Project Catalyst

Independent Market Research Report on the Overview of the Global Pharmaceutical Contract Services Market

Industry Report

Frost & Sullivan
8-26-2026

Disclaimer

Note: Fiscal Year (FY) refers to the twelve months starting 1st April and ending 31st March. Accordingly, Fiscal Year (FY26) refers to the period starting 1st April 2025 and ending 31st March 2026. Unless otherwise specified, all referenced time periods pertain to the calendar year (CY), starting 1st January and ending 31st December.

CAGR values shown in the charts are calculated using precise underlying data with full decimal values and may therefore differ from CAGRs calculated using the rounded figures displayed in the charts.

Currency conversion rates are based on the exchange rates prevailing as of 31st March of the respective fiscal year (e.g., FY26 uses the rate as of 31st March 2026).

Year	USD to INR	RMB to INR
FY 27- FY 32 (CY26-CY31)	94.31	13.64
FY 26 (CY25)	94.31	13.64
FY 25 (CY24)	85.53	11.77
FY 24 (CY23)	83.34	11.54
FY 23 (CY22)	82.15	11.94
FY 22 (CY21)	75.51	11.88

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1 GLOBAL MACROECONOMIC OVERVIEW

1.1 GLOBAL GDP AND GDP PER CAPITA OVERVIEW

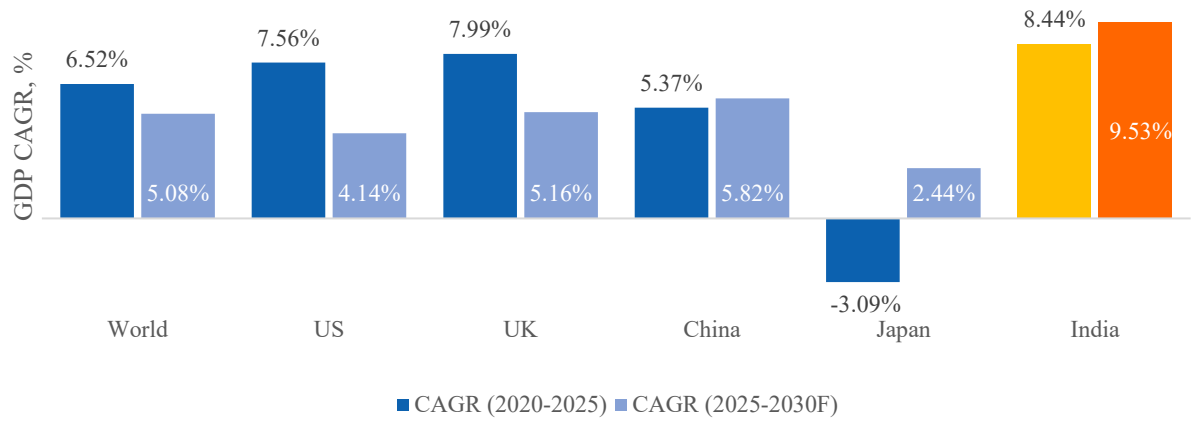
Despite multiple macroeconomic disruptions, including post-pandemic inflation, monetary tightening, geopolitical conflicts, and trade uncertainties, the global economy maintained resilient growth of 6.52% CAGR between 2020–2025. Over the forecast period, global GDP is expected to continue expanding at 5.08% annually through 2030F, supported by easing interest rates, recovering demand, and sustained investment in infrastructure and technology across major economies.

The global economy continues to demonstrate resilience, maintaining steady growth while inflation moderates following the sharp increases experienced during the COVID-19 pandemic. Despite significant challenges, including post-pandemic supply chain disruptions, the conflict between Russia and Ukraine, instability in the Middle East, and elevated energy and food prices, economic activity has remained robust and adaptable. Global Gross Domestic Product (GDP) is projected to grow at a CAGR of 5.08% between 2025 and 2030F, compared with 6.52% during the previous five-year period. While this represents a moderation in growth, it remains supported by easing inflationary pressures, continued investment in technology and infrastructure, and recovering demand across many economies.

1.2 GDP GROWTH IN KEY COUNTRIES

India is projected to record a GDP CAGR of 9.53% between 2025 and 2030F, the highest among major economies, expanding from approximately USD 4 trillion in 2025 to USD 6 trillion by 2030F. The United States and China are each projected to grow at approximately 4 to 6% over the same period, with both economies navigating structural adjustments in domestic consumption and investment composition.

Exhibit 1.1: GDP CAGR at Current Prices, Select Countries, 2020-2030F



Source: World Economic Outlook-April 2026, Frost & Sullivan
Note: F - Forecast

The world's two largest economies as of 2025, China and the United States, continue to play a central role in supporting global growth. In China, strong export performance and continued industrial activity are helping offset softer domestic demand in certain sectors, while the United States continues to benefit from resilient consumer spending, investment activity, and technological innovation. Together, these economies remain important anchors of global economic stability and growth.

In the UK, economic growth is expected to moderate in the near term before gradually recovering by 2027. The outlook is being influenced by several external factors, including the conflict in the Middle East and a slower pace of

monetary policy easing. The country is set to leverage its global financial services sector, innovation ecosystem, and expanding trade partnerships to support its growth.

Japan is expected to record an improvement in growth over the forecast period following a 3.09% contraction between 2020 and 2025. The economy is projected to grow by 2.44% between 2025 and 2030F, supported by stronger domestic consumption, increased investment activity, moderating inflation, and a rebound in tourism. Ongoing structural reforms, digital transformation initiatives, semiconductor investments, and policies aimed at improving productivity are expected to further support long-term economic growth.

Meanwhile, India is on track to become one of the world's largest economies over the coming decade. India is expected to surpass Japan in 2027 to become the world's fourth-largest economy and is projected to overtake Germany by 2031, becoming the third-largest economy globally with GDP approaching USD 7 trillion[1]. India has also set a goal of achieving developed economy status by 2047[2], supported by projected GDP growth of 9.53% between 2025 and 2030F, significantly outpacing major developed markets such as the US, UK, Germany, France, and Japan. This strong growth outlook is underpinned by favorable macroeconomic fundamentals, including a young and expanding workforce, rising domestic consumption, increasing urbanization, and sustained public investment in infrastructure. Growing consumer demand across sectors, increasing domestic and foreign investment, strengthening global trade partnerships, and policy initiatives centered around the Atmanirbhar Bharat initiative[3] are further supporting economic expansion. The continued development of the Micro, Small, and Medium-sized Enterprise (MSME) sector is also accelerating industrial activity and strengthening India's position as a global manufacturing hub.

Manufacturing is expected to play an increasingly important role in India's economic growth over the coming years. Global companies are actively diversifying supply chains and reducing dependence on concentrated sourcing markets, creating opportunities for India to capture a larger share of global manufacturing activity. The manufacturing sector, in FY25, contributed approximately 16 to 17% of India's GDP[4] and generates approximately USD 465–485 billion in gross value added (GVA)[5]. It also remains one of the largest sources of employment for India. Government initiatives aimed at industrialization, domestic production, and export competitiveness target increasing manufacturing's contribution to GDP to approximately 25.00% by 2035[6].

The pharmaceutical sector remains one of the most strategically important contributors to India's manufacturing ecosystem. The industry benefits from a cost-competitive manufacturing base, strong chemistry expertise, a large scientific talent pool, and an established regulatory track record across global markets. Pharmaceuticals contributed approximately 1.7 to 2% of national GDP[7] in FY25 and account for around 7-8% of total manufacturing GVA[8] in FY24, making the sector one of India's most globally competitive industries. India has evolved from being primarily a supplier of generic medicines to becoming a broader pharmaceutical services and innovation partner. India is expanding its presence across contract research, development, and manufacturing (CRDMO) services, biologics manufacturing, complex generics, specialty formulations, and emerging therapeutic modalities. Pharmaceutical exports exceeded USD 30 billion in FY25[9], positioning the sector as one of India's most important high-value manufacturing export industries. Rising global demand for outsourced pharmaceutical development and manufacturing is expected to further strengthen India's role in the global pharmaceutical value chain. This trend is creating opportunities across active pharmaceutical ingredient (API) manufacturing, drug product manufacturing, and research services. At the same time, increasing investment in healthcare infrastructure, R&D capabilities, and advanced manufacturing technologies is expected to support the long-term growth of India's pharmaceutical

[1] International Monetary Fund (IMF)
[2] IBEF Report on the Government's Ambition
[3] Launched in 2020, the Atmanirbhar Bharat (Self-Reliant India) initiative is a national strategy aimed at boosting domestic manufacturing, reducing import dependency, promoting Indian goods in the global supply chain markets, and enhancing resilience across key sectors such as pharmaceuticals, electronics, defense, agriculture, and renewable energy.
[4] IBEF; Confederation of Indian Industries
[5] Ministry of Statistics and Programme Implementation - Note on First Advance Estimates of Gross Domestic Product for 2025-26
[6] National Manufacturing Mission
[7] Press Information Bureau - Backgrounder: India Pharma Conference
[8] Annual Survey of Industries 2023-24
[9] Press Information Bureau - India's Pharmaceuticals in Global Healthcare

manufacturing and services ecosystem. The industry's long-term outlook is reinforced by supportive government policies and a strong manufacturing base. Initiatives such as the Production Linked Incentive (PLI) Scheme and Bulk Drug Parks are strengthening domestic API and intermediate manufacturing, while liberal foreign direct investment (FDI) policies, permitting up to 100% FDI under the automatic route for greenfield projects and up to 74% for brownfield projects, continue to attract investment and expand industry capabilities. India's competitiveness is further supported by its established pharmaceutical manufacturing ecosystem, the largest number of FDA-approved plants outside the US[10], and drug development and manufacturing costs that are approximately 30–40% lower than those in the US and Europe.

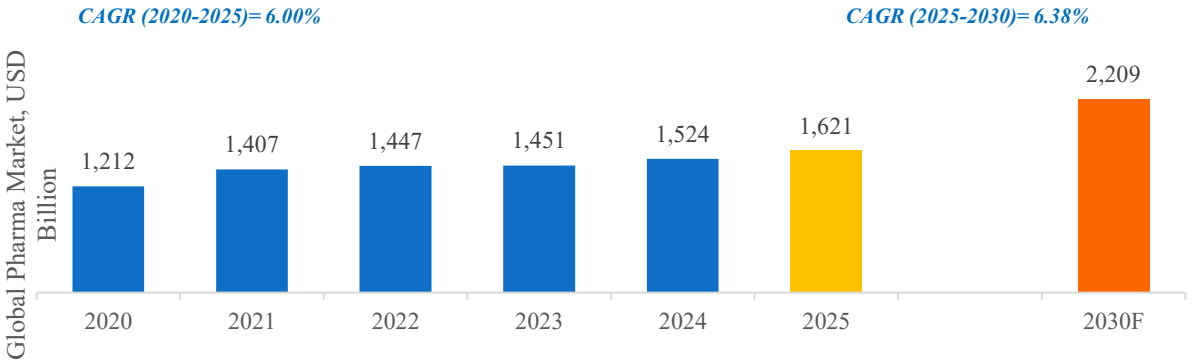
While both China and India recorded growth rates of approximately 5.00–8.00% between 2020 and 2025, India's GDP growth is projected to outpace China's by nearly 1.6 times during the 2025–2030F forecast period. India's resilience during the pandemic, particularly within the pharmaceutical sector, combined with geopolitical developments such as the "China+1" supply chain diversification strategy, has strengthened its position as a preferred destination for global investment and manufacturing. In contrast, China continues to face headwinds from geopolitical uncertainties and slowing export growth.

Compared with developed economies facing slower growth and aging industrial bases, India offers a combination of strong economic expansion, increasing industrial capacity, favorable demographics, and improving innovation capabilities. These advantages position the country favorably for sustained growth across the pharmaceutical sector and broader manufacturing economy over the coming decade.

2 GLOBAL PHARMACEUTICAL OVERVIEW

The global pharmaceutical market grew from approximately USD 1.2 trillion in 2020 to USD 1.6 trillion in 2025, at a CAGR of 6.00%. The market is projected to accelerate to a CAGR of 6.38% between 2025 and 2030F, reaching a market size of USD 2.2 trillion at the end of the period. On the supply side, growth is being supported by the launch of new therapies and increasing availability of generics and biosimilars following patent expiry. On the demand side, factors such as an aging population, rising prevalence of chronic diseases, greater focus on healthcare, improved access to lower-cost treatments, and increasing health awareness are contributing to market expansion.

Exhibit 2.1: Global Pharma Market, 2020-2030F



Source: Frost & Sullivan
Note: F - Forecast

The global pharmaceutical industry is entering a period of accelerated growth, supported by advances in scientific research, evolving patient needs, and expanding access to healthcare worldwide. Pharmaceutical companies are increasingly investing in innovative therapies, including precision medicines and potentially curative treatment

[10] IBEF – Indian Pharmaceutical Industry

modalities, as breakthroughs in biomedical science continue to expand the range of treatable conditions and improve clinical outcomes. At the same time, healthcare systems and policymakers are placing greater emphasis on affordability and access, driving continued expansion of generic and biosimilar medicines. Together, these trends are driving expansion across both innovative and cost-effective therapies, positioning the global pharmaceutical market for sustained growth across developed and emerging economies.

Several long-term structural factors continue to underpin industry growth, including aging populations, rising prevalence of chronic diseases, increasing healthcare utilization, and growing health awareness among consumers. The continued shift toward self-care and preventive healthcare also supports demand for pharmaceutical products, particularly within the over-the-counter (OTC) segment. In addition, the industry is adapting to changing geopolitical dynamics, evolving regulatory environments, and advances in healthcare delivery, all of which are influencing how therapies are discovered, developed, manufactured, and distributed. These trends are creating new opportunities across the pharmaceutical value chain while accelerating the adoption of advanced therapeutic approaches.

Supported by these factors, the global pharmaceutical market is expected to grow at a CAGR of 6.38% between 2025 and 2030F. As a result, the market is projected to expand from USD 1.6 trillion in 2025 to over USD 2.2 trillion by 2030F, marking the longest sustained period of growth above 5.00% on record.

2.1 GROWTH DRIVERS OF THE MARKET

The global pharmaceutical market is expected to grow steadily, supported by rising healthcare demand and continued innovation. Aging populations and increasing rates of chronic disease are driving demand for long-term treatments, while upcoming patent expirations are creating opportunities for generics and biosimilars, improving access and increasing competition. At the same time, ongoing R&D investment continues to advance drug development across areas such as oncology, immunology, diabetes, obesity, and rare diseases.

- **Demand Expansion:** By 2050, the global population over 60 is expected to nearly double to 22.00%, leading to an increase in age-related conditions. Additionally, chronic diseases are on the rise, with one-third of adults affected globally and treatment costs expected to reach USD 47 trillion by 2030. Combined, these factors are major drivers for demand for drugs, fueling growth in the pharmaceutical industry.
- **Conducive Market Dynamics:** Expiry of patents and the demand for cost-effective treatments are expanding availability through generics and biosimilars. Additionally, increasing demand for specialty and niche products with fewer competitors and greater pricing power will foster growth in the market.
- **Technological Transformation:** Continuously increasing R&D investment by pharma companies in high-value and differentiated formulations is leading to expansion in the market. This is supported by increasing adoption of digital platforms, artificial intelligence (AI), and data analytics to expand the number of drug targets, speed up drug discovery, and enhance lifecycle management of drugs.

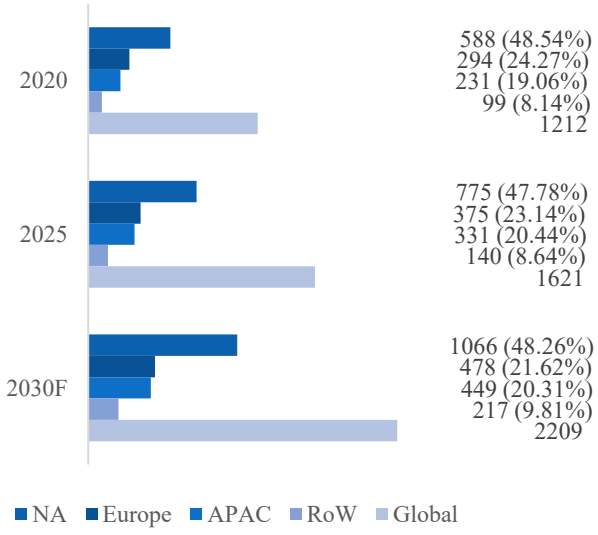
2.2 PHARMACEUTICAL MARKET BY REGIONS

The global pharmaceutical market is expected to remain geographically diversified, with developed markets continuing to account for the majority of industry revenues while emerging regions are the drivers of growth. North America is projected to retain its leadership position, contributing approximately 48.00% of global pharmaceutical sales through 2030F, supported by strong innovation ecosystems, high biologics adoption, and premium pricing dynamics. Europe is expected to remain a stable growth market anchored by established healthcare systems and specialty drug demand. Meanwhile, emerging markets, particularly across Asia-Pacific, are projected to grow at approximately 7.12% CAGR between 2025 and 2030F, faster than mature markets like North America. Growth in this region is driven by expanding healthcare access, a rising burden of chronic diseases, increasing healthcare expenditure, and strengthening domestic pharmaceutical manufacturing capabilities.

North America is expected to maintain its position as the largest pharmaceutical market globally throughout the forecast period. The regional market expanded from USD 588 billion in 2020 to USD 781 billion in 2025, representing a CAGR of 5.86%. Growth is projected to accelerate further between 2025 and 2030F, with the market expected to

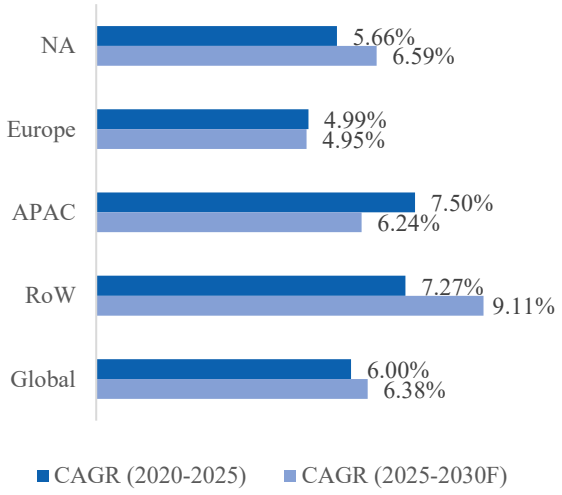
grow at a CAGR of 6.29% and reach approximately USD 1.1 trillion by 2030F. The region's leadership is supported by a combination of structural pricing power, rapid adoption of innovative therapies including orphan drugs and personalized medicines, and unparalleled access to capital. Growing concerns around supply chain concentration and geopolitical risk are encouraging pharmaceutical companies to diversify sourcing beyond China. Increased scrutiny of certain Chinese companies, including the designation of WuXi AppTec as a Chinese military company on Section 1260H list by the US Department of Defense[11] and its expected inclusion under proposed BIOSECURE Act restrictions, have heightened concerns regarding long-term supply security and regulatory risk. As a result, pharmaceutical companies are accelerating "China+1" sourcing strategies, with India emerging as a key alternative manufacturing and outsourcing destination for generics and innovative drugs, supported by its cost competitiveness, regulatory track record, and expanding pharmaceutical capabilities. Within the region, the United States remains the primary revenue contributor in 2025, accounting for 48.20% of global pharmaceutical revenues and serving as the key driver of regional market performance.

Exhibit 2.2A: Global Pharma Market by Region, 2020, 2025, 2030F, USD Billion



Source: Frost & Sullivan
Note: F- Forecast

Exhibit 2.2B: Growth Rate of Global Pharma Market by Region, 2020-2030F



Source: Frost & Sullivan
Note: F- Forecast

Europe's pharmaceutical market is expected to remain a large and stable component of the global industry, supported by universal healthcare systems, aging populations, and the growing prevalence of chronic diseases. The market is projected to expand from USD 373 billion in 2025 to USD 477 billion by 2030F, representing a CAGR of 5.05% over the period. Growth is moderated by cost-containment measures implemented across many European healthcare systems, including reference pricing, parallel trade, and policies that encourage the use of generic medicines and biosimilars.

The Asia-Pacific (APAC) region is expected to be the fastest-growing pharmaceutical market globally over the 2025–2030F period at a CAGR of 7.12%. The market grew from USD 231 billion in 2020 to USD 323 billion at a CAGR of 6.87%, and is projected to further expand to approximately USD 455 billion by 2030F. Driven by expanding healthcare access, rising incomes, aging populations, and increasing disease burden, APAC is expected to represent the largest source of incremental growth for the global pharmaceutical industry over the forecast period.

Within the region, China and India together account for more than 55.00% of pharmaceutical revenues, making them the primary drivers of regional growth. China continues to strengthen its position as a global innovation center, with

[11] US DoD – 1260H list; US Congress: H.R.7085 - BIOSECURE Act

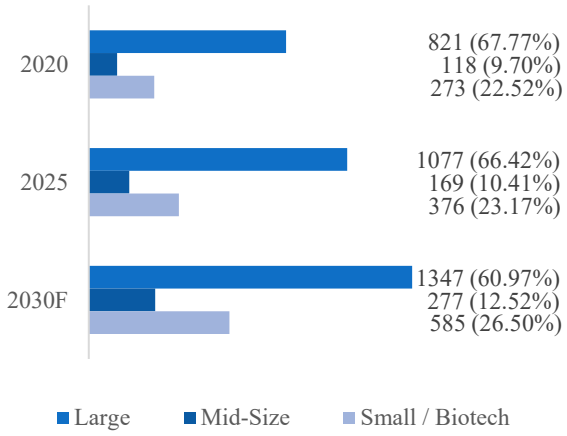
domestically developed biologics, bispecific antibodies, and antibody-drug conjugates (ADCs) increasingly being licensed to pharmaceutical companies in the United States and Europe.

India is emerging as one of the fastest-growing pharmaceutical markets, supported by a large patient population, rising healthcare expenditure, improving access to specialty therapies, and a rapidly evolving healthcare ecosystem. As the country continues to build its manufacturing capabilities in generics and innovators, it has been commonly referred to as the Pharmacy of the World, holding a 20% share of the global supply by volume for generics. The country is expected to play an important role in the commercialization of semaglutide following patent expiry, supported by an addressable population of more than 150 million patients and a growing self-pay market. Growth is also being supported by recent approvals from the Central Drugs Standard Control Organization (CDSCO) across therapeutic areas including cardiology, neurology, oncology, and gastroenterology.

2.3 PHARMACEUTICAL MARKET BY COMPANY TYPE

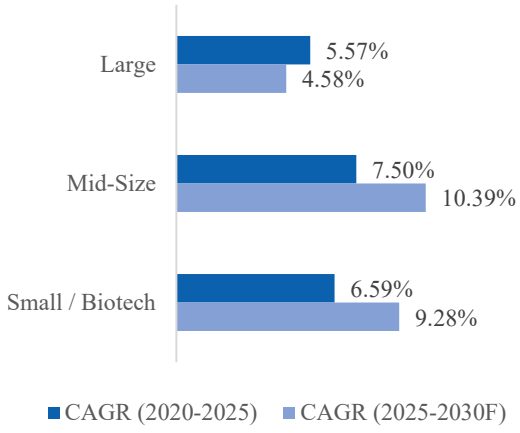
Mid-sized pharmaceutical companies are expected to be the fastest-growing segment between 2025 and 2030F, with a CAGR of 10.39%, nearly 2.3x the growth rate of large pharmaceutical companies. Small / biotech firms are projected to grow at a similar pace, with a CAGR of 9.28%, reflecting the industry's increasing focus on innovation and novel therapies.

Exhibit 2.3A: Global Pharma Market by Company Type, 2020, 2025, 2030F, USD Billion



Source: Frost & Sullivan
Note: F- Forecast, Large = Revenue > USD 10 Billion, Mid-Sized = USD 500 Million - USD 10 Billion, Small / Biotech - <USD 500 Million

Exhibit 2.3B: Growth Rate of Global Pharma Market by Company Type, 2020-2030F



Source: Frost & Sullivan
Note: F- Forecast, Large = Revenue >USD 10 Billion, Mid-Sized = USD 500 Million - USD 10 Billion, Small / Biotech - <USD 500 Million

Large multinational pharmaceutical companies currently dominate the global pharmaceutical market. They leverage extensive R&D capabilities, vast global reach, and significant financial resources to command high market share. However, the trend is gradually reversing as the aggregate market share of large pharmaceutical companies is expected to decline at an accelerating rate from 66.42% in 2025 to 60.97% in 2030F, whereas the share of small pharmaceutical and biotech companies is expected to increase from 23.17% in 2025 to 26.50% in 2030F.

Small pharmaceutical and biotech companies are typically characterized by their innovative approach to drug development and are expected to grow at a CAGR of 9.28% versus 4.58% for large pharmaceutical companies between 2025 and 2030F. The growth is largely enabled by substantial venture capital funding in these companies.

Unlike large pharmaceutical companies with diversified interests across therapeutic areas, small pharmaceutical and biotech firms as well as mid-sized pharmaceutical companies often concentrate on novel niche therapies, making them

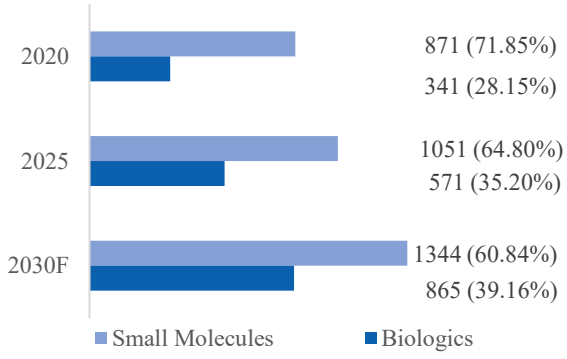
more agile and responsive to new scientific developments. However, mid-sized pharmaceutical companies benefit from greater financial resources, established commercial infrastructure, and larger development pipelines than smaller biotechs, allowing them to scale innovation more effectively while retaining operational agility. As a result, mid-sized pharmaceutical companies are projected to grow at a CAGR of 10.39% between 2025 and 2030F, making them the fastest-growing segment by company size.

The growing prominence of small pharmaceutical and biotech companies reflects a broader shift in the pharmaceutical industry towards novel therapies and innovation-driven growth.

2.4 PHARMACEUTICAL MARKET BY MODALITY

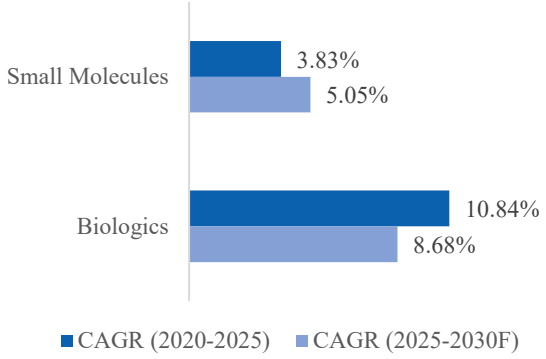
The global pharmaceutical market is expected to witness sustained growth across both small and large molecule segments[12], each supported by distinct fundamentals. Small molecules are projected to remain the dominant segment through 2030, contributing 60.84% of total pharmaceutical revenues, driven by broad therapeutic applicability, established regulatory pathways, and cost-efficient, scalable manufacturing. Large molecules (Biologics) are expected to outpace overall market growth at 8.68% CAGR between 2025 and 2030, supported by strong adoption in complex diseases, expanding next-generation biologics pipelines, and increasing biosimilar penetration following biologic patent expiration.

Exhibit 2.4A: Global Pharma Market by Modality, 2020, 2025, 2030F, USD Billion



Source: Frost & Sullivan
Note: F- Forecast

Exhibit 2.4B: Growth Rate of Global Pharma Market by Modality, 2020-2030F



Source: Frost & Sullivan
Note: F- Forecast

The global pharmaceutical market is being shaped by continued growth across both small molecule drugs and biologics (or large molecules), with each modality serving distinct roles within healthcare systems. While biologics are expanding rapidly and capturing a growing share of industry value, small molecules are expected to remain the largest segment by market size due to their broad applicability, cost-effectiveness, ease of administration, and well-established manufacturing infrastructure.

Small molecules grew at a relatively moderate CAGR of 3.83% between 2020 and 2025, while growth is expected to accelerate to 5.05% between 2025 and 2030F. Small molecules continue to dominate prescription volumes globally and remain the foundation of treatment across most therapeutic areas. Their lower production costs and broader accessibility also make them particularly important in price-sensitive and infrastructure-constrained markets, where they continue to serve as the primary treatment modality for large patient populations.

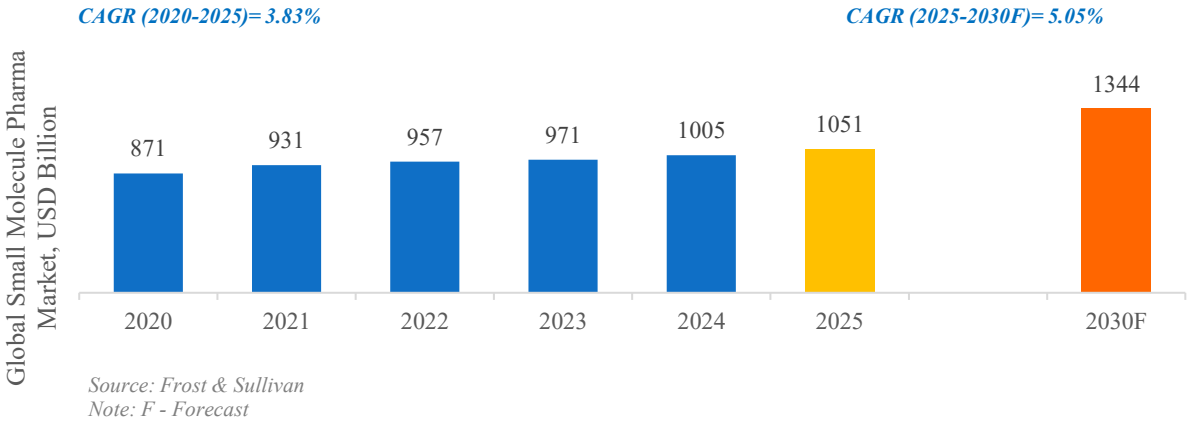
[12] Small molecules are chemically synthesized therapeutics typically characterized by low molecular weight, generally below ~1 kDa, simple and well-defined structures, and the ability to penetrate cells, often enabling oral administration. In contrast, large molecules or biologics are complex therapeutics derived from biological systems, typically exceeding ~1 kDa in molecular weight, with structurally intricate architectures such as proteins, antibodies, or nucleic acid-based therapies that generally require specialized manufacturing and parenteral administration.

At the same time, biologics are becoming an increasingly important driver of pharmaceutical industry growth. Biologics revenues are expected to grow from USD 571 billion in 2025 to approximately USD 865 billion by 2030F, representing a CAGR of 8.68% between 2025 and 2030F. This growth is being driven by advances in antibody therapeutics, gene therapies, cell therapies, recombinant proteins, and peptide-based medicines. Although biologics generally require longer development timelines and more complex manufacturing processes than small molecules, they continue to attract significant investment due to their strong commercial potential. In 2025, 13 of the world's 20 highest-selling pharmaceutical products by revenue were biologics[13], highlighting the segment's growing importance within the global pharmaceutical market.

2.4.1 GLOBAL SMALL MOLECULE MARKET

Small molecules continue to represent a large, durable, and expanding segment of the global pharmaceutical market, with revenues projected to increase from approximately USD 871 billion in 2020 to USD 1,344 billion by 2030F. The segment remains well-supported by its broad applicability across major therapeutic areas, established regulatory pathways, strong physician familiarity, scalable manufacturing economics, and a significant upcoming patent-expiry cycle that is expected to unlock a substantial generic opportunity worth USD 1 trillion between 2025 and 2030.

Exhibit 2.5: Global Small Molecule Pharma Market, 2020-2030F



Source: Frost & Sullivan
Note: F - Forecast

From a growth rate of 3.83% between 2020 and 2025, the small molecule market is set to expand at an accelerated CAGR of 5.05% between 2025 and 2030F. They continue to dominate global pharmaceutical utilization and maintain a presence across virtually every major therapeutic area. Their position reflects decades of accumulated scientific knowledge, established chemistry infrastructure, extensive clinical experience, and well-defined regulatory pathways that continue to make them the preferred foundation for drug discovery and development.

Small molecules retain several structural advantages that continue to support their widespread use across healthcare systems. Most small molecule therapies can be formulated for oral administration, enabling convenient self-administration without the need for clinical supervision. This ease of use has made small molecules particularly well suited to primary care and the long-term management of chronic diseases.

Small molecules also benefit from established manufacturing and distribution frameworks. Production is based on well-understood organic chemistry processes with defined controls and analytical methods, supporting efficient scale-up and consistent quality assurance. In addition, most small molecules remain stable under ambient storage conditions and can be distributed through conventional pharmaceutical supply chains without specialized handling requirements.

These characteristics become even more important following patent expiry. Generic versions of small molecules can typically be developed by manufacturers with the necessary chemistry and manufacturing capabilities, with regulatory

[13] Evaluate Pharma; Excludes Jardiance due to lack of details on product revenue

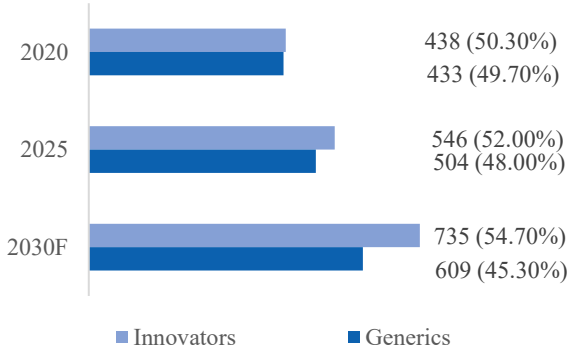
approval often based on demonstrating bioequivalence rather than conducting extensive clinical trials. As a result, generic small molecules have become the dominant source of prescription volume globally and remain a cornerstone of affordable healthcare delivery across both developed and emerging markets.

As a result, small molecules continue to offer advantages in accessibility, manufacturing scalability, affordability, and patient reach, ensuring their continued importance across global healthcare systems.

2.4.1.1 SMALL MOLECULE MARKET BY INNOVATION TYPE

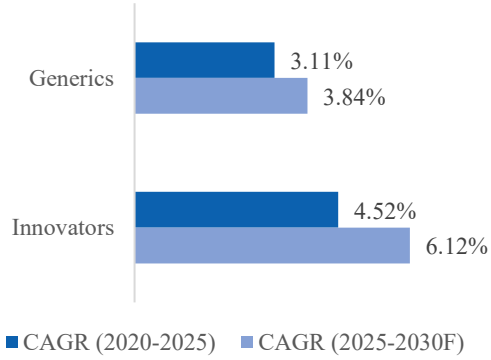
The small molecule market continues to be supported by a balanced mix of innovation-led branded therapies and high-volume generic demand. Innovative small molecules remain a key driver of value creation, particularly in oncology, immunology, and rare diseases, with the segment expected to grow at approximately 6.12% CAGR from 2025 through 2030F, supported by continued new molecular entity launches and lifecycle management strategies. At the same time, generic small molecules are projected to maintain strong volume growth and account for the majority of prescription volumes globally, driven by ongoing patent expiries, cost-containment measures, and increasing healthcare access across emerging markets.

Exhibit 2.6A: Global Small Molecule Pharma Market by Innovation Type, 2020, 2025, 2030F, USD Billion



Source: Frost & Sullivan
Note: F- Forecast

Exhibit 2.6B: Growth Rate of Global Small Molecule Pharma Market by Innovation Type, 2020-2030F



Source: Frost & Sullivan
Note: F- Forecast

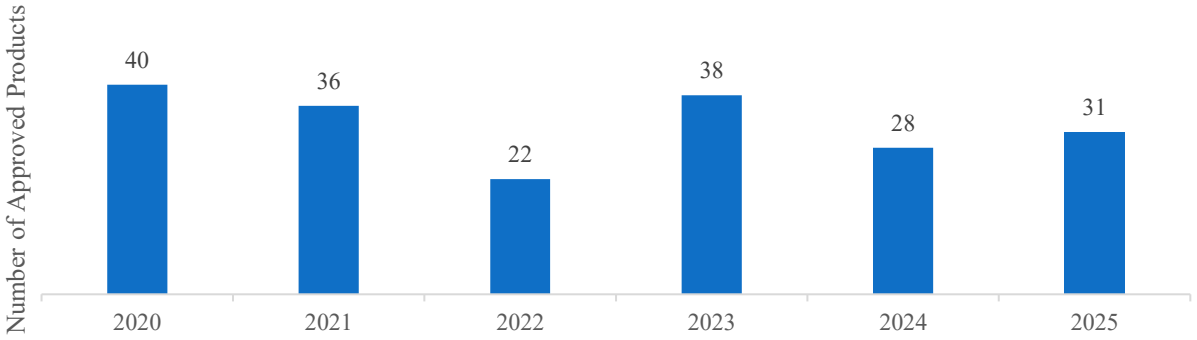
Innovator drugs continue to account for the majority of value within the global small molecule pharmaceutical market. The segment represented just over 50.30% of market value in 2020 and increased its share to 52.00% by 2025. This share is projected to rise further to 54.70% by 2030F, supported by a CAGR of 6.12% between 2025 and 2030F. Growth is being driven by sustained investment in novel therapies and emerging technologies targeting areas of unmet clinical need, particularly in oncology, immunology, rare diseases, and other specialty indications where differentiated clinical outcomes can command premium pricing. Pharmaceutical companies continue to prioritize innovation through both internal R&D and external licensing, supporting a steady flow of new product launches and pipeline replenishment. In parallel, lifecycle management strategies such as label expansions, new formulations, and combination therapies are helping manufacturers maximize the value of existing assets and offset revenue losses associated with patent expirations. The increasing focus on precision medicine, biomarker-driven therapies, and targeted treatment approaches is also supporting the development of differentiated small molecule products with stronger clinical and commercial positioning.

Despite the value leadership of innovator drugs, generic small molecules continue to account for a large share of global prescription volumes due to their lower cost and established regulatory pathways. In many developed markets, generic medicines represent more than 80.00% of prescription volumes and play an important role in supporting healthcare affordability and access. Going forward, generic small molecules are expected to remain an important component of pharmaceutical markets, growing from a market value of USD 504 billion in 2025 to reach a projected USD 609 billion in 2030F, at a CAGR of 3.84%.

2.4.1.1.1 NEW PRODUCT APPROVAL TRENDS

The FDA approved an average of approximately 47 new molecular entities (NMEs) and new biological entities (NBEs) per year between 2022 and 2025, of which approximately 55-70% were small molecules. Oncology, central nervous system disorders, and rare / genetic diseases accounted for almost 30.00% share of novel small molecule approvals over this period.

Exhibit 2.7: FDA approved NMEs, 2020-2025



Source: FDA Data, Frost & Sullivan

Small molecules continue to dominate new drug approvals by the FDA's CDER, highlighting their enduring importance within pharmaceutical innovation. In 2025, CDER approved 31 new small molecule drugs, accounting for 67.39% of the 46 novel drug approvals granted during the year[14]. This continues a multi-year trend in which small molecules have consistently represented most approvals, accounting for 59.46%, 69.09%, and 56.00% of approved drugs in 2022, 2023, and 2024, respectively. The sustained share of approvals reflects the continued attractiveness of small molecules as a drug development modality across a broad range of therapeutic areas. Their established development pathways, scalable manufacturing processes, and ability to address large patient populations continue to support strong investment and pipeline activity.

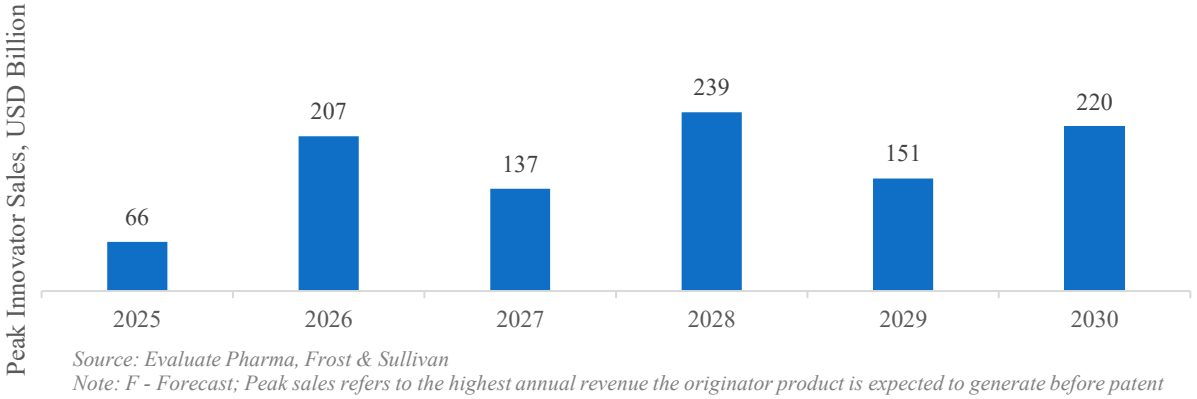
2.4.1.1.2 UPCOMING OFF-PATENT OPPORTUNITIES

Between 2025 and 2030F, blockbuster small-molecule drugs representing approximately USD 1 trillion in aggregate peak annual sales are expected to lose patent exclusivity, creating significant opportunities for generic manufacturers and pharmaceutical service providers.

More than USD 1 trillion in generic market opportunities are expected to emerge between 2025 and 2030F as several blockbuster drugs across multiple therapeutic areas lose patent protection. This creates significant opportunities for generic manufacturers and pharmaceutical service providers. This impending patent cliff is expected to drive pipeline replacement and cost rationalization initiatives among large pharmaceutical companies, which may increase outsourcing to cost-efficient contract service providers. Among the top 10 drugs facing loss of exclusivity, endocrine therapies account for 30.00%, while cardiovascular and systemic anti-infective drugs each represent 20.00%, highlighting the broad therapeutic impact of the upcoming patent cliff.

[14] FDA Data Analysis

Exhibit 2.8: Upcoming Opportunities in the Global Generic Pharma Market, 2025-2030F



Source: Evaluate Pharma, Frost & Sullivan
Note: F - Forecast; Peak sales refers to the highest annual revenue the originator product is expected to generate before patent loss between 2025 and 2030; the opportunity is indicative since patent litigation and other factors can delay or advance the launch of generics; current analysis based on last year of patent expiry

Exhibit 2.9: Top 10 Generic Opportunities, 2025-2030F

S.No.	Generic Name	Brand	Peak Revenue between 2025 and 2030F (USD million)
1.	Omeprazole	Omeprazole	82,080
2.	Bictegravir sodium; Emtricitabine; Tenofovir alafenamide fumarate	Biktarvy	78,142
3.	Fluticasone propionate; Salmeterol xinafoate	Fluticasone Propionate & Salmeterol Xinafoate	60,598
4.	Empagliflozin	Jardiance	60,383
5.	Ciprofloxacin hydrochloride	Ciprofloxacin Hydrochloride	54,862
6.	Dapagliflozin propanediol	Farxiga	52,236
7.	Metformin hydrochloride	Metformin Hydrochloride	44,187
8.	Ribociclib	Kisqali	43,435
9.	Atorvastatin calcium	Atorvastatin Calcium	42,149
10.	Sacubitril; Valsartan	Entresto	40,482

Source: Evaluate Pharma, Frost & Sullivan Analysis

2.4.1.2 GROWTH DRIVERS OF THE MARKET

Small molecule market growth is supported by increasing incidence of chronic diseases, particularly in emerging economies, expanding access to generic medicines, continued new product approvals in high-burden therapeutic areas, and the sustained commercial performance of established branded products with remaining patent protection. Generic penetration in the United States exceeds 90% by volume, while penetration in many emerging markets remains below 60%, indicating room for further volume expansion.

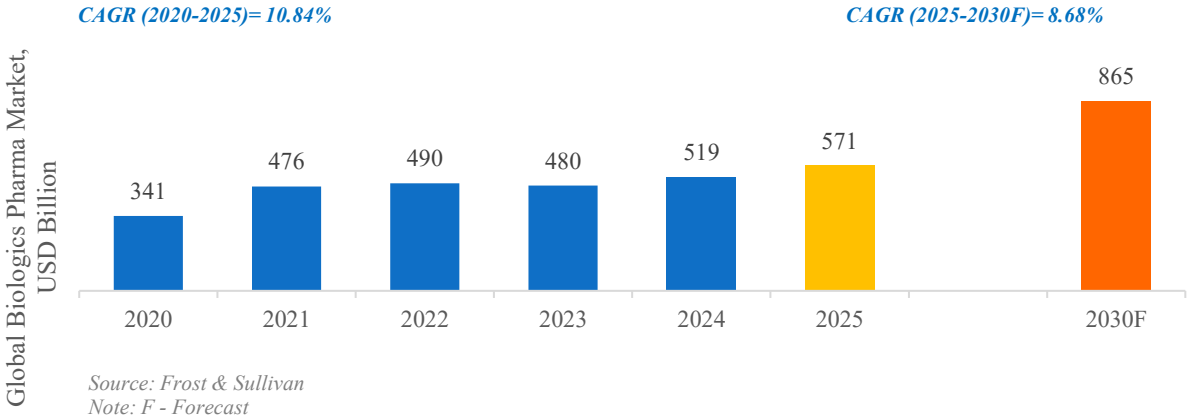
- **Increasing Disease Burden:** The rising prevalence of chronic diseases, particularly across emerging markets, is increasing demand for small molecule therapies across a broad range of indications. At the same time, continued approvals of new drugs in high-burden therapeutic areas are expanding available treatment options and supporting further growth of the small molecule market.

- **Expanding Market Access:** Generic medicines play an important role in improving access to treatment, particularly in markets where affordability is a key determinant of healthcare utilization. Their lower cost, supported by efficient manufacturing and reimbursement mechanisms, enables broader patient access and helps expand treatment availability across underserved populations.
- **Commercial Dynamics:** Strong physician loyalty and established payer coverage are supporting volume growth in the small molecule segment. This is supported by increasing patient trust and preference for branded generics.

2.4.2 GLOBAL BIOLOGICS MARKET

The global biologics market is projected to grow from approximately USD 571 billion in 2025 to approximately USD 865 billion by 2030F, at a CAGR of approximately 8.68% during the period. Growth is distributed across monoclonal antibodies, antibody-drug conjugates, recombinant proteins, cell and gene therapies, peptides, and oligonucleotides, with each sub-segment exhibiting distinct development timelines, manufacturing requirements, and commercial trajectories. Growth in the segment is supported by increasing adoption of biologic and biosimilar therapies, expanding physician and payer confidence, and the continued broadening of approved indications for established products. The growing preference for targeted therapies is also contributing to market expansion.

Exhibit 2.10: Global Biologics Pharma Market, 2020-2030F



Source: Frost & Sullivan
Note: F - Forecast

The global biologics market continues to expand rapidly and is expected to remain one of the primary drivers of growth within the pharmaceutical industry. The segment grew from USD 341 billion in 2020 to approximately USD 571 billion in 2025, representing a CAGR of 10.84% over the period. Growth is expected to remain strong between 2025 and 2030F, with the market projected to reach approximately USD 865 billion by 2030F, supported by a CAGR of 8.68%. As a result, biologics are expected to account for an increasing share of total pharmaceutical revenues throughout the forecast period. In 2025, biologics accounted for 65.00% of the top 20 products by peak revenue, indicating their strong commercial potential, pricing power, and growing importance across high-value therapeutic areas.

Growth within the biologics market is becoming increasingly concentrated around a number of high-value therapeutic classes. Protein- and peptide-based therapies, particularly GLP-1 medicines, next-generation monoclonal antibodies (mAbs), antibody-drug conjugates (ADCs), and selected cell and gene therapies (CGTs) are expected to account for a significant proportion of incremental value creation over the coming years. By contrast, more mature segments such as vaccines, legacy immunology biologics, and earlier-generation RNA therapies are expected to contribute more moderate but stable growth. This evolution reflects a broader shift in the pharmaceutical industry toward highly targeted therapies designed for specific patient populations. Revenue generation is increasingly concentrated among a smaller number of differentiated products with strong clinical outcomes and premium pricing, creating significant commercial opportunities while also increasing portfolio concentration risk.

Innovation remains a key driver of expansion within the biologics segment. Advances in therapeutic modalities, including third-generation ADCs, bispecific antibodies, engineered proteins, and cell and gene therapies, are expanding the range of diseases that can be treated through biologic approaches. At the same time, improvements in manufacturing technologies, including continuous manufacturing and advanced bioprocessing techniques, are helping increase production efficiency and scalability.

Drug discovery capabilities are also evolving rapidly. Technologies such as single-cell analysis, artificial intelligence-enabled research platforms, and integrated multi-omics approaches are providing deeper insights into disease biology and enabling the development of increasingly precise therapies. These capabilities support the continued advancement of precision medicine and accelerate the identification of novel biologic drug candidates.

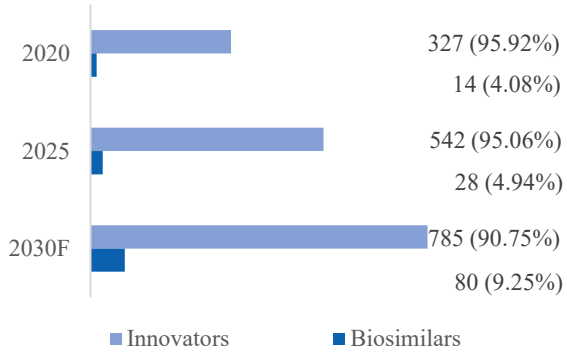
Strategic partnerships and acquisitions are expected to remain important mechanisms for innovation and pipeline expansion. Large pharmaceutical companies are increasingly collaborating with emerging biotechnology firms to gain access to specialized technologies and novel therapeutic platforms. Recent examples include collaborations focused on CAR-T therapies, multi-specific biologics, and treatments for chronic inflammatory diseases, reflecting the industry's growing emphasis on external innovation.

The biologics market is also expected to benefit from increasing biosimilar adoption across major markets. As patents expire on leading biologic products, biosimilars are expanding patient access while supporting continued growth of the overall biologics ecosystem. Together, continued scientific innovation, expanding therapeutic applications, strategic partnerships, and growing biosimilar penetration are expected to sustain strong growth across the biologics segment through 2030F and beyond.

2.4.2.1.1 BIOLOGICS MARKET BY INNOVATION TYPE

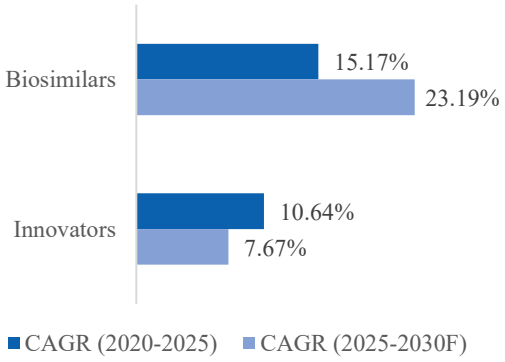
Innovator biologics are expected to remain the largest product category within the global biologics market, reaching USD 785 billion by 2030F. At the same time, biosimilars are projected to grow at faster rates, with an expected CAGR of 23.19% in the 2025-2030F period as commercialization expands and physician acceptance increases.

Exhibit 2.11A: Global Biologics Pharma Market by Innovation Type, 2020, 2025, 2030F, USD Billion



Source: Frost & Sullivan
Note: F- Forecast

Exhibit 2.11B: Growth Rate of Global Biologics Pharma Market by Innovation Type, 2020-2030F



Source: Frost & Sullivan
Note: F- Forecast

Innovator biologics are expected to remain the largest segment of the global biologics market throughout the forecast period. The segment expanded from USD 327 billion in 2020 to USD 542 billion in 2025, representing a CAGR of 10.64%. Growth is expected to remain strong between 2025 and 2030F, with the market projected to reach USD 785 billion by 2030F at a CAGR of 7.67%.

This leadership position is supported by a robust and expanding pipeline of novel therapies, particularly in high-value therapeutic areas such as oncology, immunology, and rare diseases. Innovator biologics continue to benefit from strong intellectual property protection, significant clinical differentiation, and the scientific and manufacturing

complexity associated with biologic products. These factors create substantial barriers to entry, limiting competition and enabling innovator companies to maintain premium pricing and capture a disproportionate share of pharmaceutical value growth. However, the significant research, development, and manufacturing costs associated with biologics often translate into high treatment prices, creating affordability challenges for healthcare systems and patients.

As a result, biosimilars have emerged as an increasingly important component of the biologics market. By offering comparable efficacy and safety at lower costs, biosimilars are expanding patient access to biologic therapies while introducing competition into previously protected markets. Biosimilar programs represent a fast growing opportunity, with global biosimilar sales increasing from USD 14 billion in 2020 to USD 28 billion in 2025, representing a CAGR of 15.17%. This growth is expected to accelerate, with the market projected to reach USD 80 billion by 2030F at a CAGR of 23.19% between 2025 and 2030F. Although biosimilars accounted for approximately 4.94% of the biologics market in 2025, their share is expected to increase to 9.25% by 2030F as more products enter the market and confidence among physicians, payers, and patients continues to improve.

The growth of the biosimilars market has been driven by a combination of expanding commercialization and increasing acceptance and uptake across healthcare systems[15]. In established markets, the launch of new biosimilars has created additional competition in high-cost therapeutic areas, enabling healthcare providers and payers to realize significant cost savings. These savings have, in turn, supported broader adoption of biosimilars and encouraged the introduction of additional products across a growing range of indications. In other markets, biosimilars are playing a critical role in improving access to biologic therapies that would otherwise remain unaffordable for many patients. As awareness, regulatory confidence, and physician familiarity continue to improve, uptake of existing biosimilars has accelerated, contributing to sustained market expansion.

A key advantage of biosimilars is their ability to deliver comparable clinical outcomes at a lower cost than originator biologics. This favorable value proposition has resulted in biosimilar penetration rates exceeding 80.00% in several major markets[16] and 90.00% in certain therapeutic areas within established European markets[17]. Beyond reducing treatment costs, the introduction of biosimilars has also expanded overall patient access to biologic therapies. In some cases, increased affordability has led to incremental annual volume growth of 2.00–5.00% for the underlying molecule[18].

As biologics continue to account for an increasing share of pharmaceutical innovation and spending, biosimilars are expected to play a growing role in balancing innovation with affordability. Their ability to expand access, reduce healthcare costs, and support treatment adoption positions them as one of the fastest-growing segments within the global pharmaceutical industry.

2.4.2.1.2 NEW PRODUCT APPROVAL TRENDS

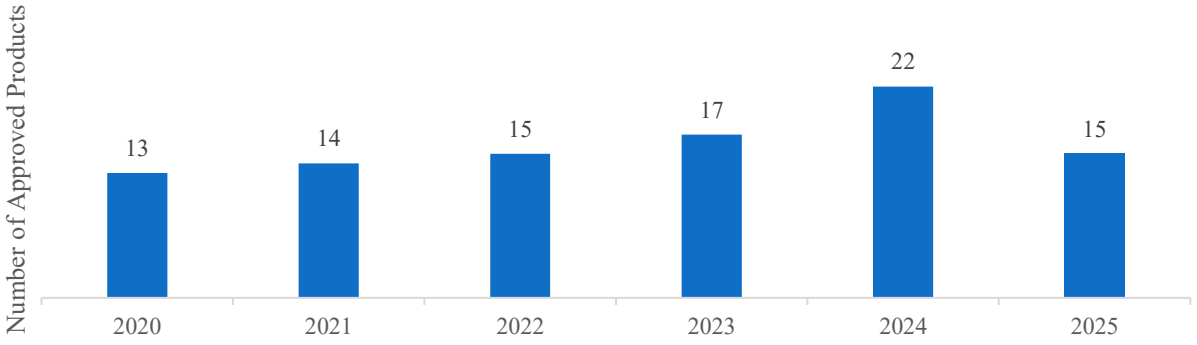
Biologics approvals have remained a significant contributor to overall novel drug approvals, with biologics accounting for approximately 36.70% of annual FDA NME and NBE approvals between 2022 and 2025. Approval activity has been increasingly concentrated in high-value therapeutic areas such as oncology, hematology, and rare / genetic diseases, alongside rising regulatory momentum for next-generation biologic modalities including bispecific antibodies, antibody-drug conjugates, and cell & gene therapies. The FDA approved an average of 17 new biological entities per year between 2020 and 2025.

Biologics accounted for 32.61% of all novel drugs approved by the CDER in 2025, with approved products spanning a range of advanced biologic modalities, including antibody-drug conjugates (ADCs), bispecific antibodies, and other complex biologic therapies. Several approvals also incorporated advances in drug delivery technologies, highlighting continued innovation beyond the therapeutic molecule itself.

[15] Other markets include all the countries not included in Europe, JANZ, and the US
[16] Major markets include established markets such as the US, Europe, Japan, and Australia, with more defined regulations
[17] Report from IQVIA Institute for Human Data Science - The Impact of Biosimilar Competition in Europe, 2023
[18] Report from IQVIA Institute for Human Data Science – Biosimilars in the United States 2023 - 2027, January 2023

Despite their increasing strategic importance, biologic approvals have exhibited a decline over the years. Biologics accounted for 40.54% of CDER approvals in 2022, declining to 30.91% in 2023, before increasing to 44.00% in 2024. This variability reflects the inherent complexity of biologic drug development, which is typically associated with longer development timelines, higher clinical risk, and more demanding manufacturing requirements. The regulatory pathway for biologics also tends to be more rigorous, often requiring extensive analytical characterization, larger clinical studies, and comprehensive evidence to demonstrate safety, efficacy, and manufacturing consistency. These factors can lengthen development timelines and contribute to fluctuations in annual approval volumes. However, once approved, biologics often address areas of significant unmet medical need, command premium pricing, and can generate substantial long-term revenues. In addition, their manufacturing complexity, specialized know-how, and stringent regulatory requirements create significant barriers to entry for competitors. Unlike small molecules, biologics are difficult to replicate exactly, resulting in slower competitive entry even after patent expiry and supporting greater commercial defensibility.

Exhibit 2.12: FDA approved NBEs, 2020-2025

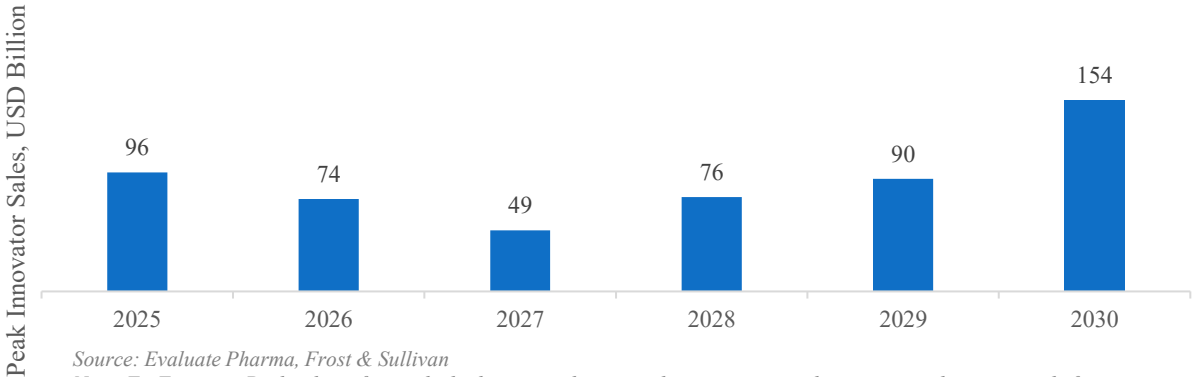


Source: FDA Data, Frost & Sullivan

2.4.2.1.3 UPCOMING OFF-PATENT OPPORTUNITIES

The biosimilar pipeline between 2025 and 2030F encompasses a range of high-revenue molecules across oncology, immunology, and ophthalmology. Regulatory pathways for biosimilar approval have matured in the United States, European Union, and Japan, enabling faster market entry and growing demand for cost-effective alternatives.

Exhibit 2.13: Upcoming Opportunities in the Global Biosimilar Market, 2025-2030F



Source: Evaluate Pharma, Frost & Sullivan
Note: F - Forecast; Peak sales refers to the highest annual revenue the originator product is expected to generate before patent loss between 2025 and 2030; the opportunity is indicative since patent litigation and other factors can delay or advance the launch of biosimilars; current analysis based on last year of patent expiry

Biosimilar opportunities are expected to exceed USD 534 billion between 2025 and 2030F as several blockbuster biologics, including Keytruda, Mounjaro, and Humira, lose patent protection. Among the top 10 drugs by peak revenue

during the 2025-2030F period, 70.00% are mAbs, underscoring the continued importance of this technology within the biologics market. Immunomodulators account for the largest share of these loss-of-exclusivity opportunities, representing 30.00% of the top 10 drugs going off patent.

Exhibit 2.14: Top 10 Biosimilar Opportunities, 2025-2030F

S.No.	Generic Name	Brand	Peak Revenue between 2025 and 2030F (USD million)
1.	Pembrolizumab	Keytruda	220,942
2.	Tirzepatide	Mounjaro	68,865
3.	Adalimumab	Humira	66,435
4.	Risankizumab	Skyrizi	62,048
5.	Trastuzumab deruxtecan	Enhertu	57,419
6.	Dupilumab	Dupixent	53,119
7.	OnabotulinumtoxinA	Botox	52,272
8.	Ocrelizumab	Ocrevus	50,586
9.	Guselkumab	Tremfya	46,008
10.	Vedolizumab	Entyvio	45,184

Source: Evaluate Pharma, Frost & Sullivan Analysis

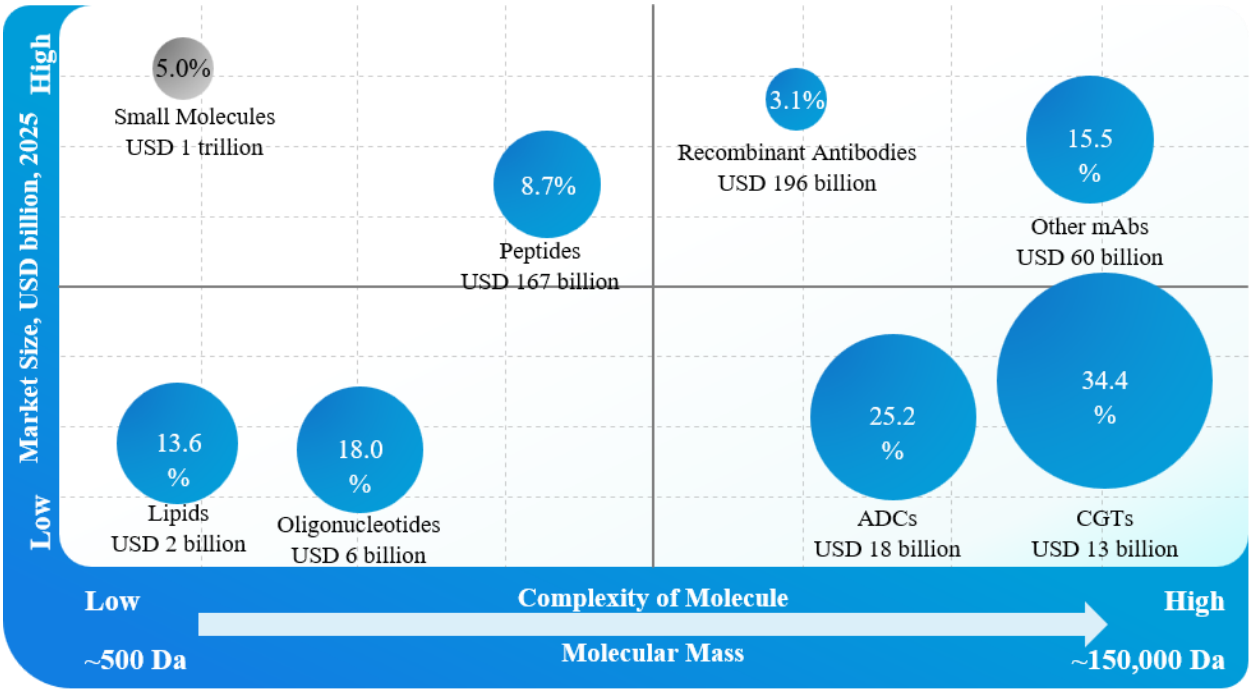
2.4.2.2 GROWTH DRIVERS OF THE MARKET

Biologics market growth is supported by the clinical performance of biologic therapies in previously unaddressed disease areas, continued new biological entity approvals, expanding biosimilar access in price-sensitive as well as mature markets, and increasing investment in next-generation modalities.

- **Regulatory Harmonization:** Markets like Australia, Singapore, and Malaysia have adopted EU guidelines, while India allows reference biologics approved in ICH countries. Recent regulatory shifts in the US are also more aligned with global norms, removing the need for switching studies required to establish biosimilar interchangeability.
- **Reimbursement Policy Support:** Supportive reimbursement strategies are improving uptake, reducing treatment costs, and broadening patient access to biologics. The Inflation Reduction Act in the US introduced negotiated drug pricing and increased reimbursement for biosimilars. Meanwhile, China has expanded its National Reimbursement Drug List to include more biosimilars, and Brazil reimburses biosimilars at parity with reference products.
- **Increasing Uptake of Biosimilars:** In mature markets, biosimilars are widely recognized as cost-effective alternatives, with newer biosimilars consistently achieving faster and broader adoption. This is supported by increasing clinical confidence and regulatory endorsement, supporting greater uptake.

2.4.3 PHARMACEUTICAL MODALITY EVOLUTION

The pharmaceutical modality landscape is increasingly moving toward therapies with greater molecular and functional complexity, with next-generation biologics accounting for the fastest-growing areas of the market. While traditional therapeutic modalities are expected to grow at a CAGR of 5.05% between 2025 and 2030, modalities such as ADCs, oligonucleotides, and cell and gene therapies (CGTs) are projected to expand at CAGRs exceeding 18% over the same period. This trend reflects the expanding application of these modalities in addressing disease pathways that are less amenable to conventional therapeutic approaches, as well as their potential to offer improved clinical outcomes in certain indications.



Note:

% in the Bubble represents the CAGR between 2025 and 2030F

Bubble size represents the growth potential between 2025 and 2030F

Molecular weight in Dalton (Da): Small Molecules (<1,000 Da), Lipids (<800 Da), Oligonucleotides (>15,000 Da), Peptides (>16,000 Da), Recombination Products (~50,000 Da), Monoclonal Antibodies (~150,000 Da), Antibody-Drug Conjugates (~150,000 Da)

Traditional Therapies Next-Gen Therapies

Small molecules have been the foundation of modern medicine for more than a century. Produced through established chemical synthesis processes, they are generally easier to develop, manufacture, and scale than biologics. Their broad applicability across multiple diseases has made them the most widely used class of medicines globally. However, their broader mechanism of action can sometimes result in off-target effects. While traditional therapeutic modalities are expected to grow at a CAGR of 5.05% between 2025 and 2030F, modalities such as ADCs, oligonucleotides, and CGTs are projected to expand at CAGRs exceeding 18% over the same period.

Within small molecules, new technologies such as proteolysis targeting chimeras (PROTACs), while nascent, are expected to gain increasing market share. PROTACs are heterobifunctional small molecules that harness the ubiquitin-proteasome system to selectively degrade disease-causing proteins. Unlike conventional small molecules that inhibit protein activity, PROTACs remove the target protein from the cell by recruiting an E3 ligase and triggering its degradation. Oncology is the leading area of PROTAC development, particularly in breast and prostate cancers through estrogen and androgen receptor degradation. Infectious and neurodegenerative diseases represent the next major areas of research. The global PROTAC market is projected to grow from approximately USD 1 billion in 2025 to USD 3.7 billion by 2030F, representing a CAGR of nearly 30% during the forecast period.

Lipids are a diverse group of organic compounds, including fats, oils, and waxes, which are insoluble in water but soluble in nonpolar solvents, and play essential roles in energy storage, cell membrane structure, and signaling. Lipids are essential biomolecules used in various applications, such as drug delivery systems, the creation of lipid nanoparticles for mRNA vaccines, and the development of cell membrane models for research and therapeutic purposes. Lipid-based drug delivery systems include various formulations aimed at presenting poorly water-soluble drugs in a solubilized form, thereby eliminating dissolution as the rate-limiting step for absorption. The market is expected to grow at a CAGR of 13.56% between 2025 and 2030F, reaching a market value of USD 2.2 billion by 2030F.

Biologics, including mAbs, ADCs, and CGTs, offer greater therapeutic specificity and have transformed the treatment of complex diseases such as cancer and rare genetic disorders. However, they are significantly more complex and costly to develop and manufacture, often requiring living cell systems, sterile production environments, and highly controlled processes.

The increased complexity of biologics needs substantially higher development and manufacturing costs. Development programs are typically longer and more resource-intensive, requiring extensive characterization, process development, clinical evaluation, and regulatory documentation. Biologic development is also associated with higher technical and clinical failure rates, as product performance can be influenced by manufacturing processes, biological variability, and immunogenicity risks. The transition toward advanced modalities such as ADCs, bispecific antibodies, and CGTs has further increased complexity across the value chain. These technologies require specialized scientific expertise, creating a steep learning curve for both developers and manufacturers. In addition, the infrastructure required to support biologic production often involves substantial capital investment in dedicated manufacturing facilities, containment systems, automation technologies, and quality control capabilities.

As pharmaceutical innovation continues to evolve, therapies are becoming increasingly targeted, potent, and personalized. While these advances offer significant clinical benefits, they also increase development risk, operational complexity, and capital requirements, driving continued investment in specialized technologies, manufacturing platforms, and technical expertise. A breakdown of the different therapies is presented below:

- **Monoclonal antibodies (mAbs)** are laboratory-engineered proteins designed to bind specific targets in the body, such as antigens on the surface of cancer cells or other disease-related biomarkers. The mAb category includes ADCs, recombinant antibodies, and other mAbs. Their high target specificity has made them a key therapeutic modality across oncology, immunology, and other complex disease areas.
    - **Recombinant Antibodies** are produced using synthetic genes and recombinant DNA technology, eliminating the need for animal immunization. This approach offers greater consistency, scalability, and design flexibility. The market is projected to grow from USD 187.4 billion in 2025 to USD 251.8 billion by 2030F, at a CAGR of 6.1%.
    - **Antibody-drug conjugates (ADCs)** combine the targeting capability of antibodies with the potency of cytotoxic drugs, enabling the selective delivery of treatment to cancer cells while minimizing damage to healthy tissue. Their manufacturing is highly complex, requiring precise conjugation of potent payloads to antibodies while maintaining product stability, safety, and efficacy. As a result, ADC production requires specialized expertise and tightly controlled manufacturing environments. Valued at USD 16.7 billion in 2025, the ADC market is projected to reach USD 53.8 billion by 2030F, growing at a CAGR of 26.3%.
- **Proteins and peptides**, including enzymes and GLP-1 agonists, offer targeted therapeutic effects with reduced systemic exposure. However, their susceptibility to degradation often requires advanced delivery technologies, such as encapsulation or chemical modification, to improve stability, bioavailability, and half-life, increasing development and manufacturing complexity. The protein and peptide market was valued at USD 158.4 billion in 2025 and is projected to reach USD 264.6 billion by 2030F, growing at a CAGR of 10.8%.
- **Oligonucleotides** are short single- or double-stranded DNA or RNA molecules that form the foundation of many RNA-based therapies, including antisense and small interfering RNA (siRNA) treatments. These therapies directly target RNA to modulate protein production and address disease at the genetic level. The oligonucleotide market was valued at USD 6.4 billion in 2025 and is projected to reach USD 12.6 billion by 2030F, growing at a CAGR of 14.4%. However, development and manufacturing remain complex, requiring specialized synthesis, purification, and delivery technologies such as lipid nanoparticles (LNPs) to ensure stability, cellular uptake, and therapeutic efficacy.
- **Cell and gene therapies (CGTs)**, including CAR-T therapies and gene-editing technologies such as CRISPR, offer the potential for durable or curative treatment by modifying or correcting genetic material. The CGT market was valued at USD 12.6 billion in 2025 and is projected to reach USD 59.0 billion by 2030F, growing at a CAGR of 36.2%. However, these therapies are among the most complex pharmaceutical modalities, requiring advanced manufacturing processes involving viral vectors or plasmid DNA, highly

specialized facilities, and stringent quality and regulatory controls, resulting in significantly higher development and production costs.

These next-generation therapeutic modalities require increasingly sophisticated discovery approaches and complex chemistry workflows. Their development often demands specialized scientific expertise, advanced technical capabilities, and a deeper understanding of novel biological mechanisms than traditional drug modalities. At an average expected growth rate of 16-22% between 2025 and 2030F, mAbs, ADCs, CGTs, and oligonucleotides are some of the fastest growing segments and represent significant opportunities for players investing in differentiated discovery capabilities, advanced chemistry platforms, and specialized development infrastructure to support emerging therapeutic classes.

2.5 TOP SELLING PHARMACEUTICAL PRODUCTS

The top 20 pharmaceutical products by global revenue in 2025 span both small molecule and biologics categories, with monoclonal antibodies accounting for a disproportionate share of high-revenue products. Immunology and oncology remain the two highest-revenue therapeutic areas by product concentration

Within the top selling molecules of 2025, biologics dominate the field, accounting for 65% of the top products. Additionally, mAbs hold the greatest share accounting for 77% within biologics drugs, and a combined peak revenue of over USD 159 billion. Meanwhile, GLP-1 drugs hold the top 2 spots, with a combined peak revenue of over USD 105 billion.

Exhibit 2.15: Top 20 Pharmaceutical Products, Peak Revenue, 2025

Rank	Drug Name	Product Modality	Peak Revenue between 2025-2030F, USD million
1.	Semaglutide	Biologics	42,548
2.	Tirzepatide	Biologics	62,568
3.	Pembrolizumab	Biologics	31,563
4.	Dupilumab	Biologics	26,559
5.	Risankizumab	Biologics	31,024
6.	Apixaban	Small Molecule	14,659
7.	Daratumumab	Biologics	19,336
8.	Empagliflozin	Small Molecule	15,109
9.	Nivolumab	Biologics	11,759
10.	Elexacaftor; Ivacaftor; Tezacaftor	Small Molecule	10,190
11.	Aflibercept	Biologics	9,137
12.	Dapagliflozin	Small Molecule	8,706
13.	Ocrelizumab	Biologics	10,125
14.	Upadacitinib	Small Molecule	15,027
15.	Sacubitril; Valsartan	Small Molecule	8,096
16.	Ustekinumab	Biologics	7,253

17.	Osimertinib mesylate	Small Molecule	9,059
18.	Denosumab	Biologics	6,879
19.	Adalimumab	Biologics	6,679
20.	Secukinumab	Biologics	7,918
Total Peak Revenue			354,194

Source: Frost & Sullivan Analysis
Note: Top 20 molecules selected on the basis of peak revenue sales for each molecule between 2025 and 2030F.

3 GLOBAL PHARMA MARKET DYNAMICS

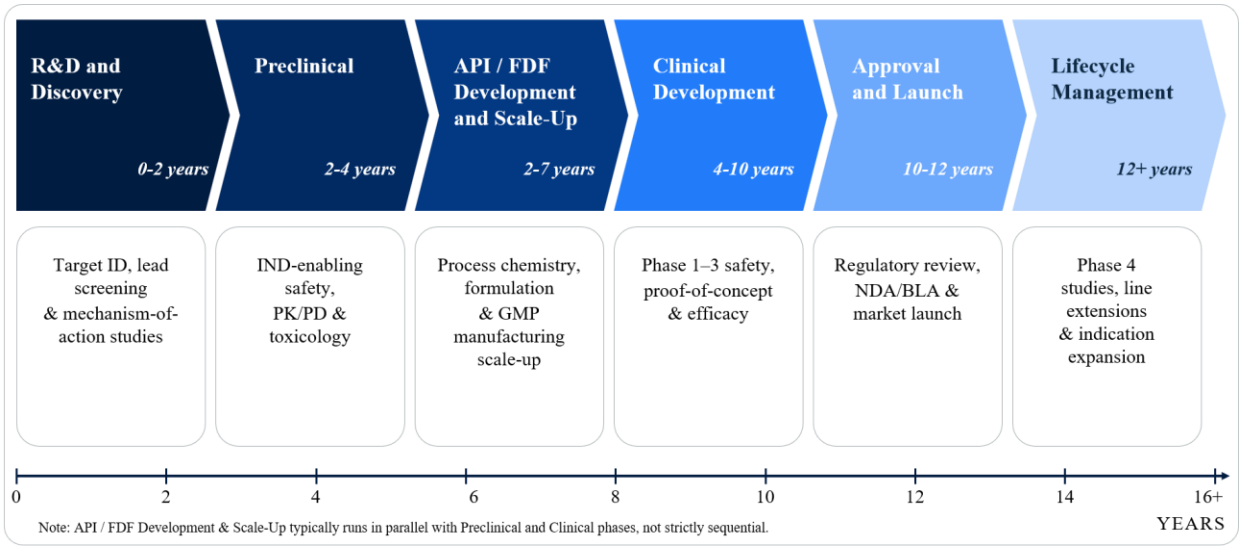
The global pharmaceutical market is expanding in absolute size while the composition of its pipeline, the economics of drug development, and the organization of manufacturing are each evolving, impacting strategic choices, operational planning, and technological adoption across the value chain.

In the pharmaceutical industry, new drugs require extensive drug discovery efforts to generate usable compounds / cells for the targeted disease as well as undergo stringent preclinical and clinical testing, followed by rigorous regulatory review, to demonstrate their safety and efficacy before reaching the market. This process typically takes more than a decade and requires USD 1 billion to USD 3 billion in R&D investment, spanning early-stage discovery through commercialization. Despite these significant investments, the probability of a drug successfully progressing from discovery to regulatory approval remains low. This lengthy process and need for controlling R&D investments is pushing pharma innovators to increasingly outsource their R&D requirements to contract services organizations such as CRDMOs.

3.1 PHARMACEUTICAL VALUE CHAIN

The pharmaceutical value chain spans target identification through commercial manufacturing and distribution, with each stage requiring distinct scientific capabilities, regulatory compliance, and capital investment. As molecular complexity increases, the boundaries between stages are converging, prompting pharmaceutical companies to seek capabilities with seamless handoffs across the continuum rather than executing individual stages in isolation.

Bringing a drug from discovery to commercialization typically takes around 10-15 years and involves multiple distinct stages, each with unique scientific, regulatory, and operational requirements. The process begins with discovery and early research, where biological targets are identified and lead compounds are screened. Promising candidates then advance into preclinical development, including safety, toxicology, and pharmacokinetic assessments. API and FDF development are generally conducted in parallel, covering process development, analytical method establishment, formulation optimization, and stability testing. Development then progresses through scale-up, technology transfer, process validation, and GMP manufacturing to support clinical trials. Clinical development is the longest and most resource-intensive stage, encompassing Phase I, II, and III studies to establish safety and efficacy. Successful candidates proceed to regulatory review before approval and commercial launch. Following commercialization, companies continue lifecycle management through post-marketing studies, indication expansions, and product extensions. The process requires sustained investment in scientific expertise, regulatory capabilities, quality systems, and specialized infrastructure, creating significant barriers to entry across the pharmaceutical value chain.



3.2 RESEARCH & DEVELOPMENT (R&D) DYNAMICS

Global pharmaceutical R&D expenditure has grown from approximately USD 245 billion in 2020 to USD 295 billion in 2025, equivalent to approximately 15 to 17% of industry revenues. Over the same period, the cost per approved molecule has more than doubled, reflecting the higher clinical and technical complexity of assets advancing through development.

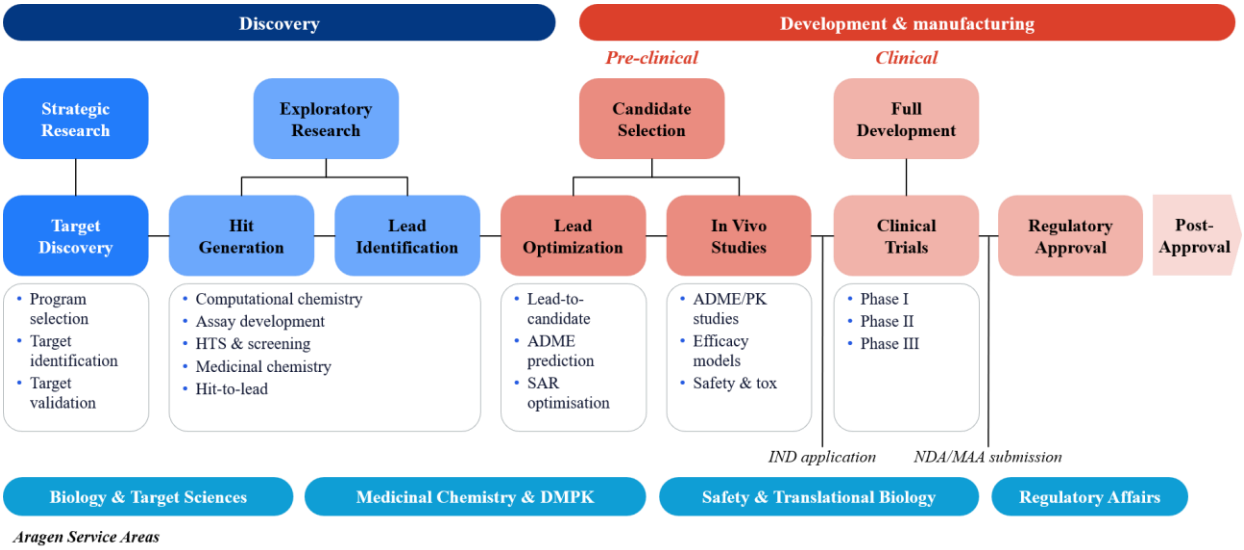
The increasing complexity of drug modalities and the growing focus on difficult-to-treat diseases have significantly raised the cost of drug development. New therapeutic approaches such as biologics, cell and gene therapies, ADCs, oligonucleotides, and other next-generation modalities require more sophisticated discovery platforms, specialized manufacturing processes, and increasingly complex clinical development programs. At the same time, many pharmaceutical companies are targeting diseases with limited treatment options, smaller patient populations, and less well-understood biological pathways, increasing both scientific uncertainty and development risk. As a result, the average cost per approved molecule more than doubled between 2020 and 2025 as companies faced greater scientific, clinical, manufacturing, and regulatory challenges throughout the development process. To sustain innovation while managing rising development costs and resource requirements, pharmaceutical manufacturers have increased their R&D investments and increasingly pursued partnerships with biotechnology companies and CRDMOs. These collaborations provide access to specialized expertise, advanced technologies, and flexible development capabilities, enabling companies to expand into new therapeutic areas, accelerate innovation, and address previously unmet medical needs.

3.2.1 R&D VALUE CHAIN

The R&D value chain progresses from target identification and hit generation through lead optimization, preclinical characterization, and phased clinical evaluation to regulatory submission, spanning 10 to 15 years with cumulative attrition exceeding 90%. Capital requirements, specialized capabilities, and regulatory expectations increase substantially at each stage, making it progressively more difficult for any single organization to maintain internal capacity across all therapeutic areas and modalities simultaneously.

Drug development follows a structured pathway from early scientific research through regulatory approval and can be broadly divided into discovery and development phases. The process begins with exploratory research and target discovery, where biological mechanisms are identified and validated to establish the foundation for a therapeutic program. This is followed by hit generation and lead identification, during which computational tools, screening technologies, and medicinal chemistry are used to identify compounds with potential therapeutic activity. Selected compounds then undergo lead optimization, where their pharmacological properties, ADME characteristics, and structure-activity relationships are refined to identify a development candidate. Candidates that meet predefined

criteria advance into preclinical testing, including in vivo studies to evaluate safety, efficacy, and pharmacokinetics. Successful completion of these studies supports the filing of an Investigational New Drug (IND) application and progression into clinical development. Clinical development is conducted across Phases I, II, and III, generating the safety and efficacy data required for regulatory submissions such as an NDA or MAA. Following regulatory review and approval, the product enters the market, with post-approval studies and ongoing regulatory obligations continuing throughout its commercial lifecycle.

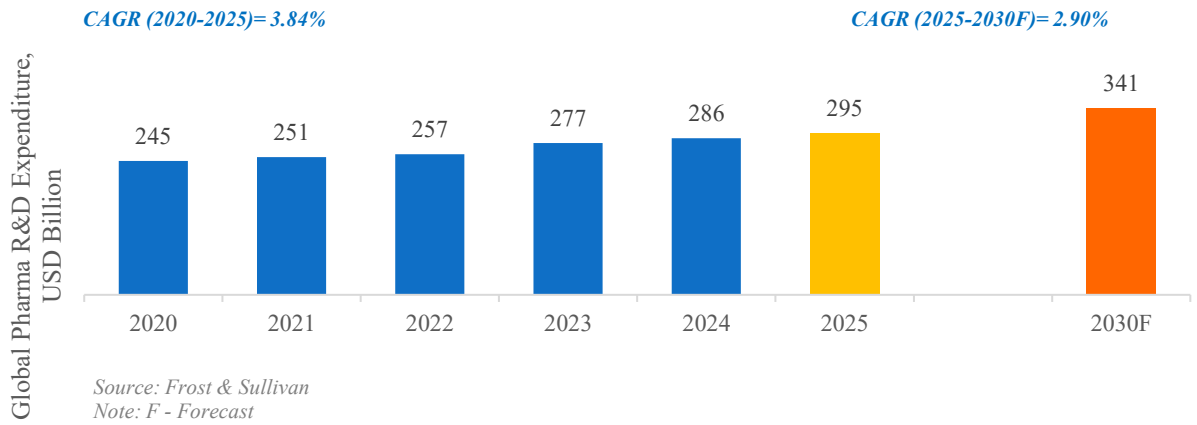


3.2.2 Total Pharma R&D Expenditure and Pipeline

Global pharmaceutical R&D expenditure is projected to reach approximately USD 341 billion by 2030, up from USD 295 billion in 2025. The global clinical pipeline exceeded 23,900 active assets in 2025, the largest recorded figure, while the number of approvals per billion dollars of R&D investment has declined over the same period, reflecting the higher complexity of assets in late-stage development.

R&D remains essential to the long-term success of pharmaceutical companies, as continuous innovation is required to replenish product pipelines, replace revenues lost to patent expirations, and sustain future growth. However, the average cost of developing and commercializing a new drug now exceeds USD 1 billion, while development attrition rates remain high. The combination of rising development costs and lower success rates has placed increasing pressure on R&D productivity and reduced returns on investment across the industry.

Exhibit 3.1: Global Pharma R&D Expenditure, 2020-2030F



Source: Frost & Sullivan
Note: F - Forecast

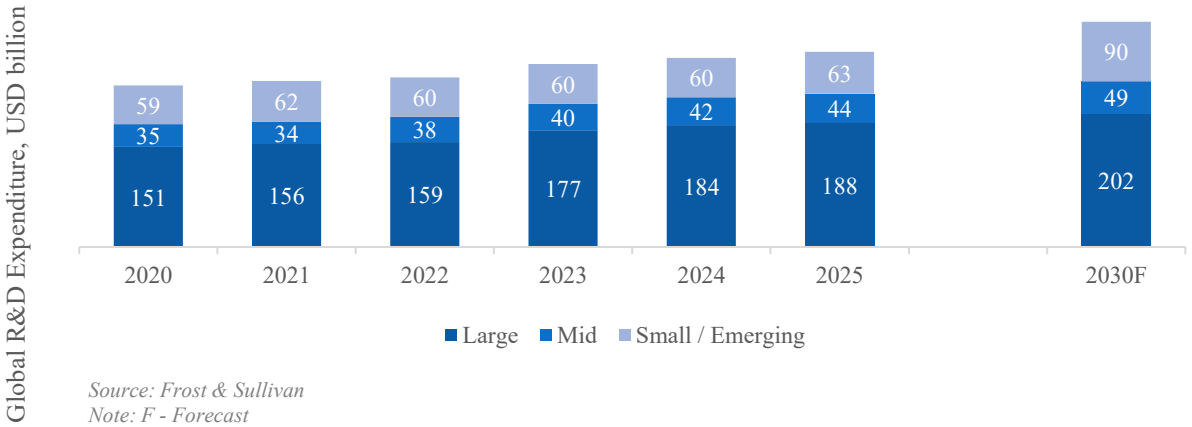
Global pharmaceutical R&D spending increased from USD 245 billion in 2020 to USD 295 billion in 2025. This growth was driven by investment in COVID-19 vaccines and therapeutics, efforts to strengthen pipelines ahead of major patent expirations, and strong funding activity across the biotechnology sector. Looking ahead, R&D spending is expected to normalize toward pre-pandemic growth levels at a CAGR of 2.90% between 2025 and 2030F. Rising development costs, lower returns on investment, and increasing challenges in late-stage clinical development are prompting many pharmaceutical companies to place greater emphasis on R&D productivity, portfolio prioritization, and operational efficiency.

3.2.2.1 PHARMA R&D EXPENDITURE AND PIPELINE BY COMPANY SCALE

R&D investment and pipeline ownership are distributed across large, mid-sized, and emerging pharmaceutical companies[19]. Mid-sized and emerging companies now collectively originate more than 60% of new molecular entities entering clinical development, enabled by venture capital availability and access to external research platforms. Large pharmaceutical companies have responded by concentrating internal resources on late-stage development and commercial activities, while accessing early-stage innovation through acquisitions and licensing arrangements.

Large pharmaceutical companies continue to account for the majority of global pharmaceutical R&D spending. In 2025, they represented 63.69% of total R&D expenditure and increased spending at a CAGR of 4.45% between 2020 and 2025. However, smaller pharmaceutical and biotechnology companies are expected to drive the fastest growth in R&D investment over the forecast period. Their combined share of global R&D spending is projected to increase from 21.48% in 2025 to 26.50% by 2030F, supported by a CAGR of 7.32%. This is despite the fact that biotechnology and small innovator pharmaceutical companies are mainly dependent on funding by financial sponsors. These companies generally are lean on resources, have limited infrastructure and may not have thorough experience in every aspect of drug discovery, development, and manufacturing. Any reduction in external funding available to such companies could adversely impact demand for outsourced services.

Exhibit 3.2: Global Pharma R&D Expenditure by Company Size, 2020-2030F



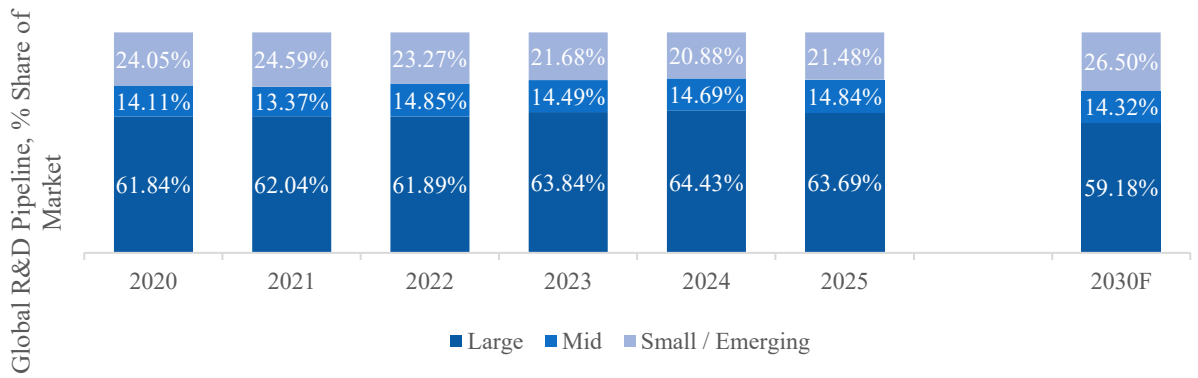
Source: Frost & Sullivan
Note: F - Forecast

However, as venture capital investment in biotechnology and small innovator companies rises and they gain improved access to drug discovery technologies, the role of biotechnology companies in pharmaceutical innovation is set to grow. More than 60% of new molecular entities (NMEs) now originate from small and mid-sized companies. As a result, large pharmaceutical companies increasingly rely on licensing agreements, partnerships, and targeted

[19] Large pharmaceutical companies are defined as those generating annual revenues above USD 10 billion; mid-sized companies generate revenues between USD 500 million and USD 10 billion; and small to emerging companies generate annual revenues below USD 500 billion.

acquisitions to access promising preclinical and early-stage clinical assets and supplement their internal development pipelines.

Exhibit 3.3: Global Pharma R&D Expenditure by Company Size, % Share of Market, 2020-2030F



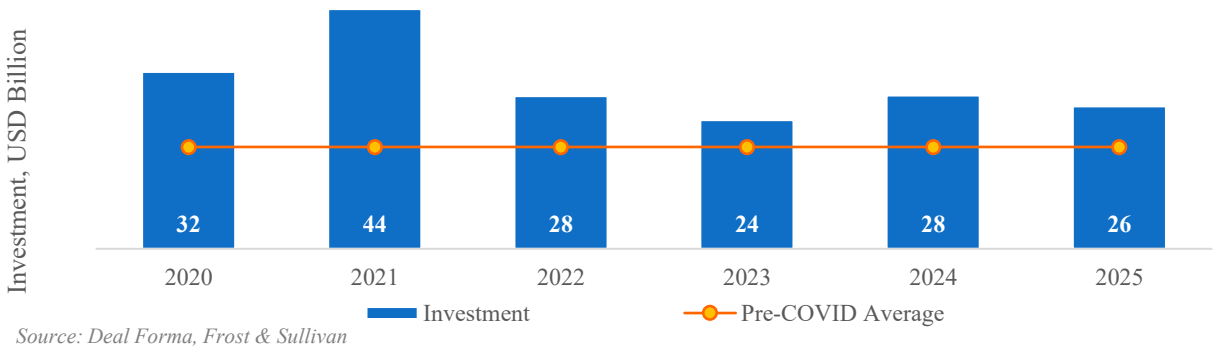
Source: Frost & Sullivan
Note: F - Forecast

3.2.2.1.1 GROWING INVESTMENT IN EMERGING PHARMA

Venture capital and private equity investment in emerging pharmaceutical and biotech companies reached USD 32 billion in 2020 and has remained above USD 23 billion annually through 2025. This capital supports a growing number of companies that conduct drug development programs without owning internal research or manufacturing facilities, relying on external service providers for execution across most or all stages of development.

Private capital investment in the biotechnology sector has remained above pre-pandemic levels in recent years. PE and VC funding was USD 24 billion in 2023, USD 28 billion in 2024, and USD 26 billion in 2025, approximately 1.4x higher than pre-pandemic levels (2018-2019). This sustained funding environment is expected to support increased R&D activity among biotechnology companies and contribute to overall growth in pharmaceutical innovation spending.

Exhibit 3.4: PE/VC Investment in Biotech, Global, 2020-2025



Source: Deal Forma, Frost & Sullivan
Notes: Pre-COVID refers to the period 2018-2019

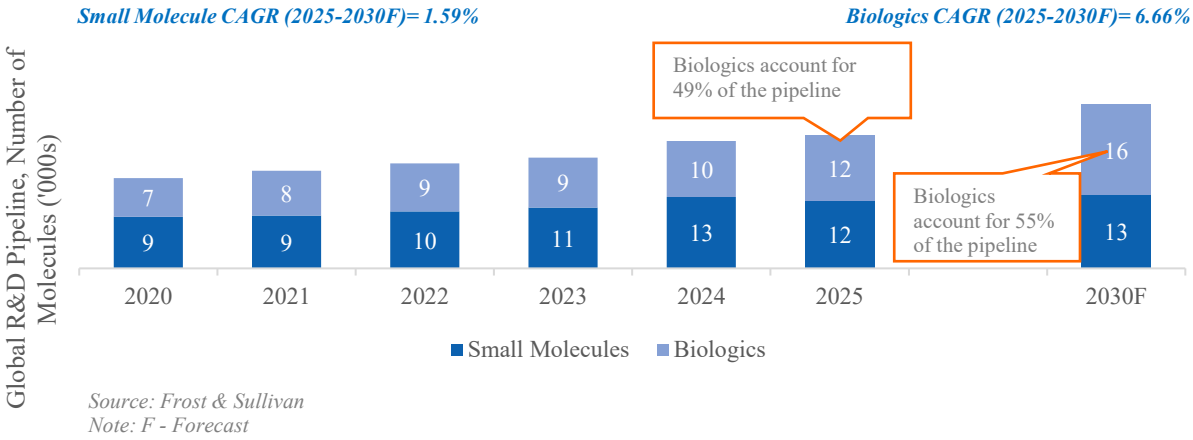
The US remains the leading center for biotechnology innovation, with major clusters in California, Illinois, Massachusetts, New Jersey, and New York hosting more than 1,000 biotechnology and pharmaceutical companies and accounting for a significant share of global pharmaceutical R&D activity. Many emerging biotechnology

companies increasingly partner with CRDMOs in cost-competitive markets such as India to support drug development, clinical supply, and commercial-scale manufacturing activities.

3.2.2.2 PHARMA R&D EXPENDITURE AND PIPELINE BY MODALITY

Biologics now account for approximately 49.00% of global clinical pipeline assets by number, up from approximately 42.75% in 2020. Both small molecules and biologics pipelines have expanded in absolute terms over this period, with biologics expected to overtake small molecules by the end of 2026.

Exhibit 3.5: Global Pharma R&D Pipeline by Modality, 2020-2030F



Source: Frost & Sullivan
Note: F - Forecast

In 2025, approximately 23,900 drug candidates were in development across all stages, from preclinical research through commercialization. Small molecules represented the largest share of the global R&D pipeline, accounting for 51.00% of all molecules under development. However, biologics are expected to grow at a faster pace over the forecast period, increasing their share of the pipeline and reaching 55.07% by 2030F, reflecting continued investment in advanced therapeutic modalities and biologic drug development.

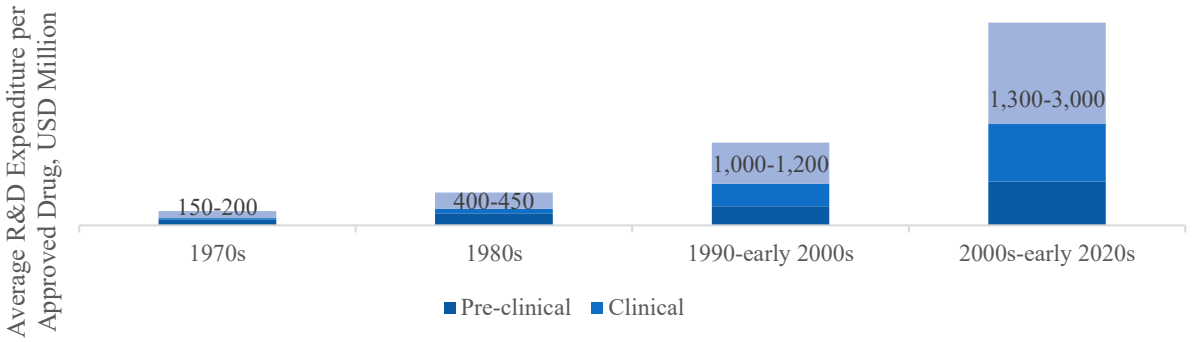
3.2.2.3 PHARMA R&D EXPENDITURE PER MOLECULE

The total cost of bringing a new molecular entity to market, inclusive of failed programs and capital costs, is between USD 1 billion and USD 3 billion. This increase is increasingly driven by growing target complexity, higher attrition rates during discovery and preclinical development, expanding requirements for translational validation, and rising investment in advanced discovery technologies and specialized scientific capabilities. As a result, pharmaceutical companies are increasingly externalizing early-stage R&D activities to specialist partners to access differentiated expertise and flexible infrastructure while improving overall R&D productivity and return on invested capital.

Drug discovery and development is a lengthy, complex, and capital-intensive process spanning multiple stages from early research through commercialization. The average cost of bringing a new drug to market now exceeds USD 1 billion, while development timelines have increased from approximately 6 years in the 1970s to around 10-15 years in the 2020s as drug technologies have become more sophisticated and regulatory requirements more stringent. These challenges are further amplified by extremely low development success rates (sometimes lower than 0.01%), with only a very small fraction of molecules progressing from initial discovery through to regulatory approval.

To address rising costs and improve R&D productivity, pharmaceutical innovators have increasingly adopted outsourcing strategies. Establishing dedicated manufacturing infrastructure for both commercial and pipeline products is often economically inefficient, particularly given development uncertainty. As a result, outsourcing has become an important tool for improving capital efficiency, reducing operational complexity, and enhancing returns on R&D investment, allowing pharma companies to continue to focus on marketing drugs as their core business.

Exhibit 3.6: R&D Expenditure per Approved Drug, 1970-2025



Source: Frost & Sullivan
Note: F - Forecast

3.2.3 New Technology and Its Impact on Pharma R&D

Artificial intelligence, machine learning, computational chemistry, and next-generation sequencing are being adopted across the R&D value chain, with applications spanning target identification, compound screening, clinical trial design, and patient stratification. Early evidence suggests these tools are compressing discovery timelines and improving the accuracy of candidate selection.

Exhibit 3.7: New Technologies

Technology	Benefits / Drivers	Select Applications
Artificial Intelligence (AI)	AI can improve drug discovery by reducing development timelines and costs, enabling analysis of complex datasets at a scale beyond human capability, and enhancing the prediction of drug–target interactions. Its ability to learn from new data improves model accuracy over time, while earlier identification of safety and efficacy risks can help reduce costly late-stage failures. This enables targeting a larger funnel of new molecules for wet lab work with better probability of success.	• De novo drug design leading to generation of new drug discovery programs • Target identification and validation • Clinical trial design optimization and patient stratification • Adverse event prediction and drug safety profiling • Biomarker discovery from imaging, EHR, and multi-omics data • Regulatory document generation and review automation
Computational Chemistry	Computational chemistry provides atomic-level insight into drug–target interactions, supporting rational drug design and candidate optimization. By evaluating compounds in silico, it reduces experimental iterations, enables exploration of large chemical libraries, and complements laboratory studies where assays are costly or difficult to perform.	• Molecular docking to predict binding poses and affinities • Molecular dynamics simulations to study protein conformational changes • Free energy perturbation calculations for lead optimization • Pharmacophore modelling to define essential interaction features • Solubility, permeability, and stability prediction for formulation • Covalent inhibitor design and allosteric site discovery
Next-Generation	NGS enables high-throughput, cost-effective genomic analysis and supports single-cell characterization of gene expression and disease	• Genomic biomarker discovery for patient stratification in clinical trials

Sequencing (NGS)	heterogeneity. It helps identify genetic drivers of disease, accelerates precision medicine research, and supports the development of companion diagnostics alongside targeted therapies.	• Whole-exome / genome sequencing to identify disease-causing mutations • RNA-seq for transcriptomic profiling of drug mechanism of action • Single-cell sequencing to map cell-type-specific drug responses • CRISPR screen analysis for functional genomics and target validation • Liquid biopsy and circulating tumor DNA monitoring in oncology trials

Source: Frost & Sullivan

The adoption of advanced technologies such as AI, NGS, and computational chemistry tools is enabling pharmaceutical service providers to improve development efficiency and enhance candidate selection. Additionally, they support innovator firms to optimize target selection, widening the molecule funnel. By integrating these technologies into existing workflows, companies can shorten discovery timelines, reduce experimental burden, and improve the probability of identifying viable drug candidates. For example, Global CRDMO players such as WuXi AppTec and Pharmaron have invested in companies developing AI tools for drug discovery in addition to offering in-house AI services. WuXi AppTec invested in Insilico Medicine in 2018[20], which specializes in the application of AI for target identification, drug discovery, and aging research, while Pharmaron in 2025[21] acquired a majority stake of Biortus, a CRO offering an AI/ML-based computational platform for the design of new protein complexes and structure analysis. Aragen has followed this global trend, incorporating AI-driven approaches into chemical synthesis workflows to help accelerate drug discovery programs and support faster project execution for its clients. This includes the inclusion of AI into ADME (Absorption, Distribution, Metabolism, and Excretion) workflows, enabling automation of data flow and analytics.

3.3 DEVELOPMENT & MANUFACTURING DYNAMICS

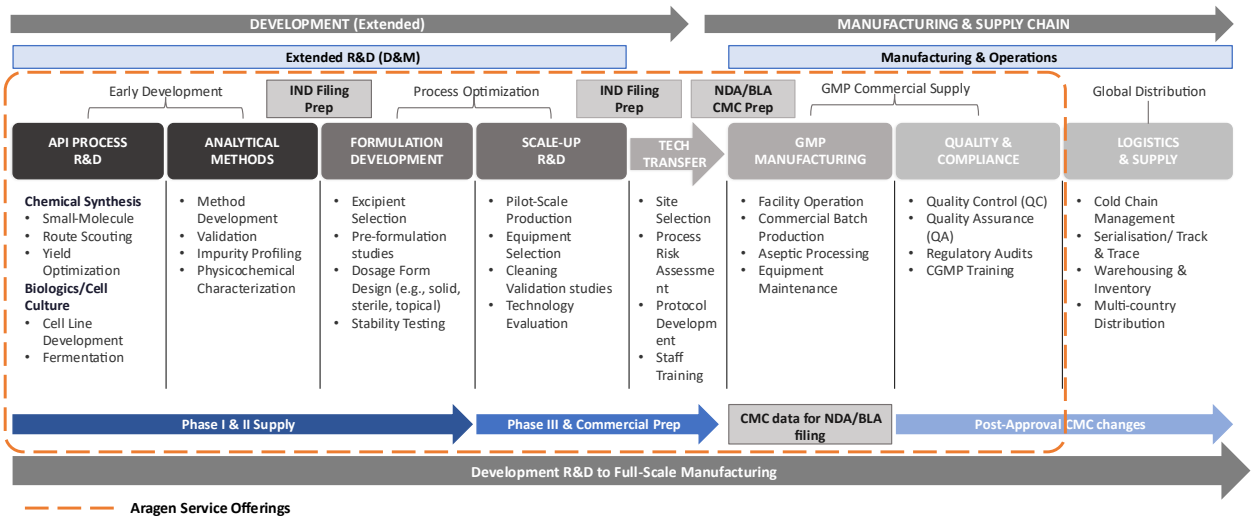
The development and manufacturing landscape is being shaped by rising product complexity, the adoption of advanced manufacturing technologies, and a realignment of global manufacturing geography. Each of these factors is altering the capability requirements, capital requirements, and competitive positioning of organizations involved in pharmaceutical development and production.

Pharmaceutical development and manufacturing are undergoing a significant transformation driven by increasing product complexity, advances in manufacturing technology, and shifts in global supply chain strategies. The growing importance of biologics, advanced therapies, and other complex modalities is raising the technical requirements for development and production, necessitating more specialized capabilities, infrastructure, and capital investment. At the same time, the adoption of next-generation manufacturing technologies is improving process efficiency, flexibility, and scalability across the value chain. These innovations are helping accelerate development timelines, enhance manufacturing precision, and support the production of increasingly complex products. Global manufacturing networks are also evolving as companies reassess sourcing strategies, supply chain resilience, and geographic concentration risks. Together, these trends are reshaping investment priorities, competitive dynamics, and the capabilities required to operate successfully within the pharmaceutical industry.

3.3.1 DEVELOPMENT & MANUFACTURING VALUE CHAIN

The development and manufacturing value chain spans process development, analytical method development, formulation, clinical manufacturing, technology transfer, and commercial production, with technical complexity increasing across both small and large molecule modalities. While biologics require specialized manufacturing platforms, advanced process controls, and complex quality systems, small molecules are also witnessing rising complexity driven by high-potency APIs, peptide-based therapeutics, and increasingly sophisticated synthetic chemistries that demand specialized infrastructure, safety controls, and process expertise.

[20] Company Press Release
[21] Company Press Release



Bringing a drug from early research to commercialization requires coordination across a broad range of scientific, regulatory, manufacturing, and supply chain activities. Each stage is interconnected, with decisions made early in development influencing downstream timelines, costs, manufacturing performance, and regulatory outcomes. The process begins with API synthesis, analytical method development, and formulation design, which establish the foundation for clinical development and regulatory submissions. As programs advance, scale-up, process optimization, and technology transfer are required to translate laboratory processes into commercial manufacturing. Commercial production introduces additional requirements related to process validation, batch consistency, equipment qualification, quality assurance, and ongoing cGMP compliance. Regulatory inspections and quality oversight remain continuous responsibilities throughout the product lifecycle. Logistics and supply chain operations are equally important, ensuring product integrity through storage, serialization, cold-chain management where required, and distribution across multiple markets with varying regulatory requirements.

Having development, tech transfer, and manufacturing conducted at a single site enhances operational continuity, accelerates timelines, and reduces execution risk by eliminating handoffs between multiple facilities. This integrated model facilitates seamless knowledge transfer, improves process understanding, streamlines scale-up activities, and minimizes delays associated with cross-site coordination, ultimately enabling faster and more reliable progression from development to commercial manufacturing.

3.3.2 New Technology and Its Impact on Pharma Manufacturing

Continuous manufacturing, single-use bioprocessing systems, and process analytical technology are changing the economics, flexibility, and quality control of pharmaceutical manufacturing, reducing batch sizes, improving yield predictability, and enabling multi-product facilities to operate economically at smaller scale. These advancements are simultaneously raising the capability expectations of pharmaceutical manufacturers, making technology investment a prerequisite for competitive positioning.

The pharmaceutical industry is increasingly adopting advanced manufacturing technologies such as biotransformation, flow chemistry, and recombinant DNA platforms. Traditional chemical synthesis often involves multi-step processes, harsh reaction conditions, specialized catalysts, and organic reagents, increasing manufacturing complexity and cost. These newer technologies improve efficiency, scalability, and sustainability while enabling the production of complex therapeutics such as peptides, oligonucleotides, and monoclonal antibodies. As pharmaceutical pipelines shift toward more advanced modalities, these manufacturing platforms are becoming increasingly important across drug development and commercial production.

Exhibit 3.8: Manufacturing Technology Platforms

Platform	Description	Benefits / Drivers	Select Applications	Examples of Top-Selling Products, 2025, USD
Biotransformation	Biotransformation / biosynthesis uses enzymes[22] as catalysts to carry out chemical reactions, reducing the need for heavy metals and other traditional chemical catalysts.	Offers a cost-efficient and sustainable alternative to traditional chemical synthesis. By using enzymes to perform highly selective reactions, biocatalysis can reduce process complexity, waste generation, and manufacturing costs. Reactions are typically conducted under mild conditions, lowering energy consumption and improving process safety.	• Green Chemistry • Organic Synthesis • Asymmetric Synthesis • Drug Modification	• Sitagliptin (Januvia): 1,675 million • Atorvastatin (Lipitor): 1,458 million • Montelukast (Singulair): 363 million
Flow Chemistry / Continuous Manufacturing	Flow Chemistry / Continuous Manufacturing is a production method in which chemical reactions are performed continuously through a flowing stream of reactants rather than through discrete batch-based processes.	Flow chemistry offers improved process control, efficiency, and safety compared to traditional batch manufacturing. It can deliver higher yields, lower operating costs, and cleaner production while enabling precise control over reaction conditions such as mixing, temperature, stoichiometry[23], and residence time.	• Peptide and oligonucleotide synthesis • API Production • Drug Formulation	• Ribociclib (Kisqali): 4,999 million • Celecoxib (Celebrex): 279 million
Fermentation	Fermentation is a biological process in which microorganisms convert substrates into desired compounds through controlled metabolic activity.	Fermentation enables the large-scale production of specific compounds through cost-efficient, high-productivity manufacturing processes.	• mAbs • Recombinant proteins • Microbial vaccines	• Ceftriaxone (Rocephin): 175 million • Minocycline (Arestin, Monocin, Minocycline): 100 million
Metal-Mediated Chemistry	Metal-mediated chemistry involves the use of metal catalysts to facilitate chemical reactions in organic synthesis.	Metal ions can enhance the toxicity of coordinated drugs through Fenton reactions. These therapies are used in indications including diabetes, ulcers, rheumatoid arthritis,	• Chiral Catalysis • Catalytic hydrogenation • Oxidation & Reduction • Carbon bond formation	• Valsartan (Diovan): 613 million • Oseltamivir (KeWei, Tamiflu): 1,026 million

[22] Proteins or RNAs that catalyze chemical changes to other molecules.
[23] Stoichiometry is a branch of chemistry, which is used to determine the exact quantities of reactants needed to produce a specific drug.

		and inflammatory disorders.		
Recombinant DNA	Recombinant DNA technology involves the use of enzymes and molecular biology techniques to isolate, modify, and combine specific DNA sequences.	Recombinant DNA technology produces proteins and antibodies with a high degree of uniformity and specificity.	• Production of Insulin, Recombinant Proteins, Human Growth Hormone • Gene therapy	• Adalimumab (Humira): 4,429 million • Etanercept: 4,052 million • Trastuzumab (Herceptin): 1,273 million
Electrochemistry	Electrochemistry uses electricity to perform chemical reactions like oxidation and reduction. It has applications in medicinal chemistry labs, early development for the synthesis of intermediates, and synthesis of impurities.	Electrochemistry enables efficient and sustainable small-molecule synthesis by using electrical energy to drive chemical reactions. It can produce molecules that are difficult to synthesize through conventional methods while reducing reliance on hazardous reagents and waste-generating processes.	• APIs and Intermediates	• NA
Photochemistry	Photochemistry uses light, typically in the ultraviolet or visible spectrum, to activate molecules or catalysts and initiate chemical reactions.	By using light to drive reactions, photochemistry reduces reliance on hazardous reagents and supports more sustainable chemical processes.	• APIs and Intermediates	• NA

Source: Evaluate Pharma, Frost & Sullivan
Note: NA = Not Available.

3.4 KEY CHALLENGES FACED BY PHARMACEUTICAL COMPANIES

Pharmaceutical companies are navigating rising R&D costs per approved molecule, increasing technical complexity in manufacturing, supply chain concentration risk, and sustained pricing pressure from government payers and insurance systems. These conditions are prompting a reassessment of internal capability investment priorities, with companies increasingly distinguishing between activities they will retain internally and those they will execute through external partnerships.

- **Constraint of resources for biotechs and small pharma companies:** Biotechs and small innovator pharmaceutical companies are mainly dependent on funding by financial sponsors. These companies generally are lean on resources, have limited infrastructure and may not have thorough experience in every aspect of drug discovery, development, and manufacturing.
- **Capital efficiency and financial flexibility:** Rising R&D costs, increasing clinical complexity, patent-related revenue pressures, and high development failure rates are intensifying the focus on capital efficiency across the pharmaceutical industry. At the same time, new therapeutic modalities require significant investment in specialized facilities, containment systems, and advanced manufacturing technologies, making large-scale in-house investments increasingly difficult to justify. As a result, many pharmaceutical companies are turning to outsourcing to convert fixed costs into variable expenditures, improving financial flexibility and reducing capital commitments. This is particularly important for small and mid-sized biotechnology

companies, which often lack the infrastructure and scale needed to advance programs through commercialization.

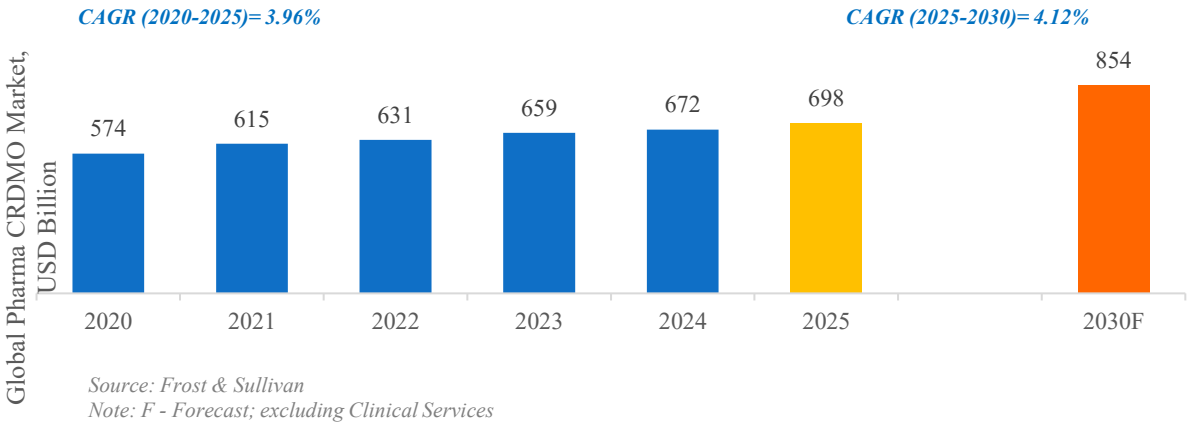
- **Need for speed in R&D:** Pharmaceutical companies often seek a first-mover advantage within a specific therapy area or biological target, as early market entry can help establish prescribing habits, build physician familiarity, secure patient adoption, and strengthen competitive positioning. Without this advantage, companies may find it more difficult to capture a meaningful share of prescribers and patients once competing therapies enter the market.
- **Increasing regulatory challenges:** The pharmaceutical industry is subject to stringent regulatory oversight and compliance requirements, which necessitate extensive expertise. Changing geopolitical dynamics can lead to new challenges such as IRA and Biosecure Act in recent times, making the environment for the pharma companies and biotechs even more challenging. The recently introduced Biosecure Act aims to prevent Chinese manufacturers from accessing US federal funding. This may lead to increasing diversion of business from US companies to other countries. The IRA (Inflation Reduction Act) introduced in 2022 allows negotiation of some of the expensive drugs bought by national health insurance providers in the US, impacting the pricing power of the pharma companies. Stringent quality standards are also intensifying operational challenges, particularly for companies managing multi-regional commercialization strategies.
- **Increasing molecular and therapeutic complexity:** The shift toward more complex molecular formats is creating substantial development and manufacturing challenges, as these modalities demand highly specialized capabilities such as sterile manufacturing, high-potency handling, and advanced analytical characterization, which are difficult to build and maintain in-house. As pipelines diversify across both traditional and next-generation modalities, sustaining broad internal capabilities across all relevant technology platforms is becoming increasingly impractical.
- **Strong operational and manufacturing pressures:** Development timelines are compressing, requiring companies to advance manufacturing readiness in parallel with clinical development while managing growing complexity across regulatory, quality, and supply chain functions. Demand patterns for specialty and personalized therapies are also harder to predict, which reduces the efficiency of fixed in-house manufacturing networks and complicates production planning.
- **Workforce constraints:** Across the industry, there is a growing shortage of the specialized talent needed to support advanced discovery, manufacturing, and development of drugs. This is creating meaningful capacity constraints for companies trying to build or scale capabilities internally.
- **Repeated supply chain threats:** Recent global disruptions have exposed the vulnerabilities of concentrated manufacturing networks, prompting companies to diversify their supply chains and establish manufacturing presence across multiple geographies. This adds further operational and coordination complexity.

4 GLOBAL CONTRACT SERVICES MARKET OVERVIEW

The global pharmaceutical contract services market encompasses contract research, development, and manufacturing activities outsourced by pharmaceutical and biotech companies to specialist service providers. The addressable market is projected to grow from approximately USD 698 billion in 2025 to USD 854 billion by 2030F, at a CAGR of 4.12%, as outsourcing penetration expands across service lines, molecule types, and company sizes.

CROs and CDMOs play an important role in the pharmaceutical and biotechnology value chain by providing outsourced services across drug discovery, development, and manufacturing. CROs primarily support research activities, including discovery, preclinical and clinical development, while CDMOs focus on process development, formulation, scale-up, and commercial manufacturing.

Exhibit 4.1: Global CRDMO Total Addressable Market, 2020-2030F



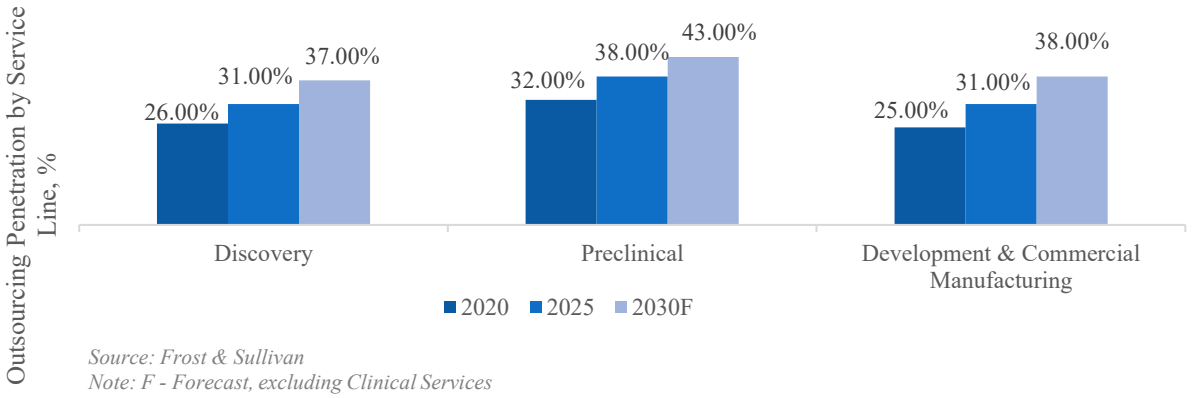
Source: Frost & Sullivan
Note: F - Forecast; excluding Clinical Services

By leveraging specialized expertise, advanced technologies, regulatory experience, and established infrastructure of contract services organizations, pharmaceutical companies gain access to capabilities that would be costly, time-consuming, or impractical to build internally. This enables them to improve operational efficiency, accelerate development timelines, optimize capital allocation, and focus internal resources on core strategic and innovation-driven activities. Growing scientific complexity, increasingly stringent regulatory requirements, and rising pressure to improve development productivity and manage costs are reshaping pharmaceutical R&D and manufacturing. In response, pharmaceutical and biotechnology companies are increasingly relying on CROs and CDMOs to access specialized expertise, enhance operational flexibility, and accelerate drug development. Integrated CRDMOs are also benefitting from this increase as customers increasingly prefer integrated services across the drug discovery and development value chain, due to increased efficiency and decreased time to market. Outsourcing has therefore evolved into a core strategic component of the pharmaceutical industry rather than simply a means of addressing capacity constraints.

4.1 GLOBAL OUTSOURCING MARKET

Rising drug development costs and increasing scientific complexity are prompting pharmaceutical companies to reassess which activities should be retained in-house and which can be outsourced. As a result, outsourcing penetration is rising across the value chain, with clinical research exhibiting the highest outsourcing penetration at 48.00% in 2025, while discovery and commercial manufacturing continue to see steady growth.

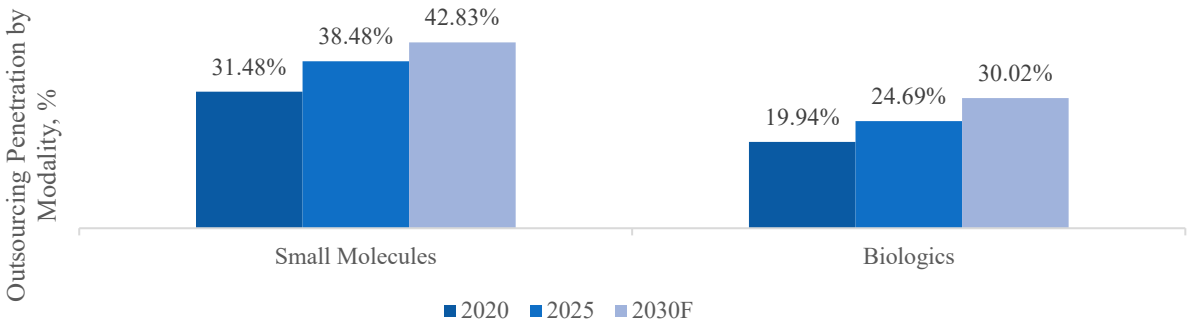
Exhibit 4.2: Outsourcing Penetration by Service Lines, 2020-2030F



Source: Frost & Sullivan
Note: F - Forecast, excluding Clinical Services

The pharmaceutical and biotechnology industry faces a range of challenges, including the growing complexity and cost of drug development, substantial capital requirements for manufacturing infrastructure, increasing demand for specialized technical expertise, supply chain disruptions, pricing pressure from payors and governments, and stringent regulatory requirements. In response, pharmaceutical companies have increasingly focused on improving operational efficiency and optimizing resource allocation, driving greater adoption of outsourced research, development, and manufacturing services.

Exhibit 4.3: CRDMO Outsourcing Penetration by Modalities, 2020-2030F



Source: Frost & Sullivan
Note: F - Forecast; excludes Clinical CRO services

Small molecules have historically exhibited significantly higher outsourcing penetration than biologics, increasing from 31.48% in 2020 to 38.48% in 2025, compared with biologics, which grew from 19.94% to 24.69% over the same period. This reflects the greater maturity of small-molecule development and manufacturing, where standardized processes, established technologies, and a broad base of experienced service providers have made outsourcing more widely adopted.

Outsourcing penetration is expected to continue increasing across both segments as pharmaceutical companies recognize the benefits of accessing external expertise, specialized infrastructure, and flexible capacity. However, biologics outsourcing is expected to remain comparatively lower because many large-molecule modalities are still evolving. As a result, despite already operating from a relatively high base, small-molecule outsourcing penetration is projected to increase further from 38.48% in 2025 to 42.83% by 2030F.

Although biologics continue to exhibit lower outsourcing penetration than small molecules, the pace of adoption has been considerably stronger. Outsourcing penetration increased by 23.82% relative to the base rate between 2020 and 2025, decreasing slightly to 21.59% from base between 2025 and 2030F. This trend is being driven by the increasing technical complexity, capital intensity, and specialized infrastructure required to develop biologics and next-generation therapeutic modalities. At the same time, pharmaceutical innovation is undergoing a structural shift, with R&D pipelines becoming increasingly concentrated in biologics and other advanced therapies that require sophisticated scientific expertise, specialized manufacturing technologies, and dedicated production facilities. Historically, these factors led pharmaceutical companies to retain a greater proportion of development and manufacturing activities in-house. However, as development costs continue to rise and biologics-focused CRDMOs expand their technical capabilities, sponsors are increasingly partnering with external providers that offer expertise and infrastructure that would be costly and time-consuming to establish internally. The continued increase in biologics outsourcing penetration reflects growing confidence in specialized CRDMOs, the increasing maturity of external biologics manufacturing capabilities, and rising demand for advanced development and manufacturing services. Together, these trends indicate a structural shift toward greater reliance on outsourcing as therapeutic modalities become more complex, even as small molecules continue to account for a higher absolute level of outsourced activity.

4.1.1 GROWTH DRIVERS FOR OUTSOURCING

Pharmaceutical companies are increasing their use of external service providers in response to R&D cost efficiency requirements, the need for specialized capabilities across an expanding range of modalities, and the imperative to reduce time from candidate selection to regulatory submission. These factors apply across large, mid-sized, and emerging pharmaceutical companies, though the relative weight of each driver varies by company scale.

The pharmaceutical industry's use of outsourcing has expanded as drug pipelines have grown more complex, spanning small molecules, biologics, and an increasing range of novel modalities. This has broadened the rationale for engaging external partners beyond cost considerations alone, to include capital allocation, access to technical capabilities, and development speed. These factors shape outsourcing decisions across the drug discovery, development and manufacturing value chain.

- **Focus on Core Competencies:** Outsourcing enables innovator companies to prioritize core internal R&D, portfolio strategy, and commercialization while leveraging external partners for technical execution.
- **Financial and Capital Efficiency:** It also allows pharmaceutical companies to optimize costs by reducing the need for significant investments in discovery, development, and manufacturing infrastructure. Rather than committing capital to specialized and dedicated facilities with medicinal chemistry teams, screening platforms, imaging equipment, sterile manufacturing capabilities, containment systems, and advanced technologies, global pharma companies can access these resources through external partners, converting their fixed cost into variable cost by outsourcing R&D and manufacturing activities. This model also provides greater operational flexibility by converting fixed costs into variable expenditures. For products with uncertain clinical outcomes or commercial demand, outsourcing helps reduce the risk of underutilized capacity and limits exposure to large upfront investments.
- **Access to Specialized Capabilities & Technology:** Outsourcing enables pharmaceutical companies to access specialized discovery expertise across complex modalities such as biologics, ADCs, oligonucleotides, peptides, HPAPIs, and CGTs without developing these capabilities internally. It also provides access to AI-driven screening, computational chemistry, advanced manufacturing technologies, automation platforms, continuous manufacturing systems, and sophisticated analytical tools. In addition, established CRDMOs offer mature quality systems and regulatory expertise, supporting compliance requirements and facilitating interactions with global regulatory authorities throughout the product lifecycle.
- **Faster Development and Time-to-Market:** CRDMOs can accelerate development timelines through established platforms, specialized expertise, and existing infrastructure. Integrated service models further support faster commercialization by streamlining discovery, development, analytical testing, technology transfer, and manufacturing activities within a single organization.
- **Improved Scalability and Flexibility:** Outsourcing allows pharma companies to rapidly scale capacity up or down based on clinical success, product demand, or portfolio changes.
- **Access to Global Networks:** CRDMOs offer geographically diversified supply chains and multi-site discovery, development, and manufacturing capabilities, improving business continuity and market access.

4.1.2 EVOLUTION OF OUTSOURCING

The pharmaceutical industry is increasingly shifting from using multiple standalone specialized service providers to working with integrated partners that can support programs across research, development, and commercial manufacturing. This approach helps reduce operational complexity and limit delays associated with transferring work between different organizations, while also supporting continuity throughout the development process. As a result, pharmaceutical companies are consolidating outsourcing relationships and placing greater emphasis on CRDMO platforms with broader end-to-end capabilities.

The pharmaceutical outsourcing industry has evolved significantly over time. During the 1980s and 1990s, outsourcing was primarily focused on low-cost manufacturing and commodity production. In the 2000s and 2010s, the emphasis shifted toward accessing specialized technical capabilities through dedicated service agreements. Today,

outsourcing relationships increasingly span multiple stages of the pharmaceutical value chain, with integrated providers supporting research, development, and manufacturing under a single partnership model. The model replaces fragmented vendor relationships, enabling greater coordination across development stages, streamlined technology transfer, reduced operational complexity, and faster progression from discovery through commercial manufacturing. As a result, both the scope and duration of outsourcing agreements have expanded considerably.

Integrated CRDMO model offers significant benefits-

- **End to end capabilities under the same roof:** One organization manages the full continuum from discovery through commercial manufacturing, removing the need for multiple external vendors.
- **Reduced tech transfer risk:** Process knowledge and analytical methods stay internal, eliminating the failure points introduced when transferring data and materials to a third party.
- **Scientific continuity:** The same scientific teams follow a program across development stages, preserving institutional knowledge that is typically lost during vendor handoffs.
- **Faster timelines and improved speed to market:** Removing external handoffs eliminates contracting delays and scheduling conflicts between separate organizations, compressing overall program timelines.
- **Enhanced efficiency:** Shared infrastructure, quality systems, and regulatory frameworks across functions reduce duplicated overhead and lower the cost per program stage.
- **Multiple entry points for client engagement:** Clients can engage at discovery, development, or manufacturing stages, broadening the addressable market beyond any single client type.
- **High barriers to entry for competitors:** Replicating an integrated model requires simultaneous capital investment, multi-disciplinary talent, regulatory approvals, and years of client track record.

4.1.3 Models of Outsourcing

Pharmaceutical outsourcing agreements are structured on a fee-for-service basis, a full-time equivalent basis, or hybrid arrangements combining elements of both. Fee-for-service contracts are used for defined scope deliverables, while full-time equivalent arrangements are more common in early-stage research where the scope of work evolves over time. Risk-sharing and milestone-based structures are applied in a subset of integrated multi-stage programs.

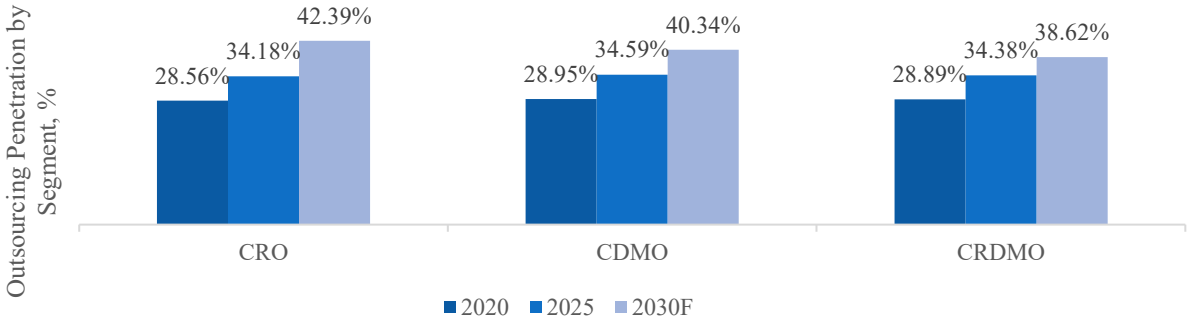
	Full-Time Equivalent (FTE) Resource-Based	Fee-for-Service /Execution (FFS) Deliverable-Based	Integrated Projects Risk-Reward	Dedicated Labs Resource-Based
Definition	Clients pay a fixed fee for dedicated staff over time, rather than per specific project deliverable.	Clients pay a for specific project deliverables or milestones completed, instead of dedicated staff time.	Contracts with shared risk-reward, with payment structured around clearly defined milestones tied to project progress	Ring-fenced facilities built to client specifications, staffed with dedicated scientific and support personnel.
Advantages for service provider	✓ Stable, recurring revenue stream ✓ Predictable resource / capacity planning ✓ Long-term client relationships and retention ✓ Better utilization of fixed headcount investments	✓ Easier to price for niche capabilities ✓ Lower long-term resource commitment risk ✓ Higher margins on specialized / complex deliverables ✓ Flexibility to take on diverse clients / projects	✓ Shared rewards on success ✓ Deeper client integration builds longer partnerships ✓ Demonstrates value, strengthening future contract wins ✓ Higher margins when milestones are met efficiently	✓ Guaranteed long-term, locked-in revenue ✓ High client switching costs once embedded ✓ Justifies upfront capex with committed utilization ✓ Strengthens strategic, multi-year client partnerships
When it works best	Ongoing, flexible R&D needs through dedicated talent without committing to specific deliverables.	Discrete, well-defined projects where scope and deliverables are clear upfront.	High-value programs with aligned incentives, sharing risk and reward against milestones.	Long-term, high-volume partnerships where stable, exclusive infrastructure, and team are a requirement.
End-user & scale	Mid-Size to Large Pharma Companies	Small / Biotech Companies	Large Pharma Companies	Large Pharma Companies

4.1.4 Outsourcing Penetration

Outsourcing penetration across all pharmaceutical R&D and manufacturing spend is estimated at approximately 34.38% in 2025, up from approximately 28.80% in 2020.

Development and Commercial Manufacturing services represent a large outsourced segment of the pharmaceutical value chain, with outsourcing penetration increasing from 28.95% in 2020 to 34.59% in 2025 and further to an estimated 40.34% by 2030F. On the other hand, drug discovery and preclinical services outsourcing is set to become the most outsourced segment by 2030F at 42.39%, after closely trailing the Development and Commercial Manufacturing services between 2020 and 2025. With strengthening IP protection laws and increasing focus on R&D productivity, pharmaceutical companies have begun to increasingly rely on CROs for early discovery and preclinical studies. Also, in the last decade, there has been a noticeable increase in the outsourcing of non-clinical services due to the emergence of smaller pharmaceutical businesses and biotechs that rely more on CROs and enhanced intellectual property protection procedures at CROs. The growing scale, complexity, and global nature of clinical trials have made external partners an essential component of trial execution for most pharmaceutical sponsors.

Exhibit 4.4: Global Outsourcing Penetration by Segment, 2020-2030F

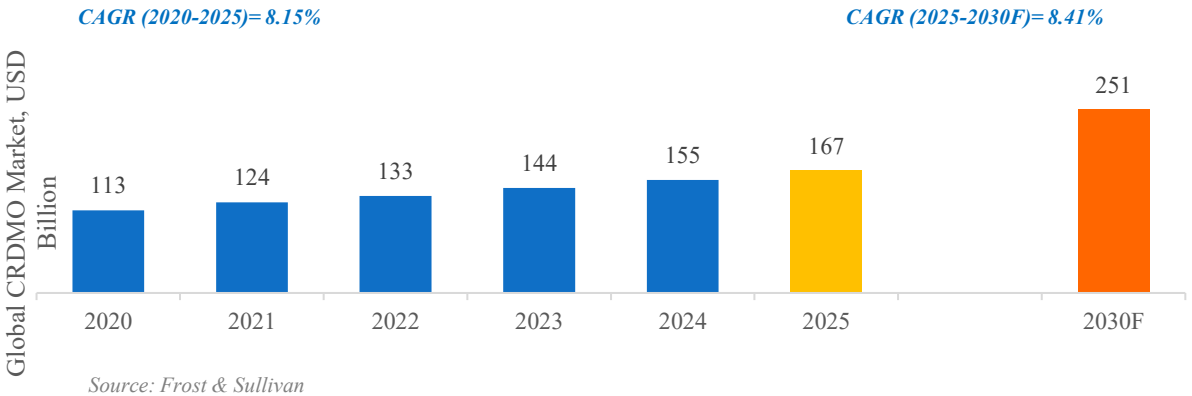


Source: Frost & Sullivan
Note: F - Forecast, excludes CRO Clinical Services

4.2 GLOBAL CONTRACT RESEARCH, DEVELOPMENT, AND MANUFACTURING MARKET (CRDMO)

Integrated CRDMOs offer services across discovery, development, and commercial manufacturing, enabling pharmaceutical companies to consolidate activities within a single provider. This approach can reduce coordination complexity, minimize technology transfer risks, and improve operational efficiency across the product lifecycle. Supported by growing demand for integrated outsourcing models, the global CRDMO market is projected to grow from USD 167 billion in 2025 to USD 251 billion by 2030F, at a CAGR of 8.41%.

Exhibit 4.5: Global CRDMO Market, 2020-2030F



Source: Frost & Sullivan
Note: F - Forecast, excluding Clinical Services

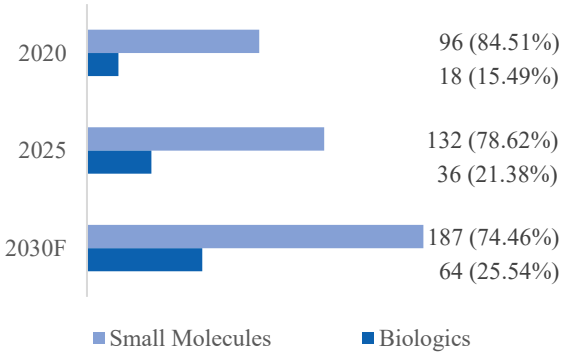
Historically, pharmaceutical companies have outsourced research activities to CROs and development and manufacturing activities to CDMOs, with some overlaps in areas such as API and formulation development. Increasingly, however, companies are turning to integrated CRDMOs that provide services spanning discovery, development, and manufacturing within a single organization. This model has gained traction among small pharmaceutical and biotechnology companies, which often operate with limited internal resources and prefer a streamlined outsourcing structure. Working with a single partner across multiple stages of the drug lifecycle can improve coordination, reduce the need for technology transfers between vendors, simplify project management, and support faster progression from discovery through commercialization.

For CRDMOs, the integrated model expands the scope of client relationships and creates opportunities to participate across a greater portion of the development lifecycle. It also supports longer-term engagements, broader service offerings, and more diversified revenue streams. Reflecting these trends, the global CRDMO market was valued at approximately USD 167 billion in 2025 and is projected to reach USD 251 billion by 2030F, growing at a CAGR of 8.41% over the forecast period.

4.2.1 Global CRDMO Market by Modalities

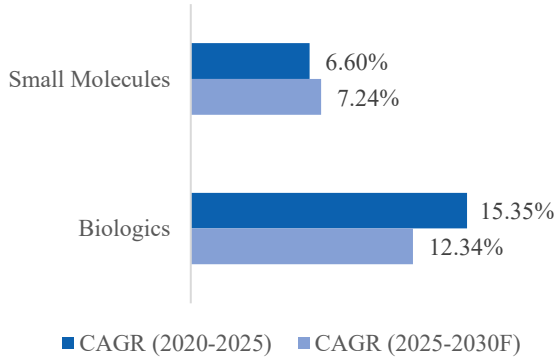
Small molecule drugs are expected to remain the largest segment of the global CRDMO market, growing from USD 132 billion in 2025 to USD 187 billion by 2030F at a CAGR of 7.24%. Biologics are projected to grow at a faster CAGR of 12.34%, increasing their share of the market from 15.49% in 2020 to 25.54% by 2030F. This reflects the continued expansion of biologics development and manufacturing capabilities within the CRDMO industry.

Exhibit 4.6A: Global CRDMO Market by Modality, 2020, 2025, 2030F, USD Billion



Source: Frost & Sullivan
Note: F- Forecast, excludes Clinical Services

Exhibit 4.6B: Growth Rate of Global CRDMO Market by Modality, 2020-2030F



Source: Frost & Sullivan
Note: F- Forecast

The global biologics CRDMO market was estimated at USD 36 billion in 2025 and is projected to grow at a CAGR of 12.34% between 2025 and 2030F, reaching approximately USD 64 billion by 2030F. By then, biologics are expected to account for 25.54% of the global CRDMO industry. Growth is being driven by increasing R&D outsourcing from pharmaceutical and biotechnology companies, sustained demand for biologic therapies, and the growing adoption of precision and targeted medicines.

Despite the faster growth of biologics, small molecules remain the foundation of the global CRDMO industry, accounting for 78.62% of the market in 2025. The segment is expected to grow at a CAGR of 7.24% between 2025 and 2030F, supported by a large small molecule development pipeline, ongoing genericization following patent expirations, and sustained outsourcing of discovery, development, and commercial manufacturing by pharmaceutical companies.

4.2.1.1 ENTRY BARRIERS FOR THE BIO-CRDMO MARKET

The biologics CRDMO market has relatively high barriers to entry due to the technical complexity of biologic manufacturing, stringent regulatory requirements, and process-specific expertise. Long development timelines, high capital investment, and the need to establish validated manufacturing facilities further limit new entrants. As a result, established CRDMOs with proven regulatory compliance, manufacturing infrastructure, and operational experience are generally better positioned to compete in this market.

- **High Technical and Regulatory Barriers to Entry:** Biologics manufacturing involves highly specialized capabilities, including cell-line development, upstream and downstream processing, and advanced analytical testing, all of which require years of investment and technical expertise to establish. In addition, new entrants must demonstrate a proven regulatory track record through successful inspections and approvals from agencies such as the FDA and EMA, as inspection history is a key consideration in CRDMO selection. These technical and regulatory barriers significantly limit the pool of credible suppliers, reducing the threat of new entrants compared with the more established small-molecule manufacturing market.
- **High Switching Costs Driving Client Stickiness:** Once a biologics manufacturing process has been validated and incorporated into regulatory filings, changing manufacturing partners becomes a lengthy and complex undertaking. The transition typically requires technology transfer, process re-validation, and, in many cases, regulatory re-submissions, introducing significant time, cost, and execution risk. As a result, pharmaceutical companies have strong incentives to retain the same CRDMO from early-stage development through commercial manufacturing, creating long-term customer relationships and providing greater revenue visibility for established service providers.
- **Capital Intensity as a Structural Moat:** Establishing biologics manufacturing capacity requires significant upfront investment in bioreactors, cleanrooms, and specialized single-use or stainless-steel production systems. Construction, qualification, and validation of these facilities typically takes multiple years. The combination of high capital requirements and a limited pool of skilled talent in cell culture and downstream purification makes it both costly and time-consuming for competitors to build comparable capabilities, strengthening the competitive position of established CRDMOs with validated infrastructure and experienced technical teams.

4.3 INDIA CRDMO MARKET

India's pharmaceutical services sector has undergone a qualitative transformation, transitioning from a cost-competitive commodity manufacturer to a scientifically sophisticated partner capable of executing complex research, development, and manufacturing programs for the world's leading innovator pharmaceutical companies. This transition is evidenced by the growing number of integrated research collaborations, novel modality programs, and multi-year strategic partnerships established between Indian CRDMOs and top-20 global pharmaceutical companies.

India's role in the global pharmaceutical value chain has evolved significantly over the past two decades. Prior to 2010, the country was primarily viewed as a low-cost supplier of APIs and generic formulations, with competition largely centered on manufacturing economics and limited engagement with innovator pharmaceutical companies.

Between 2010 and 2020, Indian CROs and CDMOs began expanding their capabilities beyond manufacturing, securing discovery and medicinal chemistry mandates from global innovators while investing heavily in quality systems, regulatory compliance, and manufacturing infrastructure. Increasing scrutiny from FDA inspections further elevated industry standards and strengthened credibility.

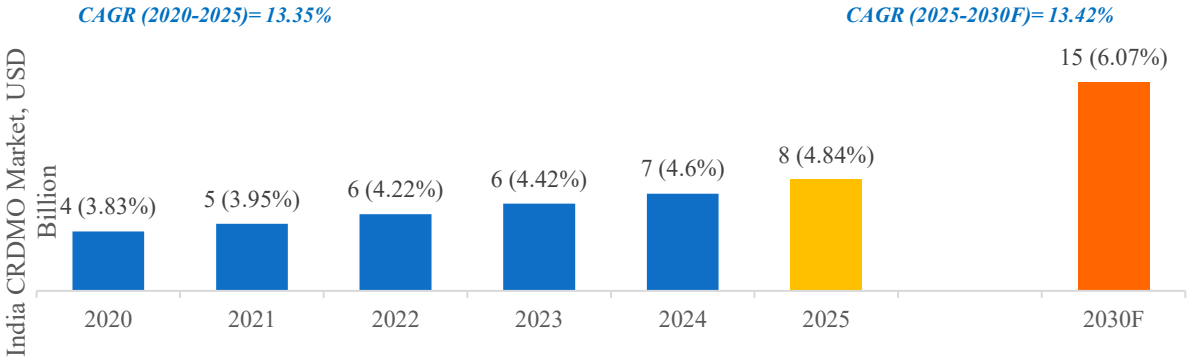
Since 2020, leading Indian CRDMOs have become increasingly integrated into the R&D and development activities of global pharmaceutical companies. Many now participate in early-stage discovery programs, operate dedicated research centers for multinational clients, and offer integrated services spanning discovery, development, and manufacturing. The growing prevalence of multi-year FTE-based partnerships, end-to-end development programs, biologics manufacturing mandates, and risk-sharing arrangements reflects increasing customer confidence in India's

scientific capabilities. As a result, India is transitioning from a cost-focused outsourcing destination to a strategic partner supporting innovation, development, and commercialization across the pharmaceutical value chain.

4.3.1 India CRDMO Market Overview

India's combined contract research and contract development and manufacturing market is projected to grow from USD 8 billion in 2025 to USD 15 billion by 2030F, at a CAGR of 13.42%. India's share of the global pharmaceutical CRDMO market is projected to increase from 3.83% in 2020 to 4.84% in 2025 and 6.07% by 2030F.

Exhibit 4.7: India CRDMO Market, 2020-2030F



Source: Frost & Sullivan
Note: F - Forecast; % in labels refers to % of the Global CRDMO Market, excludes Clinical Services

India has emerged as one of the fastest-growing CRDMO markets globally, recording a CAGR of 13.35% between 2020 and 2025. The country is increasingly being recognized as an important outsourcing destination for pharmaceutical and biotechnology companies, supported by cost competitiveness, scientific talent, manufacturing capabilities, and a growing track record in regulated markets. The Indian CRDMO market is projected to grow at a CAGR of 13.42% between 2025 and 2030F, reaching an estimated value of USD 15 billion by 2030F. This growth rate exceeds the projected global CRDMO industry CAGR of 8.41% over the same period. Evolving global supply chain strategies, including efforts to diversify sourcing and reduce concentration risk, are expected to support increased outsourcing activity toward India. Supported by strong capabilities across both research and manufacturing services, Indian CRDMO providers are well positioned to capture a larger share of global pharmaceutical outsourcing demand.

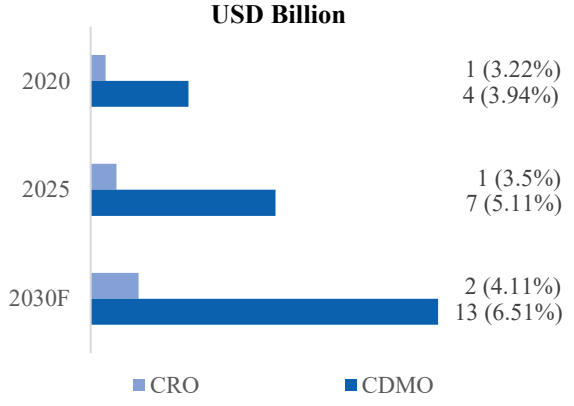
4.3.2 India CRDMO Market by Service Lines

India's contract research market, while smaller in absolute size at approximately USD 1 billion in 2025, is projected to grow at approximately 13.16% per annum to reach USD 2 billion by 2030F, reflecting India's increasing competitiveness in discovery chemistry, medicinal chemistry, and preclinical services for global innovator clients. The contract development and manufacturing segment is considerably larger at approximately USD 7 billion in 2025 and is projected to grow at a faster rate of approximately 13.51% per annum to reach USD 13 billion by 2030F, driven by expanding generic and innovator manufacturing mandates, increasing clinical supply requirements from a growing pipeline, and rising demand for complex modality manufacturing capabilities.

Development and commercial manufacturing is the largest segment of the Indian CRDMO market, accounting for approximately 87.76% of industry revenues in 2025. The segment is expected to grow at a CAGR of 13.51%, between 2025 and 2030F. Growth is being supported by continued improvements in the technical and manufacturing capabilities of Indian service providers, which are increasingly attracting outsourcing demand from global pharmaceutical companies. In parallel, Indian CRDMOs are expanding their service offerings across the value chain and increasing their focus on complex modalities and therapeutic areas, including biologics.

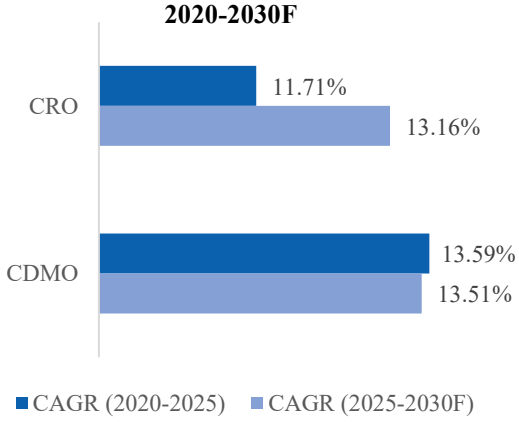
Drug discovery and preclinical services are expected to maintain strong momentum over the forecast period, with growth accelerating from a CAGR of 11.71% between 2020 and 2025 to 13.16% between 2025 and 2030F. Growth in the market is driven by increasing outsourcing penetration of discovery and preclinical services, with diversification from Chinese players under the China+1 strategy further enhancing the position of Indian CROs.

Exhibit 4.8A: Indian CRDMO Market by Service Lines, 2020, 2025, 2030F, USD Billion



Source: Frost & Sullivan
Note: F- Forecast; % in labels refers to % of the Global CRO and CDMO Market respectively; excludes Clinical Services

Exhibit 4.8B: Growth Rate of Indian CRDMO Market by Service Lines, 2020-2030F

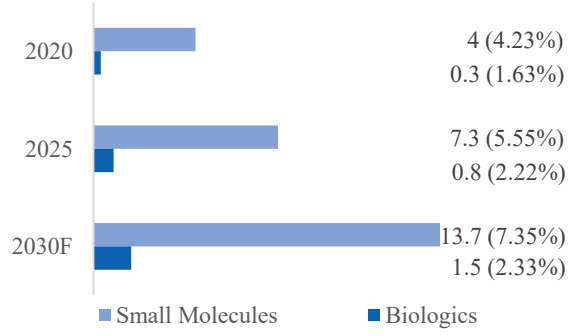


Source: Frost & Sullivan
Note: F- Forecast; excludes Clinical Services

4.3.3 India CRDMO Market by Modality

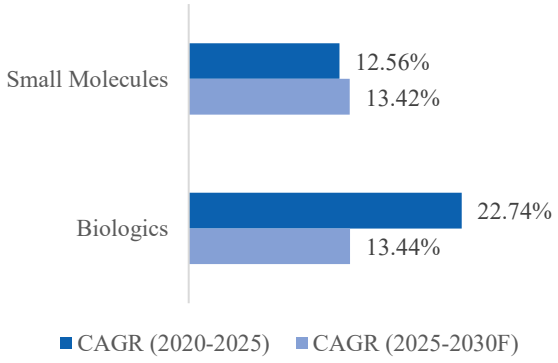
Small molecules are expected to remain the largest segment of India's CRDMO market, expanding from approximately USD 7 billion in 2025 to USD 14 billion by 2030F at a CAGR of 13.42%. This growth is supported by India's well-established capabilities in generic pharmaceuticals alongside its increasing participation in outsourced small molecule development and manufacturing services. Biologics-focused CRDMO services are projected to witness nearly 2x the value growth between 2025 and 2030F, albeit from a relatively smaller base, reflecting the gradual scaling of domestic capabilities across biologics development, manufacturing, and other advanced therapeutic modalities.

Exhibit 4.9A: India CRDMO Market by Modality, 2020, 2025, 2030F, USD Billion



Source: Frost & Sullivan
Note: F- Forecast; % in labels refers to % of the Global Small Molecule and Biologics CRDMO Market respectively; excludes Clinical Services

Exhibit 4.9B: Growth Rate of India CRDMO Market by Modality, 2020-2030F



Source: Frost & Sullivan
Note: F- Forecast; excludes Clinical Services

Small molecules continue to dominate the Indian CRDMO industry, accounting for more than 90.20% of the market in 2025. However, biologics is becoming an increasingly important segment as demand for biologic development and manufacturing services grows faster than that for small molecules. The biologics segment expanded at a CAGR of

22.74% between 2020 and 2025, reaching approximately USD 1 billion in 2025. Growth is expected to remain strong, with the segment projected to grow at a CAGR of 13.44% between 2025 and 2030F, resulting in a gradual increase in its share of the overall Indian CRDMO market. The biologics segment has relatively fewer participants than the small molecules segment due to the complexity of biologics development and manufacturing, higher technological requirements and longer development timelines. Companies such as Aragen, which was the second CRDMO in India to offer biologics services through an acquisition in 2014, are set to capitalize on this rapid growth. At the same time, Aragen's expertise in small molecules continues to expand, enabling the company to maintain a diversified revenue stream.

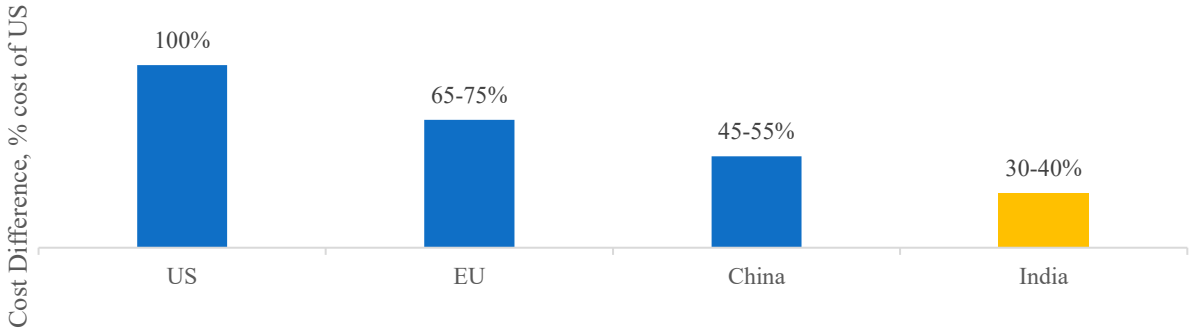
4.3.4 Demand Drivers for Indian CRDMOs

India's contract services sector is underpinned by a strong convergence of scientific talent availability, cost-efficient operating structures, and an established regulatory track record that supports global client confidence. The ecosystem benefits from a deep pool of trained STEM and life sciences professionals, alongside a mature manufacturing base with demonstrated compliance across major regulated markets. This is further reinforced by policy-led investments in pharmaceutical manufacturing and R&D infrastructure, which continue to enhance domestic capability depth and scale.

The growth of India's CRDMO industry has been driven by a combination of structural advantages, including a large pool of skilled scientific talent, cost-competitive operating economics, and a strong track record of regulatory compliance across major global markets. These strengths have been complemented by supportive government policies and evolving global supply chain strategies that are increasing pharmaceutical outsourcing to India. The following sections examine these key growth drivers in greater detail.

- **Talent and Human Capital:** India's long-standing position in the generics and API industries has fostered strong expertise in synthetic chemistry, process development, scale-up, and complex molecule manufacturing. The country also benefits from a large English-speaking workforce of scientists, engineers, chemists, and regulatory professionals that supports research, development, and manufacturing activities. In addition, a young and growing working-age population provides a favorable demographic foundation for future industry expansion.
- **Cost-competitiveness:** India benefits from a structurally cost-competitive research, development, and manufacturing base, driven by lower labor, infrastructure, and operating costs than those in Western markets. R&D services and drug manufacturing in India are approximately 30-40% lower than in the US and Europe. This combination of affordability and growing regulatory compliance capabilities is helping Indian CRDMOs gain greater traction with global pharmaceutical innovators.

Exhibit 4.10: Cost Advantage of Outsourcing to CRDMO, US versus Other Regions



Source: Industry KOL estimates, Frost & Sullivan
Note: Relative numbers indexed against the US, Average savings are indexed to manufacturing in-house

- **Regulatory Credibility and Execution Consistency:** India has established a strong regulatory reputation, supported by one of the largest concentrations of FDA-approved manufacturing facilities outside the US[24]. This track record has reinforced the country's position as a trusted global outsourcing destination. As outsourced programs become more complex and strategically important, consistent execution, regulatory compliance, product quality, and data integrity are emerging as key differentiators for Indian CRDMOs seeking to strengthen relationships with global innovators.
- **Manufacturing Scale:** India maintains a strong competitive position in the production of APIs, intermediates, and oral solid dosage forms. This leadership is supported by extensive manufacturing infrastructure and significant installed production capacity across these segments.
- **Moving Up the Value Chain:** Indian CRDMOs are expanding beyond traditional small-molecule services through investments in high-growth modalities such as biologics, peptides, oligonucleotides, and ADCs. At the same time, companies are strengthening capabilities in complex chemistry, high-potency compounds, biologics development, and integrated service offerings to move further up the pharmaceutical value chain.
- **Government and Policy Support:** Government initiatives are playing an increasingly important role in strengthening India's pharmaceutical manufacturing ecosystem. Programs such as the Production Linked Incentive (PLI) scheme, Biopharma Strategy for Healthcare Advancement through Knowledge, Technology, and Innovation (Biopharma SHAKTI), Biotechnology Industry Research Assistance Council (BIRAC) initiatives, bulk drug parks, and broader infrastructure investments are supporting capacity expansion, supply chain localization, and reduced import dependence. In parallel, supportive policies around foreign direct investment, access to capital markets, financial incentives, and regulatory process improvements are encouraging investment across the pharmaceutical value chain. Continued efforts to streamline R&D, approvals, and product registrations are also helping improve the efficiency and attractiveness of India as a global pharmaceutical outsourcing destination.
- **Global Supply Chain Realignment:** India is becoming an increasingly important destination for pharmaceutical supply chain diversification as companies seek to reduce dependence on single-country sourcing models. Initiatives such as the China+1 strategy and policy developments including the US BIOSECURE Act are encouraging global pharmaceutical companies to expand outsourcing relationships beyond China. The shift is being driven by India's competitive cost structure, the need for greater supply chain resilience, and efforts to reduce concentration risk. Regulatory, compliance, and geopolitical considerations are further supporting India's growing role in global pharmaceutical outsourcing.

4.4 GLOBAL CONTRACT RESEARCH ORGANIZATION MARKET (CRO)

The global CRO[25] market is projected to grow from approximately USD 28 billion in 2025 to USD 45 billion by 2030F, at a CAGR of 9.58%. Growth is driven by an expanding clinical pipeline, rising outsourcing penetration across discovery and preclinical service lines, and the increasing complexity of research programs across both small molecule and biologics modalities.

Integrated CROs provide end-to-end support across drug discovery, preclinical development, and clinical research, enabling smoother coordination between different stages of development. By facilitating the efficient transfer of data, samples, and technical knowledge across multidisciplinary teams, they can help reduce development timelines and improve operational efficiency. This integrated approach can lower development costs by approximately 30%[26] compared to fully in-house models, while allowing pharmaceutical sponsors to focus on core strategic activities and manage development risks more effectively.

4.4.1 CRO MARKET OVERVIEW

The CRO market serves pharmaceutical and biotech companies across the full range of pre-commercial research activities, from target identification and compound screening through to regulatory submission

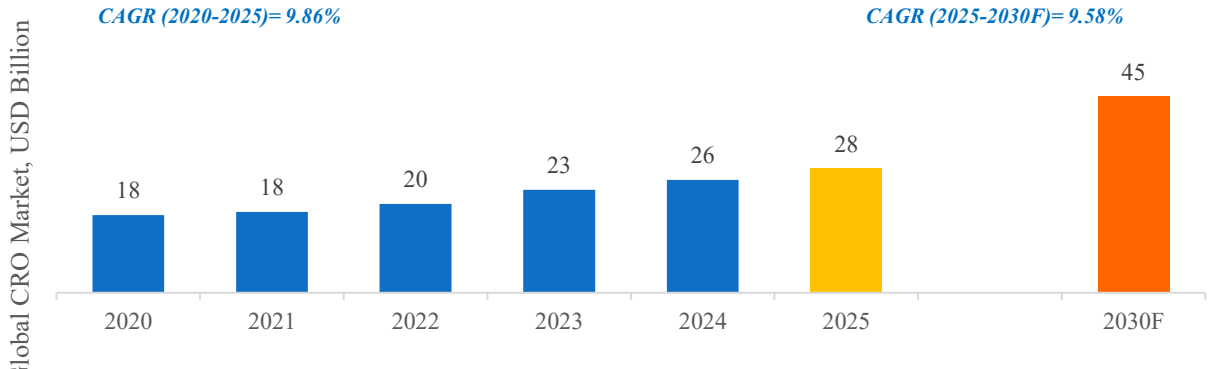
[24] PIB - India's Pharmaceuticals in Global Healthcare
[25] Excluding Clinical Services and including only Discovery and Preclinical Services
[26] Frost & Sullivan estimates

support. The market is served by a mix of large, full-service CROs with global clinical networks and smaller specialist providers with deep expertise in specific therapeutic areas, modalities, or development stages.

The global CRO market has experienced strong growth, expanding from USD 18 billion in 2020 to USD 28 billion in 2025, representing a CAGR of 9.86%. Growth is expected to continue over the forecast period, with the market projected to reach USD 45 billion by 2030F, growing at a CAGR of 9.58% between 2025 and 2030F. This expansion is being driven by increasing outsourcing by pharmaceutical and biotechnology companies, advancements in research technologies, and the growing availability of specialized scientific and regulatory expertise across global CRO networks. Integrated CROs are well equipped to handle all of these activities in a rapid and seamless manner by transferring samples, data, knowledge and technical feedback between scientists of various disciplines. CROs can help significantly lower drug development costs, facilitate a more seamless and timely entry into new markets with varying regulatory requirements, avoid the expense and labor of managing capital-intensive infrastructure and allow pharmaceutical sponsors to concentrate on their core skills while proactively mitigating any development risks. CROs have elevated their role and often emerged as co-innovators led by the expansion of small and frequently virtual biotech companies with lean teams, that rely almost entirely on an outsourcing partner for their drug discovery and development needs. By utilizing their extensive range of services, CROs can help lower drug development costs by approximately 30% when compared to in-house research.

The CRO industry witnesses high competition across pure-play full-service CROs, mid-sized and small specialty CROs, in-house departments of biopharmaceutical companies and academic institutions, and to a certain extent CDMOs. Companies providing drug discovery outsourcing services compete on factors including scientific talent, regulatory compliance and track record, intellectual property protection, pricing, speed and flexibility of execution, breadth of service offerings, ability to support end-to-end drug discovery, and integration with development projects. Discovery and preclinical services also serve as an important entry point for customer relationships, allowing CROs to engage sponsors early in the drug development lifecycle and create opportunities to secure downstream development and manufacturing work.

Exhibit 4.11: Global CRO Market, 2020-2030F



Source: Frost & Sullivan
Note: F - Forecast, excludes Clinical services

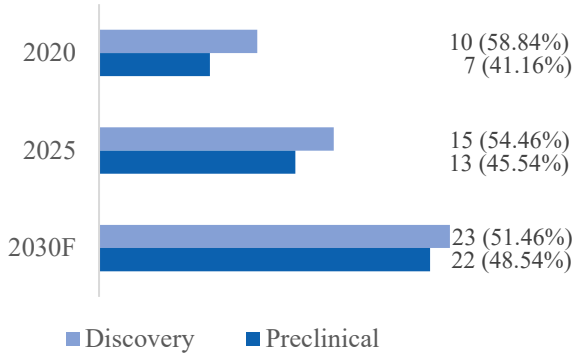
4.4.2 CRO Market by Service Lines

Preclinical services are projected to grow at 11.03% per annum over the same period, making them the fastest growing service line, while discovery services, comprising medicinal chemistry, molecular biology, and pharmacokinetics, are expected to grow at 8.39%.

Non-clinical CROs support activities such as drug discovery, candidate screening, preclinical testing, and safety assessment, while clinical CROs manage and execute trials from Phase I through Phase III and post-marketing studies. Demand for non-clinical outsourcing has increased as pharmaceutical and biotechnology companies seek specialized

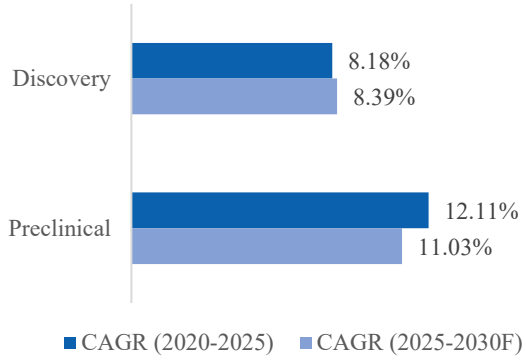
expertise for increasingly complex discovery and preclinical programs. Stronger intellectual property (IP) protections and the growing presence of small and mid-sized biopharma companies have further supported this trend. Discovery services are expected to remain the largest CRO service line throughout the forecast period. The segment benefits from relatively high margins, driven by specialized scientific expertise rather than capital-intensive infrastructure, while its shorter project cycles enable providers to scale operations more quickly than manufacturing-focused services. Preclinical services, however, are expected to narrow the gap with discovery over the forecast period. Supported by a CAGR of 11.03% between 2025 and 2030F, the segment is projected to approach discovery services in market size as demand for outsourced preclinical development continues to increase.

Exhibit 4.12A: Global CRO Market by Service Lines, 2020, 2025, 2030F, USD Billion



Source: Frost & Sullivan
Note: F- Forecast, excludes Clinical Services

Exhibit 4.12B: Growth Rate of Global CRO Market by Service Lines, 2020-2030F

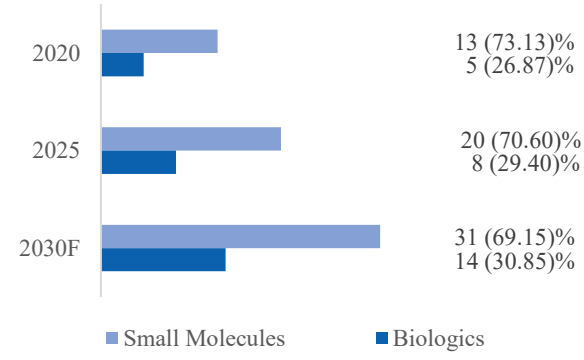


Source: Frost & Sullivan
Note: F- Forecast

4.4.3 CRO Market by Modalities

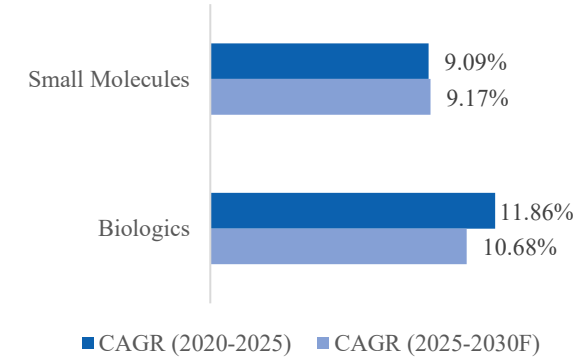
Biologics CRO services accounted for approximately 29.40% of total non-clinical CRO revenues in 2025, with small molecule services accounting for the remainder 70.60%. Biologics CRO services are expected to grow at approximately 10.68% per annum between 2025 and 2030F, faster than the overall CRO market, reflecting the expanding biologics pipeline and the specialized research requirements of complex modalities.

Exhibit 4.13A: Global CRO Market by Modality, 2020, 2025, 2030F, USD Billion



Source: Frost & Sullivan
Note: F- Forecast, excludes Clinical Services

Exhibit 4.13B: Growth Rate of Global CRO Market by Modality, 2020-2030F



Source: Frost & Sullivan
Note: F- Forecast

Demand for biologics-focused CRO services is expected to reach USD 14 billion by 2030F, expanding at a CAGR of 10.68% between 2025 and 2030F. Growth is being driven by the increasing share of biologics within global R&D pipelines, including mAbs, CGTs, mRNA-based therapies, and biosimilars. These complex therapeutic modalities

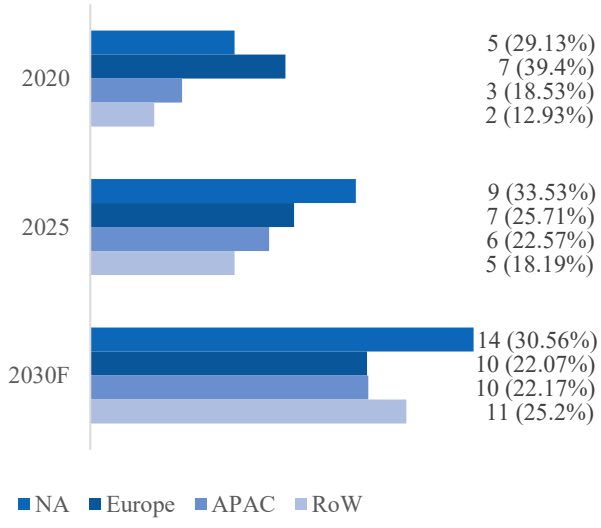
require specialized discovery, preclinical, and clinical development capabilities, leading to rising demand for outsourced services with the scientific expertise and infrastructure needed to support their development.

On the other hand, demand for small molecule CRO services is expected to grow at a comparatively slower CAGR of 9.17% between 2025 and 2030F, reaching USD 31 billion by 2030F while maintaining its dominance in the market. This growth is fueled by the continued high volume of small-molecule discovery programs. To manage rising costs, accelerate timelines, and replenish pipelines in the face of patent expirations, pharmaceutical companies are increasingly outsourcing activities such as target identification, medicinal chemistry, preclinical research, and clinical development to specialized service providers.

4.4.4 CRO Market by Regions

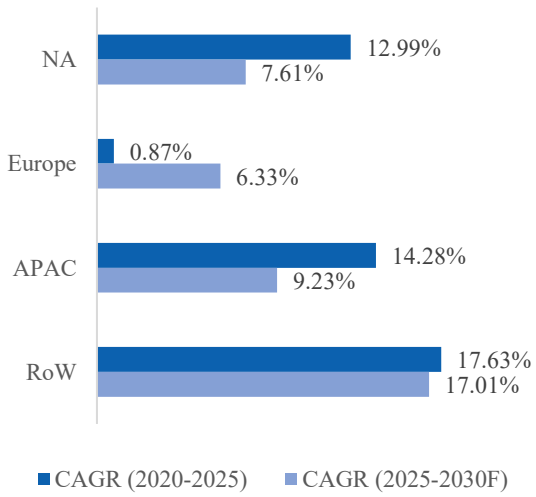
North America is the largest CRO market at approximately USD 9 billion in 2025, followed by Europe at approximately USD 7 billion. Asia-Pacific is the fastest-growing region at 9.23% per annum between 2025 and 2030F, with India's non-clinical CRO market projected to grow from approximately USD 0.6 billion in 2020 to USD 1.0 billion in 2025 and USD 1.8 billion by 2030F, increasing its share of the global non-clinical CRO market from approximately 3.22% to 4.11% over this period.

Exhibit 4.14A: Global CRO Market by Region, 2020, 2025, 2030F, USD Billion



Source: Frost & Sullivan
Note: F- Forecast, excludes Clinical Services

Exhibit 4.14B: Growth Rate of Global CRO Market by Region, 2020-2030F



Source: Frost & Sullivan
Note: F- Forecast

The global CRO market is distributed across four major regions: North America, Europe, APAC, and the Rest of the World (RoW). North America remains the largest market, accounting for 33.53% of global CRO revenues in 2025. Supported by a strong pharmaceutical industry, established CRO ecosystem, and advanced clinical research infrastructure, the region is expected to grow from USD 9 billion in 2025 to USD 14 billion by 2030F at a CAGR of 7.61%. However, its share of the global market is projected to decline to 30.56% by 2030F as growth accelerates in other regions.

Europe is the second-largest CRO market, representing 25.71% of global revenues in 2025. The region benefits from a well-established R&D ecosystem, leading academic and medical institutions, and a strong pharmaceutical research base. The European CRO market is projected to grow from USD 7 billion in 2025 to USD 10 billion by 2030F, reflecting a CAGR of 6.33%.

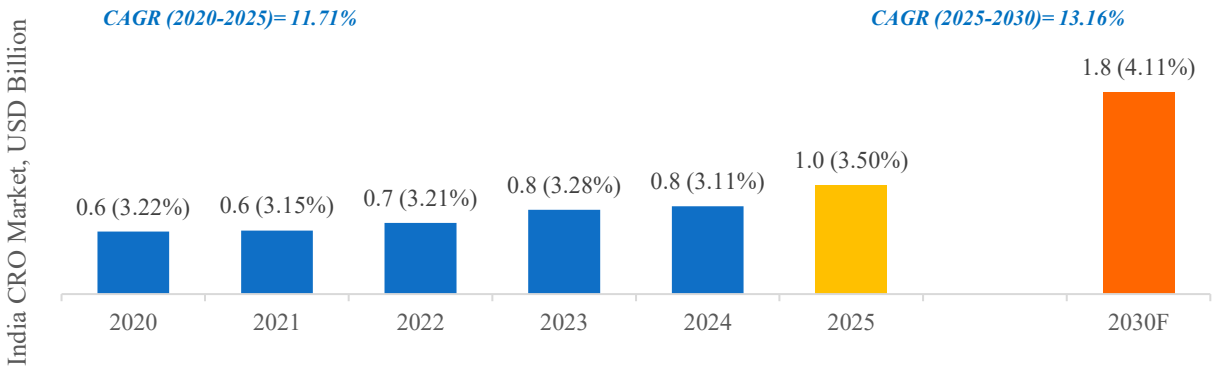
APAC is expected to be the fastest-growing region, with the CRO market expanding from USD 6 billion in 2025 to USD 10 billion by 2030F at a CAGR of 9.23%. Growth is being driven by increasing outsourcing activity, supported by cost advantages, skilled talent pools, and large, diverse patient populations in countries such as India, China, and Indonesia.

The RoW market, which includes regions such as Latin America and Africa, is also expected to grow at a similar pace, increasing from USD 5 billion in 2025 to USD 11 billion by 2030F at a CAGR of 17.01%.

4.4.4.1 INDIAN CRO MARKET

India's share of the global CRO market is expected to reach 4.11% by 2030F. This growth is being driven by the increasing competitiveness of Indian CROs, supported by their cost advantage, expanding research infrastructure, and growing capabilities across the drug development value chain.

Exhibit 4.15: India CRO Market, 2020-2030F



Source: Frost & Sullivan
Note: F - Forecast; % in labels refers to % of the Global CRO Market; excludes Clinical Services

The Indian CRO market accounted for 3.50% of the global CRO market in 2025, with a market size of USD 1 billion. It is expected to grow at a CAGR of 13.16% between 2025 and 2030F, reaching just under USD 2 billion in terms of value by 2030F. This expansion is being driven by increasing outsourcing of early-stage R&D activities as pharmaceutical and biotechnology companies seek specialized scientific expertise and greater operating flexibility. In addition, global supply chain diversification under the "China+1" strategy is strengthening the competitive position of Indian CROs and supporting continued market growth.

4.5 GLOBAL CONTRACT DEVELOPMENT AND MANUFACTURING MARKET (CDMO)

The global CDMO market is projected to grow from approximately USD 139 billion in 2025 to USD 206 billion by 2030F, at a CAGR of 8.16%. Growth is faster in the biologics segment, while the small molecules segment maintains its value dominance.

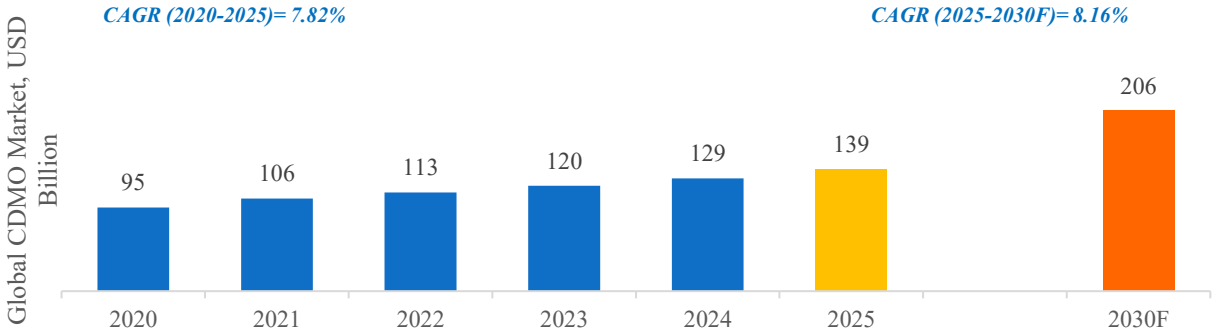
CDMOs play a critical role in pharmaceutical development and manufacturing by providing specialized development, scale-up, and production capabilities. As the industry shifts toward more complex and targeted therapies, pharmaceutical companies are increasingly relying on CDMOs to support both development and commercial manufacturing activities. This growing dependence is supported by the technical expertise, R&D infrastructure, skilled workforce, and regulatory capabilities that CDMOs offer. A proven track record of quality manufacturing, compliance, and successful execution across development and commercial stages has further strengthened their position within the pharmaceutical value chain.

4.5.1 CDMO Market Overview

The CDMO market serves pharmaceutical companies across process development, analytical development, clinical manufacturing, technology transfer, and commercial production. The market is served by large, multi-site CDMOs with broad modality capabilities alongside specialist providers focused on specific manufacturing platforms, dosage forms, or containment requirements.

The CDMO industry includes services provided for drug development and commercial manufacturing. Historically, pharma has often concentrated on selling high-volume products and used contracts with CDMOs to leverage increased manufacturing capacity. However, as the mass-distribution blockbuster pharmaceuticals faded and precision medicine, specialty indications, and more R&D in complicated treatments took center stage, pharmaceutical sponsors are starting to view CDMOs as strategic partners rather than vendors. Pharma innovators increasingly leverage cost efficiencies, specialist knowledge, latest manufacturing technologies and other benefits from CDMOs. In addition, the growing pipeline of sophisticated pharmaceutical products and the increased focus on efficiency and innovation has further driven the global outsourcing of research and manufacturing tasks to CDMOs. The reliance on CDMOs will further grow going forward as they continue to offer innovator pharmaceutical companies commercially feasible solutions for a range of drug development and manufacturing services, such as pharmaceutical formulation, analytical development, process optimization, and scale-up manufacturing. Strong technical and R&D infrastructure capabilities, availability of skilled scientific talent and quality manufacturing with clean track record of regulatory compliance, are some of the key success factors for CDMOs. The global CDMO market has grown steadily over the past several years, increasing from USD 95 billion in 2020 to USD 139 billion in 2025, representing a CAGR of 7.82%. Growth is expected to accelerate over the forecast period, with the market projected to reach USD 206 billion by 2030F at a CAGR of 8.16% between 2025 and 2030F.

Exhibit 4.16: Global CDMO Market, 2020-2030F



Source: Frost & Sullivan
Note: F - Forecast

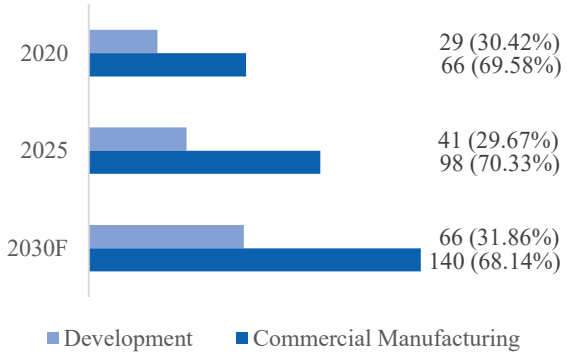
4.5.2 CDMO Market by Service Lines

Commercial manufacturing remains the larger and more stable CDMO revenue base, scaling to USD 140 billion by 2030F on the back of high-capacity utilization and long-duration supply contracts tied to marketed drugs. Development services are growing faster at 9.71% CAGR in 2025-2030F, reflecting pharma's increasing preference for integrated CDMO partners that can support a program from early development through commercial scale-up, a trend that strengthens long-term customer stickiness across the entire CDMO relationship.

Commercial manufacturing remains the largest segment of the CDMO market, supported by the large-scale, long-duration production requirements of approved products. Compared with development services, commercial manufacturing benefits from higher capacity utilization, greater revenue visibility, and longer customer engagements due to the ongoing supply needs of marketed drugs. The commercial manufacturing segment is projected to grow from

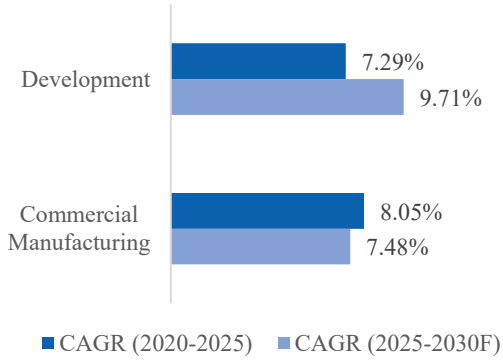
USD 98 billion in 2025 to USD 140 billion by 2030F. Development services, however, are expected to grow more rapidly over the forecast period. Growth is being driven by increasing R&D outsourcing, expanding clinical pipelines, rising complexity across drug modalities, and growing demand for specialized development expertise. Pharmaceutical and biotechnology companies are also increasingly seeking integrated partners that can support programs from development through commercialization, further strengthening demand for development services. Development services are expected to expand from USD 41 billion to USD 66 billion over the same period, reflecting a faster growth trajectory than commercial manufacturing.

Exhibit 4.17A: Global CDMO Market by Service Line, 2020, 2025, 2030F, USD Billion



Source: Frost & Sullivan
Note: F- Forecast

Exhibit 4.17B: Growth Rate of Global CDMO Market by Service Line, 2020-2030F

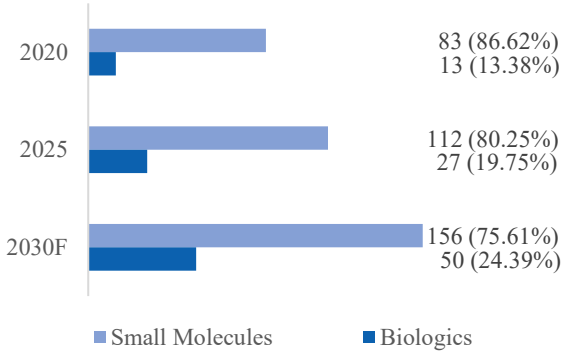


Source: Frost & Sullivan
Note: F- Forecast

4.5.3 CDMO Market by Modalities

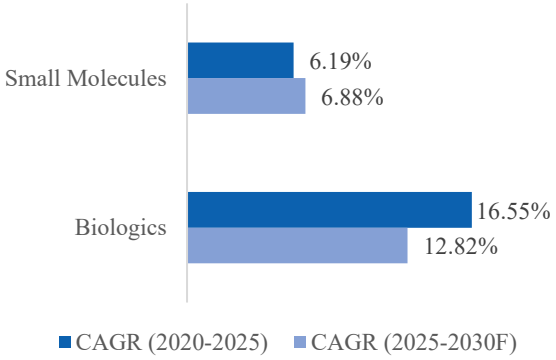
Small molecule drugs are expected to remain the largest segment of the global CDMO market, reaching USD 156 billion by 2030F. Growth in this segment is supported by continued development activity and ongoing demand for outsourced manufacturing services. Biologics are projected to grow at a faster rate, although from a smaller base, driven by increasing adoption of biologic therapies and the specialized manufacturing capabilities they require. Together, these trends indicate growth across both major modalities, with small molecules contributing the largest share of market volume and biologics increasing their share of overall market value.

Exhibit 4.18A: Global CDMO Market by Modality, 2020, 2025, 2030F, USD Billion



Source: Frost & Sullivan
Note: F- Forecast

Exhibit 4.18B: Growth Rate of Global CDMO Market by Modality, 2020-2030F



Source: Frost & Sullivan
Note: F- Forecast

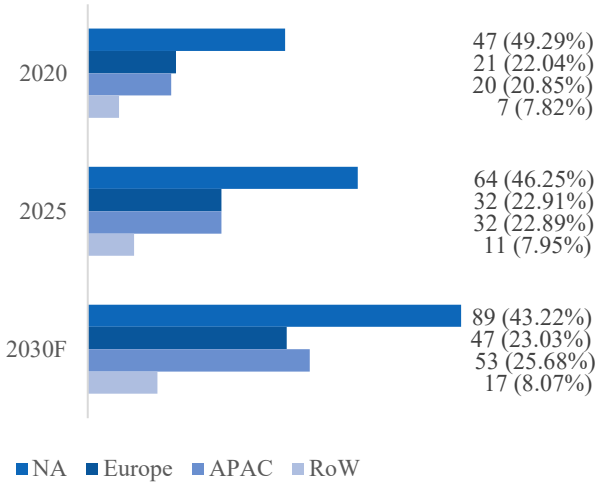
Small molecules continue to account for the majority of the CDMO market and are expected to grow at a CAGR of 6.88% between 2025 and 2030F, reaching approximately USD 156 billion by 2030F. Growth in this segment is being driven by sustained drug discovery and development activity, together with continued demand for outsourced manufacturing across the pharmaceutical value chain. As pharmaceutical companies seek to optimize costs, improve manufacturing flexibility, and accelerate time to market, they are increasingly outsourcing both development and commercial manufacturing to specialized CDMO partners.

However, biologics are gaining share within the market. After representing only 13.38% of CDMO revenues in 2020, the biologics segment expanded rapidly to reach USD 27 billion by 2025 and is projected to account for 24.39% of the market by 2030F. The stronger growth in biologics CDMO is being driven by rising biologic drug approvals, increasing demand for innovative therapies, and continued investment by pharmaceutical companies in biologic development and manufacturing.

4.5.4 CDMO Market by Regions

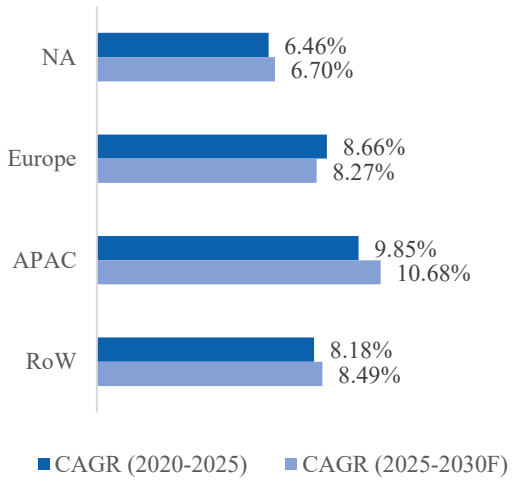
North America is expected to remain the largest CDMO market while continuing to record strong growth, supported by its large concentration of pharmaceutical and biotechnology companies and increasing demand for complex therapeutic modalities. APAC is projected to gain market share and surpass Europe in market size by 2030F, driven by the expansion of manufacturing capabilities in countries such as India and China and continued growth in outsourcing activity. Europe is expected to grow at a slower pace, reflecting the more mature nature of the market, although it is likely to maintain an important role in advanced therapy manufacturing.

Exhibit 4.19A: Global CDMO Market by Region, 2020, 2025, 2030F, USD Billion



Source: Frost & Sullivan
Note: F- Forecast

Exhibit 4.19B: Growth Rate of Global CDMO Market by Region, 2020-2030F



Source: Frost & Sullivan
Note: F- Forecast

North America is the largest CDMO market, accounting for 46.25% of global revenues in 2025. The market is projected to grow from USD 64 billion in 2025 to USD 89 billion by 2030F, with a CAGR of 6.70%, the slowest growth rate among the four regions. Growth is being driven by the region's concentration of pharmaceutical and biotechnology companies, increasing outsourcing activity, and rising demand for complex modalities such as biologics, cell and gene therapies, ADCs, and peptides. Continued investment in manufacturing capacity, strong innovation activity, and growing demand for specialized development and manufacturing capabilities are further supporting market expansion.

Europe is expected to be the third fastest-growing major CDMO market, increasing from USD 32 billion in 2025 to USD 47 billion by 2030F at a CAGR of 8.27%. The region is projected to maintain a stable 22-23% share of the global market over the forecast period. Growth in the region is supported by a well-established pharmaceutical manufacturing base, a strong presence of innovator companies, and continued demand for outsourced services. Europe remains a key hub for biologics, sterile injectables, and advanced therapies, supported by strong technical expertise and a mature regulatory environment. However, market maturity and competition from lower-cost outsourcing destinations are expected to limit growth.

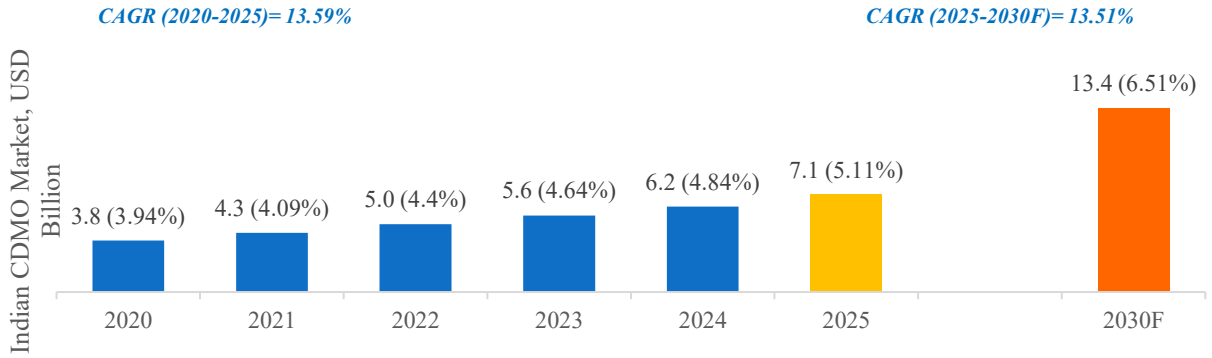
The APAC CDMO market is projected to grow from USD 32 billion in 2025 to USD 53 billion by 2030F, surpassing Europe in market size and expanding at the fastest CAGR of 10.68%. The region's expansion is driven by its cost-competitive manufacturing base, growing pharmaceutical and biotechnology sectors, and increasing outsourcing from global drug developers. Countries such as India and China continue to attract investment across small molecule and biologics manufacturing, while rising demand for integrated development and manufacturing services further strengthens the region's position within the global CDMO industry.

The RoW CDMO market is projected to grow from USD 11 billion in 2025 to USD 17 billion by 2030F, representing a CAGR of 8.49%, in line with North America. Despite this growth, the region is expected to maintain a stable share of approximately 7-8% of the global market. Increasing investment in pharmaceutical manufacturing across emerging markets, particularly in Latin America and the Middle East, is driving expansion. Efforts to strengthen domestic drug production, reduce reliance on imports, and meet growing demand for outsourced manufacturing services are supporting market growth, albeit from a smaller base than the major CDMO hubs in North America, Europe, and APAC.

4.5.4.1 INDIAN CDMO MARKET

The Indian CDMO market accounted for 5.11% of the global CDMO market in 2025, as the demand for complex dosage forms and specialty pharmaceuticals continues to rise.

Exhibit 4.20: India CDMO Market, 2020-2030F



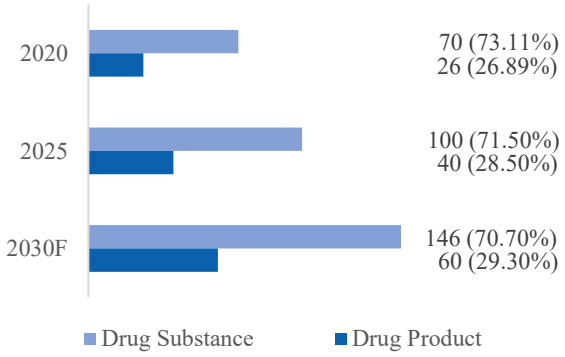
Source: Frost & Sullivan
Note: F - Forecast; % in labels refers to % of the Global CDMO Market

The Indian CDMO market is expected to grow at a relatively stable CAGR of 13.51% between 2025 and 2030F, with a projected increase from USD 7 billion in 2025 to USD 13 billion by 2030F. India is expected to account for 6.51% of the global CDMO market by 2030F. Growth is being driven by increasing outsourcing of commercial manufacturing as pharmaceutical companies optimize manufacturing networks, reduce capital expenditure, and focus internal resources on R&D and commercialization. India's position is further strengthened by government initiatives to expand domestic pharmaceutical manufacturing, growing demand for integrated development-to-commercial manufacturing partners, and global supply chain diversification.

4.5.5 CDMO Market by Product Stage

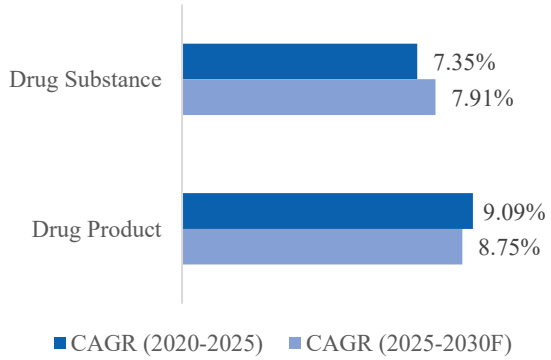
Drug substances are expected to remain the largest segment of the global CDMO market, reaching USD 146 billion by 2030F. Growth in this segment is supported by expanding pipelines and increasing demand for high potency molecules. Drug products are projected to grow at a faster rate from a smaller base, driven by the increasing requirement for specialized dosage forms and fill-finish services.

Exhibit 4.21A: Global CDMO Market by Product Stage, 2020, 2025, 2030F, USD Billion



Source: Frost & Sullivan
Note: F- Forecast

Exhibit 4.21B: Growth Rate of Global CDMO Market by Product Stage, 2020-2030F



Source: Frost & Sullivan
Note: F- Forecast

Drug Substance (DS) manufacturing continues to represent the largest segment of the global CDMO market and is expected to grow at a CAGR of 7.91% between 2025 and 2030F, reaching approximately USD 146 billion by 2030F. Growth is being supported by expanding pharmaceutical pipelines, rising demand for complex and high-potency molecules, and continued investment in specialized manufacturing capabilities. Drug Product (DP) manufacturing is expected to grow at a faster pace, increasing its share of the overall CDMO market over the forecast period. After accounting for 26.89% of CDMO revenues in 2020, the DP segment expanded to approximately USD 40 billion by 2025 and is projected to represent 29.30% of the market by 2030F at USD 60 billion. This growth is being driven by increasing demand for specialized dosage forms, higher outsourcing of sterile and biologics fill-finish operations, growing commercialization of complex therapies, and pharmaceutical companies' preference for integrated end-to-end manufacturing partners.

At the same time, pharmaceutical companies are increasingly seeking integrated DS/DP capabilities from a single CDMO partner. Consolidating API or biologics manufacturing with formulation and fill-finish reduces technology transfer risks, shortens development timelines, and simplifies supply chain coordination. In response, CDMOs are expanding their end-to-end service offerings, particularly for complex modalities such as biologics and ADCs, where seamless integration is essential to ensure manufacturability, scalability, and regulatory compliance.

4.6 CHALLENGES AND RISKS IN THE GLOBAL AND INDIAN CRDMO MARKET

Global CRDMO players face challenges, including high capital intensity for specialized capacity expansion, rising regulatory and quality compliance requirements, and increasing demand for skilled scientific talent as manufacturing complexity grows. Indian CRDMO companies additionally navigate challenges related to scaling capabilities across emerging modalities, strengthening global innovator confidence around IP protection and execution quality, and balancing capacity expansion with evolving demand visibility across development and commercial manufacturing programs.

Despite strong long-term growth drivers, the CRDMO industry faces a complex operating environment shaped by evolving regulatory requirements, increasing therapeutic complexity, and ongoing investment needs. Competitive

positioning in the CRDMO market is determined by scientific and technical depth across relevant modalities, the breadth and currency of regulatory approvals across key jurisdictions, the ability to execute programs across multiple development stages within a single organization, client relationship quality as evidenced by repeat business and multi-year agreements, and capital investment capacity to expand capabilities in response to client demand. Factors such as customer concentration, supply chain dependencies, talent availability, and technology shifts can influence competitiveness and growth. In India, these challenges are further influenced by the need to scale capabilities and strengthen relationships with global pharmaceutical innovators.

- **Market and Competitive Pressures:** The CRDMO industry faces ongoing pricing pressure, particularly in commoditized API and manufacturing services where competition can limit pricing power and compress margins. The market also remains highly fragmented, with participants competing against large global providers, regional specialists, and emerging low-cost manufacturing destinations. At the same time, pharmaceutical companies are increasingly seeking partners that can support multiple stages of the value chain through integrated service offerings. This shift creates challenges for smaller or highly specialized providers that may lack the breadth of capabilities required to meet evolving customer requirements.
- **Customer and Revenue Risks:** Dependence on a limited number of large pharmaceutical or biotechnology customers can expose CRDMOs to revenue volatility arising from program delays, cancellations, supplier transitions, or pipeline attrition. Since a significant share of industry revenues is generated from development-stage programs, clinical failures and regulatory setbacks within customer pipelines can also adversely affect business performance. Aragen mitigates this risk through a diversified global customer base including 16 of the Top 20 Big Pharma[27] companies and over 100 small / biotech companies, as of March 31, 2026. Its clientele spans large innovator pharmaceutical companies, emerging biotechnology firms, and leading businesses across the agrochemical, animal health, and specialty chemicals sectors, reducing dependence on any single customer or end market.
- **Capital Intensity and Utilization Challenges:** The CRDMO industry requires substantial capital investment in specialized infrastructure, including biologics facilities, sterile manufacturing lines, containment systems, and advanced production technologies. These investments carry utilization risk, as future customer demand and capacity requirements can be difficult to forecast accurately. Managing capacity is also a persistent challenge, requiring companies to balance long-term customer commitments with the need to maintain operational flexibility. In addition, investments in new facilities and advanced capabilities often involve extended payback periods, with meaningful utilization and financial returns typically taking several years to materialize.
- **Technology Shifts and Execution Complexity:** The emergence of new therapeutic modalities requires CRDMOs to continually invest in specialized technologies, infrastructure, and capabilities, creating a risk of technology obsolescence and ongoing reinvestment requirements. Advanced modalities such as ADCs, oligonucleotides, peptides, and CGTs also involve complex development and manufacturing processes. Limited industry expertise and specialized production requirements can increase execution risk in these areas. Aragen is one of the first Indian CRDMOs among assessed Indian peers to actively incorporate AI-enabled workflows across its drug discovery operations to accelerate chemical synthesis and improve project execution for its clients. The company has also integrated AI into its ADME workflows, enabling automated data processing, streamlined analytics, and more efficient decision-making throughout the discovery process. Additionally, Aragen's analytical and purification infrastructure includes one of India's largest supercritical fluid chromatography (SFC) capacities for chiral purification as of March 31, 2026, along with advanced evaporative light scattering detection (ELSD) and charged aerosol detection (CAD) techniques for the purification and analysis of non-chromophoric compounds, and vibrational circular dichroism (VCD) analysis for accurate determination of absolute chirality.
- **Regulatory, Quality, and EHS Compliance:** CRDMOs operate in a highly regulated environment where compliance failures can result in warning letters, import restrictions, production interruptions, and reputational damage. Quality lapses or data integrity issues can also undermine customer relationships, particularly as outsourcing programs become more strategic and complex. In addition, manufacturing

[27] Big Pharma refers to the Top 20 Big Pharmaceutical Companies by revenue, as covered in Exhibit 5.1

activities involving potent compounds, biologics, and hazardous chemicals require ongoing investment to maintain environmental, health, and safety (EHS) compliance. For example, Aragen maintains a strong focus on quality systems and regulatory compliance across its operations. The company's facilities are approved by multiple regulatory authorities including the FDA, EDQM, PMDA, MFDS, ANVISA, WHO Geneva, NABL and CDSCO.

- **Supply Chain Constraints:** Reliance on a limited number of suppliers for critical raw materials, intermediates, biologic inputs, or specialized equipment can create supply chain vulnerabilities. Any disruption in the availability of these inputs may affect production schedules, project timelines, and customer deliveries. The industry's increasing emphasis on supply chain resilience, lower dependence on China for critical raw materials, intermediates, and key starting materials (KSMs) used in pharmaceutical manufacturing, and consistently high on-time-in-full (OTIF) performance further amplifies this challenge. CRDMOs are therefore required to invest in supplier diversification, dual sourcing, regional procurement networks, strategic inventory buffers, and rigorous supplier qualification programs, all of which increase procurement complexity, working capital requirements, and operating costs while remaining essential to maintaining business continuity and customer confidence.
- **Talent Availability and Retention Challenges:** Increasing demand for specialized scientific, regulatory, and manufacturing expertise in emerging areas is intensifying competition for skilled talent across the industry. Attracting and retaining qualified personnel has become an increasingly important challenge as pharmaceutical technologies and development requirements continue to evolve. For example, Aragen has the highest PhD-to-scientific personnel ratio within the Indian CRDMO industry at 14.04% among assessed Indian peers as of March 31, 2026.
- **IP and Confidentiality Risks:** CRDMOs routinely work with confidential customer data, proprietary manufacturing processes, and intellectual property. Maintaining strong intellectual property safeguards and cybersecurity controls is therefore essential to protect sensitive information and preserve customer trust.
- **Macroeconomic and Geopolitical Headwinds:** Geopolitical developments, trade restrictions, tariffs, and localization policies can influence global supply chains, sourcing decisions, and outsourcing strategies across the pharmaceutical industry. In addition, CRDMOs are exposed to broader macroeconomic factors such as currency fluctuations, inflation, and interest rate movements, which can affect operating costs and profitability, particularly for companies with significant export exposure.

4.7 KEY SUCCESS FACTORS FOR GLOBAL AND INDIAN CRDMOS

Competitive positioning in the CRDMO market is determined by scientific and technical depth across relevant modalities, the breadth and currency of regulatory approvals across key jurisdictions, the ability to execute programs across multiple development stages within a single organization, client relationship quality as evidenced by repeat business and multi-year agreements, and capital investment capacity to expand capabilities in response to client demand.

- **Geographical Diversity:** A diversified geographic footprint can provide clients with access to both advanced scientific capabilities and cost-efficient manufacturing. By combining research operations in key innovation hubs with development and manufacturing facilities in lower-cost regions, companies can offer customers a balance of technical expertise and economic efficiency. For example, Aragen's R&D presence in the US enables close access to innovation, while its CRDMO operations in India provide cost-competitive development and manufacturing support across the value chain. This helps the company provide services to customers from Europe, Asia, and the US, diversifying its revenue streams from across the globe.
- **Adopting Enabling Technologies:** Adopting enabling technologies such as AI-driven screening, computational chemistry, advanced manufacturing technologies, and automation platforms in addition to achieving internal operational efficiencies allows CRDMOs to offer its clients various benefits across drug discovery, manufacturing, security, and more. For instance, Aragen has developed AI tools that support drug discovery, boost productivity, optimize manufacturing, and enhance data security.
- **Scientific Talent:** A technically skilled workforce provides clients with confidence that their molecules are being managed by teams with the expertise required to address complex scientific and development

challenges. It also gives sponsors access to specialized knowledge that may not exist internally, while enabling faster problem-solving and more efficient resolution of issues that arise during development and manufacturing. For example, among assessed Indian peers, Aragen has built the second largest discovery services platform in India in terms of number of scientific personnel as of March 31, 2026. Additionally, Aragen has the highest PhD-to-scientific personnel ratio within the Indian CRDMO industry at 14.04% among the assessed Indian peers as of March 31, 2026. Aragen is also the only Indian CRDMO to have received Great Place to Work Certification in last 7 years consecutively from Fiscal 2020 to Fiscal 2026.

- **Strong Technical Capabilities:** The ability to support multiple therapeutic modalities is becoming an increasingly important competitive differentiator for CRDMOs. Pharmaceutical customers are seeking partners with capabilities spanning small molecules, biologics, ADCs, oligonucleotides, peptides, CGTs, and HPAPIs, enabling them to address a broader range of development and manufacturing requirements within a single outsourcing relationship.
- **Full-Service Offerings:** Pharmaceutical companies of all sizes are increasingly seeking partners that can support the full product lifecycle, from discovery and development through clinical supply, scale-up, commercial manufacturing, and lifecycle management. Additionally, pharmaceutical companies typically consolidate a significant portion of their outsourced requirements with a limited number of CRDMO providers, creating opportunities for integrated service providers to expand the scope of engagement and increase their share of customer spending. The ability to provide these services through a single integrated platform can improve coordination, reduce handoff risks, and simplify program execution for customers. This has the added benefit of enhancing customer visibility, leading to stronger partnership opportunities from small biotechs as well as large pharma companies. A diversified customer base across emerging biotechnology companies, mid-sized pharmaceutical firms, and large global pharmaceutical companies further enhances revenue resilience by reducing dependence on any single customer, development program, or stage of the product lifecycle. It also provides a balanced mix of early-stage programs with long-term commercial potential and established commercial manufacturing contracts that generate recurring revenue, supporting more stable growth across market cycles. At the same time, relationships with larger pharmaceutical companies can further strengthen resilience during periods of market uncertainty, as these companies typically maintain more stable R&D and manufacturing outsourcing budgets than small biotechnology firms. This is particularly relevant in the current environment, where tighter funding conditions for emerging biotech companies have led to slower progression of early-stage development programs and more cautious outsourcing spending. A diversified customer mix therefore helps CRDMOs offset cyclicality in biotech funding while continuing to benefit from the long-term innovation pipeline driven by emerging biotechnology companies. For example, Aragen served a diversified global customer base comprising Big Pharma companies, large pharmaceutical companies, small / biotech companies, and mid-sized pharmaceutical companies operating across pharmaceuticals, biotechnology, animal health, agrochemicals and specialty chemicals. Aragen is also one of 2 companies among the assessed Indian peers to work with 16 of top 20 Big Pharma customers as of March 31, 2026, which collectively account for a significant share of global pharmaceutical R&D spending.
- **Regulatory and Quality Compliance:** A strong regulatory track record remains a key competitive differentiator, particularly for commercial manufacturing programs. Consistent success in inspections conducted by agencies such as FDA, EMA, MHRA, and PMDA helps demonstrate quality, compliance, and operational reliability to prospective customers. For example, Aragen's facilities are approved by most of the stringent regulated markets / developed market authorities.
- **Speed, Flexibility, and Reliability:** Execution capabilities are an important consideration when selecting outsourcing partners. Pharmaceutical companies increasingly prioritize providers that can support accelerated development timelines, efficient technology transfer, flexible manufacturing capacity, and consistent on-time delivery performance. Providers with a proven track record of high OTIF performance are better positioned to build long-term customer relationships, as reliable execution reduces supply chain risk, supports regulatory commitments, and enhances confidence in their ability to deliver critical products on schedule.
- **Advanced Manufacturing and Development Capabilities:** Technical expertise in areas such as continuous manufacturing, biologics process optimization, containment technologies, sterile manufacturing, and

advanced analytical characterization is becoming increasingly important as pharmaceutical products grow more complex. Developing these capabilities requires sustained investment in scientific talent, quality systems, regulatory expertise, and specialized infrastructure, creating significant barriers to entry for CRDMOs seeking to operate at scale.

- **Capacity and Scalability:** The ability to efficiently scale production from clinical to commercial volumes while maintaining quality standards and cost competitiveness is an increasingly important capability. This is particularly critical for therapies experiencing rapid growth or accelerated commercialization timelines. This is reflected in Aragen's service offerings, with the company providing the largest number of offerings to customers among the assessed Indian peers.
- **Global Supply Chain Resilience:** Supply chain resilience has become a key consideration for pharmaceutical companies following recent global disruptions and increasing geopolitical uncertainty. As a result, geographic diversification, dual-sourcing strategies, and stronger procurement networks are playing a larger role in outsourcing decisions to improve supply continuity and reduce concentration risk. These trends have accelerated the adoption of a "China+1" sourcing strategy, with global pharmaceutical and biotechnology companies reducing their dependence on China for development and manufacturing services. This shift has been further reinforced by the expected inclusion of WuXi AppTec on the list of companies associated with the Chinese military under the revised US Biosecure Act provisions in June 2026, raising concerns over the long-term risks of relying heavily on Chinese CRDMO partners. Although the full impact of these regulatory measures is expected to emerge gradually due to grandfathering provisions, they have prompted many global innovators to reassess their supply chain strategies. India is well positioned to benefit from this structural shift, supported by its established regulatory track record, cost competitiveness, skilled scientific workforce, and expanding manufacturing capabilities.
- **IP Protection and Data Integrity Systems:** Information security and intellectual property protection are increasingly important selection criteria for CRDMOs. Pharmaceutical companies favor outsourcing partners with strong confidentiality standards, secure digital infrastructure, and robust compliance frameworks to protect intellectual property, safeguard sensitive data, and maintain customer trust. Large pharmaceutical companies also increasingly prefer CRDMOs that hold ISO 27001 Information Security Management System (ISMS) certification as part of their vendor qualification process. Aragen's ISO 27001 certification positions it well to meet these evolving customer requirements.
- **Commercial Competitiveness and Cost Efficiency:** While technical capabilities are becoming increasingly important, cost competitiveness remains a key consideration for pharmaceutical companies when selecting outsourcing partners. This is particularly true in generics, APIs, and large-volume manufacturing programs, where pricing and operational efficiency continue to play a significant role in sourcing decisions. Sustained customer satisfaction supports the development of long-term partnerships, which contribute to greater business stability and predictability.
- **Long-term Strategic Partnerships:** Strong customer relationships and high levels of repeat business are important competitive advantages in the CRDMO industry. Early involvement in the development lifecycle can increase visibility, strengthen customer retention, and create opportunities for broader, higher-value engagements across multiple stages of a product's lifecycle.
- **Supporting Emerging Biotech Companies:** Flexible operating models, small-batch manufacturing capabilities, and collaborative scientific support are becoming increasingly important as biotechnology companies account for a growing share of global innovation. These customers often require adaptable development and manufacturing partners capable of supporting evolving program needs across early and late-stage development.
- **Increasing Investments:** Access to capital is an important competitive factor, enabling CRDMOs to invest in continuous capability enhancement, capacity expansion, and operational improvements. These investments can support greater scale, improve efficiency, and help achieve economies of scale over time.
- **Sustainability Initiatives:** Sustainability initiatives are becoming increasingly important across the pharmaceutical value chain and often require significant capital investment, as well as access to green utilities and energy-efficient infrastructure. Companies that adopt sustainability programs and obtain recognized environmental certifications can strengthen their attractiveness to customers, particularly as pharmaceutical

companies place greater emphasis on ESG considerations within their supplier selection processes. For example, Aragen became the first Indian CRDMO company to receive the Platinum EcoVadis Sustainability Rating in India in FY25 (among the assessed Indian peers). Additionally, among the assessed Indian peers, Aragen is the only CRDMO to receive a Gold EcoVadis Sustainability rating in Fiscal 26, placing it among top 5% of companies globally.

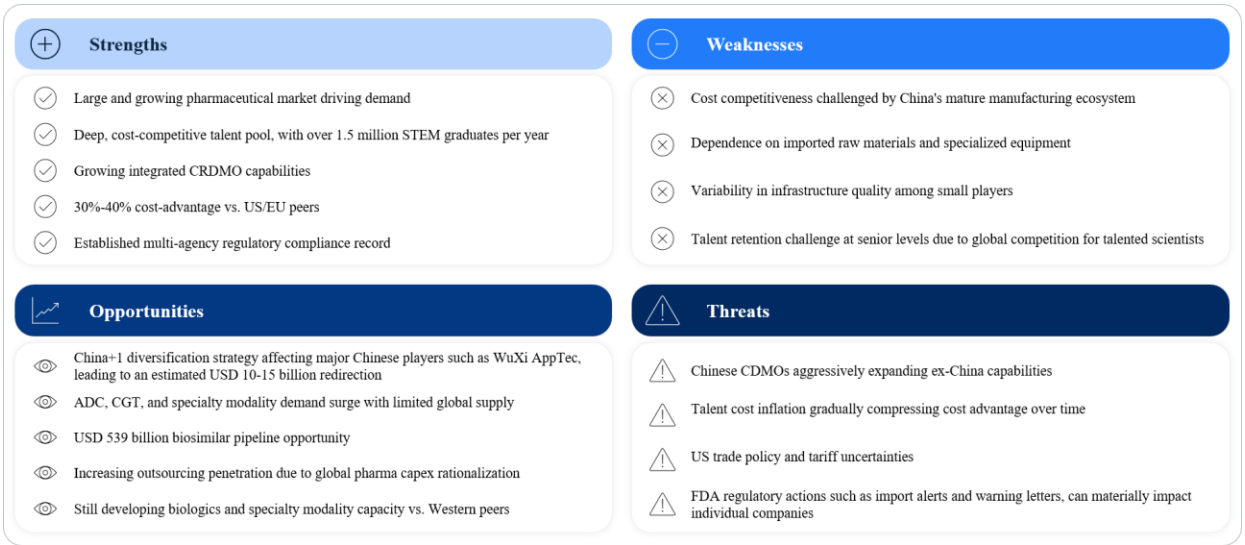
The trajectories of leading global CRDMOs illustrate how the success factors outlined above translate into market leadership. WuXi AppTec and Pharmaron began as contract research organizations focused on discovery services, initially providing capabilities such as medicinal chemistry, biology, DMPK, and preclinical research to pharmaceutical and biotechnology companies, while Charles River Laboratories has evolved from a supplier of research models and laboratory animal services into offering discovery and preclinical contract research. Over time, these companies have expanded both organically and through acquisitions to build integrated platforms spanning the pharmaceutical value chain, enabling customers to outsource activities from early-stage drug discovery through process development, clinical manufacturing, regulatory support, and commercial production. This end-to-end integration and scale has come to define leadership in the CRDMO industry.

Today, these companies have broadened their capabilities beyond traditional small molecules into complex therapeutic modalities, including mAbs, ADCs, CGTs, oligonucleotides, peptides, and advanced biologics. Their operations are supported by large scientific workforces, extensive global manufacturing and laboratory networks, active intellectual property portfolios, and increasing adoption of digital technologies, including AI-enabled drug discovery, process optimization, laboratory automation, and data-driven manufacturing workflows. In parallel, they have strengthened their environmental, social, and governance (ESG) practices through initiatives focused on emissions reduction, resource efficiency, and responsible supply chain management, reflected in external sustainability assessments such as MSCI AAA and EcoVadis Silver ratings for selected companies.

Aragen is pursuing a similar strategic direction, applying many of the same success factors to build its own position in the industry. It offers an integrated discovery-to-manufacturing model and has expanded its biologics capabilities through the launch of its CHOMax cell-line platform and a GMP biologics facility that commenced operations in 2025. The company employs more than 3,400 scientific personnel, including 479 PhDs, providing scientific depth comparable to larger global peers despite its smaller scale. Aragen has also invested in AI-enabled workflows and strengthened its ESG profile through an EcoVadis Gold rating and Science Based Targets initiative (SBTi)-approved emissions targets.

4.8 SWOT ANALYSIS OF THE INDIAN CRDMO MARKET

India's CRDMO sector is positioned in the strongest competitive quadrant relative to global peers with reinforcing strengths in talent and cost, growing strategic opportunities from supply chain realignment and biosimilar pipeline growth, and manageable threats that are being proactively addressed through government policy and industry investment in capabilities, quality infrastructure, and global regulatory certifications.



5 COMPETITIVE LANDSCAPE OF THE GLOBAL CONTRACT SERVICES MARKET

The global CRDMO landscape is characterized by a small number of large, integrated organizations with significant scale advantages, a broad mid-tier of specialist CRO or CDMO providers, and a growing cohort of Indian players that have demonstrated the capability to compete on scientific quality rather than price alone.

The CRDMO industry remains highly fragmented, with an estimated 1,000–1,500 CROs and CDMOs operating globally as of March 2026. The competitive landscape spans full-service integrated CRDMOs, standalone CROs and CDMOs of varying scale, as well as research and manufacturing capabilities retained within pharmaceutical companies and academic institutions. Despite this fragmentation, the ability to operate as a fully integrated, global CRDMO represents a meaningful competitive differentiator. Delivering end-to-end research, development, and manufacturing services requires extensive scientific expertise, advanced technology platforms, substantial investment in research and manufacturing infrastructure, and long-established relationships with pharmaceutical sponsors. While specialized CROs and CDMOs can establish positions within individual service niches with comparatively lower barriers to entry, replicating the breadth, scale, and technical sophistication of a full-service CRDMO platform remains significantly more challenging.

Demand for integrated CRDMO partnerships continues to increase across both large pharmaceutical companies and emerging biopharma firms. Large pharmaceutical companies increasingly seek strategic outsourcing partners capable of supporting diverse product portfolios across multiple modalities and geographies, while smaller pharmaceutical and biotechnology companies rely on integrated providers to access specialized development capabilities, manufacturing infrastructure, regulatory expertise, and clinical development support without the need for significant in-house investment.

5.1 TOP PHARMACEUTICAL FIRMS

The top 20 big pharmaceutical companies[28] by revenue collectively accounted for approximately 55-60% of total global pharmaceutical revenues in 2025. These companies maintain extensive internal R&D capabilities while increasingly sourcing external innovation through licensing, co-development arrangements, and acquisitions of late-stage pipeline assets from smaller biotech companies.

[28] Top 20 based on pharmaceutical revenues in 2025

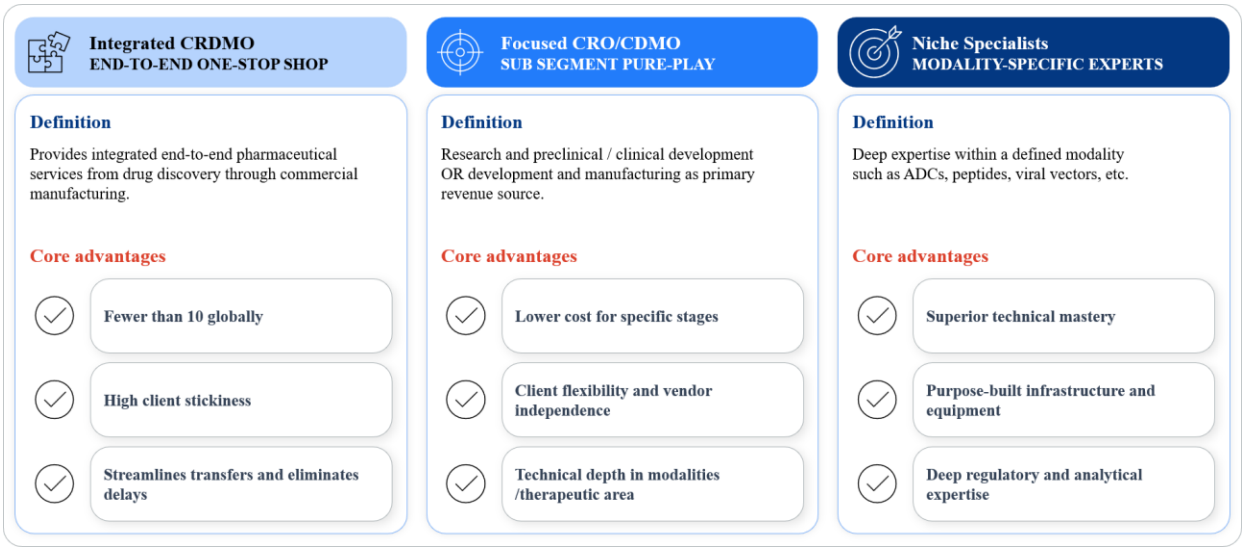
Exhibit 5.1: Top 20 Big Pharma Companies

Rank	Company	Rank	Company
1.	Eli Lilly	**11.**	Bristol Myers Squibb
2.	Pfizer	**12.**	GSK
3.	AbbVie	**13.**	Amgen
4.	Johnson & Johnson	**14.**	Gilead Sciences
5.	Roche	**15.**	Takeda
6.	AstraZeneca	**16.**	Boehringer Ingelheim
7.	Merck & Co	**17.**	Bayer
8.	Novartis	**18.**	CSL
9.	Sanofi	**19.**	Regeneron Pharmaceuticals
10.	Novo Nordisk	**20.**	Viatris

Source: Annual Reports, Earnings Calls, Investor Presentations, Company Websites as accessed on 24th August 2026.
Note: Companies are ranked based on reported pharmaceutical segment revenue for FY2025. Fiscal year periods may differ across companies in accordance with local financial reporting conventions. Reported pharmaceutical segment revenue may include allied or adjacent businesses where these are not separately disclosed in company filings. Companies whose businesses are predominantly focused on pharmaceutical distribution or consumer health have been excluded from the ranking.

5.2 LANDSCAPE OVERVIEW

The CRDMO landscape is bifurcating into distinct operational models optimized for either lifecycle efficiency or technical depth. Traditional CROs and CDMOs bring strong domain expertise in discovery or commercial-scale manufacturing, while modality specialists provide highly customized capabilities for complex therapies. However, Integrated CRDMOs are increasingly differentiated through their ability to provide seamless, end-to-end lifecycle support, enabling lower tech-transfer risk, simplified vendor management, and faster development-to-commercialization timelines.



5.2.1 KEY ENTRY BARRIERS IN THE CRDMO MARKET

Entry into the CRDMO market requires cumulative investment across facility infrastructure, quality systems, regulatory approval maintenance, and scientific workforce development, with each element requiring sustained investment over multiple years before generating commercial returns. The time required to obtain regulatory approvals from agencies such as the FDA and the EMA, build a qualifying client track record, and develop the process science capabilities required for complex modality programs represents a meaningful barrier for new entrants across most service segments.

CRDMOs provide integrated services spanning drug discovery, clinical development, process development, and commercial manufacturing. Delivering these capabilities requires expertise across scientific, regulatory, and manufacturing disciplines, supported by specialized infrastructure and quality systems. As a result, the industry exhibits high structural barriers to entry, favoring established players with proven execution capabilities, integrated platforms, and strong regulatory track records.

- **High Capital Intensity:** Establishing CRDMO capabilities requires significant upfront investment in GMP-compliant manufacturing facilities, advanced research and analytical laboratories, vivariums, specialized equipment, and production infrastructure such as biologics suites and high-potency API facilities. These investments are essential to support complex development programs and meet the quality and regulatory expectations of global pharmaceutical clients. The scale of capital required creates a significant financial barrier for new entrants seeking to compete in the industry.
- **Regulatory Complexity and Compliance Burden:** CRDMOs operate under stringent GMP requirements, with US facilities required to comply with regulations set out in 21 CFR Parts 210 and 211 governing quality systems, documentation, environmental controls, cleanliness, and process validation. New entrants must establish compliant quality systems and successfully navigate multiple regulatory inspections before earning customer confidence. Because pharmaceutical companies place significant emphasis on demonstrated regulatory compliance and clean FDA inspection histories, building a credible track record is a multi-year process that cannot be accelerated.
- **Scale and Scope for Full-Service Integration:** While entry into individual CRO or CDMO service segments may be relatively accessible, building a fully integrated CRDMO platform requires significant investment in specialized infrastructure, technical expertise, and operational capabilities. This substantially raises the barrier for companies seeking to compete beyond niche, single-service offerings.
- **Talent and Specialized Workforce Scarcity:** CRDMOs depend on a highly skilled workforce spanning research, process development, analytical sciences, and GMP manufacturing to support increasingly complex drug development programs. Scientific talent with expertise in medicinal chemistry, biology, pharmacology, and advanced therapeutic modalities is essential for executing discovery research, while GMP-trained scientists, engineers, and manufacturing professionals are critical for process scale-up and commercial production. Such talent remains in limited supply globally, with shortages particularly pronounced across North America and Europe as demand for outsourced R&D and manufacturing services continues to increase. Beyond recruiting experienced professionals, leading CRDMOs differentiate themselves through strong employee value propositions, investment in learning and career development, and workplace cultures that support talent retention. For example, Aragen is the only Indian CRDMO to have been recognized as a “Great Place to Work” for seven consecutive years from Fiscal 2020 to Fiscal 2026, underscoring its strong organizational culture and employee value proposition. Such sustained recognition reflects the workplace environment, career development opportunities, and employee engagement initiatives that help leading CRDMOs attract and retain high-quality scientific talent in an increasingly competitive market. Building a deep and experienced talent base is a gradual, resource-intensive process that cannot be replicated quickly, creating a significant barrier to entry for new market participants.
- **Customer Relationships and Retention Dynamics:** Once a pharmaceutical company selects a CRDMO for a development and manufacturing program, switching providers becomes costly and operationally disruptive because regulatory filings are linked to specific manufacturing sites and processes. Integrated CRDMOs can also onboard programs that originated with other CROs, CDMOs, or internal laboratories, creating multiple

opportunities to establish customer relationships across the pharmaceutical value chain. This strengthens customer retention, increases share of wallet, and reinforces the competitive position of established providers, making it more difficult for new entrants to displace incumbent relationships.

5.3 OPERATIONAL BENCHMARKING

Regulatory approval breadth and breadth of offerings are among the two most critical differentiation parameters in competitive mandates, and India's leading CRDMOs are demonstrating increasing competitiveness on both dimensions.

Aragen's key competitors in the India region include Anthem Biosciences, Sai Life Sciences, and Syngene International. Aragen is one of the three CRDMOs in India with strong capabilities across both small molecules and biologics among the assessed Indian peers as of March 31, 2026, allowing it to support customers across a broader range of therapeutic modalities than most Indian CRDMOs. The company has also distinguished itself through continued investment in next-generation biologics platforms while maintaining a wide portfolio of technology capabilities across discovery, development, and manufacturing. Aragen's capabilities enable it to offer comprehensive integrated DS-DP programs to customers, which is a growing area that is expected to reach USD 206 billion by Fiscal 2030. These offerings also include analytical and commercial manufacturing solutions to customers at various stages of clinical development, enabling the company to partner with customers across early and late-phase development programs as well as commercial manufacturing.

Exhibit 5.2: Capability Benchmarking of Select Indian Peers, FY26

Company	Aragen	Anthem Biosciences	Sai Life Sciences	Syngene International
CRO Basis Revenue				
CDMO Basis Revenue				
US CRO + India CDMO				
R&D Presence in Innovation Hubs				
CRO Capability				
Small Molecule CRO				
Biologics CRO				
Development Capability				
Small Molecule Preclinical / Early Phase DS				
Small Molecule DP				
Biologics Development				
Integrated Small Molecule DS/DP				
Manufacturing Capability				
Small Molecule DS				
Small Molecule DP				
Biologics DS				
Biologics DP				

Source: Annual Reports, Earnings Calls, Investor Presentations, Company Websites as accessed on 24th August 2026
Note: Dark Green represents Strong Presence, Light Green represents Moderate Presence, Amber represents Limited Presence, Red represents Negligible / No Presence.

Aragen established its biologics presence through the acquisition of Aragen Bioscience Inc. in the United States in Fiscal 2014, becoming the second assessed Indian CRDMO to offer biologics solutions. Since then, it has continued to expand its biologics capabilities through investments in advanced technology platforms and manufacturing infrastructure, strengthening its position as one of the few Indian CRDMOs with meaningful integrated expertise across both small molecules and biologics. Further, Aragen is one of the three CRDMOs among the assessed Indian peers with capabilities to offer cross border solutions supported by a nearshore R&D facility in the US together with large-scale offshore development and manufacturing facilities in India as of March 31, 2026. This US facility provides proximity to innovator biologics customers while the Indian manufacturing facilities provide a cost competitive execution base.

As of March 31, 2026, Aragen is one of only two assessed Indian CRDMOs offering a complete gene-to-GMP solution across both drug substance and drug product for biologics. This enables customers to progress biologics programs through multiple stages of development within a single platform, reducing coordination complexity and supporting integrated project execution. The company also operates the most number of vivariums among the assessed Indian peers as of March 31, 2026. Aragen is one of two Indian CRDMOs among the assessed peers to offer integrated Small Molecule drug substance and drug product development services, as of March 31, 2026.

Aragen became the first Indian CRDMO to receive the AEO T3 certification from the Indian Customs Department, reflecting its strong supply chain compliance and trade facilitation capabilities.

Over time, the company has expanded its scientific capabilities across a broad range of advanced chemistry platforms, including PROTAC chemistry, peptides, oligonucleotide and nucleic acid chemistry, ADCs, lipids, photo-redox chemistry, macrocycles, carbohydrates, organometallics, and deuterated compounds. Aragen has further strengthened its technical differentiation by establishing dedicated Centers of Excellence in peptides, oligonucleotide and nucleic acid chemistry, and PROTACs. These capabilities position the company in several of the fastest-growing areas of modern drug discovery and enable it to support increasingly complex customer programs.

Exhibit 5.3: Operational Benchmarking of Select Indian Competitors, FY26

Company	Aragen	Anthem Biosciences	Sai Life Sciences	Syngene International
Number of Service Offerings	22	15	18	21
Number of Customers	591	550	300	400
Number of Top 20 Big Pharma Customers served	16	-	-*	16
Number of PhDs	479	35	-	422
PhD-to-Scientific Personnel Ratio	14.04%	2.86%	-	7.30%
Number of R&D and Manufacturing Hubs	6	3	4	3
BSL Certification	BSL2	-	-	BSL2
AEO Certification	T3	-	T1	T3

Source: Annual Reports, Earnings Calls, Investor Presentations, Company Websites as accessed on 24th August 2026
*Note: * Sai Life Sciences serves 18 of the Top 25 Pharma Companies*

With more than 25 years of operations, Aragen has become the largest CRDMO among the assessed Indian peers in terms of number of solutions offered across the drug development value chain as of March 31, 2026. Aragen commenced its CRO solutions in Fiscal 2002 and has since grown to operate the second largest CRO solutions platform in India in terms of number of scientific personnel among the assessed Indian peers as of March 31, 2026, providing significant scientific capacity across multiple therapeutic areas and technology platforms.

The company is one of only three assessed Indian CRDMOs with meaningful capabilities across both small molecules and biologics, enabling it to support a wider range of customer programs and therapeutic modalities than most domestic peers. Its manufacturing facilities have been approved by several leading global stringent regulatory

authorities, including the FDA, PMDA, and MFDS, reinforcing its ability to serve innovator pharmaceutical companies in highly regulated markets[29].

Aragen's business relies on full-time equivalent (FTE) contracts, under which dedicated scientific teams work exclusively on customer programs over extended periods. These arrangements provide the company with greater revenue visibility, stronger customer retention, and improved resource utilization, while enabling pharmaceutical clients to access flexible, scalable R&D capabilities without expanding their internal scientific workforce. Since customers retain responsibility for material consumption and overall program success, the FTE model also offers a balanced risk-sharing framework that aligns long-term interests between the service provider and its clients. The FTE model is the preferred engagement model for Big Pharma companies particularly in early-stage CRO programs where dedicated scientific teams and continuity of research support are critical, and can be affected with the relatively high attrition rates observed during the research phase.

5.4 FINANCIAL BENCHMARKING

Indian CRDMO companies have recorded revenue from operations CAGRs of approximately 15.71% over the three years to FY26. Adjusted EBITDA margins for Indian operators average 31.89% in FY26, with Indian operators benefiting from lower facility construction costs and a cost-competitive scientific workforce.

Aragen has become one of the top three largest Indian CRDMOs in terms of operating revenue among the assessed Indian peers, operating in a global CRDMO market estimated at USD 171 billion in Fiscal 2026. This position reflects the company's continued scale-up across research, development, and manufacturing services and its growing presence in the global pharmaceutical outsourcing market. Aragen recorded the second highest revenue from operations growth between Fiscal 2025 and Fiscal 2026 among the assessed Indian peers, at 18.06%. Aragen's scale efficiencies and improved asset utilization have led it to improve its return metrics. For instance, its Return on Capital Employed (ROCE) and Return on Equity (ROE) were 18.18% and 11.96%, respectively in FY26, as compared to 14.66% and 10.70% respectively in FY25. The company's ROE was impacted in FY25 due to the infusion of fresh equity capital but recovered to pre-infusion levels in FY26, reflecting strong growth and improved capital efficiency. Investment in biologics typically depresses ROCE in the near term because capital employed rises immediately following substantial upfront investment in specialized manufacturing infrastructure, while earnings lag due to low initial capacity utilization, front-loaded R&D and regulatory costs, and higher working capital requirements. ROCE improves as facilities move from qualification to commercial production, increasing capacity utilization and fixed-cost absorption. Returns are further supported by a greater contribution from higher-margin biologics, operating leverage across multi-product facilities, additional CDMO manufacturing volumes from the same asset base, pipeline molecules progressing to commercialization, and improved working capital efficiency.

Exhibit 5.4: Benchmarking of Select Competitors, FY26

Company	Aragen	Anthem Biosciences	Sai Life Sciences	Syngene International
Financial Metrics				
Revenue from Operations (INR million)	21,783.92	21,243.33	21,924.92	37,387.00
Revenue from Operations Y-o-Y Growth (%)	18.06%	15.17%	29.38%	2.64%
PAT (INR Million)	2,576.44	5,917.92	3,489.10	3,167.00
PAT Margin (%)	11.83%	27.86%	15.91%	8.47%

[29] Regulated markets as defined by WHO as 'Stringent Regulatory Authority (SRA)' include countries such as Australia, Canada, Japan, South Korea, the US, and other SRA classified countries in Europe. All other countries are classified as emerging markets and include semi-regulated and unregulated markets. Semi-regulated markets have less-stringent regulations and offer low entry barriers in terms of regulatory requirements and intellectual property rights.

PAT Y-o-Y Growth (%)	42.83%	31.14%	105.08%	(36.17%)
Adjusted EBITDA (INR Million)	5,937.65	9,080.41	-	9,598.00
Adjusted EBITDA Margin (%)	27.26%	42.74%	-	25.67%
Adjusted EBITDA Y-o-Y Growth (%)	25.69%	27.44%	-	(11.05%)
ROCE (%)	18.18%	36.94%	-	14.47%
ROE (%)	11.96%	21.71%	15.13%	6.62%
Total Borrowings	4,472.97	510.68	951.25	94.00
Net Debt	208.19	(8,874.28)	-	(12,797.00)
Gross Fixed Asset Turnover	0.91	1.52	-	0.74
Net Working Capital Days	71	113	32	31
Inventory Days	52	104	86	59
Material Margin	15,881.86	13,120.50	16,216.00	28,201.00
Material Margin (%)	72.91%	61.76%	73.96%	75.43%
Operational Metrics				
Scientific Personnel Headcount	3,412	1,117	-	5,778
PhD-to-Scientific Personnel Ratio	14.04%	2.86%	-	7.30%

Source: Annual Reports, Earnings Calls, Investor Presentations, Company Websites as accessed on 24th August 2026.
*Note: Adjusted EBITDA = Profit before Tax and Exceptional Items + Finance Cost + Depreciation and Amortization + ESOP Expense – Other Income + Forex Gains/Losses; Adjusted EBIT = Adjusted EBITDA – Depreciation and Amortization; Adjusted EBITDA Margin = Adjusted EBITDA/Revenue from Operations; PAT Margin= PAT / Revenue from Operations; Total Borrowings = Current Borrowings + Non-Current Borrowings; Net Debt = Total Borrowings – Cash & Cash Equivalents Including Fixed Deposits with Banks – Current Investments + Margin Money Deposits with Banks; ROE = Profit Attributable to Shareholders / Average Equity; ROCE = Adjusted EBIT / Average Capital Employed; Capital Employed = Net Debt + Total Equity; Gross Fixed Assets Turnover = Revenue from Operations / Average Gross Fixed Assets; Gross Fixed Assets = Gross Block + Gross Intangible Assets; Inventory Days = (Average Inventory * 365) / COGS; COGS = Revenue from Operations – Material Margin; Net Working Capital Days = (Average Net Working Capital * 365) / Revenue from Operations; Net Working Capital = Inventory + Trade Receivables – Trade Payables; Material Margin = Revenue from Operations – Cost of Materials Consumed – Change in Work in Progress & Finished Goods; Material Margin % = Material Margin / Revenue from Operations; Scientific Personnel Headcount = Number of Scientific Personnel; PhD-to-Scientific Personnel Ratio = Number of PhDs / Scientific Personnel Headcount*

Exhibit 5.5: Benchmarking of Select Competitors, FY25

Company	Aragen	Anthem Biosciences	Sai Life Sciences	Syngene International
Financial Metrics				
Revenue from Operations (INR million)	18,451.07	18,445.53	16,945.70	36,424.00
Revenue from Operations Y-o-Y Growth (%)	11.31%	29.96%	15.66%	4.41%
PAT (INR Million)	1,803.80	4,512.59	1,701.32	4,962.00
PAT Margin (%)	9.78%	24.46%	10.04%	13.62%
PAT Y-o-Y Growth (%)	12.66%	22.86%	105.45%	(2.71%)

Adjusted EBITDA (INR Million)	4,724.04	7,125.24	4,272.15	10,790.00
Adjusted EBITDA Margin (%)	25.60%	38.63%	25.21%	29.62%
Adjusted EBITDA Y-o-Y Growth (%)	6.38%	37.13%	41.29%	6.32%
ROCE (%)	14.66%	35.11%	17.63%	19.09%
ROE (%)	10.70%	20.82%	10.96%	11.05%
Total Borrowings	4,774.78	1,089.55	1,286.36	1,196.00
Net Debt	(244.47)	(3,747.81)	(3,554.18)	(12,779.00)
Gross Fixed Asset Turnover	0.90	1.62	1.18	0.79
Net Working Capital Days	66	127	32	38
Inventory Days	60	135	81	76
Material Margin	13,755.24	11,006.41	12,288.06	26,999.00
Material Margin (%)	74.55%	59.67%	72.51%	74.12%
Operational Metrics				
Scientific Personnel Headcount	3,571	1,015	2,605	5,641
PhD-to-Scientific Personnel Ratio	12.15%	3.45%	13.05%	7.09%

Source: Annual Reports, Earnings Calls, Investor Presentations, Company Websites as accessed on 24th August 2026.
*Note: Adjusted EBITDA = Profit before Tax and Exceptional Items + Finance Cost + Depreciation and Amortization + ESOP Expense – Other Income + Forex Gains/Losses; Adjusted EBIT = Adjusted EBITDA – Depreciation and Amortization; Adjusted EBITDA Margin = Adjusted EBITDA/Revenue from Operations; PAT Margin= PAT / Revenue from Operations; Total Borrowings = Current Borrowings + Non-Current Borrowings; Net Debt = Total Borrowings – Cash & Cash Equivalents Including Fixed Deposits with Banks – Current Investments + Margin Money Deposits with Banks; ROE = Profit Attributable to Shareholders / Average Equity; ROCE = Adjusted EBIT / Average Capital Employed; Capital Employed = Net Debt + Total Equity; Gross Fixed Assets Turnover = Revenue from Operations / Average Gross Fixed Assets; Gross Fixed Assets = Gross Block + Gross Intangible Assets; Inventory Days = (Average Inventory * 365) / COGS; COGS = Revenue from Operations – Material Margin; Net Working Capital Days = (Average Net Working Capital * 365) / Revenue from Operations; Net Working Capital = Inventory + Trade Receivables – Trade Payables; Material Margin = Revenue from Operations – Cost of Materials Consumed – Change in Work in Progress & Finished Goods; Material Margin % = Material Margin / Revenue from Operations; Scientific Personnel Headcount = Number of Scientific Personnel; PhD-to-Scientific Personnel Ratio = Number of PhDs / Scientific Personnel Headcount*

Exhibit 5.6: Benchmarking of Select Competitors, FY24

Company	Aragen	Anthem Biosciences	Sai Life Sciences	Syngene International
Financial Metrics				
Revenue from Operations (INR million)	16,575.77	14,193.70	14,651.78	34,886.00
Revenue from Operations Y-o-Y Growth (%)	-	-	-	-
PAT (INR Million)	1,601.04	3,673.10	828.09	5,100.00
PAT Margin (%)	9.66%	25.88%	5.65%	14.62%
PAT Y-o-Y Growth (%)	-	-	-	-
Adjusted EBITDA (INR Million)	4,440.87	5,195.97	3,023.68	10,149.00

Adjusted EBITDA Margin (%)	26.79%	36.61%	20.64%	29.09%
Adjusted EBITDA Y-o-Y Growth (%)	-	-	-	-
ROCE (%)	14.81%	34.40%	12.69%	19.12%
ROE (%)	12.75%	20.04%	8.89%	12.95%
Total Borrowings	6,454.70	2,325.25	7,101.63	1,417.00
Net Debt	4,579.86	(4,104.04)	5,255.06	(9,350.00)
Gross Fixed Asset Turnover	0.93	1.52	1.27	0.80
Net Working Capital Days	64	120	45	54
Inventory Days	64	104	93	112
Material Margin	12,655.04	8,198.18	10,194.48	25,584.00
Material Margin (%)	76.35%	57.76%	69.58%	73.34%
Operational Metrics				
Scientific Personnel Headcount	3,195	1,500	2,353	5,656
PhD-to-Scientific Personnel Ratio	12.46%	2.33%	12.83%	9.37%

Source: Annual Reports, Earnings Calls, Investor Presentations, Company Websites as accessed on 24th August 2026.
*Note: Adjusted EBITDA = Profit before Tax and Exceptional Items + Finance Cost + Depreciation and Amortization + ESOP Expense – Other Income + Forex Gains/Losses; Adjusted EBIT = Adjusted EBITDA – Depreciation and Amortization; Adjusted EBITDA Margin = Adjusted EBITDA/Revenue from Operations; PAT Margin= PAT / Revenue from Operations; Total Borrowings = Current Borrowings + Non-Current Borrowings; Net Debt = Total Borrowings – Cash & Cash Equivalents Including Fixed Deposits with Banks – Current Investments + Margin Money Deposits with Banks; ROE = Profit Attributable to Shareholders / Average Equity; ROCE = Adjusted EBIT / Average Capital Employed; Capital Employed = Net Debt + Total Equity; Gross Fixed Assets Turnover = Revenue from Operations / Average Gross Fixed Assets; Gross Fixed Assets = Gross Block + Gross Intangible Assets; Inventory Days = (Average Inventory * 365) / COGS; COGS = Revenue from Operations – Material Margin; Net Working Capital Days = (Average Net Working Capital * 365) / Revenue from Operations; Net Working Capital = Inventory + Trade Receivables – Trade Payables; Material Margin = Revenue from Operations – Cost of Materials Consumed – Change in Work in Progress & Finished Goods; Material Margin % = Material Margin / Revenue from Operations; Scientific Personnel Headcount = Number of Scientific Personnel; PhD-to-Scientific Personnel Ratio = Number of PhDs / Scientific Personnel Headcount*