advanced Ecosystem	255	September 2025
10	Saudi Council of Health Insurance Leading the Private Health Insurance Sector	257	August 2025
11	Saudi Arabia Leads Value-Driven Healthcare Transformation	259	August 2025
12	Saudi FDA Leading a Journey of Continuous Excellence and Development	261	August 2025
13	Saudi Arabia's Pharma Leap to Global Leadership	263	July 2025
14	Saudi Arabia's Pharma Leap to Global Leadership	265	July 2025
15	A Comprehensive Overview of the Saudi and Arab Pharmaceutical Market	267	October 2024
16	The Distinct Roles of Venture Capital and Private Equity	269	August 2024

17	Thinking Globally, Acting Locally	272	August 2024
18	Disrupting Saudi Arabia’s Pharma Market	275	July 2024

SAUDI ARABIA · PART 5

In this part

NO.	TOPIC	PAGE	PUBLISHED
19	If Saudi Arabia Won't Act, then Who Will?	278	April 2024
20	Unlocking the Future of Healthcare with the Revolutionary Impact of King Abdulaziz University's 'I-ONE' Company	280	April 2024
21	Building Saudi Arabia's "Trillion-Dollar Pharmaceutical Giant"	282	February 2024
22	Advancing into the Future: Saudi Arabia's Pioneering Vision in Biotechnology and Its Global Impact	284	February 2024
23	Unlocking the Potential: Why Saudi Arabia's Investment in Pharmaceuticals and Biotechnology Holds the Key to a Promising Future	286	December 2023
24	Saudi Megaprojects are Pillars of a Global Economic Superpower: A Glimpse from 2040	288	November 2023
25	A Glimpse into 2040: Saudi Arabia's Emergence as a Global Leader in Pharmaceutical and Biotechnological Advancements	290	November 2023
26	The 21st Century's Greatest Success Story: A Glimpse from 2040	292	November 2023
27	National Strategies for Developing Pharmaceutical and Biotechnology Industries in the Kingdom of Saudi Arabia	295	November 2023
28	The Crucial Role of Venture Capital in Developing the Pharmaceutical Industries in Saudi Arabia	297	October 2023
29	What is Altriaq Pharma of King Abdulaziz University?	299	October 2023
30	Development and Localization of Pharmaceutical and Biotechnology Industries in the Kingdom of		

Saudi Arabia:
A Promising Vision for Economic Diversification and Health Innovation

301

October 20

31	Unlocking the Potential: How Venture Capital Drives Saudi Arabia's Pharmaceutical Industries	303	September 2023
32	The Power of Skilled Workforces: King Abdulaziz University Journey and Taiwan's Semiconductor Success	305	September 2023

PART 5 · TOPIC 1**Wadi Jeddah Innovation Hub**

June 2026 · First published

Dear reader, the Wadi Jeddah Innovation Hub represents an important step in Saudi Arabia's broader shift toward a knowledge-based economy, where research and ideas no longer sit in drawers or remain trapped in academic papers, but are transformed into practical solutions that can reach the market, serve society, and create jobs. The core idea of the hub is simple: to provide a place that brings together researchers, entrepreneurs, investors, and supporting institutions, so the innovation journey becomes faster and clearer, moving from an idea to a prototype, to a product, and ultimately to a company capable of growth and long-term sustainability.

The hub is built on the principle that innovation is not a one-time event, but an integrated system that needs the right environment to succeed. That is why it offers workspaces and facilities that help teams develop their ideas, alongside enabling services such as technical, legal, and commercial support. It also provides mentorship and guidance from experts with real-world experience building startups and turning early-stage projects into scalable businesses. This kind of support matters because many great ideas fail not because they are weak, but because there is no clear pathway to convert them into a product or service.

One of the most distinctive strengths of the Wadi Jeddah Innovation Hub, dear reader, is its focus on connecting scientific research to real needs. Successful innovation often does not begin with the question, "What can we build?" but rather, "What problem do we need to solve?" Here, the hub helps steer effort toward practical challenges across sectors such as health, technology, industry, and services, so outcomes are more valuable and more impactful. When innovation is tied directly to people's needs, market demand, and societal priorities, its chances of success and adoption increase dramatically.

The hub also plays a critical role in protecting ideas and organizing them through strong attention to intellectual property. Many innovators have powerful ideas but hesitate to share them out of fear of losing their rights. A clear system that supports patent filing, partnership structuring, and fair business models gives innovators confidence and encourages participation. This is essential because innovation needs legal security just as much as it needs scientific creativity.

And the hub's role does not stop at helping ideas begin. It extends into the stage of startup formation. At that point, many questions emerge: Who is the customer? How do we price? How do we manage costs? How do we prove the product works? How do we enter the market? This is where the hub's incubation and acceleration programs become especially valuable, helping teams build a balanced venture across technical, financial, and commercial dimensions. Just as importantly, the hub does not operate in isolation from the investment ecosystem. It opens channels to investors,

funding vehicles, and strategic partners, because the right funding at the right time can turn a small project into a major success story.

Looking at the bigger picture, the Wadi Jeddah Innovation Hub contributes directly to national goals, most notably economic diversification, expanding the role of emerging sectors, creating high-quality jobs, and improving quality of life through innovative solutions. When research becomes products, that can mean better healthcare services, more efficient technologies, new opportunities for young people, and Saudi companies able to compete locally and globally. This is exactly what any country needs when building the economy of the future: invest in talent, and make innovation a natural path to growth.

Socially, the hub sends an important message: innovation is not limited to a specific group. Anyone with a clear idea and serious effort can find a platform that helps them launch. It also supports a culture of experimentation and iteration, where early failure is not the end of the road, but part of learning and improving the product. When this mindset spreads, the city, the university, and the private sector become a living ecosystem full of motion and opportunity.

In the end, dear reader, the Wadi Jeddah Innovation Hub is not just a building or a project. It is a bridge between science and the market, between ideas and reality. Its real value appears when an innovation leaves a lab or a small office and becomes a product people use, a company that employs talent, or a solution that improves service efficiency. With continued support and development, innovation becomes a natural part of daily life, and investment in knowledge becomes one of Saudi Arabia's strongest sources of economic and social strength.

PART 5 · TOPIC 2**Saudi NIH**

March 2026 · First published

Dear reader, when we discuss the future of health research in Saudi Arabia, we cannot ignore the National Institute for Health Research (Saudi NIH). This new body was created under Vision 2030 to be the “research brain” and the “strategic arm” for health and innovation in the Kingdom. The Institute was established by a Council of Ministers decision in 2023, not as just another academic center, but as a national reference responsible for organizing and supporting health research that delivers real impact on people’s health and quality of life.

The Institute was launched in the middle of a major health sector transformation under the Health Sector Transformation Program. Scientific research is no longer a luxury or a purely academic activity inside universities. It is now a key tool for improving services, strengthening prevention, and reducing the burden of chronic and serious diseases. That is why the Institute has been given a central mission: to connect researchers’ questions with the actual needs of the health system and to direct research toward the real problems facing Saudi society, rather than scattered efforts that are far from national priorities.

One of the most critical roles of the Institute is overseeing translational research and clinical trials, the kind of research that moves discoveries from the lab to the patient. The idea is simple: instead of research ending as a published paper in a journal, the Institute works to take it one step further, making it the basis for a new drug, a diagnostic test, or a preventive program applied in hospitals and health centers. For this reason, the Minister of Health, as Chairman of the Institute’s Board, has emphasized that the Institute’s tasks include supporting clinical trials, improving their environment, and turning their results into health and economic benefits for society and the state.

The Institute does not stop at being just a “regulator and supervisor.” It also moves forward into research funding. It has launched funding programs for clinical research and advanced pre-clinical studies, with clear conditions: projects must be of high scientific quality, must address priority public health areas in the Kingdom, such as heart disease, cancer, diabetes, genetic disorders, and others, and must have a real chance of being applied in practice. In this way, the Institute is similar to major funding agencies in advanced countries, but with an extra focus: it is not enough for a study to be published; it should lead to changes in medical practice or health policy.

On a broader level, the Institute is seen as a tool to strengthen national health security. A central research body that monitors emerging health risks, supports studies on epidemics and emergencies, and builds scientific databases on diseases in the community provides decision-makers with a stronger foundation for designing evidence-based policies, rather than relying on impressions or incomplete information. Official statements confirm that the Institute is part of a

system that aims to use research and innovation to lower disease and death rates, reduce the cost of care, and increase the return on every riyal spent on health research.

The Institute also plays a key role in supporting national health industries, especially pharmaceuticals, medical devices, and biotechnology. The goal is not only to understand and diagnose diseases, but also to turn knowledge into products and services: innovative medicines, advanced diagnostic tools, digital health solutions, and more. According to official data, the Institute is working to link research outputs with local factories and companies, and to close the gap between the “theoretical world” of the lab and the practical world of hospitals and production lines, so that research results become part of the national economy, not just papers on a shelf.

In terms of infrastructure, the Institute aims to build a national network of clinical trial sites and research centers across all regions of the Kingdom. This network is meant to unify standards, improve the quality of studies, and increase Saudi Arabia’s ability to host competitive global trials, so that research is not limited to only a few big cities or a small number of reference hospitals.

The human side of the Institute’s mission is just as important as the regulatory and economic sides. The Saudi NIH seeks to develop a new generation of national talent in health research and innovation: doctors, pharmacists, public health specialists, data engineers, and more. The Institute presents itself as a platform that gives young researchers training, support, and recognition, and opens professional paths in translational research and clinical trials. It pays special attention to modern fields such as AI in health, big data analytics, and advanced biotechnology. In this way, the Institute is not only building “projects”, it is helping to develop a whole generation of scientists and innovators.

All of this is directly tied to the Kingdom’s ambition to become a regional and global hub for health research and innovation. The National Institute for Health Research is the executive arm of this ambition: it creates a clear regulatory and funding environment that attracts global clinical trials, gives international medical companies confidence that there is a strong system to ensure research quality and patient safety, and at the same time makes sure that research priorities reflect the real needs of Saudi society, not just external agendas.

In the end, dear reader, you can think of the National Institute for Health Research as a bridge between university and hospital, between research and industry, and between health policy and technological innovation. Its role in the country is not limited to supporting researchers or funding studies. It is about steering the research compass toward what truly serves public health, turning knowledge into added value, and building a new culture in which scientific research is seen as a practical tool to improve people’s lives and to strengthen the knowledge-based economy in the Kingdom of Saudi Arabia.

PART 5 · TOPIC 3

The Story of How the Pharmaceutical Industry Grew in Saudi Arabia

February 2026 · First published

Dear reader, the history of the pharmaceutical industry in the Kingdom is a remarkable story of transformation. It began with a society that relied on traditional healers, herbal mixtures, and “attareen,” and has moved to a modern pharmaceutical sector with dozens of factories, partnerships with major global companies, and a clear ambition to enter the era of biotechnology and advanced vaccines. In the early 20th century, the first turning point came with the opening of the first modern pharmacy in Jeddah in 1922 by Dr. Mohammed Saeed Tamer. This was not just a place to sell medicine; it was a new window for Saudi society to access imported pharmaceuticals and the latest treatments coming from Europe, India, and beyond. Over the years, that small pharmacy became the seed of Tamer Group, which later grew into one of the most critical players in medicine distribution and healthcare in Saudi Arabia and across the region. It was the first organized step toward a more professionalized pharmaceutical trade in a country undergoing significant political and economic changes.

In the 1930s, with the discovery of oil and the growth of its revenues, our country, may God protect it, began to place greater importance on the health sector. The Ministry of Health was founded, and a network of government hospitals and health centers spread across the Kingdom. Yet, despite this expansion, Saudi Arabia still relied mainly on imported medicines from Europe, the United States, Egypt, and India, through local agents and companies. Large pharmacies and distributors, such as Tamer Group, served as intermediaries between multinational drug companies on one side and hospitals and patients on the other. Local “manufacturing” at that time was minimal: it was mostly simple compounding and formula preparation in hospital pharmacies or small labs, not a real industry built to international standards. Then came the oil boom of the 1970s, and with the expansion of free healthcare, the state quickly realized that relying entirely on imported medicines posed a challenge to national medical security, especially during crises or disruptions to global supply chains. This awareness created a real need for a national pharmaceutical industry.

In this context, the Saudi Pharmaceutical Industries and Medical Appliances Corporation (SPIMACO) was founded in 1986 as a national joint-stock company to build an advanced pharmaceutical industry based on modern scientific and industrial standards. The Qassim region was chosen as the location for its main industrial complex, and the first products rolled off its production lines in the early 1990s. SPIMACO became the first Saudi pharmaceutical company to be listed on the stock market and a base for partnerships with multinational firms such as SmithKline Beecham (later GlaxoSmithKline), enabling the local, licensed manufacturing of well-known medicines within the Kingdom. In the 1990s, other strong national companies appeared as well. One of the most notable is Tabuk Pharmaceuticals, established in 1994, which grew rapidly to become one of the largest private pharmaceutical companies in Saudi Arabia and a major player in the generic medicines

market in the region. Alongside it came companies such as Jamjoom Pharma, Hikma, and AJA Pharma (part of Saudi Chemical Company), and others. These companies strengthened the culture of licensed manufacturing for global brands and expanded the list of locally produced drugs to include antibiotics, cardiovascular medicines, gastrointestinal drugs, and treatments for many chronic diseases.

With the start of the new millennium, dear reader, the idea of “localizing the pharmaceutical industry” began to take on a clearly strategic dimension. Saudi Arabia became the largest pharmaceutical market in the Middle East and North Africa, representing almost one-third of the region’s market. The value of the local drug market reached tens of billions of riyals, with expectations of continued growth in the coming years. At the same time, the number of registered pharmaceutical factories in the Kingdom increased, surpassing 40 factories by the beginning of the third decade of this century. These factories now cover a large portion of local demand, by some estimates around one-third of market value and more than 40% in volume, with annual exports exceeding one billion riyals to Gulf countries and to markets in the wider Middle East and North Africa. This means that Saudi Arabia has become not only a big consumer market for medicines, but also an important manufacturing base for generics and some specialized products.

Then came the COVID-19 pandemic and put this whole system to a real test. The crisis clearly showed the importance of local production capacity for essential medicines and hospital supplies. Saudi factories played a key role in securing antibiotics, intensive care drugs, IV nutrition solutions, and many other critical items. Local companies also took part in licensing and distribution agreements for COVID-19 vaccines; for example, Tabuk was authorized to market the Moderna vaccine in the Kingdom. All this strengthened the conviction among decision-makers that the pharmaceutical industry is not just an economic activity, but a core pillar of national health security. Under Vision 2030, the Ministry of Industry and Mineral Resources, the Ministry of Health, the Saudi Food and Drug Authority (SFDA), and investment bodies such as the Saudi Industrial Development Fund and the Public Investment Fund are working together to increase the share of locally produced medicines. The focus is expanding from traditional chemical generics to high-tech products such as biologicals, vaccines, and drugs for rare diseases, supported by an advanced research ecosystem that includes universities, the National Institute for Health Research (Saudi NIH), and specialized research centers.

Dear reader, what we are seeing today is the beginning of a new stage in which the Kingdom aims to move from “licensed and generic manufacturing” to local innovation and development. Global companies are starting to establish production lines, filling and packaging centers inside Saudi Arabia or sign local manufacturing agreements with Saudi firms, taking advantage of the Kingdom’s position as a gateway to a large regional market and of the regulatory and investment incentives designed to make it a regional hub for pharmaceutical manufacturing and biotechnology, especially after His Royal Highness Crown Prince Mohammed bin Salman launched the National Biotechnology Strategy. At the same time, major healthcare players such as Tamer Group, which began with a

single pharmacy almost a century ago, are now expanding into manufacturing and investing in research and development. This is a clear sign that the market has matured and that all parts of the value chain, importing, distribution, manufacturing, and exporting, are becoming more integrated.

Of course, challenges still exist, especially in the area of locally originated innovative medicines and in the level of R&D spending. But the size of the local market, the strategic location of the Kingdom, and the clear national direction toward supporting high-value industries all give Saudi pharma a historic opportunity: not only to remain the largest medicines market in the region, but also to become a source of new treatments developed in its own labs and universities. In other words, the story of the pharmaceutical industry in Saudi Arabia is still being written, and the next chapters may well be about Saudi-made innovations reaching patients across the world.

PART 5 · TOPIC 4

The Story of the First Pharmacy in Saudi ArabiaFebruary 2026 · First published

Dear reader, when we look back at the beginnings of modern healthcare in the Kingdom of Saudi Arabia, we find a story that starts from a small shop in one of old Jeddah's streets. It was a simple pharmacy opened by an ambitious young man, Mohammed Saeed Tamer, in 1922. But it was not just a small business; it was the first spark in a long journey that would eventually lead to what we know today as Tamer Group, one of the largest healthcare groups in the Kingdom and the region. At that time, people mainly depended on traditional medicine, herbal remedies, and "attareen" (herb sellers), while modern medicines were rare and hard to get. In this context, the idea of opening the first modern pharmacy in Jeddah was born to serve as a stable, accessible window to modern medicines in the heart of the city.

Many elderly people in Jeddah still recall how people used to go to "Tamer Pharmacy" not only to buy medicine but also to seek advice and guidance. The pharmacist played the role of a "health educator", explaining to patients what a dose means, why they must complete the full treatment course, and how to store medicines away from heat and humidity, at a time when these ideas were not common or well known as they are today. The pharmacy was, in reality, a small health school for the community, not just a shop with shelves and bottles.

Dear reader, having a leading, well-organized pharmacy like this helped shape the early structure of the pharmaceutical supply chain in the Kingdom. The pharmacy did not remain just a retail outlet; it gradually turned into a gateway for importing medicines from global companies, helping introduce new types of drugs to the Saudi market. As its business grew, Mohammed Saeed Tamer began building representation and partnership agreements with international pharmaceutical companies. Step by step, the pharmacy evolved from a small personal project into the core of a structured family company, which became the foundation of what we now know as Tamer Group.

This transformation shows how a simple idea can grow over time, especially when it moves in parallel with strong government support for this vital sector. May God preserve this country. From a single pharmacy in Jeddah more than a century ago, the group's activities expanded to include the distribution of medicines, medical devices, nutrition products, and personal care items across different regions of the Kingdom and the Gulf. It now represents dozens of global pharmaceutical brands and plays a major role in managing medicine supply chains for both public and private hospitals. It has also entered into important industrial partnerships, such as the Saudi-Japanese Pharmaceutical Company (SAJA) and others. In this way, the impact of the first pharmacy went far beyond the street where it started and became part of building an integrated health and economic system serving society at the national and regional levels.

With the establishment of colleges of pharmacy in the Kingdom and the graduation of the first generations of Saudi pharmacists in the last century, the story of this pharmacy was no longer only about trade, but also about building human capacity. The group that grew out of that historic pharmacy became a place that absorbed hundreds of Saudi pharmacists, working in its warehouses, branches, and subsidiaries. They receive practical training on good storage practices, distribution management, pharmaceutical marketing, and structured corporate work. In this sense, Tamer Group became a practical school parallel to university education, combining scientific knowledge with field experience and fostering a new professional culture in the Saudi pharmaceutical market.

Today, in an age of e-prescriptions, smart pharmacies, and medicine delivery apps, it may be easy to forget how the story began. But when we pause and look again, we realize that behind the advanced pharmaceutical system we see in the Kingdom, there are founding stories like the story of the first pharmacy in the country, a small shop with wooden shelves, medicines arriving in simple boxes by ship, run by one man with a big dream. That dream is what turned that first pharmacy into a starting point for a journey that has lasted more than a hundred years, where the story of a pioneering Saudi family became intertwined with the story of a nation building its modern healthcare system.

And with the ambitions of Vision 2030 to localize pharmaceutical and biotech industries, supported endlessly by the leadership of this blessed country, the story continues. The same spirit that once opened a small pharmacy in old Jeddah is now pushing towards factories, research centers, and partnerships that aim to make the Kingdom not only a consumer of medicines, but also a producer and innovator that serves patients at home and abroad.

PART 5 · TOPIC 5

Saudi FDA Between Innovation and Generic Drugs

February 2026 · First published

Dear reader, between protecting innovation and encouraging generic medicines, the Saudi Food and Drug Authority (SFDA) has to manage an essential balance: how can it protect the rights of companies that spent huge time and money developing new drugs, while at the same time allowing cheaper generic versions to enter the market and reduce the burden on the health system and on patients? The regulation that explains how SFDA handles patents when registering generic drugs, prepared in cooperation with the Saudi Authority for Intellectual Property, was created to provide a clear framework for this balance, grounded in transparency, clear responsibilities, and an organized path for generics to enter the market.

This methodology has three main goals that matter to any patient or person interested in healthcare. First, to increase transparency in SFDA procedures so that the registration path for both innovative and generic medicines is clear and understandable for everyone. Second, to build trust in how SFDA handles patents so it is not seen as favoring one side over another. And third, to make it easier to register generic medicines, so they are more available at lower prices, without affecting the legal protection period of patent holders.

The system works in two main stages: one for the originator (innovative) companies and one for the generic companies. In the first stage, innovative companies registering a new drug must submit a copy of the patent document issued by the Saudi Authority for Intellectual Property as part of the registration file, or add it later as soon as it is granted, and they bear the responsibility for any delay. If the innovative drug is already registered and protected by a Saudi or GCC patent, the company must attach that patent to its documents.

SFDA makes it very clear that receiving a patent document does not mean it is responsible for protecting it or deciding patent disputes. Suppose an originator company believes a generic product infringes its patent. In that case, the proper legal route is to go to the commercial court, not to SFDA, while SFDA's role is to implement any final court judgment in favor of the patent owner.

In the second stage, it is the turn of generic companies, which want to register an equivalent version of an innovative drug whose patent protection has ended or is about to end. Here, SFDA follows a precise mechanism: when a company applies to register a generic medicine. SFDA finds that the original drug still has a valid patent in the Kingdom, it asks the generic company to provide a "Freedom to Operate" (FTO) letter from an intellectual property office or agent licensed by the Saudi Authority for Intellectual Property.

This letter is a professional statement in which the specialist confirms that the generic product, with its name, strength, and dosage form, does not infringe any registered patent for the innovative drug

inside Saudi Arabia. The company must attach this letter, together with a copy of the agent's license, and submit it within a defined time limit, along with a formal declaration from the generic company that it is not infringing any protected IP rights in the Kingdom.

Based on this letter and declaration, SFDA continues the registration process, but at the same time, it stresses that it is not "approving" or legally certifying the content of the FTO letter. It simply relies on it as a procedural document, while full legal responsibility stays with the generic company and the IP agent if any dispute arises later. If an innovative company claims that a generic medicine infringes its patent, the matter is returned to the commercial court for decision, not to the SFDA.

The methodology also offers generic companies a smart option for accelerating market entry after patent expiry. It allows them to submit a registration application up to 24 months before the patent expires without an FTO letter, provided that the registration is not activated and the product is not allowed on the market until the patent actually lapses. This way, SFDA enables early preparation so the generic drug is ready to enter the market as soon as protection ends, reducing the time gap between patent expiry and the arrival of cheaper alternatives for patients, while fully respecting the innovator's protection period.

At its core, this methodology clearly defines each party's role. SFDA is responsible for the quality, safety, and availability of medicines and is not a court for patent disputes. The Saudi Authority for Intellectual Property is the body responsible for granting and registering patents and licensing IP agents. The commercial court is the legal venue where patent infringement claims are decided. Both innovative and generic companies are responsible for the accuracy of their documents, their strategic choices, and whether they rely mainly on strong patent protection, price competition, quality, or other tools.

Dear reader, what this framework aims to achieve is a delicate balance. On the one hand, it sends a strong message to global pharma companies that the Saudi market respects intellectual property and does not open the door to patent infringement. On the other side, it reassures the health system and the patient that the door to generic medicines will not be closed and that there is a clear, organized path for them to enter the market once protection ends. In this way, the regulation helps make the Kingdom an attractive environment for investment in innovative drugs, while also supporting access to generics and price competition that benefits both patients and the health system in the long run, an essential but sensitive balance between fostering innovation and making medicines affordable.

PART 5 · TOPIC 6

Why Localizing Clinical Trials in Saudi Arabia Has Become a Health and Economic NecessityJanuary 2026 · First published

Dear reader, imagine there is a new medicine that could change the lives of thousands of patients in Saudi Arabia, but it remains locked inside reports and scientific papers abroad, never reaching the hospital where you or your family members are treated. This is exactly where clinical trials come in. They are the bridge that takes a treatment from the lab bench to the patient's bedside. In Saudi Arabia, talking about localizing clinical trials is no longer just a slogan; it is now a core part of Vision 2030 and the National Biotechnology Strategy, which aim to make the Kingdom a regional and global hub for vaccines, advanced therapies, and precision medicine.

When clinical trials are conducted inside the Kingdom, under the supervision of Saudi researchers and on Saudi patients, the results are more accurate and relevant to our reality. They take into account our lifestyle, environment, genetic makeup, and disease patterns. Localizing clinical trials also means that Saudi patients can gain access to new, innovative treatments years before they are commercially available, in a controlled setting with close medical monitoring and ethics committees that protect participants' rights and privacy. For this reason, clinical trials in Saudi Arabia are no longer a "scientific luxury"; they are a necessary path if we want to see research results turn into real medicines in our clinics and hospitals.

From this perspective, the King Abdullah International Medical Research Center (KAIMRC) has launched important initiatives to strengthen this bridge between research and treatment. The center aims to involve large numbers of Saudi patients in advanced treatment protocols over the coming years and to create many jobs in fields such as clinical research, nursing, clinical pharmacy, and data management. It also seeks to significantly increase the number of clinical trials, so that the Kingdom becomes a key player on the global clinical trials map, rather than a passive recipient of results from studies conducted in other countries on very different populations.

To organize this growing activity, the National Institute for Health Research (Saudi NIH) was established in 2023 as a national umbrella to coordinate translational research and clinical trials. The Institute directs funding toward health priorities that matter directly to you: heart disease, cancer, diabetes, rare diseases, and genetic disorders, among others. It also requires that projects align with Vision 2030 and international quality standards. In this way, research is no longer just scattered efforts across different universities and hospitals, but part of a unified pathway that serves public health and turns results into treatment guidelines and health policies that can actually be implemented in Saudi hospitals.

Reports show that the number of active clinical trials in Saudi Arabia has, in recent years, passed the 400 mark, with a market valued at around 200 million US dollars per year, a figure expected to grow

as more global pharmaceutical companies and biotech start-ups enter the scene, attracted by the Kingdom's advanced regulatory environment. The Saudi Food and Drug Authority (SFDA) adopted ICH-GCP-aligned regulations early on and requires companies to report any serious adverse events occurring anywhere in the world. This strengthens international confidence in the Kingdom's oversight and patient safety and encourages companies to include Saudi trial sites in their global development plans, especially in fields like oncology, immunology, and diabetes, which are major health and economic burdens in our society.

From an economic point of view, this direction is tightly linked to the National Biotechnology Strategy, which aims to create thousands of specialized jobs and a significant contribution to non-oil GDP in the coming years. The strategy is building a complete value chain that includes vaccines, biomanufacturing, genomic medicine, and advanced therapies such as gene therapy and CAR-T cell treatments. For this chain to be truly complete, the country must be able to design and run its own clinical trials on its own soil, rather than relying entirely on other countries to test the drugs we ourselves will use in the end.

Dear reader, despite this great progress, there is still vital work to be done. We need more training for professionals in areas such as study design, biostatistics, data management, and adherence to international ethical standards. We also need to raise public awareness about the importance of voluntary participation in clinical trials and clearly explain the safeguards that protect participants' rights and safety. In addition, most trials are still concentrated in major cities, which means we need to expand networks to include hospitals in other regions, so that access to innovative treatments does not remain limited to a small segment of the population.

In the end, you can look at the localization of clinical trials in Saudi Arabia as a project that brings together both heart and mind. It speaks to the heart because its first goal is your interests as a patient or citizen who wants better, fairer healthcare. And it speaks to the mind because it is a strategic, economic project that builds a national pharmaceutical and biotech industry, strengthens health security, and supports economic diversification. As investment continues in the Saudi NIH, KAIMRC, King Faisal Specialist Hospital and Research Centre, the SFDA, universities, and research centers, and as international partnerships grow, the Kingdom appears to be on its way to becoming a model country that has turned clinical trials from a marginal, limited activity into a central pillar of its health sovereignty and scientific presence on the global stage. And all of that, dear reader, ultimately reflects on you and on the quality of life for you and those you love.

PART 5 · TOPIC 7**Leading Causes of Death in Saudi Arabia**

October 2025 · First published

Dear reader, Saudi Arabia has been experiencing significant and continuous advancements in its healthcare system, guided by the ambitious Vision 2030, where healthcare improvement is a crucial element. Within this context, the Saudi National Institute for Health Research (Saudi NIH) launched a strategic project of paramount importance, aimed at defining national health research priorities. This initiative is designed to guide research efforts and allocate resources efficiently and effectively.

This project is part of Saudi Arabia's ongoing efforts to position itself among leading countries in health research and development. By leveraging successful international experiences from nations such as the UK, Canada, and the USA, while tailoring approaches to meet national specifics and needs, the initiative adopted a combined methodology that combines the Essential National Health Research (ENHR) model and the Combined Approach Matrix (CAM). This ensures inclusive and transparent participation, reflecting the actual healthcare needs of Saudi society.

Public health, dear reader, remains one of the top priorities for countries globally. Saudi Arabia is determined to enhance healthcare standards and effectively combat the primary causes of mortality affecting its citizens. Statistics from 2021 highlighted several prominent causes of death, reflecting significant health challenges facing the Kingdom.

Cardiovascular diseases top the list of causes of death in Saudi Arabia, accounting for 20.75% of total deaths. This high percentage necessitates the allocation of intensive healthcare resources for preventive measures, early diagnostics, and effective treatments. Additionally, hypertension-related diseases rank fifth, accounting for 3.96%, further emphasizing the importance of health awareness and preventive lifestyle interventions.

One striking statistic, dear reader, is that road traffic injuries ranked second, with 9.07%, highlighting road safety as a pressing national concern that requires stringent preventive measures and regulations to ensure safer roads.

COVID-19 also significantly impacted mortality rates, responsible for 5.73% of deaths. This reflects the global and local impact of the pandemic, underscoring the importance of early preparedness for future health crises. Strokes rank fourth, contributing 4.76% to the total deaths, highlighting the need for enhanced prevention of risk factors such as obesity and smoking, and increased awareness campaigns about recognizing stroke symptoms and the urgency of immediate treatment.

Other chronic illnesses, dear reader, including type 2 diabetes at 3.17%, and chronic kidney disease related to hypertension and diabetes, totaling about 6.7% (including all forms of kidney failure),

represent major issues requiring widespread awareness programs and early intervention to prevent progression to advanced stages.

On the respiratory disease front, lower respiratory infections constitute 2.59% of deaths, while chronic obstructive pulmonary disease (COPD) accounts for 1.80%. These figures underscore the urgent need for improved primary healthcare services and enhanced preventive measures, particularly during peak seasons for respiratory conditions.

In terms of infectious diseases, hepatitis C with liver cirrhosis accounted for 1.78% of deaths. In comparison, hepatitis B with liver cirrhosis accounted for 0.80%, underscoring the significance of vaccination campaigns and health awareness initiatives.

Considering conditions like Alzheimer's disease and dementia, these accounted for 1.09% of total deaths, reflecting the growing health and social burden as life expectancy continues to increase in the Kingdom.

Notably, despite the seriousness of cancer, colorectal cancer accounted for only 0.93% of deaths, indicating relative success in early detection programs and public health education in this area.

In conclusion, dear reader, it is essential to commend the substantial efforts Saudi Arabia is undertaking to combat these diseases and reduce mortality through clear, practical strategies aligned with the directives of the Kingdom's leadership. Vision 2030 ambitiously addresses public health, launching targeted initiatives and programs that aim to significantly improve the quality of life, delivering comprehensive and sustainable healthcare.

These steps underscore the Kingdom's unwavering commitment to ensuring the health and safety of everyone living within its borders, ultimately contributing to a healthier and more prosperous future for all citizens and residents.

PART 5 · TOPIC 8

Hevolution is Pioneering the Future of Health and Longevity

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The importance of research in health and longevity is rapidly gaining prominence both nationally and globally. Within this context, Saudi Arabia's Hevolution Foundation plays a leading role, steering international efforts towards tangible, impactful outcomes aligned with the Kingdom's Vision 2030. Dr. Mehmood Khan, CEO of the Hevolution Foundation, emphasizes that humanity's most significant challenge in longevity and health improvement is not merely discovering scientific breakthroughs but transforming these innovations into sustainable, investable economic sectors.

The Hevolution Foundation is firmly committed to advancing this field by investing in cutting-edge scientific research and actively supporting venture capital initiatives that aim to transition discoveries into real-world solutions rapidly. One critical challenge addressed by the foundation is the shortage of qualified human capital specializing in longevity research. To bridge this gap, Hevolution has launched multiple initiatives, including new investigator awards, postdoctoral training programs, academic fellowships, and funded research chairs. These efforts aim to nurture a new generation of researchers and leaders in this vital domain.

Another significant challenge the foundation seeks to resolve is the absence of standardized, objective biomarkers for aging and healthspan. This gap substantially hampers research progress. Consequently, Hevolution supports pioneering research focused on identifying reliable, internationally accepted biomarkers, comparable to the revolutionary impact of discovering low-density lipoprotein (LDL) in cardiovascular medicine.

Beyond scientific advancements, Dr. Khan and the Hevolution team emphasize the critical need to convert healthspan and longevity into clearly defined investment opportunities. Although the costs of diseases are well-documented, a definitive financial model quantifying the long-term economic value of sustained health remains elusive. To address this, the foundation collaborates with global experts to create new financial frameworks that effectively incentivize private-sector investment in health and longevity.

At the policy level, Hevolution actively works to establish a clear regulatory and legal environment, allowing businesses and private entities to market innovations effectively and expand their practical applications. Dr. Khan stresses the importance of governmental support in this investment domain through policies that encourage private sector engagement in longevity and health initiatives.

Hevolution's efforts align seamlessly with Saudi Arabia's Vision 2030, which aims not only to raise life expectancy from 76 to 81 years but also to ensure healthier and higher-quality lives for its citizens. The Kingdom recognizes that the true objective is not merely prolonging life, but comprehensively enhancing health to support active, productive lifestyles.

According to Dr. Khan, Hevolution's success is measured not only by scientific discoveries or talent development but significantly by its direct influence on policy-making, legislation, and the practical implementation of research. Through advanced research support and extensive collaborations across academia, industry, and government, the foundation is establishing a global standard for innovation in health and longevity.

Ultimately, Hevolution views the primary challenge as ensuring the broad application of scientific innovations rather than merely their discovery. Dr. Khan emphasizes that the future of longevity research depends on creating an integrated, transparent regulatory and commercial model capable of delivering the desired global impact.

PART 5 · TOPIC 9

King Faisal Specialist Hospital Leading the Future of Saudi Healthcare with an Integrated Advanced Ecosystem

September 2025 · First published

King Faisal Specialist Hospital and Research Centre (KFSHRC) has undergone remarkable developments, positioning itself among the top global medical institutions. Through delivering advanced healthcare services, expanding specialized medical care programs, and conducting meticulous scientific research, KFSHRC currently treats more than a quarter of Saudi Arabia's cancer patients and performs approximately 65% of the nation's organ transplants. Additionally, it is a leading institution in genetic testing and the study of rare blood diseases.

Dr. Majid Al Fayyadh, CEO of King Faisal Specialist Hospital, previously explained that the hospital's role complements Saudi Arabia's comprehensive healthcare transformation. The vision of KFSHRC emphasizes strengthening its capabilities in precision medicine, employing advanced diagnostic techniques and personalized treatments, particularly in the areas of cardiovascular diseases and oncology, thereby significantly enhancing the quality of life for the country's citizens.

In 2025, KFSHRC launched an innovative precision medicine program designed to facilitate the early detection of approximately 280 genetic diseases. This major initiative is expected to save the Saudi healthcare system approximately SAR 360 million (USD 96 million). The hospital's excellence is particularly evident in its application of artificial intelligence in diagnostics, genomic research, and minimally invasive surgical procedures, placing it among the world's leading medical institutions.

KFSHRC's efforts extend beyond medical treatment, encompassing medical research and advanced education designed to support the next generation of healthcare professionals. The hospital collaborates closely with biotechnology companies to advance medical science and shares expertise with international medical institutions. This cooperation has been notably successful, exemplified by the introduction of advanced therapies such as bone marrow transplants in the 1990s and, more recently, CAR-T cell therapy.

The hospital's vision does not center around competing with other medical institutions but instead focuses on overcoming diseases themselves. When any healthcare institution achieves better treatment outcomes, it represents a collective success for the entire healthcare sector, reflecting genuine integration within the Saudi health system.

Amid organizational transformations, KFSHRC transitioned from a government institution into an independent non-profit organization. This strategic shift aimed to facilitate rapid and efficient decision-making, free from bureaucratic hindrances. Dr. Al Fayyadh emphasized that this transition has not altered the hospital's core mission, which remains treating the most complex medical cases, fostering medical innovation, and providing world-class healthcare.

He also noted that this new governance model significantly improved the hospital's operational performance while preserving the legacy and original vision of its founder, King Faisal. Remarkably, this new administrative model has become a benchmark, prompting other institutions, such as King Khaled Eye Specialist Hospital and King Saud University, to adopt similar governance frameworks.

Before the establishment of healthcare clusters, the hospital received approximately 22,000 new patients annually in 2019. This figure is projected to nearly double, reaching about 42,000 patients by 2024, highlighting the success of the latest healthcare ecosystem in expanding capacity and meeting patient demands.

Ultimately, the success of healthcare transformation depends on integrating efforts across all components of the healthcare system, from primary and secondary care to specialized, advanced care. KFSHRC continues to strengthen its partnerships with healthcare clusters, ensuring comprehensive patient care and effectively supporting their sustained recovery.

PART 5 · TOPIC 10

Saudi Council of Health Insurance Leading the Private Health Insurance SectorAugust 2025 · First published

In recent years, dear reader, Saudi Arabia's healthcare sector has undergone substantial transformations in terms of regulation, finance, and service delivery. The Council of Health Insurance (CHI) has played a pivotal role in leading this significant shift, particularly within the private health insurance market. Through these dedicated efforts, CHI has redefined the sector to align seamlessly with Saudi Arabia's Vision 2030, aiming to enhance the quality of life and establish a sustainable, efficient healthcare system.

CHI functions as a central regulatory authority, playing an essential role in developing the private health insurance market within the Kingdom. Over the past two decades, CHI has collaborated closely with insurance providers, healthcare entities, and government agencies to create a robust legislative and regulatory foundation for a more mature and effective health insurance market.

Through its recent five-year strategic plan, CHI has achieved notable outcomes, including a comprehensive redesign of health benefit packages and an approximately 40% increase in coverage. Additionally, it significantly boosted both claim volumes and Gross Written Premiums (GWP), reflecting rapid sector growth.

With the establishment of the new National Insurance Authority at the end of 2023, oversight of insurance companies transitioned from CHI to this specialized authority.

Consequently, CHI now focuses primarily on enhancing healthcare providers' capacities, refining benefit package designs, and advocating a value-based healthcare model, aiming to improve service quality and efficiency.

Furthermore, within the framework of digital transformation, CHI manages the National Platform for Health and Insurance Exchange Services (NPHIES). This platform serves as the cornerstone of Saudi Arabia's digital healthcare infrastructure, significantly contributing to resource optimization, transparency, and the overall efficiency of healthcare services.

Dr. Shabab bin Saad Alghamdi, Secretary-General of CHI, emphasizes that the future of Saudi Arabia's insurance sector is closely tied to broader national economic transformations. As the Kingdom's economy accelerates, the health insurance sector, particularly private insurance, is expected to witness substantial growth in the coming years.

Recent statistics reflect this development, as the number of individuals covered by private health insurance has increased remarkably from only 3 million in 2010 to over 13 million today. Over the past

five years, this sector has experienced growth exceeding 40%, with beneficiary numbers doubling consistently each year.

Future projections indicate that by 2030, the number of individuals covered by private health insurance will range between 22 and 24 million. This underscores the immense significance and growth potential of the sector within Saudi Arabia's healthcare landscape.

This anticipated growth represents a golden opportunity for private health insurance providers. The government aims to empower these providers further, ensuring the establishment of a robust and transparent health insurance system that guarantees efficiency and improves long-term health outcomes.

Notably, Saudi Arabia stands out by not adopting existing international healthcare or insurance models. Instead, the Kingdom has chosen to design a unique, tailored insurance healthcare framework reflective of its specific social values, demographic profile, and economic ambitions. The goal is to create an authentically Saudi model designed explicitly to meet the population's unique needs and future aspirations.

In conclusion, the exceptional efforts of the Saudi Council of Health Insurance highlight its central role in achieving the nation's broader goals. By ensuring high-quality healthcare services and fostering a robust, sustainable insurance sector, CHI significantly enhances the satisfaction of citizens and residents, solidifying Saudi Arabia's position as a global leader in healthcare excellence.

PART 5 · TOPIC 11**Saudi Arabia Leads Value-Driven Healthcare Transformation**August 2025 · First published

Over the past few years, Saudi Arabia has undergone a significant transformation in its healthcare sector, spearheaded by the Ministry of Health. The shift moves from traditional treatment-focused approaches toward preventive and sustainable healthcare based on value. This strategic shift aligns with Vision 2030's goals of providing comprehensive healthcare coverage and improving overall quality of life.

A key element of this transformation is the clear emphasis on preventive healthcare services. The government has initiated extensive national programs aimed at early disease screening, expanding early detection programs, and conducting large-scale vaccination campaigns. These efforts significantly improve public health outcomes and reduce the need for costly medical interventions in the long run.

An essential component of Saudi Arabia's digital health strategy is the "Sehhaty" virtual platform, considered one of the largest and most advanced telemedicine platforms globally. This platform provides specialized medical services to remote regions, effectively bridging the gap between rural and urban healthcare access. Patients across the country can now conveniently access expert consultations from leading specialists across various medical fields.

Additionally, the National Platform for Health and Insurance Exchange Services (NPHIES) plays a pivotal role in accelerating digital transformation within the healthcare sector. Having processed approximately 30 million transactions, NPHIES demonstrates Saudi Arabia's exceptional capability in digitizing healthcare, significantly improving communication between patients, healthcare providers, and insurance companies.

Moreover, the Saudi government has shown a robust commitment to developing its biotechnology sector. Biotechnology is expected to play a pivotal role in positioning Saudi Arabia as a global leader in medical research and innovation by 2040. One notable achievement in this area is the Saudi Food and Drug Authority's (SFDA) approval of CRISPR-based gene therapy, marking a groundbreaking advancement in the treatment of genetic and previously incurable diseases.

Through its National Biotechnology Strategy, the Kingdom aims to foster an environment that encourages innovation, offering significant incentives to international investors in research and development. This strategy seeks to establish Saudi Arabia as a global hub for biotechnological innovation.

Public-private partnerships (PPPs) have also played a critical role in driving this healthcare transformation. The government actively encourages private investment in hospitals, clinics, and

medical supply companies, fostering an environment conducive to innovation and investment while maintaining service quality.

Current data indicates that Saudi Arabia's healthcare sector investments amount to approximately \$40 billion, positioning it as a regional leader in healthcare investment per capita. Notable achievements in this investment landscape include the successful initial public offering (IPO) of Dr. Sulaiman Al Habib Medical Group and the substantial growth of the Fakeeh Care Group.

The pharmaceutical industry has notably experienced impressive growth, recording an approximate annual growth rate of 9%, one of the highest among G20 nations. Furthermore, the medical devices market is projected to reach approximately SAR 80 billion by 2030. The commercial health insurance sector has also grown significantly, with the number of insured individuals increasing from roughly 3 million in 2011 to over 12 million last year.

These transformations have a profound impact on Saudi society, raising public health awareness and significantly improving the quality of life. Led by the Ministry of Health in collaboration with other key sectors, including the Ministry of Industry and Mineral Resources and the Ministry of Investment, these initiatives reduce the economic burdens associated with advanced-stage diseases, allowing resources to be redirected toward development in other crucial areas. Consequently, these improvements have strengthened Saudi Arabia's position as a global healthcare destination, serving as a model for sustainable healthcare innovation.

In conclusion, the healthcare transformation in Saudi Arabia underscores the Kingdom's strong commitment to revolutionizing healthcare delivery, with a focus on value-based care. Central to this shift is the improvement of the quality of life for all citizens and residents, ensuring a comprehensive, efficient, and sustainable national healthcare system.

PART 5 · TOPIC 12

Saudi FDA Leading a Journey of Continuous Excellence and Development

August 2025 · First published

Dear reader, according to recent reports and statistics from the Saudi Food and Drug Authority (SFDA), significant and remarkable developments have been achieved over the past few years across all regulated sectors. These developments have solidified the SFDA's standing as a leading regulatory body, not only in the region but also globally. This continuous advancement is part of broader efforts to improve and regulate pharmaceuticals, medical devices, and food products, sectors that are critically important to public health.

SFDA is notably one of only three national regulatory bodies worldwide, alongside those of Singapore and South Korea, to have attained maturity level four (ML4) in the regulation of medicines and vaccines, according to the World Health Organization (WHO). Achieving this highest level of regulatory competency underscores the exceptional capabilities and efficiency of the SFDA. Furthermore, in 2023, the SFDA became the first Arab member of the Pharmaceutical Inspection Co-operation Scheme (PIC/S), an achievement that highlights international trust in Saudi Arabia's pharmaceutical oversight capabilities.

Additionally, the SFDA collaborates closely with prominent global organizations such as the International Medical Device Regulators Forum (IMDRF), the International Council for Harmonisation (ICH) of pharmaceuticals, and Codex Alimentarius, which ensures global food safety standards. These partnerships significantly contribute to harmonizing local and international regulatory systems and standards, enhancing the quality of healthcare and food products both within Saudi Arabia and internationally.

The SFDA's regulatory role has notably expanded beyond its traditional functions of approving pharmaceuticals and medical devices. At the recent Global HealthSpan Summit held in Riyadh, Dr. Hisham Bin Saad Al-Jadhey, CEO of the Saudi Food and Drug Authority (SFDA), emphasized that the role of regulatory authorities has become increasingly comprehensive and influential. He explained that SFDA's responsibilities now extend beyond ensuring safety and efficacy to actively supporting innovation, adopting advanced health technologies, and regulating health practices that impact all aspects of the healthcare system.

A key component of these broader responsibilities is the growing emphasis on the role of nutrition in public health. Recognizing Saudi Arabia's high incidence of chronic diseases such as diabetes and obesity, the SFDA has launched several practical initiatives aimed at reducing these health challenges. These include implementing clear labeling of calorie content, restricting salt content, and minimizing sugar and trans fats in food products.

These initiatives are not limited to food alone but extend to incorporating modern health technologies into daily societal practices, significantly contributing to public health improvements and reducing hospital admissions related to chronic diseases.

Moreover, the SFDA plays a crucial role in stimulating investment and growth within the regulated sectors by creating a safe and efficient regulatory environment that encourages innovation and product development. Balancing safety, efficiency, and innovation not only fosters growth in local healthcare industries but also enhances Saudi Arabia's global reputation as a leading investment and health destination.

The importance of these developments is evident, as they significantly enhance Saudi Arabia's international standing and its attractiveness to global investors in the healthcare and food sectors. Furthermore, these advancements positively impact the national economy by creating new investment opportunities, generating high-quality jobs for citizens, and generally improving public health quality. Consequently, Saudi Arabia has become a global model in healthcare regulation and food and drug safety.

In conclusion, dear reader, the continuous and significant achievements of the SFDA underscore the ambitious vision adopted by the Kingdom to establish an advanced healthcare system based on global best practices, fundamentally aimed at enhancing the quality of life and ensuring public health and safety. These ongoing efforts solidify Saudi Arabia's position as a leader in healthcare at both regional and global levels.

PART 5 · TOPIC 13

Saudi Arabia's Pharma Leap to Global Leadership

July 2025 · First published

Dear reader, over the past decade, Saudi Arabia has undertaken an ambitious overhaul of its healthcare and life sciences landscape. Guided by Vision 2030, the Kingdom is positioning itself as a knowledge-driven economy with a robust, self-reliant pharmaceutical sector. Recent data from IQVIA and Euromonitor highlight progress on several key fronts, including market expansion, manufacturing capacity, hospital infrastructure, and tender market dynamics. Here's a closer look at the numbers and why they matter.

Across the broader Middle East and Africa (MEA) region, pharmaceutical sales increased from USD 24.2 billion in 2020 to USD 29.5 billion in 2023 and are projected to surpass USD 32.6 billion in 2024, representing a cumulative growth of approximately 35% over the four years. Saudi Arabia is the primary growth driver, with the Kingdom's share increasing from USD 8.7 billion to USD 11.6 billion, underscoring strong domestic demand and rising purchasing power. The UAE, South Africa, and Algeria follow closely, while smaller markets, such as Lebanon, Jordan, and Kuwait, are expanding steadily from a lower base.

Dear reader, Zooming in on Saudi Arabia's five largest therapy areas, combined sales rose from about USD 3.8 billion in 2019 to a forecasted USD 5.6 billion by 2026 (a 6.5% compound annual growth rate). General medicines alone are expected to exceed USD 2.8 billion by 2026, followed by consumer health products at roughly USD 750 million, driven by trends in preventive care and wellness. Dermatology, digestive health, and ophthalmology remain smaller niches, but they are growing at 5–7% per year as urban lifestyles increase demand for allergy treatments and chronic disease medications.

Government tenders remain the backbone of public procurement, valued at approximately USD 5.6 billion. Two multinationals, Hikma and Sanofi, lead with 9% share each. Local champions SPIMACO (8%) and Tabuk Pharmaceuticals (7%) rank closely behind, while Pfizer, Novo Nordisk, and Novartis each hold 5–6%. At the other end of the scale, Jameel Pharma captures just 1%, signaling headroom for domestic firms to ramp up portfolios tailored to tender specifications.

Dear reader, domestic production is spreading across a broader base of players (over 2,100 registered items). Pharmaceutical Solution Industries (PSI) tops the chart with 21% of national output, followed by Tabuk (18%) and SPIMACO (15%). Jameel, Riyadh Pharma, and Jazeera Pharma each command roughly 8–9%, while a long tail of other manufacturers together accounts for 20%. The distribution highlights Ministry of Industry incentives to increase local content, promote innovation, and enhance exports, particularly following the launch of the National Biotechnology Strategy.

Dear reader, several forces are converging: sweeping healthcare financing reforms, incentives for local manufacturing that deepen supply chain resilience, a welcoming stance toward foreign direct investment, and rapid digital adoption, from telemedicine to e-prescriptions. Although rising healthcare costs and chronic disease burdens pose challenges, current indicators suggest an ample runway for both local and international drugmakers, especially in biologics, targeted therapies, and self-care products.

Saudi Arabia is charting a course to become the region's premier hub for pharmaceutical innovation and high-quality healthcare services. With a sizable domestic market, expanding infrastructure, and policies favorable to private enterprise, the Kingdom could, by the end of the decade, rank among the most attractive healthcare markets in the broader Middle East and North Africa.

In short, the "Saudi pharma leap" is no longer aspirational rhetoric; it is unfolding on the ground. Continued execution will be vital, but the trajectory points to a future where Saudi Arabia not only meets local medical needs more efficiently but also exports health solutions to the world.

PART 5 · TOPIC 14

Saudi Arabia's Pharma Leap to Global Leadership

July 2025 · First published

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PART 5 · TOPIC 15

A Comprehensive Overview of the Saudi and Arab Pharmaceutical Market

October 2024 · First published

Dear reader, in a constantly changing world, the Arab market is experiencing dynamic developments that are shaping the future of the region's economies. In this context, the data on overall market sales from 2019 to 2023 shows a continuous increase in market size, driven by economic growth and structural reforms in many Arab countries. In this article, dear reader, we will highlight the critical milestones of sales growth in the Arab markets and reveal the region's opportunities and challenges.

The sales volume in Arab markets increased significantly between 2019 and 2023, with total value jumping from \$23 billion in 2019 to \$32 billion in 2023. These figures reflect the growing demand for products and services and the increasing government commitment to achieving economic diversification and promoting sustainable development.

Among the Arab markets, Saudi Arabia maintained its position as the largest market in the region, with sales rising from \$8.6 billion in 2019 to \$11.3 billion in 2023, reflecting the intense efforts made by the Kingdom under Vision 2030 to broaden its economic base beyond oil.

Several Arab countries have achieved impressive growth rates, with Egypt recording the highest compound annual growth rate (CAGR) of 16.6%. This growth reflects bold economic reforms that have improved the investment climate and increased spending on infrastructure, stimulating the private sector and expanding the market size.

In the United Arab Emirates, markets achieved a compound annual growth rate of 13.0%, as the UAE benefited from economic stability and diversification policies focusing on developing sectors such as technology and innovation, making it an attractive investment destination.

Dear reader, the data indicates that Saudi Arabia is steadily advancing towards enhancing economic diversity and reducing reliance on oil revenues. The Kingdom achieved a compound annual growth rate of 7.3%, attributed to several factors, most notably the economic reforms introduced under Vision 2030, such as enhancing the role of the private sector and encouraging investment in non-traditional sectors like technology and tourism.

Saudi Arabia is also improving its investment and commercial infrastructure, making it an attractive environment for capital and investors seeking promising opportunities in the region.

The growth indicators witnessed in Arab markets from 2019 to 2023 are strong evidence of the region's immense potential. With the continued implementation of economic diversification plans, markets are expected to maintain positive growth, driven by investments in infrastructure and major projects and a focus on technology and innovation as growth tools.

Saudi Arabia and the United Arab Emirates are two prominent examples in this context, as they strive for further economic diversification by focusing on new sectors and investing in projects that add value to the local economy.

Saudi Arabia is one of the leading countries in the region in terms of adopting ambitious economic strategies, such as Vision 2030, which aims to achieve economic diversification and reduce dependence on oil. The recent growth in market sales serves as evidence of the success of this vision, with a focus on increasing infrastructure investment, supporting the private sector, and enhancing competitiveness. Additionally, innovation and support for entrepreneurship reflect Saudi Arabia's commitment to economic diversification and building a sustainable future that strengthens its ability to face global challenges and achieve further progress.

In summary, the data on Arab market sales from 2019 to 2023 reflects the market's dynamism and adaptability to global and local changes. The variation in growth rates among countries highlights each country's challenges while emphasizing the significant opportunities that Arab countries can seize to achieve progress and prosperity.

If Arab governments continue to focus on developing the investment environment and promoting innovation, the region will witness a bright future filled with opportunities and growth. Bold economic reforms and ambitious future visions represent a strong foundation for achieving sustainable development and prosperity for the region's people, making Arab markets one of the promising destinations for investment and growth soon.

PART 5 · TOPIC 16**The Distinct Roles of Venture Capital and Private Equity**August 2024 · First published

Dear reader, in recent years, Saudi Arabia has made significant strides in diversifying its economy beyond oil, with a strong focus on fostering innovation, entrepreneurship, and technology.

This has led to the rise of numerous investment entities, including venture capital (VC) firms and private equity (PE) funds.

Understanding the distinction between VC and PE is crucial for investors and entrepreneurs, as each type of investment has different implications for growth, risk, and returns. Today, we will explore some of the investment landscape in Saudi Arabia, focusing on the characteristics, strategies, and impacts of these investment forms.

Before delving into the specifics of Saudi Arabia's investment ecosystem, it is essential to define VC and PE.

VC involves investing in early-stage companies with high growth potential. These companies are often startups that lack access to traditional financing due to their early stage and high risk.

VC firms provide capital, strategic guidance, industry connections, and operational support. The primary goal is to nurture these startups until they reach a point where they can be sold or go public, yielding significant returns for the investors.

On the other hand, PE involves investing in more mature companies that are usually not publicly traded.

These investments are typically more significant than VC ones and often involve buyouts, where the PE firm acquires a controlling interest in the company.

The objective is to restructure, improve operational efficiency, and grow the business, eventually selling it at a profit. PE firms might also invest in distressed companies, turning them around for future gains.

Saudi Arabia's investment landscape has been evolving rapidly, driven by the government's Vision 2030 initiative, which aims to diversify the economy and reduce dependence on oil revenues.

This vision has spurred the development of various investment vehicles, including both VC and PE. However, determining whether most of these investments align more closely with VC or PE requires a closer examination of the characteristics and strategies employed by Saudi investors.

Saudi Arabia has experienced significant growth in its startup ecosystem, particularly in the technology, .healthcare, and renewable energy sectors

Organizations such as the Saudi Venture Capital Company (SVC) and other funds have been at the forefront, providing early-stage funding to startups. These investments are characterized by high risk and high reward.

Investing in early-stage companies involves significant risk due to their unproven business models; however, the potential for high returns is compelling. In addition to funding, VC firms offer mentorship, industry expertise, and networking opportunities, which are essential for startups to navigate early challenges. VC investments are often directed towards innovative solutions and disruptive technologies that have the potential to transform industries.

One noteworthy example is the investment in Careem, a ride-hailing company that became a regional competitor to Uber. Early investments from Saudi VC firms played a crucial role in Careem's growth, leading to its acquisition by Uber for \$3.1 billion. This prominent exit illustrates VC's potential returns and strategic impact in Saudi Arabia.

In Saudi Arabia, PE typically focuses on well-established businesses, especially those undergoing restructuring or looking to expand. One key characteristic to note is that PE investments are generally considered lower risk than VC investments, as they involve more mature companies with established revenue streams. PE firms often bring expertise to improve operational efficiencies, implement strategic changes, and drive growth. PE firms can influence company decisions to maximize returns by acquiring a significant or controlling stake.

An example of PE activity is the Public Investment Fund (PIF), which acquires stakes in global companies such as Lucid Motors and others across different sectors. These investments typically aim to leverage the companies' expertise and technologies to support Saudi Arabia's broader economic goals.

VC usually has a shorter to medium-term investment horizon of around 5-7 years, focusing on growth and eventual exit through IPOs or acquisitions. On the other hand, PE typically involves a medium to long-term investment horizon, often 7-10 years, emphasizing restructuring, operational improvement, and eventual sale.

VC fosters innovation by funding pioneering startups, resulting in job creation and growth across various sectors of the economy.

Conversely, physical education enhances the effectiveness and competitiveness of established businesses, potentially leading to industry consolidation and economic stability.

The investment landscape in Saudi Arabia exhibits characteristics of both VC and PE.

However, the distinction between the two is increasingly blurred, as some investment entities engage in activities that span both domains.

Ultimately, the Saudi Arabian investment ecosystem is unique in its blend of VC PE characteristics, reflecting the nation's dynamic economic diversification and growth approach. Investors and entrepreneurs can find ample opportunities supported by a robust framework that encourages innovation and strategic development.

PART 5 · TOPIC 17

Thinking Globally, Acting Locally

August 2024 · First published

The Saudi Arabian pharmaceutical and biotechnology sector stands on the cusp of a transformative era, fueled by Vision 2030, a comprehensive strategy aiming to diversify the economy and elevate the Kingdom to a global hub for biotech and pharma. To achieve these ambitious goals, the industry must adopt a mindset that embraces global opportunities and local responsibilities.

This dual approach encapsulated in the philosophy of "Thinking Globally, Acting Locally," is essential for the sector's sustainable growth and international competitiveness.

Vision 2030 outlines a strategic framework to propel Saudi Arabia into the global biotech and pharmaceutical arena.

The vision aims to foster innovation, attract international investments, and develop a robust regulatory environment that supports advanced research and development (R&D). Central to this strategy is recognizing that the Kingdom must cater to its domestic needs and position itself as a key player in the global market.

The pharmaceutical and biotech sector in Saudi Arabia needs to expand its reach beyond local boundaries in order to succeed in the global market. It is crucial to invest in advanced research and development. Saudi Arabia has allocated billions of dollars for health and life sciences research as part of its Vision 2030 initiatives.

By establishing partnerships with top international research institutions and biotech companies, Saudi Arabia can expedite the development of innovative therapies and medical technologies.

Harmonizing local regulations with international standards will facilitate smoother entry into global markets. This includes adopting best practices in clinical trials, manufacturing, and quality assurance. The Saudi Food and Drug Authority (SFDA) is working towards aligning with the U.S. Food and Drug Administration (FDA) and the European Medicines Agency (EMA) to streamline approval processes.

Based on the projections and strategic goals outlined in Saudi Arabia's Vision 2030, the Kingdom aims to increase its pharmaceutical exports significantly. Presently, Saudi Arabia's pharmaceutical exports stand at approximately \$1.5 billion. However, the Kingdom has set an ambitious target to boost this figure to \$5 billion by 2030.

Saudi Arabia plans to double its domestic pharmaceutical manufacturing from 20% to 40% to meet the local market demand while aiming for a global presence. The Kingdom's pharmaceutical industry currently holds a 37% share of the MENA market, and it is projected to achieve annual sales of over

\$10 billion by 2032. By 2030, the industry is expected to grow at a compound annual growth rate (CAGR) of over 5%, with estimates forecasting a growth rate of more than 9% by 2033.

Under Vision 2030, Saudi Arabia plans to invest \$65 billion to enhance healthcare infrastructure and promote local production. This initiative includes shifting pharmaceutical imports to domestic manufacturing through agreements with the Saudi National Unified Procurement Company (NUPCO). Additionally, major international biopharmaceutical companies like Pfizer and GSK are establishing regional facilities to boost local production capabilities and contribute to the Kingdom's goal of becoming a leader in the MENA region's life sciences sector.

This strategic push is part of a broader effort to diversify the economy and reduce dependency on oil revenues by developing a robust pharmaceutical and biotechnology sector. The Saudi government is heavily investing in local manufacturing capabilities and fostering partnerships with international pharmaceutical companies to achieve these goals. These initiatives include local production incentives, regulatory reforms aligning with global standards, and substantial investments in research and development.

It is essential to create a skilled workforce knowledgeable in global industry trends and practices. International training programs, exchange initiatives, and collaborative research projects can aid in developing local expertise with a global perspective. To meet industry demands, the number of biotech graduates is expected to increase by 20% annually.

While seeking global prominence, the Saudi pharmaceutical and biotech sector should not overlook its local responsibilities. Ensuring that the domestic market benefits from these advancements is equally important.

It is crucial to ensure that the latest medical innovations and treatments are accessible to the Saudi population. This involves enhancing healthcare infrastructure and ensuring that advanced therapies are available at reasonable prices. Presently, 70% of pharmaceuticals are imported, and the aim is to decrease this to 30% by 2030 through increasing local production.

Strengthening local manufacturing capabilities can reduce import dependency, create jobs, and ensure a stable supply of essential medicines. This aligns with the broader goals of economic diversification and self-sufficiency. Driven by local manufacturing initiatives, the local pharmaceutical market is projected to grow from \$8 billion in 2020 to \$25 billion by 2030.

Focusing on public health challenges specific to the region, such as diabetes, cardiovascular diseases, and genetic disorders, can have a significant impact. Tailoring research and healthcare solutions to address these issues will enhance the overall health and well-being of the population. The prevalence of diabetes in Saudi Arabia is around 18% and addressing such endemic health issues through local R&D is critical.

For Saudi Arabia to realize its Vision 2030 ambitions, a balanced approach that integrates global aspirations with local impact is essential. The biotech and pharma sector must cultivate a mindset that recognizes the interconnectedness of local and international markets. By doing so, the industry can ensure that it contributes meaningfully to the Kingdom's economic growth while also making a mark on the global stage.

The Saudi pharmaceutical and biotechnology sector is at a pivotal juncture. Embracing a strategy of "Thinking Globally, Acting Locally" is not just a choice but a necessity. By aligning with the goals of Vision 2030 and adopting a dual-focused approach, the sector can become a powerhouse of innovation, meeting local and global healthcare needs. This vision of a globally integrated yet locally committed industry will pave the way for Saudi Arabia to become a leader in the biotech and pharmaceutical landscape.

PART 5 · TOPIC 18

Disrupting Saudi Arabia's Pharma Market

July 2024 · First published

The pharmaceutical market in Saudi Arabia is experiencing a profound disruption, shifting from a long-standing focus on generic drug manufacturing to an emphasis on innovation and research and development (R&D). This transition is not merely a strategic adjustment but a transformative movement aimed at addressing modern healthcare demands, enhancing drug security, and positioning Saudi Arabia as a global leader in pharmaceutical innovation.

For a long time, Saudi Arabia's pharmaceutical industry has been primarily focused on producing and distributing generic drugs. These lower-cost alternatives to brand-name medications have been instrumental in ensuring that a wide range of essential treatments are available to the population. The emphasis on generics has led to the establishment of a strong manufacturing foundation and has fostered the growth of local expertise.

While generics have ensured the availability of affordable medicines, they do not cater to the growing need for advanced therapeutic solutions or align with global trends towards personalized medicine. As healthcare needs become more complex, the limitations of a generics-centric approach become apparent, prompting the necessity for a disruptive shift towards innovation and R&D.

The market disruption is being driven by Saudi Arabia's Vision 2030 initiative. Vision 2030 aims to diversify the economy and reduce reliance on oil revenues by strengthening other sectors, such as healthcare and pharmaceuticals. Significant investments are being made in healthcare infrastructure, education, and the establishment of specialized research institutions to support this transformative shift.

One of the primary motivations behind this disruption is enhancing drug security. Relying heavily on imported medications exposes the country to global supply chain vulnerabilities and geopolitical risks. By fostering a robust pharmaceutical R&D ecosystem, Saudi Arabia aims to secure a steady supply of critical medications, reducing dependency on external sources and enhancing national drug security.

The shift towards innovation and R&D requires comprehensive investment in several key areas. This includes establishing and strengthening research institutions and universities to conduct advanced pharmaceutical and biotechnological research, as well as fostering collaborations with international research organizations. Talent development is also crucial. Investments in education and training programs are needed to develop a skilled workforce capable of driving pharmaceutical innovation. This encompasses scholarships, research grants, and partnerships with leading global institutions. Additionally, a supportive regulatory framework is essential, one that encourages innovation while

ensuring patient safety by streamlining drug approval processes and promoting clinical trials within the country. Public-private partnerships are equally important, as collaborations between the government, academia, and the private sector facilitate sharing resources, knowledge, and expertise, thereby accelerating the development of new drugs.

Technology transfer is a crucial element in this disruptive shift. Saudi Arabia can accelerate its journey toward innovation by acquiring advanced technologies from global pharmaceutical leaders and integrating them into the local ecosystem. This process involves transferring technical knowledge, skills, and equipment, allowing regional companies to produce high-quality, innovative drugs. Technology transfer agreements and collaborations with multinational pharmaceutical companies can provide access to cutting-edge research and development practices, enhancing the local industry's capability to innovate and compete globally.

The transition from standard manufacturing to innovation and research and development (R&D) in the market offers substantial advantages.

Economic growth and diversification: Investing in pharmaceutical R&D stimulates economic growth and diversification. The creation of innovative drugs and therapies generates high-value jobs, attracts foreign investments, and fosters the growth of related industries like biotechnology and medical devices. This aids in reducing the economy's reliance on oil revenues.

Improved healthcare outcomes: Innovative drugs and therapies can significantly enhance healthcare outcomes by providing advanced treatment options for complex and chronic diseases. Personalized medicine, which tailors treatments to individual patients based on their genetic makeup, is one area of innovation that promises to revolutionize healthcare. By investing in research and development (R&D), Saudi Arabia can ensure access to the latest and most effective treatments.

Establishing itself as a center for pharmaceutical innovation can boost Saudi Arabia's global competitiveness. By creating and exporting innovative medications, the country can position itself as a leader in the global pharmaceutical market. This can attract more investments and partnerships, leading to a cycle of growth and innovation.

Saudi Arabia's ambition to become a global hub for pharmaceutical innovation requires a strategic and comprehensive approach. Key steps include significant investment in infrastructure, such as building state-of-the-art research facilities, laboratories, and manufacturing plants equipped with the latest technologies to support advanced research and production processes. Fostering innovation clusters where pharmaceutical companies, research institutions, and startups can collaborate and share resources is also crucial, as these clusters facilitate the rapid exchange of ideas and accelerate drug development. Developing a robust clinical trial ecosystem is essential for testing new drugs and therapies. This can be achieved by streamlining regulatory processes and providing incentives for conducting clinical trials within the country, thereby attracting international pharmaceutical companies to invest in local R&D. Ensuring strong intellectual property protection is vital for encouraging innovation, as companies need assurance that their R&D investments will be protected.

from infringement. Strengthening IP laws and enforcement mechanisms creates a favorable environment for pharmaceutical innovation. Finally, forming strategic partnerships with leading global pharmaceutical companies and research institutions provides access to advanced technologies and expertise. Collaborative research projects and joint ventures can accelerate the development of innovative drugs and therapies.

PART 5 · TOPIC 19

If Saudi Arabia Won't Act, then Who Will?

April 2024 · First published

One of the prominent business leaders in the United Arab Emirates once said, "If Saudi Arabia won't act, then who will?"

Amidst the current global political and economic changes, the Kingdom of Saudi Arabia has emerged as a significant power in the Middle East and globally. The country has become a driving force for progress beyond its borders, influencing the region and the rest of the world. This resurgence is exemplified by the Kingdom's Vision 2030, which signifies its deep commitment to achieving sustainable development and comprehensive economic transformation. The goals of Vision 2030 aim to enhance the quality of life, foster innovation, and advance technology on a global scale. This is happening under the wise leadership of King Salman bin Abdulaziz Al Saud and Prince Mohammed bin Salman, the Crown Prince and Prime Minister.

Saudi Arabia is making significant investments in large-scale projects to modernize its infrastructure and reduce dependence on oil as its primary source of income. The country also focuses on diversifying its economy by developing new tourism, technology, and renewable energy sectors. This strategy aims to create sustainable revenue streams and boost economic growth, ultimately positioning Saudi Arabia as a critical player in the global economy across multiple sectors.

Saudi Arabia is aware of the crucial role that science and technology play in driving progress and development. Therefore, the country is emphasizing the advancement of education, research, and innovation by establishing modern educational and research institutions and providing support for entrepreneurship and innovation. The ultimate objective is to create a knowledge-based economy that encourages comprehensive and sustainable growth.

The Kingdom of Saudi Arabia has demonstrated the importance of leadership and ambition in shaping the future of the Middle East and beyond. By undertaking mega-projects and futuristic strategies, Saudi Arabia is progressing toward achieving its Vision 2030 goals. The country has highlighted several landmark projects that serve as significant milestones on this path, including:

NEOM: It is a project to create an advanced economic and technological zone on the Red Sea coast. The zone will focus on innovation, technology, renewable energy, and other sectors.

Qiddiya: It is one of the most significant entertainment projects in the world and is located near Riyadh. Its goal is to establish Saudi Arabia as a premier tourist destination by providing global entertainment, sports, and arts experiences.

The Red Sea Project: Over 50 islands will be developed into a luxury tourist destination, with a focus on sustainable tourism and preserving the natural environment.

Amaala: This luxury tourism destination, situated on the northwestern coast of the Kingdom, aims to create a luxurious and sustainable environment. It is dedicated to wellness and relaxation.

AlUla Vision: An initiative to make AlUla a global destination for heritage, culture, and nature, leveraging its rich history and natural beauty.

The Saudi Green Initiative and the Middle East Green Initiative: Their goal is to promote sustainability by planting trees, reducing carbon emissions, and developing renewable energy sources.

Recognizing the significant role played by the Public Investment Fund (PIF) in realizing Vision 2030 is essential. As one of the world's most significant sovereign wealth funds, PIF is committed to diversifying Saudi Arabia's sources of income and investing in various sectors, including technology, renewable energy, industry, tourism, and infrastructure. Below are some notable examples of PIF's investments in the technology and industry sectors:

Global technology companies: PIF invested in major tech companies, such as Uber and Lucid Motors, to expand its investment portfolio and benefit from the growth in the tech sector.

Technology funds: The fund invests in technology-focused venture capital funds, including those for early-stage start-ups and high-growth companies.

Local tech hubs: PIF supports and funds tech projects in Saudi Arabia with the aim of turning the country into a regional center for innovation and technology.

Renewable energy and clean industries: PIF invests in solar and wind energy projects, emphasizing clean industries and renewable energy as part of the Kingdom's commitment to transition to clean energy.

Manufacturing industries: The fund invests in developing manufacturing industries in the Kingdom, including heavy and light industries, to enhance the country's industrial base and create job opportunities.

Industrial infrastructure: PIF supports industrial infrastructure projects such as industrial cities and special economic zones to attract foreign investments and facilitate production and export processes.

Saudi Arabia is positioning itself as a leader in innovation and sustainable development. It emphasizes the importance of teamwork and global cooperation in addressing common challenges. The Saudi Renaissance is proof of its ability to evolve and progress.

If Saudi Arabia won't act, then who will?

PART 5 · TOPIC 20

Unlocking the Future of Healthcare with the Revolutionary Impact of King Abdulaziz University's 'I-ONE' Company

April 2024 · First published

You are likely aware of Saudi universities' crucial and significant role in education, research, innovation, community service, and other pioneering areas. King Abdulaziz University has excelled in all these areas, not only on a national level but also regionally and globally.

In our previously published article, we discussed Wadi Jeddah Company's leadership role as King Abdulaziz University's investment arm and highlighted the exceptional performance of its medical subsidiary, Al-Teriaq Pharma, in providing unique and high-quality university products in the local market. This effort aims to develop and localize the pharmaceutical and biotechnological industries.

Wadi Jeddah Company's outstanding achievement, I-ONE, produces radioactive isotopes and molecular imaging for medical purposes.

In its continuous effort to advance healthcare, "I-ONE" introduces the latest medical solutions and plays a crucial role in diagnosing and treating various diseases, including oncology, neurology, cardiology, and orthopedics.

I-ONE is a specialized medical imaging company situated in the heart of Jeddah, on the premises of King Abdulaziz University. The company has access to the latest medical research and technologies, and it offers advanced PET/CT-MRI services that combine magnetic resonance, computed tomography, and nuclear imaging to provide accurate and comprehensive diagnostics for patients.

"I-ONE" is an advanced diagnostic system designed to conduct various medical tests for different conditions. These include oncology, brain disorders such as Alzheimer's and epilepsy, heart diseases, and bone and tissue-related ailments. The system employs specially manufactured radioactive isotopes customized to each patient, producing more precise test results. This accuracy assists doctors in identifying the most effective treatment plan for each patient.

The company employs sophisticated molecular imaging technology known as the Cyclotron to manufacture "radioactive medical isotopes." These cutting-edge technologies enable precise and rapid medical examinations, reducing patients' discomfort and accelerating healing. The company's integrated facility produces isotopes with the highest safety standards and technological advancements that have a global impact.

Dear reader, we all take pride in the fact that the "I-ONE " company relies entirely on Saudi talents, as all of its employees are from the Saudi elite.

The company focuses on early disease detection and effective treatment monitoring while contributing to the university's development of nuclear medicine and molecular imaging research.

I-ONE plays a crucial role in enhancing the Saudi community's healthcare quality. The company is dedicated to improving disease diagnosis accuracy early and providing a solid foundation for scientific research, which could lead to new medical discoveries.

I-ONE is a healthcare company that is dedicated to providing advanced diagnostic services. The company believes that early detection of diseases can lead to improved healing rates, and hence, it strives to offer its community the best possible healthcare services. I-ONE is committed to excellence and innovation and has a team of qualified specialists and the latest technologies to support this goal.

Investing in specialized medical sectors like I-ONE is a crucial step towards the future of healthcare in the Kingdom of Saudi Arabia. This investment ensures patients receive the best possible services and strengthens the country's capacity to meet future health challenges.

The Vision 2030 plan lays a strong foundation for comprehensive development in all aspects of life in the Kingdom of Saudi Arabia. Its fundamental goal is to improve the people's quality of life. King Abdulaziz University, Wadi Jeddah Company, and their subsidiaries, such as Al-Teriaq Pharma and "I-ONE," are excellent examples of how the strategic objectives of the Vision and the university are integrated into practical projects that directly improve the people's quality of life.

Focusing on innovation, scientific research, and modern technologies in healthcare and medical fields, "I-ONE" and other King Abdulaziz University projects reflect the national ambition to achieve self-sufficiency in vital sectors and enhance the Kingdom's research and innovation capabilities.

Initiatives such as those of the Wadi Jeddah Company serve as exemplary models for universities, the government, and the private sector. They demonstrate the significant role that the company and university can play in developing the medical and health sectors. This approach can serve as a model for integrating the educational, health, innovation, and economic sectors to achieve comprehensive and sustainable development that benefits society.

PART 5 · TOPIC 21

Building Saudi Arabia's "Trillion-Dollar Pharmaceutical Giant"

February 2024 · First published

Can we, in the Kingdom of Saudi Arabia, build and own the largest pharmaceutical company in the world? And is the private sector in the Kingdom ready to participate in achieving this monumental goal?

The answer is undoubtedly yes! We have outstanding leadership and vision for a magnificent nation. We are capable of establishing the world's largest pharmaceutical company. Why not when we have a great "Biotechnology Strategy" with a global vision launched by His Royal Highness Prince Mohammed bin Salman, the Crown Prince and Prime Minister? Building a "Saudi Trillion-dollar Pharmaceutical Giant" is, from my perspective as a specialist in this field and guided by what His Royal Highness Prince Mohammed bin Salman said, "There is no impossible in the Saudi dictionary" and "Our ambition reaches the sky." As Saudis, our ambition is enormous, and we can achieve anything if we have the will, determination, and clear strategic plans for implementation.

Constructing a giant pharmaceutical company in the Kingdom worth "one trillion US dollars" is a monumental task and the first of its kind globally. However, it is not impossible, considering no pharmaceutical or medical company has reached a market value exceeding one trillion US dollars globally. As of the beginning of 2024, the American pharmaceutical company "Eli Lilly and Co." is the world's largest, with a market value approaching 600 billion US dollars.

Dear reader, for the Kingdom to achieve this ambitious goal, planning and hard work on crucial and ambitious strategies are necessary. These include receiving exceptional government support, massive investments in financing, tax incentives, regulatory support, and other financial matters, all vital to creating an ecosystem conducive to significant growth in the pharmaceutical and biotechnology industries.

Intensive investment in research and development (R&D) is essential and unavoidable. This requires establishing advanced research facilities, employing top talent, and focusing on developing innovative quality drugs, especially in areas with high demand and profitability. Moreover, forming genuine strategic partnerships in drug development and technology transfer by collaborating with emerging and global pharmaceutical companies, advanced research centers, prestigious universities, and other related sectors is crucial for accessing expertise and quality technology. This includes joint efforts in drug development, clinical trials, technology transfer, and more, focusing not just on "manufacturing" but, importantly, on "industry" in general and "technology transfer" as a top priority and key to developing innovative pharmaceutical products.

Another crucial strategy for building Saudi Arabia's "Trillion-Dollar Pharmaceutical Giant" is "bold investment" in the best global opportunities in biotechnology for ownership and transfer of

innovative deep technology. Additionally, mergers and acquisitions (M&A) of the best startup and medium-sized companies in the global pharmaceutical and biotechnology industries, as well as strategic alliances with the world's leading pharmaceutical companies in "drug innovation," are extremely important. This should include apparent harmony and integration in all these operations.

While focusing on the domestic market is essential and strategic, the real value lies in accessing global markets. This includes adhering to international standards and obtaining necessary approvals like the U.S. Food and Drug Administration (FDA) clearance. The U.S. market, representing approximately 40% of the global pharmaceutical market size, is considered the "golden key" to most global markets. Also, building solid global distribution networks and leveraging Saudi Arabia's strategic location and economic status to establish innovative drug manufacturing centers is beneficial at an advanced stage.

Building a solid global Saudi brand is fundamental for all of us as Saudis. Addressing global health challenges, such as participating in combating pandemics or tackling widespread diseases, will present the Kingdom as a worldwide leader in healthcare and a model for health innovation. This journey is filled with challenges and opportunities. Yet, success depends on the company's ability to adapt to continuous changes in global markets and meet evolving healthcare needs, maintaining a clear and steady vision that drives it toward achieving its ambitious goals.

In conclusion, dear reader, as we started with the saying of His Royal Highness Prince Mohammed bin Salman, we also end today's article with his quote: "We try to work only with dreamers who want to create something new in this world."

PART 5 · TOPIC 22

Advancing into the Future: Saudi Arabia's Pioneering Vision in Biotechnology and Its Global Impact

February 2024 · First published

Dear reader, the Kingdom's leadership's significant attention to the biotechnology sector underlines its forward-looking vision for achieving sustainable health, economic prosperity, and quality of life.

I propose in this article that "the 13th day of the month of Rajab" be designated annually as the "Saudi Biotechnology Day." This is to commemorate the launch of the "National Biotechnology Strategy" by His Royal Highness Prince Mohammed bin Salman, Crown Prince and Prime Minister. Biotechnology has become a fundamental pillar in the Kingdom's national strategy, reflecting the Crown Prince's insightful vision for a bright future that ensures regional and global leadership and sustainable development.

The "National Biotechnology Strategy" is a key component in achieving the goals of Saudi Vision 2030. It aims to develop and localize vaccine manufacturing, enhance biomanufacturing, lead in genome research, and improve plant cultivation. This is a significant step towards strengthening the Kingdom's regional and global leadership.

Dear reader, the COVID-19 pandemic has highlighted the importance of biotechnology and the development of effective vaccines for combating infectious diseases. Saudi Arabia has strengthened its vaccine manufacturing capabilities and supported research, development, and innovation towards self-sufficiency and vaccine export. This enhances regional health security and contributes to scientific advancement in this field.

The Kingdom is working to reduce its reliance on imported biopharmaceuticals and ensure its citizens have quick, cost-effective access to essential medicines. This includes localizing the production of key biopharmaceuticals, establishing an integrated biomanufacturing platform, and providing locally accessible, high-quality, affordable medicines.

The "National Biotechnology Strategy" focuses on genomics to innovate treatments at lower costs, particularly for common genetic diseases in the region. This improves the efficiency of healthcare resources. The strategy includes expanding national genome databases, creating a regulatory environment to support innovation, and using genomic technologies for diagnosis and treatment, aiming to position the Kingdom as a global leader in genomics.

Furthermore, Saudi Arabia aims to improve plant cultivation to secure sustainable food sources, particularly in its arid climate. This will reduce dependence on food imports and enhance environmental sustainability. The strategy involves developing a comprehensive system for crop cultivation, innovative methods, and applying biotechnology to grow trees resistant to dry climates as part of the Saudi Green Initiative.

These initiatives go beyond their four main directions, striving for integration and inclusiveness in various biotechnology applications to meet needs and ensure the growth of the biotechnology sector.

Dear reader, we are confident that under its wise leadership, the Kingdom of Saudi Arabia will emerge as a global hub for biotechnology. The Kingdom possesses all the essential elements to achieve this goal, including specialized ministries and agencies, distinguished scientists, advanced infrastructure, cutting-edge research centers, and sophisticated regulatory and legislative systems. It also boasts active government and private sectors, significant investment power, advanced industrial and manufacturing capabilities, and, most importantly, a clear vision and strategy from an inspiring leadership aiming to position Saudi Arabia as a global force in biotechnology.

The "National Biotechnology Strategy" benefits for the Kingdom of Saudi Arabia extend beyond achieving self-sufficiency in medicine and food to becoming a global center for innovative biotechnology, aligning with Vision 2030. Through enhancing research and innovation, developing sustainable industries, and improving food and health security, the Kingdom positions itself as a world leader, affirming its role as a significant player in the global economy and scientific community.

PART 5 · TOPIC 23

Unlocking the Potential: Why Saudi Arabia's Investment in Pharmaceuticals and Biotechnology Holds the Key to a Promising Future

December 2023 · First published

Before answering the question of today's article, dear reader, can you imagine that the global pharmaceutical sector's size is over seven trillion US dollars, which exceeds 26 trillion Saudi Riyals in 2021 alone? Is the pharmaceutical and biotechnology industry promising?

The annual revenue of the global pharmaceutical sector in 2021 exceeded \$1.44 trillion US dollars (more than 5 trillion Saudi Riyals). The global pharmaceutical sector is massive, and if you compare the "revenues" of this sector with the Gross Domestic Product (GDP) of the world's largest countries over a specific period, this sector would rank 13th as the largest economy in the world in terms of budget size. Is the pharmaceutical and biotechnology industry promising?

The size of the global pharmaceutical sector doubled in just eight years. Is the pharmaceutical and biotechnology industry promising?

In 2021, the United States leads as the largest pharmaceutical market, accounting for nearly 40% of the global pharmaceutical market size, followed by China with 12%, and then Switzerland, the United Kingdom, and Germany. Is the pharmaceutical and biotechnology industry promising?

There are several compelling reasons why the pharmaceutical and biotechnology sector is up-and-coming, not only on a global scale but specifically for Saudi Arabia:

Saudi Vision 2030: Saudi Arabia's Vision 2030 significantly emphasizes diversifying the economy. The government recognizes the potential of the pharmaceutical and biotechnology industry to contribute to this diversification by creating high-skilled job opportunities, reducing the country's dependency on oil, and fostering innovation and research.

Global Demand: The world's population is continuously growing and aging. With these demographic shifts comes an increased need for healthcare, pharmaceutical products, and innovative biotechnological solutions. As healthcare becomes a global priority, the demand for pharmaceuticals and biotechnology advancements will remain robust.

Healthcare Innovation: Advances in biotechnology have the potential to revolutionize healthcare. New therapies, precision medicine, and gene editing techniques are just a few examples of groundbreaking developments within the sector. Investing in these technologies can improve healthcare outcomes and drive economic growth.

Strategic Location: Saudi Arabia provides a unique advantage for tapping global pharmaceutical markets. It can bridge Europe, Asia, and Africa, facilitating trade and collaboration in the sector.

Investment Incentives: The Saudi government has introduced various incentives and initiatives to attract domestic and foreign investors. These include funding research and development, offering tax incentives, and providing regulatory support to encourage the growth of the pharmaceutical and biotechnology industry.

Local Manufacturing: Encouraging local pharmaceutical manufacturing reduces import dependency and enhances the country's self-sufficiency in critical medicines and vaccines, making it more resilient to global supply chain disruptions.

Research and Development: Investing in research and development within the pharmaceutical and biotechnology sectors can lead to discovering new drugs, therapies, and medical technologies. Saudi Arabia's commitment to fostering research institutions and innovation centers can drive significant advancements.

Export Opportunities: By nurturing a thriving pharmaceutical and biotechnology sector, Saudi Arabia can meet domestic healthcare needs and export products to international markets, contributing to economic growth.

The pharmaceutical and biotechnology sector holds immense promise for Saudi Arabia due to global demand, ongoing healthcare innovation, government support, strategic advantages, investment incentives, and the potential for economic diversification. By capitalizing on these opportunities, Saudi Arabia can position itself as a leader in this critical industry and reap the associated economic, scientific, and healthcare benefits.

Dear reader, in response to the question, "Is the pharmaceutical and biotechnology industry promising?" The unequivocal answer is yes. The factors mentioned earlier underscore the vast investment potential within this sector. With the steadfast vision of our rational government and the ambitious goals outlined in Saudi Vision 2030, Saudi Arabia is fervently striving to position itself as a global hub for the biotechnology and pharmaceutical industries.

PART 5 · TOPIC 24

Saudi Megaprojects are Pillars of a Global Economic Superpower: A Glimpse from 2040

November 2023 · First published

By 2040, Saudi Arabia was no longer just a vast desert nation known for its oil riches. Its vision had materialized into a reality where innovation, tourism, culture, and economic prowess intertwined seamlessly, placing the country at the center of global attention.

Neom, once an ambitious plan, had become the global city of the future. Its futuristic skyline is blended with the northwestern region's sustainable architectures and tech-integrated ecosystems. This city is an economic powerhouse hotbed of research, innovation, and next-gen technologies. Neom is a model for cities worldwide, showcasing how urban spaces could be advanced and sustainable.

Riyadh, the capital, had evolved into a dynamic urban center, rivaling global cities better than the best world-class cities such as New York and Tokyo. Besides being a political and administrative hub, Riyadh emerged as a center for fintech, biotechnology, AI-driven industries, cutting-edge scientific research, and others. Its business districts buzzed with global headquarters and state-of-the-art tech facilities.

The coastal gem of Saudi, Jeddah, is the epitome of blending tradition with modernity. As a hub for marine research and sustainable oceanic projects, Jeddah also retained its status as a gateway for pilgrims, further boosting its global tourism profile.

Al Ula, once a hidden gem in the kingdom's northwestern region, had risen to global fame. This ancient city, with its rock formations and archaeological sites, fused history with contemporary art and culture. Resorts, museums, and galleries made Al Ula a sought-after destination for cultural tourism.

With their unique landscapes and terrains, the southern regions had become a beacon for eco-tourism and adventure seekers. Integrated resorts, mountain retreats, and sustainable farming projects attracted visitors and researchers alike.

Each direction in Saudi held its unique allure. Research facilities and academic institutions marked the northern regions. With its oil reserves, the East had transformed into an energy research and innovation hub, focusing on sustainable and renewable sources. The western coastline, dotted with luxurious resorts, marinas, and entertainment zones, had become a Riviera for the world's elite.

Beyond cities, projects like the Red Sea Project and Qiddiya have altered the tourism landscape. The Red Sea Project, with its untouched islands and coral reefs, was a luxury destination focusing on

marine conservation and high-end experiences. Qiddiya, on the outskirts of Riyadh, was the entertainment capital, home to theme parks, sports arenas, and cultural venues.

By 2040, these mega-projects had transformed Saudi Arabia into a multifaceted jewel. The nation was not just an economic superpower but also a nexus for global innovation, a destination for discerning tourists, and a hub for culture and arts.

Saudi's strategic investments in education, infrastructure, and technology had borne fruit. The world now looks at Saudi for oil and leadership in various sectors. Saudi was at the forefront, from innovations in renewable energy to breakthroughs in biotechnology.

Tourism flourished, with visitors flocking to experience Saudi's unique blend of tradition and modernity. Diverse sectors, from tech startups in Neom to art festivals in Al Ula, buoyed the nation's economy.

In 2040, Saudi Arabia had realized its vision. It was not just self-reliant but was guiding the world in several domains. As a testament to its visionary leadership and relentless pursuit of excellence, Saudi Arabia stood tall, not as an oil-rich nation, but as a global superpower shaping the 21st century.

PART 5 · TOPIC 25

A Glimpse into 2040: Saudi Arabia's Emergence as a Global Leader in Pharmaceutical and Biotechnological Advancements

November 2023 · First published

From the expansive horizons of "Neom" to the bustling metropolises of "Riyadh," "Jeddah," and other cities, we are now in 2040, which paints a picture of Saudi Arabia quite unlike any other period in its history. The kingdom has metamorphosed into the epicenter of pharmaceutical industries and biotechnological advancement, akin to how Taiwan cemented its global position in the semiconductor sector almost 40 years ago.

But why did Saudi Arabia focus on the biotechnology and pharmaceutical industries, and why are these industries so vital?

In the 21st century, the importance of health and wellness has become more pronounced than ever. The ability to combat diseases, enhance longevity, and improve quality of life was a matter of personal well-being, national security, and global cooperation. Biotechnology and pharmaceuticals stood at the crossroads of these essential pursuits. They represented sectors where research could translate into tangible solutions to address some of the world's most pressing health challenges. For Saudi Arabia, investing in these sectors meant investing in the future of humanity.

Economically, the biotech and pharmaceutical industries presented immense growth potential. They promised a shift from traditional industries, paving the way for a knowledge-based economy characterized by innovation, research, and high-value production. By 2040, Saudi Arabia's decision to focus on these sectors saw it reaping exponential economic benefits. The nation's GDP witnessed an unprecedented spike, making it a pillar of global economic stability.

Moreover, the advancement in these sectors did not just influence the country's economic metrics; it translated into tangible improvements in the quality of life for its citizens. With cutting-edge medical solutions being developed domestically, healthcare in Saudi Arabia underwent a radical transformation, placing it at the forefront of global health standards.

This year, 2040, Saudi Arabia's pharmaceutical and biotechnology landscape has demonstrated its global significance with impressive milestones. Half of the big global pharmaceutical companies are now based in Saudi Arabia. Additionally, the Saudi FDA approves numerous innovative Saudi drugs each year, all developed by these leading Saudi pharmaceutical giants. The innovation isn't restricted to established giants alone; the nation has become a cradle for biotechnological startups. Hundreds of these ventures, backed by cutting-edge research and driven by young Saudi visionaries, show immense promise for the future. This surge in startups, complemented by the support from established pharmaceutical leaders, showcases a diverse and robust ecosystem. It's clear that from research and innovation to production, Saudi Arabia is setting a gold standard in pharmaceutical and

biotechnological advancement. As we move through the dynamic cities of "Neom," "Riyadh," and "Jeddah," witnessing this incredible transformation offers a glimpse into a future where Saudi Arabia's mark on global health innovations becomes even more profound.

The year 2040 has also seen Saudi Arabia ascend as a global hub for clinical trials, underpinning its prominence in the pharmaceutical sector. State-of-the-art facilities, stringent ethical standards, and a diverse patient pool have made the nation a preferred destination for multi-phase clinical testing. Collaboration between research institutions, hospitals, and pharmaceutical giants has streamlined the clinical trial process, ensuring rapid yet thorough evaluations. As a result, novel therapies and drugs are tested with unmatched precision and rigor, solidifying Saudi Arabia's reputation for excellence in clinical research. This advancement accelerates drug approvals and patient access and places Saudi at the forefront of medical breakthroughs, further cementing its pivotal role in global healthcare innovation.

Saudi's strategic focus on these industries did more than bolster its economy and well-being; it positioned the nation as a beacon of hope and innovation for the global community. New drugs, state-of-the-art medical equipment, and groundbreaking therapies from Saudi research facilities became instrumental in addressing global health crises, ensuring the country's influence was felt far beyond its borders.

About two decades ago, a visionary blueprint was laid down by Saudi leadership. This blueprint, which identified pharmaceuticals and biotechnology as sectors ripe for pioneering and robust investments in education, research, and infrastructure, ensured the country's meteoric rise in global health. Now, as we navigate the state-of-the-art facilities in Neom, Riyadh, and Jeddah, the fruits of this vision are evident.

Maybe in one of our upcoming articles, we will delve deeper into this transformative journey, tracing the steps taken, the strategies employed, and the relentless drive that led Saudi Arabia to its present stature. We'll unravel the story of how the nation became the epicenter of biotech and pharma innovations that propel its future and shape the world's destiny. Stay with us as we chronicle this inspiring saga of vision, dedication, and unparalleled success.

PART 5 · TOPIC 26

The 21st Century's Greatest Success Story: A Glimpse from 2040

November 2023 · First published

As the second decade of the 21st century dawned, many nations sought to make their mark on the global stage. However, by 2040, one country stood out from the rest, not just as a success story but as the most compelling and transformative journey of the century: Saudi Arabia. Under the leadership of Mohammed bin Salman and propelled by Vision 2040, the country experienced a metamorphosis that would go down in history.

Saudi Arabia is no longer an oil-rich nation but the epicenter of global innovation. With cities like Neom leading the charge, the kingdom showcased a blend of advanced technology, sustainability, and forward-thinking that became a benchmark for cities worldwide. From the northern regions to the east, research facilities nationwide continuously broke barriers in sectors from renewable energy to biotechnology. The world now looked to Saudi for the next big breakthrough, not just the next barrel of oil.

From the archaeological wonders of Al Ula to the pristine beaches of the Red Sea Project, Saudi became a magnet for global travelers. But it wasn't just the destinations that captivated us; it was the harmonious blend of ancient traditions with ultra-modern facilities. The country crafted a unique tourism tapestry that wove in its rich history, culture, and cutting-edge amenities, making Saudi a must-visit for every global traveler.

By this year, 2040, the Saudi Arabian economy is a force to be reckoned with. Diversifying from its oil-centric past, the nation flourished in various sectors. Riyadh transformed into a global financial hub, Jeddah's ports became models for intelligent logistics, and the southern regions attracted eco-tourism and sustainable farming ventures. The kingdom's growth wasn't just vertical; it was expansive, covering sectors few had imagined.

By 2040, Saudi Arabia had firmly established itself as a global epicenter of innovation. Vision 2040's relentless pursuit of fostering innovation has yielded remarkable results. The nation had become a living testament to what visionary leadership, strategic investments, and an unwavering commitment to progress could achieve. From the advanced technological marvels of Neom to groundbreaking research in renewable energy and biotechnology, Saudi Arabia's innovation ecosystem has set new benchmarks for the world. It wasn't just about creating cutting-edge technologies but addressing global challenges, from climate change to healthcare, sustainable energy solutions, and food security. Saudi Arabia's journey has redefined the role of innovation, positioning it as the lifeblood of future economies and highlighting the nation's indispensable role in shaping global narratives and strategies.

Here, dear reader, are some examples that highlight why the success story of the Kingdom of Saudi Arabia is considered the greatest of this century: Economic Transformation: From its previous reliance on oil as a primary resource to successful diversification into various sectors, including innovation, industry, tourism, and more, it is a global economic powerhouse.

Innovation and Technology: Initiating a revolution in innovation and technology with significant investments in research and development.

Tourism: Saudi Arabia has transformed into a splendid destination, combining natural beauty, authentic culture, and modern facilities.

Diplomatic Role: Expanding its role in international relations and playing a crucial role in mediating regional and global conflicts.

Sustainability: Commitment to sustainable growth and environmental protection through innovative ecological projects.

Culture and Arts: Solidifying the role of culture and arts as essential elements of Saudi identity by organizing international festivals and artistic events.

Investment and Entrepreneurship: Supporting startups and creating an attractive investment environment.

Participation in Humanitarian Projects: Effective contribution to global humanitarian projects and supporting countries in times of crisis.

Infrastructure Development: Modernizing infrastructure, including transportation, communications, energy, technology, etc.

Sports and Entertainment: Hosting international sports and cultural events, making the Kingdom a global hub.

What made Saudi Arabia's journey truly remarkable was its holistic transformation. Under Vision 2040, the country didn't just evolve; it reinvented itself. The Saudi populace, empowered with education and opportunities, became active contributors to this national renaissance. Women in the workforce, technological advancements, and cultural revolutions – every facet of Saudi society echoed with progress and promise.

The success of Saudi Arabia was not confined to its borders. The nation emerged as a beacon of hope and a testament to what visionary leadership can achieve. Its metamorphosis taught the world about ambition's power, sustainable growth's importance, and the magic of melding traditions with modernity.

In this year, 2040, as the world looked back, Saudi Arabia's journey from a desert kingdom with a great heritage to a global superpower in innovation, economy, and culture was not just a success

story but a success story of the century. Under the aegis of the inimitable and inspiring leader Mohammed bin Salman and the roadmap of his Vision, Saudi Arabia didn't just meet the challenges of the times; it soared above them, crafting a legacy that would inspire generations to come.

PART 5 · TOPIC 27

National Strategies for Developing Pharmaceutical and Biotechnology Industries in the Kingdom of Saudi Arabia

November 2023 · First published

Dear reader, for the Kingdom of Saudi Arabia to excel in the pharmaceutical and biotechnology sectors, it is essential to adopt a comprehensive approach that covers all aspects, including research, development, manufacturing, innovation, and regulatory framework. This article aims to provide an overview of a roadmap that outlines the steps the Kingdom of Saudi Arabia can take to achieve this goal.

To support the growth of the pharmaceutical industry, it is essential to invest in research, development, and innovation. This can be achieved by establishing well-funded research centers and partnerships between academic, industrial, and research institutions, specifically focusing on advanced drug discovery and development research. Innovation can be encouraged by providing incentives for research and development, protecting intellectual property, and facilitating technology transfer. Collaboration between startups, innovative pharmaceutical companies, and research centers is also important. Localizing clinical trials is critical to creating a supportive environment for the development of pharmaceutical industries. Attracting global pharmaceutical companies to test their products in Saudi Arabia can help stimulate local research and contribute to medical advancement.

Investing in education and training programs is essential for developing a highly skilled workforce in the pharmaceutical and biotechnology industries and related fields. Constructing modern manufacturing facilities that adhere to international quality standards is also crucial for building infrastructure. These efforts will facilitate innovation, development, and local production, positioning Saudi Arabia as an attractive destination for pharmaceutical industries.

Legal and regulatory reforms are crucial to simplify and update processes for drug approvals and ensure international compliance, boosting. Also, attractive investment incentives such as tax reductions, grants, and financial support for pharmaceutical companies can encourage local and foreign investment in this promising sector.

Establishing trade agreements and collaborating with other countries to export Saudi pharmaceutical products and access global markets is crucial. Public-private partnerships are also essential to promote innovation, research, and development by fostering cooperation between government, private, and academic institutions. By combining resources and expertise, these partnerships can achieve mutual growth. Additionally, adopting sustainable practices in the pharmaceutical industry can reduce environmental impact and enhance the reputation of Saudi-manufactured pharmaceutical products locally and globally.

Launching targeted marketing and promotional campaigns is crucial to raising consumer awareness of the quality, safety, and innovation of pharmaceutical products in Saudi Arabia.

In summary, by implementing a holistic strategy encompassing research, innovation, manufacturing, regulation, and international partnerships, the Kingdom of Saudi Arabia can become a leader in the pharmaceutical and biotechnology sectors. This will drive economic growth and promote progress in healthcare on a global scale.

PART 5 · TOPIC 28**The Crucial Role of Venture Capital in Developing the Pharmaceutical Industries in Saudi Arabia**

October 2023 · First published

The pharmaceutical industries are a crucial component of healthcare systems around the world. It has significantly contributed to medical advancements and the overall well-being of populations. With its ambitious Vision 2030, Saudi Arabia aims to diversify its economy and become a regional hub for various industries, including pharmaceuticals and biotechnology. Venture capital (VC) is essential in achieving this goal, as it fosters innovation, growth, and sustainability in the pharmaceutical sector.

Dear Reader, venture capital firms are vital in providing financial support, guidance, and resources to startups and early-stage companies. This support is crucial in helping these companies bring their innovative ideas to life. In Saudi Arabia, VC funding has been instrumental in fostering a culture of innovation and entrepreneurship, and this support also will extend to the pharmaceutical industries.

Investing in Research and Development (R&D) is crucial for creating new pharmaceuticals and biotechnologies. However, it can be a lengthy and expensive process. Venture capitalist firms can fund startups and research institutions, speeding up their R&D efforts. This support helps to discover and develop innovative treatments and medical solutions faster.

The stage of clinical trials in developing drugs is critical. VC investments can aid pharmaceutical companies in carrying out these trials smoothly, guaranteeing that newly developed medicines satisfy the necessary standards of safety and effectiveness. This accelerates the approval process for getting these drugs to market.

VC firms have extensive networks and connections, facilitating collaborations between pharmaceutical firms, research institutions, and technology companies. These foster cross-disciplinary approaches that lead to groundbreaking innovations.

Pharmaceutical startups backed by VC can attract highly skilled professionals in medicine, chemistry, and biotechnology who contribute to the growth of the local workforce in Saudi Arabia.

VC funding can aid Saudi pharmaceutical firms in expanding worldwide, enabling them to access international markets and collaborations. This global reach diversifies revenue streams and positions Saudi Arabia as a key player in the global pharmaceutical arena.

The injection of VC into the pharmaceutical industry fuels innovation and supports Saudi Arabia's Vision 2030 objectives. Pharmaceutical startups funded by VCs create job opportunities for skilled Saudi scientists, researchers, and healthcare professionals.

One of the main goals of Vision 2030 is to decrease reliance on oil revenues. The Saudi economy can become more diverse with the help of VC investments in the pharmaceutical industry. Pharmaceutical innovations backed by venture capitalists can lead to the development of new medical treatments and technologies, ultimately improving healthcare delivery and elevating the quality of life for citizens of Saudi Arabia. As Saudi pharmaceutical companies export their products, they earn revenue from international markets, contributing to economic growth.

While VC offers numerous opportunities, it also presents challenges that need to be addressed for sustainable growth in the pharmaceutical sector.

It is crucial to have a robust regulatory framework for pharmaceuticals to guarantee the safety and effectiveness of new drugs. The Saudi Food and Drug Authority (SFDA) should work closely with VC-funded pharmaceutical companies to achieve this goal. Also, VC firms typically require assurance of IP protection. Saudi Arabia is successfully strengthening IP laws and enforcement to attract more VC investments. Moreover, developing a skilled pharmaceutical workforce is crucial and collaborating with educational institutions can help bridge the talent gap for VC-backed startups. Also, Saudi pharmaceutical companies must invest in meeting international quality standards and overcoming trade barriers to expand globally.

To sum up, venture capital can significantly stimulate the progress and advancement of the pharmaceutical sector in Saudi Arabia. It encourages creativity, generates employment opportunities, promotes economic variety, and ultimately improves healthcare results for the country's people. As Saudi Arabia strives to achieve its Vision 2030, the significance of venture capital in propelling the pharmaceutical industry toward progress should not be underestimated. With a conducive environment and well-planned investments, Saudi Arabia is in a favorable position to become a significant participant in the regional and global pharmaceutical arena, contributing to a healthier future for everyone.

PART 5 · TOPIC 29

What is Altriaq Pharma of King Abdulaziz University?

October 2023 · First published

Dear reader, before we answer today's article, let's talk about the origin of the word 'Altriaq.'

'Altriaq' is an Arabic word used to refer to medical substances or therapies used to treat diseases or poisoning. These substances can include medicines and other means used to improve health or alleviate the symptoms of illness. The word 'Altriaq' has been used throughout the ages in Arabic to refer to these matters. Its history dates back to ancient times and beyond. In ancient and medieval times, Arabic medicine relied on many medical texts that used the term 'Altriaq' to refer to treatments and medicines. Today, the word 'Altriaq' is commonly used in modern Arabic in the medical and health context to refer to medicines and substances used for treatment and healing.

Now, let's discuss the importance of startups and innovators in the pharmaceutical and biotechnology industries. The importance of the pharmaceutical sector locally, regionally, and globally is not hidden, with the global pharmaceutical sector exceeding seven trillion US dollars in 2021. This sector relies on research, development, and innovation to produce innovative medical and pharmaceutical products.

You may also be aware of the efforts of the Saudi government in developing and localizing the pharmaceutical and medical industries, contributing to the achievement of the Saudi Arabia Vision 2030 in developing and localizing strategic industries.

In this context, King Abdulaziz University, one of the best universities regionally and globally, has pioneered by establishing the first university-owned company specialized in discovering and developing medical and pharmaceutical products derived from the university's research, development, and pharmaceutical innovation.

With a visionary approach from King Abdulaziz University and the leadership of the Jeddah Valley Company, the investment arm of King Abdulaziz University, Alteriaq Pharma Company was established about a year and a half ago. During this relatively short period, the company achieved many unique and qualitative achievements at the level of Saudi universities, with unlimited support from the university's leadership, the Ministry of Education, and other supportive government and private sectors.

Alteriaq Pharma has developed a large number of innovative medical and pharmaceutical products. The company has registered five products with the Saudi Food and Drug Authority as the first stage, followed by many subsequent stages. These products have also been registered in the "Made in Saudi Arabia" program after the company was registered as a partner in this program. Thousands of these products have been manufactured, and many distinguished partnerships have been formed in

manufacturing, distribution, and marketing with the best national companies in these fields. The aim is to transform the research and innovative outputs of King Abdulaziz University into valuable products and economic returns for the nation, benefiting citizens and residents. Alteriaq Pharma aspires to enhance its presence and position in the Saudi market and regional and global markets soon.

Alteriaq Pharma aims to be a successful example of university-owned companies and a model for benefiting from research and scientific outputs, transforming them into tangible products, and applying the knowledge-based economy concept.

What is noteworthy is how King Abdulaziz University turned these values into realistic projects that benefit society and the nation. The research and studies conducted within its premises have made a qualitative leap in the pharmaceutical and medical industries, thanks to Alteriaq Pharma.

In addition to the above, Alteriaq Pharma promotes mutual cooperation with local and global research and development centers and innovators to ensure the exchange of expertise and the application of the latest technologies available in the pharmaceutical and medical industries. This cooperation is not limited to the academic level but also extends to include the private sector and specialized global companies, ensuring the development of high-quality products that meet the needs of the local and global markets.

It is worth mentioning that King Abdulaziz University plays a significant role in supporting scientific research and entrepreneurial projects. The university always strives to create a stimulating environment for researchers and innovators, providing all support to achieve excellence in various scientific fields. One of the most important initiatives in this regard is establishing a distinguished and specialized center in this field, contributing to the transfer of technology and its transformation into tangible products, namely, the "Innovation and Entrepreneurship Center."

Within the strategic directions of the Kingdom of Saudi Arabia, Alteriaq Pharma is considered an exemplary model of efforts to achieve economic and social sustainability through knowledge, technology, and innovation. A clear vision, defined goals, and continuous support from the government and relevant institutions remain the key factors ensuring the continued success and progress of Alteriaq Pharma.

In conclusion, King Abdulaziz University has proven that research, innovation, and entrepreneurship are not just slogans but a way of work through which it seeks to achieve excellence and leadership in all fields. Contributing to the progress and prosperity of the nation is a responsibility placed on every individual and institution in our beloved country.

PART 5 · TOPIC 30

Development and Localization of Pharmaceutical and Biotechnology Industries in the Kingdom of Saudi Arabia: A Promising Vision for Economic Diversification and Health Innovation

October 2023 · First published

Dear reader, you are likely familiar with the Kingdom of Saudi Arabia's abundant oil reserves and rich cultural heritage. Thanks to the guidance of our esteemed Crown Prince, His Royal Highness Prince Mohammed bin Salman, the Kingdom has embarked on an ambitious path towards economic diversification and reducing its dependence on oil revenue.

The pharmaceutical and biotechnology sector has been receiving a lot of focus lately in the effort to diversify the economy. Establishing and supporting these industries within Saudi Arabia is seen as a strategic move towards achieving global excellence and becoming a leader in healthcare. This will encourage innovation and help to build a knowledge-based economy.

Saudi Arabia used to rely heavily on imported medical and pharmaceutical products to meet its healthcare needs. As you may know, dear reader, this reliance had negative consequences, particularly during worldwide disruptions like the past COVID-19 pandemic crisis. Consequently, there has been an initiative to strengthen the national pharmaceutical and biotechnology sectors, with the aim of localizing these important industries and supporting Saudi Arabia's Vision 2030, which outlines the nation's objectives for economic transformation and social progress.

The Saudi government is working on enhancing the pharmaceutical and biotechnology industries through programs such as the National Industrial Development and Logistics Program (NIDLP). This will have a significant impact on both local and global markets. With abundant raw materials, a strong healthcare infrastructure, and a growing pool of skilled human resources, Saudi Arabia is well on its way to becoming a global hub for these industries. Its strategic location at the intersection of Asia, Europe, and Africa further bolsters its potential as a pharmaceutical hub.

One example of a center that focuses on advanced research in medical and pharmaceutical fields is the King Abdullah International Medical Research Center (KAIMRC). These initiatives not only contribute to the local economy but also promote the development of local expertise and innovation.

The Saudi Food and Drug Authority (SFDA) is crucial in shaping regulations and aiding the localization of the pharmaceutical industry. They enforce strict quality standards and simplify approval processes to make sure that pharmaceutical products made in Saudi Arabia meet global quality standards. This not only increases confidence in locally made products but also establishes Saudi Arabia as a dependable source of pharmaceuticals for international markets.

Working together with international pharmaceutical companies has been a crucial tactic in progressing the growth and adaptation of this industry. By forming partnerships and agreements for

technology transfer, we can share expertise and implement more advanced manufacturing techniques. These collaborations result in an improved standard of pharmaceuticals produced locally and also foster the development of skills and capacity-building among the local workforce in this field.

The pharmaceutical and biotechnology industries in Saudi Arabia have a lot of potential for growth and success, but there are obstacles to overcome. Creating a strong environment for research and innovation, protecting intellectual property rights, and maintaining a steady supply of skilled workers are all crucial areas that need ongoing attention. As the country moves towards being self-sufficient in pharmaceuticals, it's important to have careful planning, resource allocation, and supportive policies in place. This transition from relying heavily on imports to having a self-sustaining industry requires dedicated effort.

To summarize, the Kingdom of Saudi Arabia's pharmaceutical and biotechnology industries' development and localization signifies a crucial move towards attaining economic diversification and self-sufficiency in healthcare. With its strengths and strategic benefits, Saudi Arabia is progressively becoming a worldwide hub for innovation, pharmaceuticals, and biotechnology, guided by a clear vision and dedication to establishing a sustainable knowledge-based economy. As the industry keeps growing, there's a chance for it to cater to both local and global healthcare needs, consolidating Saudi Arabia's position as a notable global player.

PART 5 • TOPIC 31

Unlocking the Potential: How Venture Capital Drives Saudi Arabia's Pharmaceutical Industries

September 2023 • First published

Let's explore how venture capital (VC) affects pharmaceutical industry development in Saudi Arabia, including challenges, opportunities, and success factors.

The pharmaceutical industry is regulated worldwide, including in Saudi Arabia, where the Saudi Food and Drug Authority (SFDA) enforces strict requirements. The SFDA has made significant progress in enforcing these regulations. For pharmaceutical companies supported by venture capital, navigating the complex regulatory process and ensuring that their products meet the necessary safety and efficacy standards can be challenging. This can be incredibly daunting for startups without prior experience in the pharmaceutical sector.

When seeking investment from VC, they commonly request assurances that intellectual property rights (IPR) will be protected. To increase the chances of attracting VC funding, improving the enforcement of IPR laws in Saudi Arabia is essential. Fortunately, the Saudi FDA and the Saudi Authority for Intellectual Property are already leading the way. This includes measures such as granting patent protection for new drug formulations and innovative medical technologies.

For pharmaceutical companies in Saudi Arabia, venturing into global markets can be challenging. To effectively compete, they need to focus on innovation and develop distinctive products instead of merely exporting generic drugs. Saudi pharmaceutical companies should invest in research, quality control, and regulatory compliance to thrive in the global market.

It should be noted that there are numerous opportunities available for local pharmaceutical companies in Saudi Arabia, primarily due to the country's dedication to healthcare transformation. The government has been investing heavily in healthcare infrastructure and services, which has resulted in a continuously growing domestic market for pharmaceutical products. Continued support and collaboration from the Saudi government are crucial. Initiatives like the Saudi Vision 2030 and the National Industrial Development and Logistics Program (NIDLP) are pivotal in creating a conducive environment for pharmaceutical development.

Saudi Arabia's strategic location at the crossroads of Asia, Europe, and Africa presents an ideal opportunity for pharmaceutical companies to use it as a distribution hub for their products across the MENA region and beyond. With venture capital financing, companies can leverage this geographical advantage to expand their local and global market reach.

Establishing collaborations between venture capital-backed pharmaceutical startups and educational institutions can effectively address the shortage of skilled professionals in the local talent pool. By joining hands with universities and research centers, these startups can create

specialized pharmaceutical programs and curricula, which can groom and equip the upcoming generation of pharmaceutical scientists and professionals with the required skills and expertise. Building a solid healthcare and pharmaceutical ecosystem that includes academia, research institutions, industry experts, and VC firms is crucial. This collaborative environment encourages innovation and speeds up the development of pharmaceutical products.

Moreover, incorporating technology, specifically artificial intelligence and big data analytics, in pharmaceutical research and development is becoming increasingly popular. Venture capital firms can aid startups in adopting these innovative technologies to improve drug discovery, clinical trial design, and personalized medicine approaches.

Attracting VC funding relies heavily on investor confidence, which can be achieved through transparency, a strong legal framework, and safeguarding intellectual property rights. For Saudi pharmaceutical startups, partnering with international pharmaceutical companies, research institutions, and healthcare organizations can grant access to global expertise, markets, and resources.

In conclusion, Saudi Arabia has excellent potential to establish flourishing pharmaceutical industries and biotechnology with the help of venture capital support despite the significant challenges that come with it. By dealing with regulatory complexities, safeguarding intellectual property, expanding market access, and leveraging the country's healthcare transformation initiatives, Saudi Arabia can be a leader and a hub in pharmaceutical innovation and production regionally and globally. To achieve this goal, it's essential to establish a strategic partnership between VC firms, innovative startups, educational institutions, and government agencies. I believe this collaboration will lead to better healthcare outcomes and economic growth for the country.

PART 5 · TOPIC 32

The Power of Skilled Workforces: King Abdulaziz University Journey and Taiwan's Semiconductor Success

September 2023 · First published

Dear reader, I would like to start today's article with a quote from His Royal Highness Crown Prince Mohammed bin Salman: "We welcome dreamers who want to create a new world."

Today, we will talk about the Importance of Developing a Skilled Pharmaceutical and Biotechnology Workforce in Saudi Arabia. In recent years, the fields of pharmaceuticals and biotechnology have seen unprecedented growth and innovation worldwide. Recognizing the importance of these sectors for its future economic prosperity and healthcare advancement, Saudi Arabia, led by institutions like King Abdulaziz University, has embarked on a journey to develop a skilled pharmaceutical and biotechnology workforce. This endeavor is critical for the nation's self-sufficiency in healthcare and its emergence as a regional and global player in these industries.

A skilled pharmaceutical and biotechnology workforce is crucial for ensuring that Saudi Arabia can produce its innovative medications and biotechnological products. This self-sufficiency reduces the nation's reliance on foreign imports and ensures a stable supply of essential drugs and medical technologies. This became especially evident during the COVID-19 pandemic when many nations faced shortages of critical medical supplies.

Saudi Arabia, traditionally reliant on oil exports, has been actively seeking economic diversification. The pharmaceutical and biotechnology sectors provide an excellent opportunity to achieve this diversification by generating new sources of revenue. Developing a skilled workforce in these fields can attract foreign investment, create high-value jobs, and stimulate innovation.

Skilled professionals in pharmaceuticals and biotechnology can drive research and development efforts within the country. This has the potential to result in the development of state-of-the-art medical treatments, diagnostics, and therapies that can significantly improve the quality of healthcare services available to Saudi citizens. This, in turn, would reduce the necessity for seeking medical treatment abroad, ultimately yielding a positive economic impact on the country.

Now, revisiting the article's title, let's establish a comparison with Taiwan's semiconductor industry experience to underscore the significance of nurturing human capital for driving economic transformation. How does this relate to King Abdulaziz University?

Taiwan, despite being a geographically small island, offers a compelling case study illustrating the transformative potential of investing in human capital. In its historical context, Taiwan predominantly relied on agriculture for its economic sustenance. Nevertheless, through purposeful initiatives aimed at cultivating a highly skilled workforce, the nation achieved a remarkable transition, emerging as a

dominant force in the global semiconductor industry, currently accounting for approximately 70% of the global market share.

Taiwan made significant investments in education, particularly in science and technology fields, to cultivate a skilled workforce. This commitment laid the foundation for the development of the semiconductor industry. Taiwan fostered close collaboration between academia and industry. Universities worked hand-in-hand with semiconductor companies, creating a continuous pipeline of talent and fostering innovation.

In both Saudi Arabia's quest to develop a skilled pharmaceutical and biotechnology workforce and Taiwan's semiconductor industry journey, human capital development is central to the success of these industries. The parallels between these two experiences emphasize the importance of investing in education, fostering collaboration between academia and industry, and providing government support to nurture skilled professionals who can drive economic transformation.

Dear reader, I have been closely working and collaborating with numerous national and international pharmaceutical companies, drawing from my extensive executive strategic leadership and investment experience within the pharmaceutical and biotechnology sectors locally and globally, I can confidently assert that King Abdulaziz University, a recognized academic and research powerhouse both nationally and globally, holds the substantial potential to help the Kingdom in replicating innovative Taiwan's remarkable success in semiconductors across a diverse range of fields and industries, including pharmaceuticals and biotechnology. Through strategic partnerships with prominent entities in both local and global private sectors, such as SaudiVax and Sartorius, and through forging alliances with vital governmental bodies like the Saudi Human Resources Development Fund, the Saudi Commission for Health Specialties, as well as other pivotal sectors within the Kingdom, including the Ministry of Education, Ministry of Industry and Minerals, Ministry of Health, Ministry of Investment, Saudi FDA, and more, the university, alongside these influential stakeholders, can assume a central role in nurturing a world-class workforce specialized in the fields of pharmaceuticals and biotechnology. This collaborative synergy between academia, industry, and government is undeniably vital, serving as the linchpin for fostering innovation, facilitating the seamless transfer of knowledge, and molding an exceptionally skilled workforce capable of catalyzing a transformative evolution within Saudi Arabia's pharmaceutical and biotech landscapes.

The emulation of Taiwan's outstanding achievements holds paramount significance for Saudi Arabia's overarching goals of achieving economic diversification, heightened global competitiveness, and advancing healthcare services, aligning seamlessly with the nation's ambitious Vision 2030. This well-planned investment in human capital not only stands to fortify the country's economy but also promises to enhance its healthcare capabilities, thus inevitably elevating the overall quality of life for its valued citizens. With unlimited support from our government and the backing of all relevant sectors, the Kingdom of Saudi Arabia will become a significant global hub for pharmaceutical and biotechnology industries.

PART 6

Science & Technology

15 TOPICS

Medicine no longer advances on biology alone. Artificial intelligence proposes molecules, quantum computers model how they will fold, nanotechnology carries them to a single cell, and green chemistry asks what the manufacturing leaves behind. This section reaches beyond the pharmacy, into computing, chemistry, and the history of discovery, including the long stories behind medicines so ordinary we forget they were ever invented.

WHY READ THIS PART

Read this section for the technologies arriving in medicine next, explained without the jargon that usually guards them.

SCIENCE & TECHNOLOGY · PART 6

In this part

NO.	TOPIC	PAGE	PUBLISHED
1	Genes Load the Gun, but Environment Pulls the Trigger	309	July 2026
2	Exposome	311	April 2026
3	Alchemy	313	November 2025
4	Unlocking the Secrets of Longevity	315	September 2025
5	Blockchain Technology in the Pharmaceutical Industry	317	June 2025
6	Nanorobots and the Revolution of Targeted Therapy	319	May 2025
7	Quantum Computing and Drug Development	321	April 2025
8	NVIDIA and the Pharmaceutical Industry	323	March 2025
9	Medicine 3.0	325	March 2025
10	Quantum Computing and Drug Development	327	March 2025
11	Horses and Autonomous Driving	329	September 2024
12	Forging Innovation by Bridging Academia and Industry	332	June 2024
13	The Campus!	335	May 2024
14	The Dawn of the "Generative AI" Era in Healthcare	337	March 2024
15	Your Cup of Coffee and Strychnine	339	July 2023

PART 6 · TOPIC 1

Genes Load the Gun, but Environment Pulls the TriggerJuly 2026 · First published

Dr. George A. Bray captured one of modern medicine's most complex truths in a single phrase: genes load the gun, but the environment pulls the trigger. The image is harsh but accurate, describing the relationship between genetics and environment in chronic diseases such as obesity and type 2 diabetes.

Disease is not a destiny written in our genes, nor is it simply weak willpower. The truth lies between a hidden genetic predisposition and an environment that can either ignite it or keep it dormant. Understanding this frees us from two illusions: surrendering to heredity and blaming ourselves.

The loaded gun is our genetic makeup. Some people are born with a greater tendency toward weight gain, insulin resistance, or diabetes, yet a loaded gun causes no harm unless its trigger is pulled. The triggers are environmental: poor food quality, calorie-dense diets, inactivity, disturbed sleep, stress, easy access to fast food, and cities that discourage walking. The gene creates the possibility; the environment turns it into reality.

This is why two people with similar predispositions can diverge; one develops obesity or diabetes while the other stays healthier. The difference often lies not in the genes but in the surroundings, habits, and conditions that shaped the body over the years.

A strong argument supports this: human genes have not changed significantly in recent decades, yet obesity and diabetes rates have risen sharply worldwide. If the cause were purely genetic, we would not see such an explosion within one or two generations. What changed was the environment. Modern humans moved from physical effort and simple food to environments flooded with calories and processed foods, where genes that once helped our ancestors store energy during scarcity became a burden in an age of abundance.

Scientists explain part of this through the "thrifty gene": some bodies are programmed to store energy efficiently, useful during famine, but a risk when calories are constant and movement scarce. Epigenetics adds another layer: the environment may not change genes themselves but can influence how they function. Food, sleep, stress, and exposures act like switches, activating some pathways and silencing others, changing gene expression without rewriting the code.

The Pima people illustrate this. One group lives in Arizona within a Western lifestyle, low activity, processed, high-calorie food. A related group with a similar genetic background lives in Mexico on a more traditional diet with greater activity. The result is striking: obesity and diabetes among the Arizona Pima are among the world's highest, far lower among the traditional, active group. The gun is loaded in both, but the environment pulled the trigger far harder in one.

The image seems written for our region. The Gulf records high rates of obesity and diabetes. There may be genetic predispositions, but the region has undergone one of the world's fastest environmental transformations, from physical activity and natural food to cars, offices, screens, fast food, and sweetened beverages. The gun remained, but the new environment pulled the trigger with unprecedented force.

It is not enough to tell people to eat less and move more; the advice is incomplete if the environment pushes the opposite way every day. Cities, schools, workplaces, food policies, marketing, and the price of healthy options are all triggers that must be addressed.

This perspective treats the patient fairly without removing responsibility. It rejects blaming people with obesity or diabetes as lazy, since real biology and environmental pressure lie behind the condition, yet it also rejects surrender to heredity, since the environment can change. Fairness means recognizing that the environment is not merely individual choice: unaffordable healthy food, unsafe sidewalks, inactive schools, and aggressive junk-food marketing lie beyond any one person's control. Treating these diseases requires smarter health, environmental, and social policies, not moral advice alone.

Still, the individual has a real role, reshaping part of their surroundings, reducing exposure to harmful triggers, and building small protective habits over time. The equation is neither fixed fate nor an isolated personal decision; it is a shared responsibility among the individual, society, and the state.

We do not choose the genes we inherit, and we cannot unload the gun. But we can keep our fingers off the trigger as much as possible and build healthier environments for ourselves and our children. Better food, daily movement, good sleep, less stress, walkable cities, and healthier schools and workplaces are real tools to prevent the trigger from being pulled. Genes may load the gun, but our responsibility is to keep it from firing.

PART 6 · TOPIC 2

Exposome

April 2026 · First published

Dear reader, imagine that your health is not determined by genes alone, nor by a single decision you make today. Rather, it is the outcome of a long journey of exposures, large and small, that you encounter from before birth through old age. This is where the concept of the exposome comes in: it is the comprehensive, cumulative picture of everything a person is exposed to, externally and internally, throughout life, and how these exposures leave biological “fingerprints” in the body that shape health and disease.

Exposome science emerged to complement the idea of the genome. Just as the genome describes the genetic code we carry, the exposome describes the world we live in, our environment, lifestyle, behaviors, and stressors, and the measurable biological changes they trigger. The core idea is that many chronic diseases, such as diabetes, cardiovascular disease, asthma, some cancers, and fertility disorders, cannot be fully understood by looking at genes alone. Genes constantly interact with the surrounding environment, and health risks arise from these interactions.

Exposome research is often described in terms of three interconnected levels. The first is the general external exposome, which includes broad contextual factors such as climate, air quality, urban pollution, noise, the built environment, public policy, and socioeconomic conditions. The second is the specific external exposome, which is closer to the individual and includes diet, smoking, physical activity, sleep, medications, occupational exposures, workplace chemicals, sunlight, infections, and psychological stress. The third is the internal exposome, which represents the body's response to these exposures: inflammation, hormones, metabolites, immune markers, changes in the microbiome, and epigenetic modifications. This makes it clear that exposure is not simply the presence of a substance in air or food, but how the body processes it, absorbing, transforming, storing, or eliminating it, and how its effects accumulate over time.

Why is exposome science especially important now? Because measurement tools have advanced rapidly, and modern life has become more complex, filled with mixtures of pollutants and constantly changing behaviors. In the past, researchers often linked one factor to one disease, but in reality, humans are exposed to dozens or even hundreds of factors simultaneously, with effects that may overlap, sometimes reinforcing each other and sometimes counteracting one another. This is why the idea of Exposome-Wide Association Studies (EWAS) has emerged, analogous to genome-wide studies: researchers scan a broad range of exposures and biomarkers to discover new patterns associated with disease, or protection from it.

To measure the exposome, multiple methods are used in a complementary way. External environmental data can be collected through air pollution monitoring stations, satellite remote sensing, and pollutant dispersion models, and then linked to geography and mobility patterns.

Wearable devices can help track physical activity, sleep quality, heart rate, and, in some cases, noise or fine-particle exposure. For diet, medication use, and daily exposures, questionnaires and health records are common, but they can be subject to recall bias and inaccuracies. That is why biomonitoring is increasingly valuable: analyzing blood, urine, saliva, or hair shows what actually entered the body.

The practical value of exposome science extends far beyond the laboratory. At the public-policy level, when evidence shows that exposure to fine particulate matter, certain solvents, or pesticides is linked to higher risks of asthma or heart disease, policymakers have stronger grounds to tighten standards, improve air quality, monitor water, and enhance food safety. At the individual level, knowledge can be carefully translated into exposure-reduction plans that improve ventilation, choose safer materials, reduce secondhand smoke, adjust diet, improve sleep, and manage stress, especially when supported by objective measurements and follow-up that show improvements in biomarkers.

Exposome science also opens a wide door to precision medicine. Two people may share similar genetic susceptibility, but differences in exposures can explain why one becomes ill early while the other remains healthy. By integrating exposome data with genomic information and health records, we can build more accurate predictive models of risk and select more personalized interventions based on an individual's "exposure profile." In cancer, this may help clarify the origins of certain mutations or pathways of chronic inflammation. In neurological disorders, it may highlight the role of neurotoxic pollutants, sleep disruption, and long-term stress. In fertility, it may reveal how endocrine disruptors affect hormones and the quality of eggs or sperm.

In our region, exposome science is becoming increasingly important due to rapid urbanization and the overlap of environmental and lifestyle factors. Urban expansion and heavier traffic can increase exposure to air pollutants, while dust storms add an additional burden of particulates. At the same time, modern dietary patterns, reduced physical activity, and sleep disruption contribute to rising rates of obesity and diabetes. The exposome approach can strengthen preventive medicine through long-term population studies and biobanks, linking environmental measurements with health data, and developing local indicators that reflect the region's unique exposure patterns. With quality-of-life initiatives and digital health programs, the exposome can become a practical bridge between big data and measurable interventions.

Ultimately, as measurement quality improves, standards become more unified, and databases linking exposures to health outcomes expand across diverse communities, exposome science appears to be one of the most promising tools for understanding the roots of disease before it appears, and for shifting medicine from "treating symptoms" to managing risk by reducing harmful exposures for individuals and society.

PART 6 · TOPIC 3

AlchemyNovember 2025 · First published

Dear reader, since ancient times, humanity has tirelessly pursued nature's hidden secrets, driven by a dream to turn ordinary metals into pure gold and to discover an elixir that grants eternal life. This extraordinary quest, captivating imagination, and stirring curiosity are known as alchemy. It wasn't simply a primitive attempt at chemical experiments, but rather an intriguing fusion of emerging scientific ideas, philosophical contemplation, and mystical symbolism, a symbolic journey toward a deeper understanding of both the world and oneself.

Alchemy thrived notably during the Islamic Golden Age, but with a spirit entirely different from mere superstition or magic. Arab scientists adopted a practical, experimental approach. Among the prominent figures was Jabir ibn Hayyan, known as the father of chemistry, whose work profoundly influenced both the Arab world and Europe. In the eighth century, Jabir emphasized the value of careful experimentation and meticulous laboratory work. He invented essential laboratory equipment, including the alembic, retort, and various distillation apparatuses, and developed key chemical processes such as distillation and crystallization. Jabir authored hundreds of influential texts describing processes related to transforming metals and prolonging life. He famously wrote, "The first essential in chemistry is that you must perform practical work and experiments, for he who does not carry out practical work can never achieve even the smallest degree of mastery." His words marked the transition of alchemy from vague speculation to a more methodical science.

In the ninth century, the renowned physician Abu Bakr al-Razi continued this scientific tradition, approaching it with critical analysis. He openly questioned attempts to turn base metals into gold and extend life indefinitely, seeing them as unrealistic pursuits. Al-Razi meticulously documented his experiments and the instruments used. Many chemical terms, such as "elixir," "alembic," and "alcohol," coined initially in Arabic, were passed into European languages through the translation of Arabic manuscripts. From the twelfth century onward, Europe rediscovered these Arabic texts, making the works of Jabir, Al-Razi, and Ibn Sina indispensable references up to the Renaissance, profoundly shaping the development of European chemistry.

In medieval Europe, the knowledge inherited from Arab alchemists merged seamlessly with Greek philosophy, creating a distinctive European alchemical tradition. By the thirteenth century, alchemy had captivated scholars, philosophers, and even religious figures, blending scientific inquiry with metaphysical and spiritual aspirations. Medieval alchemists believed the universe was composed of four basic elements, earth, air, fire, and water, thinking that combining these elements in precise proportions could yield any substance. This belief spurred their relentless quest to convert lead into gold and create a miraculous elixir to cure illnesses and extend life indefinitely.

Yet alchemy in medieval Europe was more than a quest for wealth or health; it carried profound philosophical and spiritual meanings. Practitioners believed success required inner purity and genuine intent. To protect their secrets from misuse by unqualified individuals, they used elaborate symbolism and cryptic codes. Their ultimate goal was not just material transformation but spiritual elevation, a profound journey from ignorance and impurity ("lead") to wisdom and purity ("gold").

The legendary Philosopher's Stone particularly captured their imagination, symbolizing ultimate achievement. Alchemists considered it a magical substance capable of turning base metals into gold and producing an elixir for immortality and spiritual perfection. However, many viewed the Stone symbolically rather than literally. They interpreted "transforming lead into gold" as a metaphor for inner transformation, a purification of the soul from a lower state to a higher, purer existence. Thus, the alchemical quest for the Stone became as much about personal and spiritual refinement as about chemical experimentation.

Although medieval alchemists never succeeded in their literal quest for gold and immortality, their efforts laid crucial foundations for modern science. Through continuous experimentation, they discovered new materials, developed processes, and paved the way for modern chemistry, metallurgy, and medicine. By the seventeenth century, a new scientific methodology emerged. The British scientist Robert Boyle notably criticized traditional alchemical ideas in his influential 1661 book, "The Sceptical Chymist," urging a rigorous experimental approach to the study of matter. This shift marked the end of classical alchemy and ushered in the age of modern chemistry. Later, in the eighteenth century, French scientist Antoine Lavoisier revolutionized chemistry by establishing systematic principles and classifications, earning recognition as the father of modern chemistry. Ironically, the dream of turning lead into gold eventually became a reality, not through alchemy, but through contemporary nuclear science, which can indeed transmute elements, albeit in minute quantities and at immense cost.

Today, dear reader, alchemy no longer exists as a scientific practice; it remains an intriguing chapter in the history of human knowledge. Nonetheless, its echoes persist in cultural and academic circles. Historians continue reevaluating its legacy. Remarkably, in 2006, a scholarly symposium revealed that Sir Isaac Newton himself devoted significant time to alchemical studies, leaving behind thousands of pages filled with alchemical experiments and musings.

In popular culture, alchemy remains a rich source of inspiration, vividly depicted in literary and cinematic works such as the "Harry Potter" series. Paulo Coelho's novel, "The Alchemist," resonated globally, selling more than 65 million copies, demonstrating the enduring allure of alchemy in contemporary imagination.

Thus, dear reader, while alchemy as a practical science has vanished, its intriguing narrative and symbolic legacy endure, reflecting humanity's perpetual fascination with unraveling mysteries and aspiring toward perfection.

PART 6 · TOPIC 4

Unlocking the Secrets of Longevity

September 2025 · First published

Dear reader, for over the past five millennia, humans have continuously sought to uncover the mysteries of aging and find methods to prolong life. This pursuit has captivated mankind across generations. Ancient civilizations, such as those of Babylon, Egypt, Greece, and Rome, recognized early on that aging posed significant challenges to their health and well-being.

Aging, dear reader, is fundamentally a natural biological process, marked by a gradual decline in bodily functions and the decreasing ability to adapt to internal and external changes. This decline arises from various factors, including cumulative damage to cells, shortening of telomeres (DNA segments at the ends of chromosomes that regulate cell replication), increased oxidative stress, inflammation, and a weakened immune response. Over time, these factors combine to reduce organ functionality, eventually leading to age-related illnesses.

Historical texts from ancient Babylon, including Hammurabi's Code, reflect a longstanding interest in medicinal practices addressing aging. Likewise, Egyptian civilization, documented in texts such as the Edwin Smith Papyrus (around 1700 BC), described substances that promised rejuvenation, turning old men youthful, a testament to early human desires to counteract the effects of aging.

In ancient Greece, dear reader, Aristotle (around 350 BC) formulated one of the earliest theories linking longevity to effective breathing. He believed that the gradual loss of "innate heat" inevitably led to aging and death. Aristotle's views profoundly influenced medical thinking for centuries and notably impacted Galen (170 AD), who emphasized moderation and proper diet as key to delaying aging and promoting longevity.

The Middle Ages witnessed a sustained interest in aging research, although explanations frequently drew on Galenic theories that emphasized the imbalance of bodily fluids, often interwoven with alchemy and astrology. Avicenna (Ibn Sina), around 1010 AD, described aging in his famous "Canon of Medicine" as resulting from an internal imbalance, recommending healthy lifestyles to delay the effects of aging.

Roger Bacon (1270 AD), on the other hand, systematically attempted to establish scientific principles to combat aging in his book "The Cure of Old Age," advocating for healthy diets, exercise, and living in clean and balanced environments.

Dear reader, during the early modern period (16th and 17th centuries), scientific approaches gained prominence. Philosophers and scientists, such as Francis Bacon (1623), considered the struggle against aging a fundamental goal of science. Similarly, Paracelsus (1574) introduced a chemical perspective to aging, suggesting that detoxifying the body could prolong life.

The 18th century brought clearer theories, exemplified by Luigi Cornaro (1558), who attributed his longevity to a highly moderate diet. His influential book "The Art of Living Long" continues to be referenced in modern discussions of longevity and health.

In the 19th and 20th centuries, aging research advanced remarkably due to the development of sophisticated scientific theories and experimental approaches. Leonard Hayflick (1961) discovered that human cells have a limited number of divisions, a concept known as the Hayflick limit, which significantly enhanced our understanding of cellular aging.

In the latter half of the 20th century, research focused on telomeres, cell division, and oxidative stress, all of which are crucial factors contributing to bodily decline. Discoveries such as the enzyme telomerase by Elizabeth Blackburn (1978) and Cynthia Kenyon's identification of genetic factors influencing longevity (1993) opened entirely new frontiers in aging science.

Entering the 21st century, research has made significant advancements, with breakthroughs in cellular reprogramming that can revert mature cells to stem-like states. This groundbreaking ability holds tremendous potential for tissue regeneration and delaying the effects of aging.

Currently, in the 2020s, we are experiencing a golden age in aging research. Scientific studies have increased exponentially, leveraging technologies such as artificial intelligence, genomic analysis, and novel approaches like CAR-T cell therapies, which effectively address the biological challenges posed by aging.

Finally, dear reader, the pathway for future research remains open and promising. This continuous endeavor is likely to instigate profound social and philosophical transformations. Should humanity succeed in significantly delaying or even halting the aging process, it would not merely be a scientific triumph; it could fundamentally reshape our understanding of life and death, and dramatically alter societal and economic structures.

PART 6 · TOPIC 5

Blockchain Technology in the Pharmaceutical Industry

June 2025 · First published

Dear reader “Blockchain technology” stands out as one of the most revolutionary innovations in the tech world today. It is increasingly making its mark across various sectors, including the pharmaceutical industry, a field that grapples with complex challenges such as ensuring a secure supply chain, maintaining the integrity of clinical trial data, and combating counterfeit drugs. In this article, we explore how blockchain can drive a transformative change in the pharmaceutical arena by enhancing transparency, safeguarding data, and playing a critical role in the fight against fake products.

In recent years, digital technology has witnessed remarkable advancements, with blockchain emerging as a solution that offers an unprecedented level of security and transparency. This technology operates on a decentralized system where data is stored in interconnected blocks, making it extremely difficult to alter or hack. This unique feature makes blockchain ideally suited for applications that demand high precision and reliability. In the pharmaceutical industry, where trust in the supply chain and the credibility of clinical trial data is paramount to ensuring patient safety and quality healthcare, blockchain holds immense promise.

The pharmaceutical supply chain faces a myriad of challenges, from verifying the authenticity of products to tracking their journey from manufacturing facilities to the end consumer. Transparency and reliability are essential at every step. Blockchain offers a comprehensive solution to these issues by permanently and transparently recording every stage of the supply chain. This process makes it easy to verify the source, manufacturing date, storage conditions, and transportation details of each product. For instance, doctors, pharmacists, and even patients can use a QR code linked to a blockchain record to confirm a product's authenticity, thereby bolstering consumer trust and reducing the health risks associated with counterfeit medications.

Clinical trials, often considered the cornerstone of new drug development, rely heavily on the accuracy and integrity of data to make critical decisions about a drug's safety and effectiveness. These trials are vulnerable to issues such as data manipulation or leaks, which can compromise results and damage a company's reputation. By leveraging blockchain, all information related to clinical trials can be secured in a tamper-proof ledger. Every transaction or data change is recorded immutably, providing a clear audit trail that regulatory bodies and researchers can review. This transparency not only builds confidence in trial results but also minimizes legal and regulatory risks.

Dear Reader, despite its many advantages, the integration of blockchain into the pharmaceutical industry is not without challenges. On the technical front, implementing blockchain requires significant investments in digital infrastructure and comprehensive training for new systems. Dear reader, there is also the need to ensure compatibility with existing technologies and to address

challenges related to processing speeds and the management of large data volumes. From a regulatory perspective, establishing robust legislative frameworks is crucial. Regulatory authorities must work closely with technology and healthcare companies to develop clear standards that protect personal data and consumer rights, all while fostering continued innovation and development.

Encouragingly, some leading pharmaceutical companies have already begun to successfully implement blockchain in their operations. These pioneering efforts have led to notable improvements in the efficiency of tracking processes and have significantly enhanced trust among stakeholders. Moreover, these initiatives have contributed to a reduction in counterfeit products in the market, underscoring blockchain's potential to improve the quality of healthcare services. Looking ahead, it is anticipated that the adoption of blockchain in healthcare will expand further, especially as it becomes integrated with other emerging technologies such as artificial intelligence and the Internet of Things. This integration is expected to create a holistic environment that enables better data analysis and offers innovative solutions to ongoing challenges in the pharmaceutical industry, ranging from research and development to improving patient experiences and ensuring that only authentic, safe medications reach consumers.

Dear reader, the future of the pharmaceutical industry may very well be shaped by the digital transformation driven by blockchain technology. This evolution opens up exciting new avenues for development and innovation. Beyond merely improving existing processes, blockchain promises to create an integrated platform that guarantees patient safety and elevates the overall quality of healthcare services worldwide.

PART 6 · TOPIC 6

Nanorobots and the Revolution of Targeted Therapy

May 2025 · First published

Dear reader, with the rapid technological advancements the world is witnessing today, nanotechnology has emerged as one of the most important research fields that are revolutionizing various scientific areas, particularly medicine. The concept of "nanorobots" for targeted therapy is one of the most promising applications in this field. It enables the precise delivery of drugs to abnormal cells and their repair when necessary. In this article, dear reader, we explore how these tiny robots can be designed for drug delivery and cellular repair, and how they could transform the future of medicine and pharmacy.

"Nanorobots" are defined as extremely small devices ranging from 1 to 100 nanometers in size, capable of navigating within the human body without causing harm to surrounding tissues. These microscopic devices can modify traditional treatment methods by directing drugs precisely to the area where they are needed, reducing the side effects associated with high drug doses. Thanks to this targeted approach, greater therapeutic effectiveness can be achieved, along with improved quality of life for patients.

One of the most important features of "nanorobots" in medicine, dear reader, is their ability to identify diseased cells using specific receptors that bind to certain markers on the surface of cancerous or chronically ill cells. This technology relies on an intelligent system that allows the robots to accurately locate target sites, making them act as "target hunters" within the body. Once the nanorobot reaches its target, it releases the drug directly into the affected area, reducing the time required for the treatment process and minimizing the doses needed.

Dear reader, when discussing cellular repair, "nanorobots" hold great promise in several fields, such as tissue regeneration and the repair of damaged cells. For example, "nanorobots" can be programmed to carry molecular compounds that stimulate natural healing processes within the body, such as activating stem cells or enhancing gene expression that helps repair cellular damage. This approach is not only beneficial in treating cancer but extends to various diseases, including inflammatory diseases that affect vital organs like the heart, liver, and brain.

Developing this technology is one of the greatest challenges researchers face in the fields of medicine and microbiology. Designing a "nanorobot" capable of effectively moving within the human body requires in-depth study of the physical structure of cells and tissues, along with the need to design precise control mechanisms to ensure no unexpected harm is caused. Additionally, it is important to ensure that these robots can break down or exit the body after completing their task without leaving any residue that could negatively affect the patient's health.

On the other hand, the integration of artificial intelligence with nanotechnology is a crucial step towards enhancing the performance of "nanorobots." AI can analyze live data from the body, enabling the system to make instant decisions about directing the robots and adjusting drug doses according to the patient's precise needs. This ability to adapt in real-time to physiological changes in the body could represent the future of personalized medicine, where each patient receives treatment tailored to the composition of their cells and unique health conditions.

Although the possibilities seem promising, dear reader, the application of "nanorobots" for targeted therapy faces many obstacles that must be addressed before they become a routine part of medical systems. Among the primary challenges are safety and security issues, where it is essential to ensure that these devices do not trigger immune responses or cause complications in the body. The high cost of manufacturing and programming them also poses a barrier to widespread adoption, necessitating joint research efforts between scientists and engineers to reduce costs while maintaining performance efficiency.

On another note, dear reader, clinical trials are a crucial step in assessing the effectiveness of "nanorobots" in real-world treatment environments. Many research institutions and universities around the world are conducting preliminary experiments on animals and in laboratories, with some early-stage trials on humans in rare cases. Initial results indicate that the use of "nanorobots" may improve healing rates and reduce side effects, enhancing hope for a transformative shift in the medical field in the coming years.

Dear reader, the future holds great promise for "nanorobots" technology, as it could become an integral part of hospitals worldwide, contributing to a reduction in mortality rates and improving the quality of life for patients with serious diseases. With the ongoing advancements in biotechnology and artificial intelligence, research will likely continue to offer innovative solutions that help overcome current obstacles and expand the use of this technology across various medical specialties.

PART 6 · TOPIC 7

Quantum Computing and Drug DevelopmentApril 2025 · First published

Dear reader, in recent years we have witnessed a rapid rise in quantum computing, a technology that represents a major leap forward in the world of information technology. Built on the properties of quantum particles, quantum computing can solve highly complex problems at unprecedented speeds compared to traditional computers. As these quantum computers steadily advance, various industrial and research sectors have begun to leverage their capabilities, with drug development standing out as one of the fields most likely to experience revolutionary breakthroughs, thanks to the immense computing power that quantum technology offers.

Quantum computing is rooted in the core principles of quantum mechanics, most notably “superposition,” which allows a “qubit”, the fundamental unit of quantum computing, to exist in more than one state at a time. This is unlike the conventional “bit,” which can only be 0 or 1. Additionally, the concept of “quantum entanglement” enables qubits to be deeply interconnected so that a change in one affects another immediately, even if they are spatially distant. These characteristics create an extraordinary capacity for parallel processing and the rapid solving of complex mathematical problems, opening the door to solutions that have been previously impossible or nearly impossible with traditional computing alone.

The design and development of new drugs involves complex, lengthy stages, beginning with the study of molecular interactions and the selection of promising therapeutic compounds, followed by testing in laboratories and on animals, before moving on to clinical trials in humans.

These steps require detailed analyses of molecular structures and their potential interactions with the body's proteins and biological systems. Many research organizations use high-performance computing to reduce the time and cost of lab testing through “molecular simulations,” which predict the function and structural compatibility of molecules. Nevertheless, numerous physical and chemical aspects remain too complex for today's computers to handle accurately and quickly enough to expedite drug design.

Understanding how molecules interact with cellular receptors is one of the most crucial steps in drug design.

Here, quantum computing's advantages become clear. Its ability to explore vast computational spaces at high speed enables more detailed simulations of chemical interactions and deeper analysis of the links between proteins and drug molecules. Quantum computers can perform mathematical operations that solve highly complex equations describing electron behavior and interactions within molecules much faster than conventional systems.

This quantum-driven computational support can shorten the drug discovery cycle by simulating drug formulations and predicting how they bind to target proteins, cutting back on expensive lab tests. It can also improve compound selection for experimental studies, raising the likelihood of success in clinical trials while reducing wasted time and resources. Moreover, quantum computers can analyze more intricate molecular structures, containing hundreds of atoms, with enhanced precision, paving the way for developing treatments for rare diseases or those resistant to traditional therapies.

Some leading companies have already begun forming partnerships with tech firms to integrate quantum computing into drug research. For instance, Pfizer has announced collaborations with quantum computing developers such as IBM and Google to evaluate molecular simulation models. New startups have also emerged, focusing exclusively on quantum simulation technologies and drug-molecule analysis in a bid to offer solutions beyond the scope of conventional computing. Although these initiatives are still in their early stages, preliminary results are encouraging and highlight the significant potential for more accurate simulations and faster drug-discovery processes.

Despite these promising advances, quantum computing still has a long way to go before becoming a mainstream tool in drug discovery. Maintaining quantum states requires extremely cold environments and meticulous shielding from any vibrations or noise that could weaken qubits and compromise computing results. Today's quantum devices are also limited by a relatively small number of qubits that can operate with high fidelity, constraining large-scale applications in the global pharmaceutical industry.

Cost-effectiveness questions remain as well, since research in this domain still requires major investments and often depends on long-term partnerships between research institutions, governments, and tech companies.

Nonetheless, the integration of quantum computing into the pharmaceutical sector is an emerging trend with the potential to evolve substantially in the years to come. This technological revolution promises to transform our understanding of biochemistry and the development of targeted therapies and personalized medicine.

In the future, scientists may be able to model complex drug molecules within days or hours, rather than months or years, thereby speeding up the time to market for innovative treatments targeting challenging diseases and alleviating the heavy financial burden of clinical research for pharmaceutical companies.

PART 6 · TOPIC 8

NVIDIA and the Pharmaceutical Industry

March 2025 · First published

In recent years, the pharmaceutical industry has undergone a major transformation in research and development approaches, fueled by advanced computing technologies and artificial intelligence (AI) that help accelerate the discovery of drug compounds and enhance the understanding of complex biological interactions. In this context, NVIDIA has emerged as a prominent name and key player in high-performance computing (HPC) and AI. Recognizing the urgent need for fast, flexible solutions in designing new medications, NVIDIA is making bold moves to enter the world of pharmaceutical development.

Originally known for its graphics processing units (GPUs) designed for gaming and 3D design, NVIDIA quickly proved that these GPUs excel at executing parallel computing tasks with remarkable efficiency, a breakthrough that propelled the company to the forefront of HPC. Since the early 2000s, NVIDIA has expanded to deliver comprehensive platforms for AI and machine learning, now widely used in critical fields like big data analytics, robotics, and self-driving vehicles. Today, the company is applying its computational and software capabilities to provide revolutionary tools for the pharmaceutical sector, aiming to accelerate drug discovery and cut costs.

The field of drug design is undergoing a notable shift toward leveraging intelligent algorithms that evaluate thousands of potential drug compounds and identify those that are most viable and safest. NVIDIA's high-performance processing units offer significant speed in training machine-learning models and handling vast datasets. Pharmaceutical companies are increasingly seeking computing solutions that can process molecular simulations and the huge volumes of data generated by clinical trials and genome analyses. NVIDIA sees this rising demand as an opportunity to broaden its reach beyond graphics and gaming. Since designing drugs often requires highly complex operations in quantum physics, molecular chemistry, and protein interactions, NVIDIA's robust HPC architecture provides the key to accelerating these calculations and delivering quick, accurate results.

One standout example of NVIDIA's work is the launch of one of Europe's most powerful supercomputers "known as Cambridge-1" in the United Kingdom. Built in collaboration with major pharmaceutical companies like AstraZeneca and GlaxoSmithKline (GSK), this supercomputer aims to speed up drug discovery, genome analysis, and AI modeling. NVIDIA has also released a dedicated AI platform to support researchers in simulating molecular interactions, analyzing biological images, and evaluating clinical data. By offering tools to design software solutions and train models quickly, this platform shortens initial testing phases and enhances result accuracy. Moreover, NVIDIA has entered into strategic partnerships with both major and emerging pharmaceutical companies, providing integrated hardware and software packages that combine parallel-processing power with

advanced AI platforms, ultimately helping researchers optimize R&D budgets and improve the efficiency of drug-compound design.

Despite these tremendous possibilities, several challenges remain, high financial costs for HPC systems, the need for specialized personnel trained in quantum physics, AI, and molecular biology, as well as ongoing concerns around data security and privacy, especially when handling sensitive health information. Nevertheless, NVIDIA appears determined to strengthen its footprint in the sector, backed by its extensive HPC expertise and ownership of cutting-edge software platforms, alongside forming strategic collaborations that unite major technology companies with pharmaceutical and medical research organizations.

NVIDIA's move into the pharmaceutical domain undoubtedly marks a significant turning point, both in the global race to develop new drugs more quickly and in underscoring the expanding role of AI and high-performance computing in essential fields. While this approach shows promise in reducing costs and shortening the time needed to discover novel treatments, it also highlights the growing influence of tech companies in shaping the future of healthcare and, specifically, the pharmaceutical industry. Ultimately, both patients and the scientific community benefit from closer cooperation between computer science and medicine, bringing drug innovations closer to reality and taking an additional step toward addressing the health challenges that have long impeded human progress.

PART 6 · TOPIC 9

Medicine 3.0

March 2025 · First published

The concept of Medicine 3.0 revolves around rethinking the entire healthcare system so that it shifts from focusing on “treating illness” to emphasizing “health care” in all its aspects throughout a person's lifetime, rather than waiting for problems to arise and then treating them at high costs, costs that may extend lifespan without necessarily improving actual health levels or what is sometimes referred to as “healthspan.” This vision differs significantly from what the world experienced during Medicine 1.0 and Medicine 2.0: Medicine 1.0 refers to the traditional or classical approach that relies on diagnosing and treating diseases using limited resources and non-digital clinical analyses, while Medicine 2.0 witnessed the digitization of paper records and the introduction of technology and the internet into healthcare, including remote monitoring applications. In contrast, Medicine 3.0 takes a major step toward a more comprehensive, data-driven future by advancing the principles of holistic care, early diagnosis, and sustainable prevention, drawing on significant breakthroughs in biotechnology (Biotech), artificial intelligence, smartphone and wearable-device applications, as well as developments in genetics, the microbiome, and the complex molecular ecosystem of bacteria, viruses, and other microorganisms that affect our health. By following this vision, Medicine 3.0 aims to achieve a true balance between extending lifespan and enhancing its quality, helping individuals maintain well-being over the long term, rather than merely treating symptoms after health problems have escalated.

At its core, Medicine 3.0 is built on the idea that healthcare must be flexible and personalized above all else, with treatment, dietary, and preventive plans designed to match the immense diversity of genetics, environmental conditions, lifestyle, age, diet, and mental health. Here, advanced digital technologies intersect: smartphones, health apps, and wearable devices like smartwatches, heart-rate monitoring bands, and fitness trackers give individuals the ability to continuously monitor their well-being and record their daily readings, which are then analyzed using AI and machine-learning algorithms. As a result, clinicians and researchers can gain deeper insight into each patient's unique circumstances, delivering advice based on continually updated real-world data, rather than general observations or broad statistical studies that may not apply equally to everyone. In this regard, biotechnology companies play a particularly prominent role.

This is where genetic-testing and home-testing firms come into play, with 23andMe serving as one of the most notable examples. Since its founding in 2006 in California, the company has conducted over 13 million genetic tests, producing a vast database of information about customers' genetic makeup. From this data, it provides simplified reports on the risks of developing certain diseases or genetic predispositions for specific health traits, as well as general lifestyle recommendations, such as dietary guidance and physical exercise. This approach showcases the practical aspect of Medicine 3.0 by making patients more aware and engaged in managing their own health, urging

them to follow “small and repeated” tips over longer periods—daily dietary steps or specific exercises, for instance, thereby improving their chances of avoiding chronic health problems and reinforcing sustainable positive habits.

Of course, the future vision of Medicine 3.0 is not limited to genetics; it also covers environmental and social influences, along with psychological factors like stress management and improved sleep quality. In this context, researchers are now highlighting specific techniques around deep breathing, exposure to cold or heat, and fine-tuning nutrition with supplements tailored to genetic-test results that indicate potential deficiencies in certain micronutrients.

From an economic standpoint, there are also clear benefits. Technologies that can continuously track vital signs and monitor physical activity pave the way for more affordable and efficient healthcare systems, improving hospital resource management and reducing financial burdens associated with prolonged treatments of chronic illnesses. As companies start developing apps that remind users of medical appointments and the correct dosages of their medications, and offer personalized dietary programs that take into account one’s gut microbiome and individual needs for vitamins and amino acids, we gradually move away from the “one-size-fits-all” model to a “high-precision personalized treatment” approach that sees each person as a unique case requiring a carefully designed preventive and therapeutic plan.

PART 6 · TOPIC 10

Quantum Computing and Drug Development

March 2025 · First published

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unprecedented speeds compared to traditional computers. As these quantum computers steadily advance, various industrial and research sectors have begun to leverage their capabilities, with drug development standing out as one of the fields most likely to experience revolutionary breakthroughs, thanks to the immense computing power that quantum technology offers.

Quantum computing is rooted in the core principles of quantum mechanics, most notably “superposition,” which allows a “qubit”, the fundamental unit of quantum computing, to exist in more than one state at a time. This is unlike the conventional “bit,” which can only be 0 or 1. Additionally, the concept of “quantum entanglement” enables qubits to be deeply interconnected so that a change in one affects another immediately, even if they are spatially distant. These characteristics create an extraordinary capacity for parallel processing and the rapid solving of complex mathematical problems, opening the door to solutions that have been previously impossible or nearly impossible with traditional computing alone.

The design and development of new drugs involves complex, lengthy stages, beginning with the study of molecular interactions and the selection of promising therapeutic compounds, followed by testing in laboratories and on animals, before moving on to clinical trials in humans. These steps require detailed analyses of molecular structures and their potential interactions with the body's proteins and biological systems. Many research organizations use high-performance computing to reduce the time and cost of lab testing through “molecular simulations,” which predict the function and structural compatibility of molecules. Nevertheless, numerous physical and chemical aspects remain too complex for today's computers to handle accurately and quickly enough to expedite drug design.

Understanding how molecules interact with cellular receptors is one of the most crucial steps in drug design. Here, quantum computing's advantages become clear. Its ability to explore vast computational spaces at high speed enables more detailed simulations of chemical interactions and deeper analysis of the links between proteins and drug molecules. Quantum computers can perform mathematical operations that solve highly complex equations describing electron behavior and interactions within molecules much faster than conventional systems. This quantum-driven computational support can shorten the drug discovery cycle by simulating drug formulations and predicting how they bind to target proteins, cutting back on expensive lab tests. It can also improve compound selection for experimental studies, raising the likelihood of success in clinical trials while

reducing wasted time and resources. Moreover, quantum computers can analyze more intricate molecular structures, containing hundreds of atoms, with enhanced precision, paving the way for developing treatments for rare diseases or those resistant to traditional therapies.

Some leading companies have already begun forming partnerships with tech firms to integrate quantum computing into drug research. For instance, Pfizer has announced collaborations with quantum computing developers such as IBM and Google to evaluate molecular simulation models. New startups have also emerged, focusing exclusively on quantum simulation technologies and drug-molecule analysis in a bid to offer solutions beyond the scope of conventional computing. Although these initiatives are still in their early stages, preliminary results are encouraging and highlight the significant potential for more accurate simulations and faster drug-discovery processes.

Despite these promising advances, quantum computing still has a long way to go before becoming a mainstream tool in drug discovery. Maintaining quantum states requires extremely cold environments and meticulous shielding from any vibrations or noise that could weaken qubits and compromise computing results. Today's quantum devices are also limited by a relatively small number of qubits that can operate with high fidelity, constraining large-scale applications in the global pharmaceutical industry. Cost-effectiveness questions remain as well, since research in this domain still requires major investments and often depends on long-term partnerships between research institutions, governments, and tech companies.

Nonetheless, the integration of quantum computing into the pharmaceutical sector is an emerging trend with the potential to evolve substantially in the years to come. This technological revolution promises to transform our understanding of biochemistry and the development of targeted therapies and personalized medicine. In the future, scientists may be able to model complex drug molecules within days or hours, rather than months or years, thereby speeding up the time to market for innovative treatments targeting challenging diseases and alleviating the heavy financial burden of clinical research for pharmaceutical companies.

PART 6 · TOPIC 11

Horses and Autonomous DrivingSeptember 2024 · First published

Dear reader, the world is on the verge of a new transportation revolution.

Just as the car replaced horse-drawn carriages over a century ago, autonomous vehicles are poised to redefine our relationship with transportation.

The shift from traditional driving to self-driving cars is not merely about convenience or novelty; it represents a fundamental transformation in how we live, work, and interact with our environment.

This shift, like the transition from horses to cars, could lead to the demise of entire industries while opening the door for new ones.

In this article, we will explore the potential impact of self-driving cars on society and draw parallels with the early 20th-century transition from horses to automobiles.

By examining how this historical shift led to the collapse of industries related to horse-drawn transportation, we can better understand the challenges and opportunities ahead as we move toward a future dominated by autonomous vehicles.

In the early 20th century, horses were the primary means of transportation in both urban and rural areas. Cities were filled with horse-drawn carriages, and industries thrived on horses' care, maintenance, and support. Blacksmiths, carriage makers, stable owners, and feed suppliers were essential to urban life. However, this all began to change with the introduction of the automobile.

By 1910, cars became more accessible to the public thanks to Henry Ford's Model T and his innovations in assembly line production.

Over the next two decades, the use of horses for transportation rapidly declined. Cars offered incredible speed, efficiency, and convenience, and by 1930, horses had nearly vanished from urban streets.

The impact on related industries was profound.

Blacksmiths who had been shoeing horses found themselves out of work, and carriage makers saw their businesses collapse.

The demand for hay and feed plummeted, negatively affecting agricultural sectors that had relied on feeding urban horse populations. Supply chains that supported horse-drawn transportation virtually disappeared overnight.

Self-driving cars are no longer a distant dream.

Major technology companies and automakers are heavily investing in autonomous vehicle technology, and several companies have already launched early versions of these vehicles.

I noticed them frequently on the roads during my recent visit to the United States a few weeks ago.

The promise of safer roads, reduced congestion, and increased mobility for all have fueled excitement about this new era of transportation.

With the increasing prevalence of self-driving cars, the conventional models of car ownership may diminish.

Individuals might not find it necessary to possess a personal vehicle when they can simply request a self-driving car as needed.

This change could result in a decrease in car sales, especially for luxury and performance vehicles that cater to driving enthusiasts.

Car dealerships, which depend on the sale and maintenance of vehicles, may face challenges in adapting to this new environment.

The rise of electric self-driving cars is expected to become more common, further reducing the gasoline demand. Gas stations may need to diversify their offerings or transition to providing electric vehicle charging stations.

Similarly, traditional car maintenance services could see a decline in business, as self-driving cars are likely to require less frequent maintenance.

The emergence of self-driving cars is expected to significantly influence real estate and urban planning. With the widespread adoption of autonomous vehicles, traditional parking lots and garages may no longer be necessary as people rely on self-driving cars that do not require parking spaces.

This change could liberate valuable urban land for alternative purposes, triggering a shift in the way cities are planned and constructed.

Companies specializing in developing and maintaining autonomous vehicle technology will be at the forefront of this new era. This includes manufacturers of self-driving cars and companies that provide the software, sensors, and infrastructure needed to support them.

The transition from owning personal cars to utilizing transportation as a service may lead to the development of a new industry.

Businesses providing on-demand access to self-driving cars could prosper in a future where fewer individuals find it necessary to own a vehicle.

As the use of self-driving cars increases, cities will need to adjust their infrastructure to accommodate them.

This could lead to a boom in smart city technologies, including advanced traffic management systems, vehicle-to-infrastructure communication, and new urban planning approaches prioritizing pedestrian and public spaces over parking.

With self-driving cars' increased connectivity, cybersecurity and data privacy will become even more critical. Companies specializing in protecting these vehicles from hacking and ensuring the privacy of passengers' data will play a vital role in this new era.

The shift towards electric self-driving cars will also create new opportunities in the sustainable energy sector.

Companies providing renewable energy solutions, such as solar and wind power, will be essential in supporting the increased demand for electricity needed to power these vehicles.

Just as horseback riding has become a niche recreational activity, driving may one day be seen as a hobby rather than a necessity.

In the future, driving enthusiasts may visit racetracks or designated driving areas to indulge their passion, much like equestrians visit stables and riding clubs today.

PART 6 · TOPIC 12

Forging Innovation by Bridging Academia and Industry

June 2024 · First published

In today's fast-paced world, collaboration between academia and industry has become increasingly important. This partnership has led to significant advancements in science, technology, and the economy. The relationship between these two entities is mutually beneficial, with both parties reaping benefits from the collaboration. In this article, we will explore how this collaboration works and provide examples that illustrate the positive impact of these partnerships.

Academia is renowned for its excellence in conducting fundamental research, which provides in-depth insights into complex problems and promotes learning and innovation. Academic institutions are recognized for their rigorous research methodologies and long-term perspectives on research projects.

On the other hand, the industry excels in applying these research findings to develop practical applications and commercialize new technologies. Its strengths lie in its ability to scale solutions, quickly bring products, and efficiently respond to market needs.

The collaboration between academia and industry can take various forms, including:

Research Partnerships: Companies often fund research projects within universities to tap into the wealth of knowledge and innovative solutions that academics can provide.

Internships and Co-op Programs: These provide students with hands-on experience while allowing companies early access to the next generation of talent.

Technology Transfer: Universities often have technology transfer offices that help patent and license discoveries to businesses.

Several successful collaborations between academia and industry across various sectors have been demonstrated. The University of Oxford and AstraZeneca partnered to develop a COVID-19 vaccine in the pharmaceuticals and biotech field. This collaboration led to the successful creation and global distribution of over 2 billion doses to more than 170 countries by 2023. Financially, AstraZeneca committed to distributing the vaccine not-for-profit during the pandemic, highlighting the partnership's focus on public health rather than profit.

The Massachusetts Institute of Technology (MIT) and IBM jointly established the MIT-IBM Watson AI Lab to advance research in technology and engineering. The lab has over 50 active projects on developing AI algorithms and their applications across various industries. IBM invested \$240 million over ten years, demonstrating its commitment to long-term research and development.

Stanford University and Google joined forces to develop smart grids and sustainable energy technologies for a better future. They collaborated on numerous projects; one notable outcome was the 'Google Sunroof' initiative. The project uses machine learning to evaluate the solar potential of individual roofs, making it easier to make informed decisions about solar energy usage. Google provided significant financial support for the project through research grants and infrastructure development, demonstrating its strong commitment to advancing sustainable energy technologies.

Saudi universities, including King Abdulaziz University, are distinguished by entities like "I-ONE Medical Molecular Imaging Company" and "Al-Teriaq Pharma," both subsidiaries of Wadi Jeddah Company, the university's investment arm. "Al-Teriaq Pharma" excels in developing innovative medical and pharmaceutical products available in thousands in the local market, achieved through collaboration with numerous national and international medical and pharmaceutical companies to integrate in all stages of relevant industries and manufacturing. One result of these partnerships is the development of many medical products available in local markets. Al-Teriaq Pharma has 9 products in the markets and over 20 products under development in collaboration with many national and international pharmaceutical companies. Meanwhile, "I-ONE Medical Molecular Imaging Company" specializes in producing and manufacturing innovative radioactive isotopes with Saudi hands. The company also provides specialized medical imaging services using advanced PET/CT-MRI technology, which combines magnetic resonance imaging and computed tomography with nuclear imaging, to innovatively provide accurate and comprehensive diagnoses for patients through collaboration with national and international companies to develop and transfer deep technology.

The future presents an excellent opportunity for academia and industry to collaborate more closely. With technology continuously advancing and new challenges emerging, it becomes increasingly evident that innovative solutions are needed. By combining the theoretical knowledge of academia with the practical, market-driven expertise of industry, these collaborations can more effectively tackle complex global issues.

Collaborations between academia and industry have led to outcomes neither party could have accomplished alone. This paves the way for a future where academic discoveries are quickly transformed into practical, life-improving technologies. As we continue cultivating these relationships, we can expect a surge in advancements that benefit society on multiple levels.

Saudi Arabia's Vision 2030 aims to strengthen the nation's economic, social, and technological capacities by implementing diversified initiatives. A vital component of this transformation is the collaboration between academia and the industry, which will help reduce the kingdom's historic dependence on oil by encouraging innovation in non-oil sectors such as renewable energy, technology, and tourism. Such partnerships will promote the growth of new industry sectors and position Saudi Arabia as a potential leader in these areas. Additionally, academic-industrial collaborations are crucial for developing a knowledge-based economy that can create high-value jobs and industries, leading to sustainable economic growth.

Collaborations between different entities are crucial in several aspects, such as employment and skill development, job creation, and improving workforce competencies. These collaborations align the competencies of the Saudi nationals with industry needs, boosting their employability. Furthermore, such partnerships support the development of regional hubs and the startup ecosystem, both vital for economic revitalization and innovation. These partnerships also help establish strategic international relationships that make Saudi Arabia more attractive to foreign investors and enhance its competitiveness on the global stage. Achieving Vision 2030's ambitious objectives is essential for making Saudi Arabia a leading global economy.

PART 6 · TOPIC 13

The Campus!May 2024 · First published

Dear Reader, universities are more than just educational institutions; they are complete ecosystems where innovation, culture, and sustainability converge to foster academic and personal growth. The race to create the best, most beautiful, and most effective university campus goes beyond traditional academic rankings and architectural creativity. It also includes environmental beauty, advancements in prominent facilities, and university life that inspire and encourage creativity.

The term "campus" originates from the Latin word "campus," meaning "field" or "plain," and initially referred to vast open spaces. However, over time, the word evolved to encompass the entire educational environment, including education, research, student activities, and more. The campus offers a comprehensive community that supports and nurtures students, academic staff, and researchers in an inclusive and stimulating environment. It serves as a microcosm of society, providing a platform for students and staff to develop and grow in all aspects of academic, cultural, and social life.

By adopting an integrated approach that combines sustainable design with technological advancement, Saudi universities can develop campuses that reflect architectural beauty and principles of sustainability, inclusiveness, and vibrant student life. In the quest to enhance their academic environment and global standing, adopting these standards represents a path toward creating campuses distinguished by aesthetic appeal and as bastions of innovation, cultural diversity, and environmental awareness.

Globally, many universities are known for their academic and research strength, as well as for their exceptional campuses that offer a distinctive student experience. These universities have successfully blended historic architecture with modern innovations.

Today, we will be exploring the factors that make universities unique and attractive to students, professors, and visitors. The design and architectural beauty of a campus play a pivotal role in giving a university its character and atmosphere, transforming it into a place of inspiration and creativity. The aesthetic appeal of the buildings, ranging from historic constructions to modern sustainable ones, provides daily motivation for students and professors alike. Additionally, the harmonious planning of the campus ensures that these architectural landmarks are not just separate features but part of an integrated environment.

Environmental sustainability is a fundamental pillar globally, with universities increasingly committed to preserving green spaces and focusing on energy efficiency. These initiatives reflect the university's commitment to protecting the environment and educate and inspire students to adopt more sustainable lifestyles.

The quality and diversity of student facilities and support services significantly enhance the university student experience, providing the necessary support for academic and social well-being. The modern campus considers a wide range of services, from libraries rich in resources to comprehensive sports complexes and comfortable dining and housing options that contribute to creating an exceptional educational environment.

Environmental sustainability and technological advancement are prominent features of universities that look to the future. These universities recognize the importance of integrating sustainable practices and advanced technology in their operations and educational programs. This approach prepares students to face future challenges and demonstrates the institution's commitment to environmental conservation and innovation for a better future.

Considering these standards, it becomes clear that the concept of "the best" campus can vary significantly based on the community's priorities and values.

To enhance their academic environments, Saudi universities can invest in redesigning and improving campuses to be sustainable and innovative, combining traditional architectural elements with modern technology and enhancing community spaces that encourage cultural exchange and intellectual growth, with a priority on green spaces and quality environmental initiatives.

In conclusion, the pursuit of creating a campus transcends architectural beauty to include a comprehensive approach encompassing sustainability, innovation, inclusiveness, and community engagement. Universities worldwide have set remarkable examples by integrating these elements, enhancing the educational experience, and creating environments where students and staff can thrive.

PART 6 · TOPIC 14

The Dawn of the "Generative AI" Era in Healthcare

March 2024 · First published

The rise of artificial intelligence (AI) has brought about a significant shift at the intersection of technology and healthcare. It promises to revolutionize the way diseases are diagnosed and treated, thanks to its unique ability to generate new content and simulate complex patterns. In this article, we will delve into the remarkable and transformative capabilities of AI in healthcare. We will explore its current applications, future prospects, and the main challenges it faces.

Generative AI is an advanced form of artificial intelligence that is focused on creating innovative and original content, such as text, images, audio, and video, that resembles human creativity. This type of AI relies on deep neural networks and machine learning systems that are trained on vast amounts of data to recognize patterns, styles, and structures within the content. Through this process, generative AI can imitate human styles of creativity and generate unique ideas and designs that may exceed traditional human creative capabilities. This technology has opened up new horizons in various fields such as art, design, creative writing, and scientific research, providing powerful tools for content creation and innovative solutions to complex challenges.

Generative AI uses complex algorithms and data models to make decisions by recognizing patterns and relationships in the input data. AI relies on machine learning, which involves training systems to learn. This learning process has three stages: "supervised learning," where models are trained on pre-classified data, "unsupervised learning," which autonomously discovers patterns in unclassified data, and "reinforcement learning," which uses a trial-and-error approach, rewarding correct decisions. Thanks to computing technology advancements and vast data sets availability, AI can now perform complex tasks with high accuracy. Some of these tasks include image and natural language recognition, event prediction, and autonomous vehicle navigation. These advancements are opening up new prospects in various industries and research fields.

The potential applications of generative AI in healthcare are broad and varied. It has the potential to revolutionize drug discovery by significantly reducing the time and costs associated with traditional methods. However, there are certain challenges that need to be addressed before adopting generative AI in healthcare. These include concerns over data privacy and the need for thorough validation to ensure the accuracy and safety of AI-generated solutions.

AI has a lot of potential in healthcare, especially in medical research and drug discovery. Generative AI can speed up medical and pharmaceutical research by predicting molecular interactions and simulating drug responses, making it easier to develop new treatments. It can also help diagnose diseases with greater accuracy and customize gene therapies through analyzing large datasets in clinical diagnosis and personalized medicine. AI can create customized educational materials for patients, offer virtual health assistance, and monitor patient health by gathering data from wearable

devices. Generative AI can also create realistic medical scenarios for simulation-based training, giving medical professionals practical experience without any risk to patients.

Integrating generative AI into healthcare has raised concerns about data privacy and security, as it involves handling sensitive patient information. The ethical implications of AI in diagnostic and treatment decisions have also raised questions about responsibility and consent. To address these challenges and ensure that the benefits of AI do not come at the expense of patient rights and safety, it is essential to establish regulatory frameworks that govern the use of generative AI in healthcare.

Experts anticipate that generative AI will become an integral part of the healthcare system in the next decade, transforming everything from patient care to medical and pharmaceutical research. The key to this evolution lies in continuous research, increased investment, and collaboration across the technology and healthcare industries..

PART 6 · TOPIC 15

Your Cup of Coffee and StrychnineJuly 2023 · First published

Dear reader, I hope you've had your daily dose of caffeine from your favorite cup of coffee today. And if you haven't, I urge you to prepare your coffee cup before continuing to read this article, with one condition: you don't drink it until you finish reading it.

Do you know what your coffee has to do with "strychnine"?

Jim Rohn, an American entrepreneur, and author, answered this question.

Let's first define what "strychnine" is. It is a colorless, bitter-tasting, deadly poison extracted from the seeds of certain plants, such as "the *Strychnos nux-vomica* tree." It is a potent poison that affects the central nervous system, causing muscle spasms and, ultimately, death by asphyxiation. "Strychnine" was used in the past as a pesticide, but due to its extreme toxicity, it is now banned in many countries.

When I was a third-year pharmacy student at King Abdulaziz University, we conducted a scientific experiment injecting strychnine into laboratory mice to study its effects on the body. Its effect was powerful and almost instantaneous.

So, what's the relationship between your coffee and this deadly substance?

The relationship is about "guarding your mind, work, and life."

What if someone put in your coffee, especially the one you just made and haven't drunk yet, as I told you? What if your worst enemy puts "sugar" in your coffee? What would happen if you drank this coffee? The answer is nothing, except that you'll get a tasty and fabulous coffee.

Now, let's ask another question. What if someone, intentionally or unintentionally, put "strychnine" in your coffee, someone from your family, friend, colleague, or someone close to you? What would happen to you, dear reader?

That's why our lives are a mix of "sugar" and "strychnine." So, you must always guard and protect your coffee, whether from your closest ones or your worst enemies.

The relationship between "your coffee and strychnine" reflects on all aspects of our professional and personal lives. We must guard our minds, work, and lives against negative influences, whether intentional or unintentional. The effect has already occurred if the negative impact has already happened, whether from your enemy or your close friend. We should choose the information we receive carefully and be cautious about the people we allow to interact with or influence us.

Be cautious in choosing the people who influence you. The people we spend time with significantly impact our thoughts, feelings, and behaviors. Choose positive, encouraging, and supportive people.

Sometimes, the people closest to your heart can hurt you more than your worst enemies, even unintentionally.

Dedicating time each day to reflect on your thoughts, feelings, and behaviors is essential. This will help you identify any negative influence, whether actions, words, or ideas, that might affect your life.

So, dear reader, always remembers, before drinking your daily coffee, its relationship with "strychnine."

PART 7

The Space Economy

9 TOPICS

Space earns its place in a book about medicine for a simple reason: it is the clearest example we have of a frontier science becoming an industry. Launch costs collapse, private companies take work that belonged to states, capital arrives, and a research programme turns into a market. Biotechnology is walking the same road a few years behind. These topics follow the space economy on its own terms, and as a rehearsal for what happens when any hard science learns to pay for itself.

WHY READ THIS PART

Read this section to watch a science turn into an economy, the same transition biotechnology is living through now.

THE SPACE ECONOMY · PART 7

In this part

NO.	TOPIC	PAGE	PUBLISHED
1	Artificial Intelligence in Space	343	May 2026
2	The Rapid Growth of the Space Industry	345	December 2025
3	The Global Space Economy	347	September 2025
4	AST SpaceMobile and Revolutionizing Global Connectivity from Space	349	August 2025
5	Global Competition for Space Supremacy	351	July 2025
6	Rocket Lab Leading a Revolution in the Space Industry	353	June 2025
7	Three Pioneering Companies Reshaping the Future of Space	355	May 2025
8	How Biotechnology is Revolutionizing Space Exploration	357	April 2025
9	Drawing Lessons from the Apollo 13 and Columbia Missions	359	January 2024

PART 7 · TOPIC 1

Artificial Intelligence in SpaceMay 2026 · First published

Dear reader, imagine that the photos, videos, and streams of data we use every day are not processed in massive data centers on Earth, but in space. It sounds like science fiction, yet it has become a serious topic in the tech world: AI data centers built on satellites or on platforms in low-Earth orbit. The reason is straightforward: data volumes are exploding, AI workloads consume enormous energy, and Earth-based infrastructure is under increasing strain. So a new question is emerging: what if we moved part of computing into space?

On Earth, data centers depend on three essentials: a lot of electricity, continuous cooling, and fast connectivity. As AI models grow, energy and cooling bills have become a major challenge, not only in cost but also in environmental impact. This is where space looks tempting: sunlight can provide abundant power via solar panels, and being close to the satellites that collect data could reduce the need to send everything down to Earth first. In theory, space offers different ways to manage heat and to be close to the data source.

But why would we need data centers in space at all? One of the biggest reasons is reducing latency for certain tasks. Today, satellites capture high-resolution images of Earth and then transmit them to ground stations for analysis. That creates delays: the satellite must pass over a receiving station, the data must be processed, and then the results must be delivered back to users. If a powerful computer sits on the satellite itself, it can analyze imagery immediately and extract only what matters. Think of early wildfire detection, flood monitoring, tracking vegetation changes, maritime surveillance, or disaster response. Instead of downlinking terabytes of raw images, a satellite could transmit compact outputs such as a risk map, an early warning, or a rapid report.

There is another important motivation: resilience and security. In major disasters, network outages, or situations where independent communications are needed, having processing capabilities in orbit could offer higher continuity for critical systems. Some defense and security applications may also value direct, on-board analysis without relying entirely on Earth-based infrastructure that could be targeted, disrupted, or overloaded.

Still, this does not mean space data centers will replace Earth. The more realistic future is a hybrid model: some processing occurs in orbit, while the rest remains on the ground. The rule is simple: tasks that require immediate response or initial filtering can be done in space, while heavy workloads, such as training giant AI models, remain on Earth. Training frontier-scale models typically requires thousands of processors, stable operations, frequent updates, and flexible maintenance, which are still far easier and cheaper on the ground.

The biggest barrier to “space computing” is not the concept, but the engineering and economics. First comes heat. Space may be cold, but removing heat generated by computing is not trivial. On Earth, we use air flow, water, and HVAC systems. In space, there is no air to carry heat away, so you rely on thermal radiation through large surfaces and radiators. The more computing power you add, the larger (and heavier) those radiators must be, driving up size, mass, and cost.

Second is the cost of launch and operations. Sending heavy equipment to orbit is expensive, and even if launch prices fall over time, building and running a space-based data center will usually remain more complex than expanding one on Earth. Ground data centers can be upgraded, repaired, and refreshed quickly. In space, a failure may mean losing an entire unit, and upgrades require new missions or highly complex designs that allow servicing and assembly in orbit.

Third, electronics in space are exposed to radiation that can cause errors or permanent damage. That pushes designers toward radiation-hardened components or sophisticated error-correction strategies, both of which add cost and may limit access to the newest, highest-performance commercial hardware available on Earth.

So why does the idea keep gaining attention? Because a practical path is already underway: edge computing in space, placing modest AI capabilities on satellites to process data locally. This approach can scale gradually. With each new generation of satellites, processing power, energy management, and communications improve. And as laser-based inter-satellite links mature, moving data within space could become faster, enabling networks of distributed computing rather than a single massive orbital “data center.”

In the end, the real question is not “Can we build a data center in space?” but when it makes sense. It becomes compelling when decision speed matters more than cost, when data volumes are so large that downlinking everything is inefficient, and when independence and resilience carry strategic value. In that scenario, space may become not only a home for satellites, but a new frontier for computing... and perhaps an entire industry forming above our heads.

PART 7 · TOPIC 2

The Rapid Growth of the Space Industry

December 2025 · First published

Dear reader, the global competition in space is intensifying, as reflected in the increasing number of rocket launches each year. Launching satellites or spacecraft into space is no longer a rare event. Instead, it has become almost routine, with numerous organizations now capable of conducting these launches. For instance, in 2022, approximately 186 rocket launches were attempted worldwide, with 178 successful launches, a record-breaking figure compared to previous decades. This surge can largely be attributed to the significant participation of private companies alongside governmental entities. Commercial launch companies are frequently deploying satellites to support communication services, internet connectivity, and Earth observation, among other applications.

This heightened commercial competition has significantly reduced launch costs and enhanced efficiency, thereby encouraging even more entities to deploy payloads into orbit. Simultaneously, the global space industry continues to grow rapidly in terms of investment and revenues. Recently, the global space economy has reached nearly half a trillion dollars annually, and it is anticipated to exceed a trillion dollars within the next few years if this rapid growth continues.

This expansion, dear reader, reflects the world's increasing reliance on space-based services, from satellite communications and television broadcasting to Global Positioning Systems (GPS), which are relied upon daily by billions, and satellites dedicated to climate monitoring, weather forecasting, and scientific research support. In essence, space has evolved into a strategic economic sector, attracting substantial investment and offering diverse business opportunities. Countries and corporations are racing to secure a foothold, benefiting from significant future returns.

Despite notable achievements and current momentum in the space race, complex challenges are emerging on the horizon. The primary challenge is the substantial cost associated with developing advanced technologies and launching space missions. Sending a rocket into orbit or a spacecraft to another planet requires immense financial and human resources, which are not readily available to all countries. The second challenge is the escalating issue of space debris orbiting Earth. Hundreds of thousands of pieces of space junk from defunct satellites and old rockets orbit our planet, heightening the risk of collisions and threatening space missions. Experts have warned that without international coordination and strict regulation, some orbital paths might become unusable due to debris accumulation and lack of governance. This situation also jeopardizes scientific activities such as astronomical observations, as artificial debris can obstruct astronomers' views into deep space.

Moreover, geopolitical and security challenges accompany the expansion of space activities. With military forces increasingly entering space arenas, exemplified by the establishment of the United States Space Force, concerns are growing about potential space arms races or the transformation of Earth's orbit into a strategic battleground. Fierce competition may complicate international

cooperation, even though such collaboration is essential for managing shared issues, such as satellite traffic and collision avoidance. Additionally, the environmental impact of the space industry cannot be overlooked; emissions from rocket launches and fuels affect both Earth's environment and its upper atmospheric layers. Addressing these challenges requires global cooperation and ongoing research efforts to ensure space remains accessible and sustainable for future generations.

Despite these challenges, dear reader, there is a broad consensus that the space sector represents a bet on the future and a fundamental driver of human scientific and technological progress. Space exploration is no longer merely about national pride or technological showcasing; it has become integral to our daily lives and modern economy. Communication services, television broadcasting, navigation systems, and maritime and air transport all depend on satellites orbiting above us. Satellites also provide critical information on climate conditions, environmental changes, and natural disasters, enabling nations to plan, make informed decisions, and save lives. Looking ahead, space innovations are expected to help address some of humanity's greatest challenges, such as monitoring climate change, discovering new energy and mineral resources, and achieving scientific breakthroughs that could reshape our understanding of the universe and our place within it.

PART 7 · TOPIC 3

The Global Space EconomySeptember 2025 · First published

Dear reader, the global space economy has experienced remarkable growth in recent years, transitioning from a government-driven sector to an expansive marketplace driven by innovative private companies. This dynamic industry encompasses a wide range of fields, from rocket and satellite manufacturing to everyday services such as satellite-based internet and global positioning systems (GPS). Interestingly, today's enthusiasm for space exploration closely mirrors the era of geographical discoveries in the 15th century when European nations competed fiercely to explore and colonize the Americas.

In 2023, dear reader, the global space economy reached an estimated \$570 billion, marking a 7.4% increase from 2022, when it was valued at approximately \$531 billion. Over the past five years, this sector has expanded consistently at an annual compound growth rate of nearly 7%, essentially doubling its size compared to a decade ago. Although it currently represents less than 1% of the overall global economy, experts predict continued rapid growth. According to a recent McKinsey report, the global space economy is expected to reach approximately \$1.8 trillion by 2035, highlighting enormous future opportunities.

The significant size of the space economy reflects the increasing economic value of various space-related activities. These include critical services in today's global economy, such as satellite communications that link communities worldwide, global navigation systems that support transportation and logistics, and Earth observation services that provide essential data for weather forecasting, climate monitoring, agriculture, and disaster management. These services rely on continuously expanding, advanced space infrastructure driven by substantial public and private investments, making space a key driver of innovation and economic growth this century.

The space economy is broadly divided into two main areas: space infrastructure and space-enabled applications and services.

Space infrastructure involves designing, manufacturing, and launching spacecraft and supporting ground facilities. This includes launch vehicles, rockets, satellite production for communications, navigation, and remote sensing, as well as the operation of ground stations and control centers. Recent technological advancements, notably reusable rocket technology, have significantly reduced launch costs. Consequently, the number of operational satellites has surged dramatically, from approximately 3,300 at the end of 2020 to more than 6,700 by 2022, driven by large-scale commercial satellite constellations. This infrastructure expansion has significantly enhanced global capabilities in communications, navigation, and Earth observation.

The second major component, space-enabled services, comprises economic activities directly benefiting humanity. Satellite communications stand out as essential, providing television broadcasting, global phone coverage, and high-speed internet even in remote locations. Global navigation services, such as the American GPS, Russian GLONASS, and European Galileo systems, facilitate precise navigation, which is essential for vehicles, aircraft, ships, and various everyday mobile applications. Earth observation satellites provide invaluable data for weather prediction, climate change monitoring, agricultural management, and disaster response. These services constitute the bulk of current economic returns in the space sector.

Additionally, Earth observation services have experienced substantial growth driven by increasing demand for satellite imagery in precision agriculture, environmental monitoring, and urban planning. Space tourism, although still in its early stages and primarily available to affluent individuals, is also emerging through suborbital flights offered by private companies.

The space economy is supported by both national government programs (like those of the US, Europe, Russia, China, and India) and significant private sector investments. Historically dominated by governments, recent decades have seen the rise of a new commercial-driven space economy. Private companies now play a leading role, generating around 78% of total revenues in 2023, with governmental spending (civilian and military) accounting for only about 22%. Specifically, US government spending represents around 13%, with other global governments collectively making up about 9%. This demonstrates the private sector's growing importance as the primary driver of the space economy's growth.

Ultimately, maximizing the benefits of the space economy sustainably and responsibly will require international cooperation, just as the age of exploration demanded cooperation alongside competition among nations. As we look ahead, the space economy remains filled with both challenges and immense opportunities, potentially influencing the 21st century's economic and geopolitical landscape as profoundly as the discovery of the New World reshaped history centuries ago.

PART 7 · TOPIC 4**AST SpaceMobile and Revolutionizing Global Connectivity from Space**

August 2025 · First published

Imagine, dear reader, being able to completely bypass traditional telecom companies and enjoy seamless global communication services, whether you're deep in the desert or sailing across the ocean, with unmatched internet speeds and no network interruptions. Over the recent years, satellite communication technology has undergone significant advancements, increasing the need for reliable connectivity in remote areas without traditional network coverage. Amidst this rapid technological evolution, AST SpaceMobile has emerged as one of the leading global companies offering innovative satellite communication solutions, designed to provide direct, high-quality connectivity to mobile phones worldwide without requiring any additional ground-based infrastructure.

Founded in 2017 by American entrepreneur Abel Avellan, AST SpaceMobile aims to revolutionize global communication through an advanced satellite network. The unique capability of this network is its direct connectivity with standard smartphones, eliminating the need for specialized modifications or extra antennas. This makes AST SpaceMobile's services highly accessible and cost-effective compared to traditional communication methods.

In 2023, AST SpaceMobile successfully launched its first satellite, BlueWalker 3, achieving a significant milestone by conducting successful trial communications directly with smartphones on the ground. This groundbreaking achievement marks an important advancement in satellite communication technology. According to the company's data, BlueWalker 3 has extensive coverage capabilities, enabling reliable connectivity in regions lacking conventional network infrastructure.

Currently, AST SpaceMobile has an ambitious plan to deploy dozens to hundreds of satellites into low Earth orbit (LEO), with full-scale operational capabilities expected soon. This strategic initiative underlines the company's vision to provide comprehensive and reliable communication services to approximately 5 billion people globally who currently face limited or no access to traditional network coverage.

Financially, AST SpaceMobile has attracted significant attention from international investors. In 2021, the company completed a merger with New Providence Acquisition Corp., a deal valued at approximately \$1.8 billion, which enabled it to enter the financial markets and secure funding for its ambitious growth plans. Additionally, in 2022, AST SpaceMobile successfully raised an additional \$200 million through multiple investment rounds, including prominent investors like Vodafone and American Tower. This further strengthened the company's financial capabilities to expand its global network.

Market analyses indicate that the satellite communication industry is expected to reach approximately \$40 billion by 2030, with a compound annual growth rate (CAGR) of nearly 10%. AST SpaceMobile aims to capture a substantial portion of this market by leveraging its unique technology and ability to provide direct connectivity solutions without the need for expensive ground-based infrastructure.

However, AST SpaceMobile faces specific challenges, notably obtaining regulatory approvals from key agencies such as the U.S. Federal Communications Commission (FCC) and other regulatory authorities in targeted countries. Fortunately, AST SpaceMobile has already secured FCC approval in the United States and has established cooperative agreements with international telecommunications companies, streamlining its global market entry.

Additionally, technical challenges related to ensuring continuous and high-quality service, especially as user numbers grow, pose another hurdle. Nonetheless, AST SpaceMobile addresses these challenges with confidence through substantial investments in research and development, alongside partnerships with leading technology firms.

In conclusion, AST SpaceMobile is poised to revolutionize the satellite communication industry. With an increasing global demand for reliable connectivity in remote areas, the company continues to achieve remarkable milestones, solidifying its position as a key player that deserves close attention in the years to come.

PART 7 · TOPIC 5

Global Competition for Space SupremacyJuly 2025 · First published

Dear reader, in the mid-20th century, the world witnessed the first great space race between the United States and the Soviet Union. Their goal was clear: achieve dominance in space exploration by launching the first satellite and sending the first human into orbit. Indeed, the Soviet Union succeeded in launching Sputnik in 1957, followed by Yuri Gagarin's spaceflight in 1961. After the United States landed humans on the Moon, this competition subsided temporarily. However, today, a renewed and broader space race is unfolding, involving numerous nations with ambitions that surpass simply reaching the Moon.

The United States and Russia still lead this traditional rivalry. The U.S. continues to allocate massive budgets to NASA, exceeding \$25 billion annually. Russia, inheriting the Soviet legacy, remains pivotal by operating missions like the International Space Station, despite recent financial and technical hurdles.

The most significant new competitor in recent decades is China. Though it joined the space community late, China has rapidly become a leading player. It launched astronauts into Earth's orbit beginning in 2003, built its space station, and successfully landed robotic missions on the Moon, becoming the first nation to explore the far side of the Moon in 2019. Moreover, China returned lunar samples to Earth for the first time since the 1970s. In 2021, China landed the Zhurong rover on Mars, cementing its status as a formidable rival to the U.S. and Russia. China's space program funding reached approximately \$14 billion in 2023, nearly half that of NASA's budget.

Europe represents a different kind of space power through international collaboration under the European Space Agency (ESA). Europe boasts advanced technological capabilities in launching satellites and scientific missions. For example, Europe's Ariane rocket program supports international satellite launches and makes significant contributions to global projects, such as the ISS and the James Webb Space Telescope. European missions, such as Rosetta's comet landing in 2014 and the Galileo navigation system, underscore Europe's influential role in space, backed by substantial funding from member states.

The space competition isn't restricted to traditional powers; other nations are making significant strides. India, notably ambitious, has made impressive achievements. In 2014, India became the first Asian nation to reach Mars, achieving a unique success on its first attempt. Its Chandrayaan missions to the Moon have also been successful, notably achieving a smooth lunar landing in 2023. India's cost-effective yet highly efficient space program has garnered international respect, and it plans soon to send astronauts into orbit through the Gaganyaan mission.

New Zealand has emerged as an unexpected contributor to space exploration despite its small size. It hosts launch facilities for the U.S.-New Zealand company Rocket Lab, specializing in launching small satellites. Numerous successful Electron rocket missions have launched from New Zealand, demonstrating that smaller nations can participate meaningfully through private-sector partnerships and hosting launch sites. Alongside New Zealand, countries such as the UAE, which sent a probe to Mars in 2020, and South Korea, which is developing its rocket technology, are further evidence of the expanding global participation in the space race.

Saudi Arabia, dear reader, is steadily positioning itself as a significant player in global space exploration, aligning with its strategic investments and ambitious Vision 2030. Key initiatives include establishing the Saudi Space Commission, forming partnerships with international space agencies such as NASA and the China National Space Administration, and undertaking ambitious projects, such as the Saudi satellite communications initiative. Saudi Arabia is expected to play a crucial role in the global space economy by developing local technologies, fostering innovation, and attracting international expertise to build a strong national foundation in this promising sector.

Recognizing the strategic importance of space, nations continue to invest heavily in space programs and expand international and private-sector partnerships. Although competition is intense, it stimulates innovation and encourages unprecedented achievements. Just as the first Moon landing marked a giant leap for humanity, today's global space race may lead to even greater strides toward a prosperous future, bringing humankind closer to the stars.

PART 7 · TOPIC 6

Rocket Lab Leading a Revolution in the Space Industry

June 2025 · First published

Dear reader, the space industry is one of the most exciting and challenging fields in the world, requiring massive technological innovations and advanced research to make progress. Among the companies making significant strides in changing the space industry, "Rocket Lab" stands out as one of the key players. The company is contributing not only through modern space launch technologies but also through a strategic vision that aims to make space more accessible and scalable (The End-To-End Space Company).

Founded in New Zealand in 2006 by engineer Peter Beck, Rocket Lab was driven by a deep passion for developing space technology and reducing the high costs of rocket launches. With this vision, the company succeeded in developing innovative solutions that made satellite launches easier and more cost-effective.

Rocket Lab began its journey in space launches with small-sized rockets, which opened the door for smaller companies and even countries with limited budgets to access space. This was a significant departure from the larger companies that had dominated the broader space launch market, allowing Rocket Lab to fill a large gap in this sector.

One of Rocket Lab's most notable innovations is the "Electron" rocket, a small rocket specifically designed for launching small satellites. This rocket is known for its high efficiency and cost-effectiveness, proving its ability to provide a reliable and affordable solution in the space launch market. The Electron rocket can carry payloads of up to 300 kilograms into low Earth orbit, a crucial feature for companies developing small satellites or conducting space research. Thanks to its unique design and continuous innovations, Rocket Lab has become one of the leading players in this field.

Rocket Lab's contribution to the space industry doesn't stop with the Electron rocket. The company is also working towards making space more sustainable by enhancing its ability to reuse rockets. This is an important step towards reducing the environmental and financial costs associated with rocket launches.

Rocket Lab's future plans include the development of fully reusable rockets, which could significantly reduce costs in the long term. This would expand the accessibility to space and strengthen its competitive position in the industry.

In addition to its innovative rocket solutions, Rocket Lab is also advancing new technologies in the satellite sector. In recent years, the company has started launching a range of satellites aimed at various applications in industries such as communications, weather, and Earth observation.

Thus, Rocket Lab's vision isn't limited to launching rockets; it's focused on creating a comprehensive solution by providing everything that companies and organizations need to access space. For example, in the future, Rocket Lab could become a primary supplier of satellites that improve communication infrastructure, provide accurate environmental data, or even develop space projects related to mineral and energy exploration.

Along with its technological innovations, Rocket Lab continues to build strategic relationships with major space companies, further enhancing its market presence. For instance, the company has announced collaborations with NASA to carry out several space missions, including launching satellites and testing new technologies. This collaboration signals Rocket Lab's growing status as a trusted partner for key industry players, providing it with an opportunity to further develop its technologies and tools.

Rocket Lab aims to maintain its leadership in the space industry by expanding its operations. The company is currently developing new rockets like the "Neutron" rocket, a larger and more powerful rocket that will enable Rocket Lab to enter the heavy-lift space launch market. This move will enhance its ability to compete with major companies such as SpaceX and Blue Origin.

Rocket Lab will continue working towards its ambitious goal of making space more accessible and developing sustainable technology, which will have a positive impact on the long-term growth of the space sector.

Dear reader, Rocket Lab is a strong competitor to SpaceX in the rocket launch sector, despite the differences in the scale of the projects each company handles. While SpaceX focuses on launching heavy rockets and carrying large payloads to space, Rocket Lab provides an innovative, cost-effective solution for small satellites and light payloads.

Finally, Rocket Lab is quickly establishing itself as a one-stop space company, offering comprehensive solutions for all stages of space missions. From designing and launching small satellites with its Electron rocket to developing reusable rocket technology and expanding into satellite manufacturing, the company provides end-to-end services for businesses and governments looking to enter space. This integrated approach makes Rocket Lab a unique and reliable partner for space exploration and innovation.

PART 7 · TOPIC 7

Three Pioneering Companies Reshaping the Future of SpaceMay 2025 · First published

Dear reader, as this marks my 100th article in Makkah Newspaper, I wanted to share with you a different and exciting topic, the future of commercial space. Dear reader, today, SpaceX stands as one of the dominant companies in the global space industry, having made significant strides in space exploration. This includes the launch of its reusable rockets, which revolutionized space travel costs. Furthermore, SpaceX has solidified its position as a leader in transporting passengers and cargo to space, notably through its partnership with NASA. The company's ambitious projects, such as Starlink, aim to provide global satellite-based internet connectivity.

However, despite SpaceX's current dominance in several areas of the space industry, many new companies are starting to compete fiercely. These companies span various specializations and target different sectors of space exploration, creating unprecedented competition and innovation. Among the most prominent of these companies are Rocket Lab, AST SpaceMobile, and Redwire, each focusing on different aspects such as space logistics, global connectivity through space, and developing advanced space infrastructure.

Rocket Lab is one of the leading companies that offers innovative solutions in space logistics. With an ambitious vision, the company enhances the space industry by launching small rockets that help place satellites into orbit. Rocket Lab plays a crucial role in facilitating access to space using small rockets, providing affordable services to small and medium-sized companies wishing to launch their satellites. The company focuses on offering cost-effective space logistics solutions with high flexibility for its clients. Through advanced rocket launch technologies that are efficient and customizable to meet the clients' needs, Rocket Lab accelerates space operations and improves the effectiveness of the services it provides. The company is also expanding its services to include the development of specialized rockets and overall space innovation. Rocket Lab aims to become an integrated space company, offering comprehensive services ranging from design and development to rocket launches, rather than limiting itself solely to the launch phase.

AST SpaceMobile is working to change the way the world connects to the internet using space technology. The company's mission is to develop a space-based communication network that improves connectivity in remote and geographically isolated areas that cannot benefit from traditional terrestrial networks. This network involves a system of satellites providing high-quality connectivity globally, all through mobile phones without the need for additional equipment, which is quite groundbreaking. AST SpaceMobile stands out by offering innovative solutions to users in areas suffering from poor connectivity, whether in major cities or remote rural areas. By providing reliable and secure connections, the company helps link the entire world together, contributing to

international cooperation and promoting sustainable development across industries such as healthcare, education, and commerce.

Redwire is a leader in building and developing space infrastructure. The company specializes in designing and implementing integrated space solutions that enhance space infrastructure, including manufacturing satellites and advanced technologies that support space operations. Redwire offers a range of services, including space systems design, spacecraft manufacturing, and developing infrastructure that facilitates global space operations. Innovation in developing space tools and technologies is a core part of Redwire's vision. By utilizing advanced techniques in designing and manufacturing space equipment, the company delivers effective solutions that contribute to the overall development of the space industry. Additionally, the company strives to provide solutions that support sustainability in the space sector, making space utilization more efficient.

In conclusion, these three companies form a vital pillar in the global space industry. Each specializes in a different field but together they contribute to improving available technologies and enhancing space capabilities. Rocket Lab offers innovative solutions in space logistics, AST SpaceMobile improves global connectivity through space, and Redwire plays a crucial role in developing space infrastructure. If these companies continue to develop their technological solutions, they will play an integral role in the future of space exploration and contribute to unlocking new opportunities for the global economy.

PART 7 · TOPIC 8

How Biotechnology is Revolutionizing Space ExplorationApril 2025 · First published

Dear reader, space exploration stands as one of the greatest challenges of our modern era. Scientists and engineers are tirelessly working to push the boundaries of knowledge and to harness the vast potential of outer space as a new frontier for scientific and technological advancement. In this ambitious quest, biotechnology plays a pivotal role in laying the groundwork for long-duration space missions, merging pharmaceutical research with cutting-edge biotechnological innovations to offer novel solutions for health and life support in the cosmos.

The harsh environment of space presents unprecedented challenges for the human body. The absence of Earth's familiar gravity leads to muscle loss and a decrease in bone density, while exposure to cosmic radiation elevates the risk of severe conditions such as cancer and immune system disorders. Moreover, the psychological toll of isolation and stress that astronauts experience can have serious repercussions on mental well-being. These factors make it essential to develop advanced medical strategies and biological solutions to ensure the safety and effectiveness of extended space travel.

At the core of these efforts is pharmaceutical research. Numerous teams are now focused on developing specialized medications that remain effective under the unique conditions of space. The human body undergoes significant changes in microgravity and under constant radiation, prompting scientists to explore ways to modify drug formulations for enhanced stability amid fluctuating temperatures and altered absorption rates. Researchers are also investigating improved methods of drug distribution within the body to counteract the physiological shifts that occur during prolonged missions.

In addition to these approaches, nanotechnology is being employed to improve targeted drug delivery. This innovative method not only holds the promise of reducing necessary dosages but also enhances therapeutic outcomes. The integration of nanotechnology into treatment regimens is part of a broader, ongoing evolution in medical systems designed specifically for the demanding environment of space. These advances aim not only to treat illnesses but also to preempt potential health complications that could arise during missions.

Biotechnological innovation in space is not limited to pharmaceuticals. It also encompasses the development of comprehensive biological systems capable of sustaining life in an alien environment. On long-duration missions, the availability of food, water, and breathable air becomes critically important. This necessity has spurred research in genetic engineering aimed at creating modified organisms that can thrive in closed ecosystems. Such organisms could serve as sustainable sources of nourishment or even produce pharmaceutical compounds in situ.

For example, research teams are working on altering certain plants to make them more resistant to the extreme conditions of space, thereby enabling their cultivation aboard space stations. Similarly, studies are exploring the potential of microbes to convert organic waste into edible resources or energy. These innovations are not just experimental; they represent strategic steps towards establishing self-sufficient space colonies that minimize reliance on supplies from Earth.

Over the past decade, numerous experiments conducted on the International Space Station have shed light on how space affects living organisms. These studies have revealed critical insights into the genetic and biochemical changes that cells undergo in a gravity-free environment. By understanding these changes, scientists have begun to identify the genetic modifications necessary to enhance the resilience of certain organisms to the rigors of space travel.

International collaboration plays a crucial role in these advances. Universities, research centers, and biotechnology and pharmaceutical companies from around the world are pooling their resources and expertise. This diverse collaboration accelerates innovation and facilitates the application of scientific breakthroughs in real-world space missions. Many global initiatives now focus on exchanging data and experiences related to the impact of space on living systems, opening up new avenues for developing comprehensive therapeutic and preventative solutions.

Furthermore, the rise of artificial intelligence and advanced data analytics is proving invaluable. These technologies help researchers analyze experimental outcomes and predict future challenges that astronauts might face on upcoming missions. With AI-assisted modeling, scientists are better equipped to refine their biological systems and devise more precise strategies, ensuring that space crews remain healthy and safe.

In conclusion, the strides we are making in biotechnology represent a landmark achievement in both science and technology. They embody the international community's unwavering commitment to solving complex problems with innovative solutions. As research and experiments continue to evolve, we are likely to witness even greater advances in safeguarding human health during space travel. This progress not only brings us closer to venturing into the deepest reaches of the universe but also helps unlock the secrets it holds.

Ultimately, biotechnology, with its limitless potential, is poised to be the key that unlocks humanity's dream of reaching distant planets and stars. By revolutionizing our approach to space exploration through groundbreaking medicines, advanced drug delivery systems, and sustainable life support networks, we are paving the way for a future where space becomes a second home. The progress we see today is just the beginning of an incredible journey toward a bright and promising future among the stars.

PART 7 · TOPIC 9

Drawing Lessons from the Apollo 13 and Columbia MissionsJanuary 2024 · First published

The Apollo Space Program, NASA's extraordinary venture in the 1960s, culminated with the remarkable lunar landing of Apollo 11. However, it was the problematic Apollo 13 mission that truly highlighted the program's courage. In 1970, an oxygen tank explosion en route to the moon transformed a routine mission into a desperate struggle for survival. About 320,000 kilometers from Earth, astronauts Jim Lovell, Jack Swigert, and Fred Haise faced an unprecedented crisis when their spacecraft sustained severe damage. With dwindling power and oxygen, they had to rely on the lunar module as a temporary haven in space. NASA's Control Center in the United States became a hub of intense activity, where immediate and innovative solutions were developed to resolve this crisis. The team, with no margin for error, had to devise urgent solutions using available resources, repurposing the lunar module and finding ways to remove carbon dioxide from the spacecraft's command module. The return journey, fraught with uncertainties about its failure, was a testament to the crew's discipline and the ground team's creativity, culminating in a safe landing in the Pacific Ocean. This mission became a model for crisis management and problem-solving under pressure. NASA's subsequent review of Apollo 13 led to enhanced safety measures and a renewed commitment to future space endeavors.

In contrast, the 2003 Columbia Space Shuttle disaster stands as a painful antithesis to the successes in space exploration history. The incident, which claimed the lives of seven astronauts, did not stem from unknown risks like Apollo 13 but from known hazards tragically underestimated. During Columbia's launch, a piece of foam from the shuttle's external tank struck the shuttle, creating a seemingly minor event. This incident, previously occurring in past missions without severe consequences and known to NASA, was not addressed adequately due to its perceived insignificance. However, it tragically impacted the left wing's edge this time, leading to the disaster. The high ascent speeds turned the collision into a small, unnoticed hole, which proved fatal during re-entry into the atmosphere as the shuttle experienced intense atmospheric heat, ultimately leading to the spacecraft's disintegration. The loss of Columbia and its crew was a harsh reminder of the unforgiving nature of space travel and the severe consequences of underestimating risks, no matter how small they may seem.

Both experiences highlight the need for careful learning and extracting valuable lessons to enhance the journey towards progress. The Apollo 13 incident underscored the importance of resilience, innovative problem-solving, and exceptional teamwork in the face of unexpected challenges. From the Columbia tragedy, the vital lessons include the severe consequences of underestimating risks, the necessity of a risk-aware culture actively seeking to address and mitigate hazards promptly and effectively, and the importance of vigilance and proactive safety measures in high-risk situations.

Adopting innovative and effective ways to deal with unexpected challenges includes establishing robust risk assessment and management strategies and ensuring all projects and initiatives are not only ambitious in scope but also rooted in safety and sustainability. The key lessons from the Apollo 13 and Columbia incidents stress the need for resilience, the ability to adapt quickly and effectively to crises, the value of cohesive teamwork and leveraging diverse expertise in problem-solving, the critical importance of not only recognizing risks but actively engaging in mitigating them, and the need for a systematic safety culture that prioritizes risk management as an essential part of all operations. Caution and conscious planning are as necessary as innovation in achieving developmental goals.

**Colophon**

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