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UNITED STATES LIFE SCIENCES 2023

Finance - Regulatory Climate - Clusters - Academia
Drug Discovery and Development - Contract Services - New Technologies

Dear Reader,

Welcome to the 2023 edition of the *United States Life Sciences* industry report.

In many ways, 2022 was a turning point for the US life sciences industry. After having experienced a record number of deals, IPOs, and drug approvals in 2020 and 2021, the past year was marked by post-pandemic recovery, macroeconomic shockwaves, and regulatory changes that industry leaders fear could cool the industry's expansion going forward.

Yet, positive signs point toward another year of growth for the life sciences industry. With large pharma firms on the hunt for new technologies to bolster their drug pipelines, deal-making and M&As have already seen an uptick in 2023. And as the giants go on the hunt for biotechs' most promising discoveries, that influx in capital – estimated at over US$1 trillion – will benefit investment throughout the whole industry. Companies are also adapting their long-term strategies to consider the future effects of the Inflation Reduction Act on the industry. The latter was received with mixed feelings by life sciences leaders, who, when it came to negotiating drug prices that will affect their margins, recalled the importance of ongoing R&D expenditure to prevent unsighted events, such as Covid-19.

Biopharma and biotechs can rely on multiple allies on the road from discovery to commercialization: the CDMO, CMO, CRO, and services segments of the industry have never looked so healthy. This segment continued to strengthen in 2022, as the onshoring of manufacturing capabilities in the US, the push for green chemistry, and the need for skilled labor to industrialize promising technologies such as cell and gene therapies continue to drive for the industry.

As market uncertainty remains throughout 2023, multiple headwinds have not deterred an industry that is known for its innovation and resilience, but mostly for the strength of its science. With the return of international travel and trade events, the industry is poised to witness a supercharged period for partnering, strategic alignment, and contract agreements in the next 18 months. For life sciences firms – focused on cell and gene therapies, immune-oncology, or pioneering CNS breakthroughs – the focus will be on embracing digitalization, navigating a changing regulatory and financial landscape, and tackling health inequalities. As diseases know no boundaries, 2023 will certainly continue to bring about broader global cooperation, as US stakeholders continue to strengthen their global reach through academic, public, and private partnerships.

Beyond East and West dominance, the traditionally polarized US life sciences industry is now more integrated than ever. This report provides analysis derived from over 80 interviews with the industry's most insightful, thought-provoking, and authoritative executives across the life sciences value chain, spanning 19 US states, and with firms from three continents with large footprints in America. We would like to warmly thank these leaders as well as our association partners at BioNJ, MassBio, and Biocom California, and hope that you enjoy the read.

Alfonso Tejerina
Director and General Manager
Global Business Reports (GBR)

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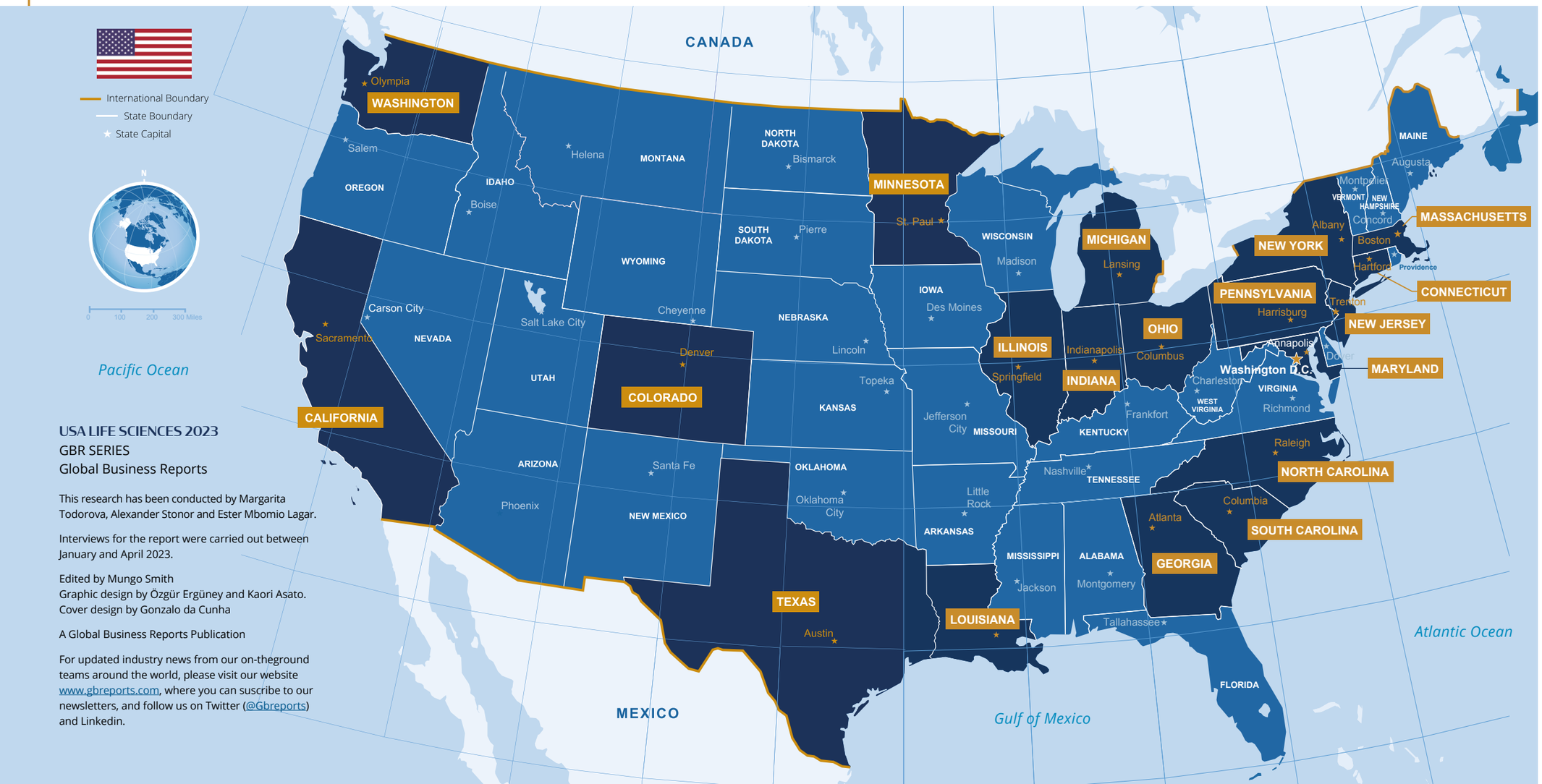
Established and Emerging Hubs

Drug Discovery and Development

Contract Manufacturing, Services and Chemicals

New Technologies



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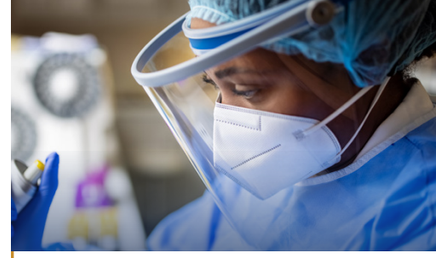

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INTRODUCTION

"The US is responsible for most new biopharmaceutical innovations. A recent pursuit of policies that will inevitably inhibit this innovation is worrying. A central pillar of the nation's hospitable environment for the life sciences ecosystem has been its strong, predictable, and reliable intellectual property framework."

Debbie Hart,
President and CEO,
BioNJ

Image by Luis Alvarez at GettyImages, courtesy of Veranova

Introduction to USA Life Sciences Industry

Weathering the storm

Image courtesy of Etihad Cargo

The ability of the US life sciences industry to attract innovation, talent, and investment remains unparalleled worldwide. From the R&D labs of the East Coast to the biotech leaders of the West, and passing by growing manufacturing hubs countrywide, biopharmaceutical leaders continue striving to keep the US in pole position for life sciences globally. Yet, following a "sugar high" for the industry in 2020-2021 at the height of the Covid-19 pandemic, 2022 felt like a hangover for several players across the value chain, bringing more uncertainty than guarantees for many, and raising concerns about the future of the industry.

Deemed, perhaps too harshly, as an "annus horribilis", 2022 was certainly a rocky year for the life sciences industry in the US. With capital markets having peaked in Q1 2021, the past 18 months were marked by macroeconomic shockwaves, repercussions of the Ukraine war, talks of a global recession, and a biotech space that arguably hit rock bottom. There is a silver lining, however. 2023 is deemed by many industry leaders to be the much-awaited M&A year. With big pharma holding over US$1 trillion in capital to deploy to deal-making, it will likely soon be shopping season for the 20 biggest firms in the industry, further reinforcing their pipeline and boosting R&D investments that will benefit biotech through a trickle-down effect. Looking ahead, the growth of the global pharmaceutical market (from US$1.42 trillion in 2021 to US$1.48 trillion in 2022 and a forecasted US$1.50 trillion finish in 2023) should accelerate significantly, as recent studies estimate the pharmaceutical industry to grow to over US$2.4 trillion by the end of 2029.

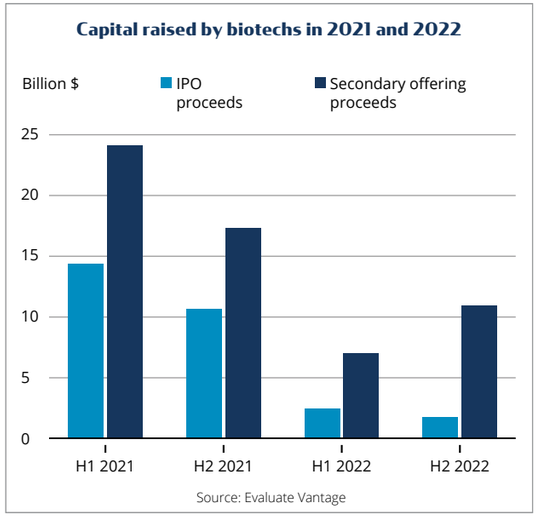
Beyond external geopolitical factors and recent turmoil in the banking system in March 2023 (rocked by the collapse of the Silicon Valley Bank, Signature Bank, and the last-minute rescue of Credit Suisse by UBS – perhaps the most substantial event for the life sciences industry in recent months came with the passing of the Inflation Reduction Act (IRA). Since August 2022, top-selling prescription drugs are subject to Medicare price negotiation, which has already impacted margins, revenue forecasting, and asset valuation for biotechs and biopharma. Among the giants, AstraZeneca and Pfizer have been vocal about the IRA's potential negative impact on their cancer drugs pipelines, worrying that close to 60 therapies will likely be affected by 2030. President and CEO of Biocom California Joe Panetta shared concerns about the regulation's impact on innovation: "Our elected representatives in Congress were

> Moving forward in 2023, we want to take what we learned from the pandemic and take this forward into a proactive end-to-end supply chain state.
>
> **Trevor Caswell, Chairman, Pharma.Aero**

short-sighted in passing the IRA. It will have a detrimental effect on investment in innovation. Beyond large pharma, the bottleneck will slow the pace at which smaller companies can raise the capital they need to sustain their discovery and development efforts."

There are nevertheless reasons to be excited for the upcoming decade of life sciences progress. From new drugs to advanced manufacturing techniques for cell and gene therapies, mRNA, orphan, and rare diseases discovery, the pharmaceuticals field is back to its pre-pandemic focuses, boosted by huge capital allocated by big pharma to R&D. With the pandemic redesigning the public's relationship with the industry, ESG, health equity, and precision medicine are now actual trends rather than buzzwords. With Covid-19 re-engineering home health, consumers become more comfortable with the self-administration of drugs. As put by John Pennett, partner-in-charge of the national technology and life sciences group at EisnerAmper: "It is a convergence of health care, payers, providers, AI, and connected patients that is under development. Individuals are making their own decisions, self-regulating and self-medicating."

Home health brings about risks for the consumer, however. The pharmaceutical counterfeiting market is currently valued at US$200 billion, with no signs of a decrease in sight. "Individuals' acceptance of online pharmacies will be the next main driver in the boom in counterfeiting," explained Steve Tallant, senior director, solution marketing group at Systech, a solutions division of Markem-Imaje.



Unsung heroes: the pharma distribution chain

With the height of the pandemic in the rear mirror, the life sciences industry is now reviving disrupted clinical trials for key drugs and vaccines and battling backlogs. Managing supply, cold, and refrigerated chain logistics is more important in an industry where time is of the essence (for both patients and shareholders).

Aerial logistics are therefore likely to increase in the coming years. Building on the success of air corridors established to deliver vaccines during the pandemic, several firms continue to answer seemingly impossible challenges. Etihad Cargo was a founding member of the HOPE Consortium, a vaccine distribution initiative that proved its value during the pandemic. "With the HOPE Consortium, we created a unique ecosystem from a logistics point of view, which was possible through collaboration with the government and businesses. Overall, 260 million Covid-19 vaccine doses were distributed to more than 60 different countries", detailed Fabrice Panza, manager of global cool chain solutions at Etihad Cargo.

The hyper-focus put on developing cell and gene therapies – widely accepted as the most revolutionary field in life sciences – will bring about further logistic challenges and more opportunities for air carriers. These technologies are highly sensitive to temperature deviations and must be handled according to tight frozen and cryogenic standards. As put by Trevor Caswell, chairman of Pharma.Aero, a collaboration platform bringing together manufacturers, certified cargo firms, airport operators, and logistics specialists: "The future of pharma is moving towards individualized treatment processes and protocols, which means we need to start looking more into how biopharma and cell and gene products are moved by air."

From air to land, earlier investments into the cold chain infrastructure will undoubtedly be leveraged as a pipeline for upcoming novel therapies and technologies in 2023 and beyond. Logistics firms must be innovative to best deliver vaccines and drugs to patients: UPS Healthcare delivered over 3 million doses of Covid-19 vaccines in Africa by drone. Dan Gagnon, vice president, global strategy & acquisition integration at UPS Healthcare, emphasized: "There is a strong pipeline of biologics and pharmaceuticals that will benefit from that readily available cold chain infrastructure."

Science does not stop. The formidable challenges of 2022 did not deter an industry known for its ability to adapt and resilience. Rapid innovation, strategic repositioning, and deal-making continued, albeit at a slower pace and with lower valuations than in the past two years. With the return of international travel and trade events, it is anticipated that over the next 12-18 months, the industry will see a 'supercharged' period for partnering, strategic alignment, and contract agreements. For life sciences firms – focused on cell and gene technology, providing lab equipment, or pioneering CNS breakthroughs – the focus will be on embracing digitalization, navigating a changing regulatory and financial landscape, and tackling health inequalities. As diseases know no boundaries, 2023 will certainly continue to bring about broader global cooperation, as US stakeholders continue to strengthen their global reach through academic, public, and private deals globally. ■

> I am excited about Janssen's aspirational vision to eliminate cancer. With targeted therapies and immunotherapies, cancer treatment can be more effective and less toxic, enabling individuals to manage their disease while also maintaining their quality of life.

Tyrone Brewer

President, US Oncology
JANSSEN PHARMACEUTICAL COMPANIES OF JOHNSON & JOHNSON

How did the oncology division perform in 2022 and what are the key areas of focus in 2023?
Our multiple myeloma portfolio has been a key growth driver for us, and we are one of the fastest growing oncology companies. We have assets that are best-in-class and revolutionary in the hematology space. We are also engaged in industry-leading work in solid tumors, prostate cancer, and lung cancer, and look forward to growing our portfolio of targeted therapies for patients.

How does Janssen leverage new machine learning and AI?
AI and machine learning are redefining our go-to-market strategy and ability to work with patients. Our precision medicine research, which is supplemented by artificial intelligence, is challenging our understanding of what is possible. This is exciting as it has the potential to unlock different diagnostics and treatment approaches and to change clinical practice and benefit patients of the future.

We're developing predictive biomarkers to guide targeted, personalized treatment options for different cancers and using digital tools to measure the signs and symptoms of the disease so that cancer can be diagnosed and intercepted at the earliest phases of malignancy.

Are ESG considerations key to improving the public perception of the pharma industry?
Our commitment to sustainability is anchored in three focus areas: our commitment to client action, reducing our impact throughout a product's lifecycle, and integrating principles of green chemistry and engineering in the development of our medicines.

A key area of focus for us is health equity. In the coming years, it will be even more critical that we solve inequities in oncology by removing barriers to access, designing more inclusive clinical trials, and collaborating with leaders at the community level. At J&J, we have a global initiative called Our Race to Health Equity, to rebuild healthcare from a diverse perspective and create a world where the color of your skin is not a determinant of your access to care, quality of care, or health outcomes.

Participation of diverse communities in clinical trials is critical to forward progress. In oncology, a clinical trial is an important therapeutic action. It might be the only opportunity for some patients to receive care. To overcome systemic barriers, Janssen Oncology launched a new, comprehensive approach from study planning through enrollment completion designed to improve access for and enrollment of racial/ethnic minority populations in cancer clinical trials.

What trends are likely to shape the biopharmaceutical industry in 2023?
There have been recent talks about the importance of M&A, particularly in oncology. It will certainly be a key part of the focus for us, the difference will be how to carry out these deals. It's critical we identify areas that are complementary where there are still high unmet needs. My assessment is that unmet needs will bolster deal-making and be a driver for acquisitions.

One of the most significant advancements in treating cancer has been the advent of immuno-oncology (I-O), harnessing the body's immune system to fight cancer. Identifying how to leverage a patient's immune system by addressing immune exhaustion, evasion and resistance is a key capability for Janssen. We formed a dedicated multifunctional team entirely focused on immunotherapy research.

Precision medicine will also be important for advancing diagnoses and treatment. In this new world, you will see more partnership with patients throughout their care. This will drive better collaboration to educate, inform and empower patients. Importantly, innovation cannot and should not happen without involvement and feedback from patients. It's critical that the patient's voice is heard, and that programs are designed with a patient-centric approach.

What excites you so far in 2023?
I am excited about Janssen's aspirational vision to eliminate cancer. With targeted therapies and immunotherapies, cancer treatment can be more effective and less toxic, enabling individuals to manage their disease while also maintaining their quality of life. This means people can continue to participate in important life events, spend time with loved ones and pursue their hobbies and interests, even while undergoing treatment. Through the development of novel treatments and technologies to new care models and delivery systems, we're working to help more patients live longer and live better with cancer. ■

Fabrice Panza

Manager Global Cool Chain Solutions
ETIHAD CARGO

How did Etihad Cargo perform since 2021?
Globally, Etihad Cargo performed well in 2021 and 2022 due to the global environment. The Covid-19 pandemic highly impacted global air traffic, and Air Cargo was a lifeline for Etihad Airways in 2021. Since then, our pharmaceutical and cool chain operations have significantly increased, both in volume and revenue. We have heavily invested in three main areas: training, infrastructure and collaboration. In 2023, we want to ensure that if any crisis should occur, we will be better prepared. Digitalization will be key, so we strive to dematerialize and simplify the flow of our pharmaceutical deliverables as much as possible.

What was your role in distributing the Covid-19 vaccine?
In 2020 we co-created the HOPE Consortium; a unique ecosystem from a logistics point of view, which was possible through collaboration with the government and businesses. Overall, 260 million Covid-19 vaccine doses were distributed to more than 60 different countries through the HOPE Consortium, which is remarkable.

Can you speak to recent technological investments you made?
When it comes to air cargo transportation, you need an airway bill that represents heavy documentation, and tons of paper. So, a key initiative for us is the dematerialization of the airway bill, which we call an e-airway bill. We achieved in just one year a remarkable penetration; more than 85% of airway bills were electronic in 2021, and now we are above 90%.

Where does the US fit within your longer-term strategy?
The US remains key inbound and outbound for the pharma market. We are connecting to and from the US with a full freighter service on top of our passenger schedule five times a week from Abu Dhabi- Frankfurt-Chicago, and are keen on developing partnerships. We will double our capacity to JFK soon. ■

Dan Gagnon

Vice President, Global Strategy & Acquisition Integration
UPS HEALTHCARE

How was growth for UPS Healthcare in 2022 and early 2023?
In 2019, UPS invested in a dedicated healthcare vertical. All of our healthcare logistics experts, facilities, cold chain infrastructure, and assets were brought together under one group. This vertical stands at almost US$10 billion today, and focuses primarily on providing end-to-end logistics support for the pharmaceutical, medtech, lab diagnostics, and clinical trial sectors.

The Covid-19 pandemic hit shortly after UPS Healthcare was established. Our clinical trials unit, Marken, worked closely with vaccine manufacturers. In November 2022, UPS purchased Bomi Group, a Europe and Latin America-based healthcare logistics provider. This has put UPS Healthcare in a leading position in Italy, Spain and France, added competencies in medtech, and overall benefited our cold chain capabilities expansion in priority markets.

How did the pandemic impact cold chain and refrigerated logistics, and how did UPS navigate it?
Covid-19 accelerated investment in cold chain logistics across the industry. Cold chain logistics are costly and complex, but with Marken running most of the Covid-19 vaccine clinical trials, we knew there was a high chance of mRNA vaccines being approved for use. It allowed us to have conversations with manufacturers about what their logistics needs would be once their vaccines were commercialized. We put investment upfront into that network, which paid off, especially for mRNA vaccines. There is a strong pipeline of biologics and pharmaceuticals that will benefit from that readily available cold chain infrastructure.

What are the drivers behind the forecasted growth of the cold chain logistics healthcare market?
The cold chain logistics healthcare market is due to reach US$20 billion in value by 2024, as the pipeline is loaded with great vaccines, biologics, and innovation. A leading component of that growth will certainly be cell and gene therapies, and Marken, our clinical trials arm, has a strategy to become the number one player in cell and gene logistics. ■

The Investment Climate

Picking ripe apples: a sweet spot for M&As

Image by dbvirago at Adobe Stock

The capital bonanza seen in 2021 and early 2022 (before the Ukraine war) waned in the second part of the year, yet this did not deter R&D investment among the largest pharma players. Roche, Pfizer, J&J, Novartis, and Merck all saw increases in their R&D budgets, as these oscillated between 11%-23% of the percentage of total revenue in 2022. Yet, the steepest bull market in pharma's recent history is over, and several factors – from geopolitical tensions and macroeconomic uncertainty, to patent cliffs – will continue to trouble board meetings throughout 2023.

The prospects of a recession, rising interest rates in the US, and a global slowdown in the economy have altered VC funding, and recent banking turmoil will likely cause a slowdown in funding at least until the end of Q2 2023. In 2022, both M&A and venture deal-making in life sciences declined, with overall M&A deal value down over 40% year-on-year to US$158.5 billion, according to PwC. Yet, VC funding in 2023 is still on track to exceed pre-pandemic levels by 20% according to data from CBRE, and NIH grants and funds were on the rise in 2022.

Indeed, with big pharma surfing on bumper sales from vaccines and pandemic-recovery cancer treatments, and with biotechs juggling higher interest rates and lower valuations, early 2023 saw a much-anticipated uptick in M&A activity. J&J announced the merger with Abiomed, Amgen secured the US$28.3 billion acquisition of Horizon, and Pfizer snapped up cancer-focused Seagen for US$43 billion. With most of the drug discovery in the hands of smaller biotechs, the top pharma firms are looking to bolster their pipelines. With a cumulated US$1.4 trillion war chest in capital to deploy toward inorganic growth, 2023 is shaping up as a bullish year for large pharma to go shopping for pre-revenue companies to bolster its pipelines and increase revenue – thus for M&A.

Beyond M&A, conditions also seem ripe for reverse mergers. With financing options limited due to the aftermath of the geopolitical turmoil, the state of the economy, and dormant transactions in the mid-range due to limited SPACs in recent years, investors are in the driving seat in terms of valuation and structure, but life sciences firms must remain creative regarding financing techniques. As forecasted by John Pennett, partner-in-charge of the national technology and life sciences group at EisnerAmper: "We see this as an exciting time to be investing in record-high levels of innovation at very attractive valuations. Companies are looking for public vehicles, and we may see some reverse mergers into some of these fallen angels over the next year."

These comments were seconded by Chris Garabedian, chairman and CEO of Xontogeny, and portfolio manager of the Perceptive Xontogeny Venture (PXV) Fund, who explained: "A slowdown in the IPO window means crossover investors have focused more on their public equity investments as opposed to private equity. Consequently, there

are more opportunities for firms that cannot go public in this environment but that still need private equity."

The prospect of a patent cliff for pharma looms ahead. Evaluate Pharma forecasts that US$258 billion are at risk as firms' leading products face competition from lower-priced generic and biosimilar challengers. In that sense, acquiring fast-growing and de-risked biotechs is a clear strategy for pharma firms with deep pockets to battle revenue erosion. BMS, Amgen, and Pfizer have acted upon it, as they will lose exclusivity on some of their best-selling drugs in the short term. Cures for unmet needs are also attracting industry giants. Tyrone Brewer, president, US oncology, Janssen, shared: "My assessment is that unmet needs will bolster deal-making and be a driver for acquisitions. Our focus is to follow the science and put the strongest R&D team in the industry together to help expedite the development of these opportunities."

Standing out from the pack

The plunge in IPO numbers in 2022 left most biotechs unable to raise capital from public offerings. In 2022, 47 biotech IPOs raised US$4 billion. A far cry from the US$25 billion raised by the 152 offerings in 2021. From West to East Coast (the San Francisco/Bay Area led VC funding with over US$12 billion, seconded by the Boston area with US$8 billion), cash-strapped firms at the end of their runway are presented with closed public markets and a highly competitive environment in which to attract capital, almost enforcing deal-making as the only recourse to bring their candidates over the finished line.

Raising money will remain a challenge for early-stage firms with no late-stage clinical assets. Indeed, in this macroeconomic environment, investors have shifted their stance towards de-risked assets as opposed to a trend observed pre-pandemic of capitalizing on technologies before significant value inflection points. As initial seed and Series A investment dollars become a sought-after commodity, generating data and reaching milestones in the clinic and with the FDA will be crucial for firms seeking venture capital. Tellus Therapeutics, a neonatal care company focusing on the development of treatments for the unmet needs of newborns, secured a US$35 million Series A investment in December 2022. CEO Jason Kralic detailed what prompted Xontogeny Perceptive Venture Fund to pull the trigger: "The financing was triggered by reaching nonclinical development and regulatory milestones that increased our confidence in the clinical development path for the treatment of preterm infants."

Many of the inexperienced investors that tagged along during the pandemic have now turned around and fled, thus dropping share prices for publicly traded companies. That cycle damaged a lot of relatively low-cap, publicly traded biotech companies, which saw their promising technologies falling out of favor. As specialist funds regain most demand for shares, capital allocation will become ever so selective, according to James Gale, founding partner, and managing director at Signet Healthcare Partners: "There is sufficient capital capacity among ven-

» The pandemic cycle brought several companies into the public markets too early, and it exaggerated their valuations. This has now left them stranded and struggling to find capital. It will take us a while to get through this, but as the fundamentals are so positive, I am confident that in the long term, our sector will thrive.

Douglas Crawford,
Managing Director, Mission BioCapital «

ture firms but there may be a slowdown in future commitments to these funds in the mid-term. New capital will be infused selectively and could reflect tightening capital market conditions."

The year ahead: health equity, clinical data, and RWE

For revenue-generating firms, ESG and health equity are no longer merely buzzwords. For the life sciences industry, incorporating ESG strategies starts with health equity and patient access to healthcare. The past years have shown that ESG is gradually being embedded in business operations and more central in the context of third-party engagement, which is vital in reinforcing the improving public perception of the industry, as mistrust remains a growth challenge for pharma. Detailing J&J's "Our Race to Health Equity" initiative – put in place to address access to care and quality of outcomes to everyone – Tyrone Brewer explained: "I would be shocked if you could pick up any corporate report that does not talk about an ESG commitment. It is all about increasing awareness in education and access to clinical trials for underrepresented ethnic communities."

Early-stage firms seeking investment will have to face increased due diligence from VCs after the "sugar high" experienced in 2020-2021, when several companies went public too soon and without a well-thought-out strategy. Today these firms must focus on finding partners to develop their assets or find them a different home. This makes life harder for pre-revenue life sciences firms that do not yet have clinical data. Christina Bardon, co-managing partner at MPM | BioImpact Capital explained: "In 2020, several companies invested in platforms without necessarily paying attention to reaching clinical milestones. Investors are now more parsimonious and looking for clinical-stage assets and tangible value creation. 2023 is a time to focus on clinical data."

With unique access to the biotech ecosystem in Massachusetts, Kendalle O'Connell, CEO and president at MassBio, shared investors' analysis: "Companies will have to be able to give more clinical data to investors to create confidence in their ideas and raise funding in future rounds."

Indeed, for biotech companies running out of cash, the silver lining could be pushing to that later stage onto their next clinical data readout. Firms that can provide real-world evidence (the combination of real-world data and analytics) will have a competitive edge moving forward. The FDA uses RWE (Real World Evidence) to make regulatory decisions, and the latter is being used to strengthen clinical trial designs and observational studies to create new treatment options for patients. This impacts FDA approvals and accelerates the drug development process, which saves late-stage firms and drugmakers time and cash. Denise Juliano, who leads the Life Sciences division at Premier Inc., a leading healthcare improvement company, said: "The RWD (Real World Data) and RWE market is expected to reach US$2.3 billion by 2026, up from US$1.2 billion in 2021. RWE is the future."

The life sciences story in 2023 should continue to unfold with a stronger investor appetite, particularly for de-risked projects. Emerging technologies and early-stage firms will likely continue to face headwinds to prove the long-term value of their candidates in a market where de-risking is key, while steady valuations for companies that are well established are likely. Both public and capital markets will likely continue to reward firms that survived the translational gap (or "valley of death") stage from discovery to translation into effective proof-of-concept, (including Phase 2 clinical development), pushing more firms to be in the clinic before their IPO. ■

Leading states in bioscience venture capital investments, cumulative 2018-2021

Leading States	Total (Billion $)
California	$79.3
Massachusetts	$ 41.4
New York	$ 18.4
Washington	$ 5.7
Pennsylvania	$ 5.3
Texas	$ 4.9
Illinois	$ 4.2
Minnesota	$ 3.9
Colorado	$ 3.4
Maryland	$ 3.4

Source: TEConomy Partners analysis of PitchBook Data, Inc

» **When it comes to 'onshoring', we help explain that 'everyone has a shore', and that a robust supply chain is better than a geographically constrained one.** «

Gil Roth

President
PHARMA & BIOPHARMA OUTSOURCING ASSOCIATION (PBOA)

The Generic Drug User Fee Amendments were a key focus for PBOA in 2022. What has your progress looked like, and what else kept you busy last year?

A core focus of ours in 2022 was helping shepherd the GDUFA 5-year reauthorization along. It was a little bumpy for a variety of reasons not tied to our negotiations, so the user fees — Generic, Prescription, Biosimilars and Medical Device — got approved later than they usually do in the fiscal year. Because of that delay, some FDA-related riders intended for the UFA legislation "fell out", but some were included in the year-end Appropriations Omnibus bill. One of these was a pilot program for FDA to review advanced manufacturing platforms and technologies in a way that's not tied to specific drug applications, making them "application-agnostic". We believe that will help free up resources on the FDA side over time as CDMOs' platforms are better understood by the agency, helping those technologies proliferate. In addition, there is also legislation to create Centers of Excellence in Advanced and Continuous Manufacturing that got passed in the Appropriation Bill that will help with new technologies in the US.

What have been your Supply Chain Task Force's main achievements?

That PBOA subgroup has connected with several agencies to discuss supply chain issues. We help when the HHS and other groups want to discuss how to ensure that supply chains are ready for the next pandemic. For some areas, there is plenty of capacity in the US, and we help explain why investments and incentives need to be targeted; it is about getting sources of discrete doses and finding that balance. When it comes to 'onshoring', we help explain that 'everyone has a shore', and that a robust supply chain is better than a geographically constrained one. We talk about some of the international dynamics; for example, Europe wants to increase its domestic manufacturing base, while Canada realized it had no vaccine manufacturing capacity and ended up buying Covid-19 vaccines from CEPI at one point.

To what extent do you expect a reshoring of the supply chain, and how does one close the manufacturing loop in the US?

It would take decades and add a huge cost to drugs to 'reshore' the supply chain. In 2020, the previous administration put out an Essential Medicines List, the idea being to make sure these medicines have a secure supply chain. The new administration looks more towards "friend-shoring", while still pushing for more domestic manufacturing. But friends are not immune to natural disasters. As far as onshoring goes, we have explained that within the dosage form space, there is plenty of manufacturing capacity and room for expansion in the US. With APIs, it is a different story, because of a variety of factors, but reshoring a lot of commodity APIs manufactured in China would involve a significant cost.

How is the current geopolitical uncertainty impacting the life sciences industry?

The Ukraine crisis highlighted how Europe needs to look at its energy supply and how it will make sure it has secure supply chains. Part of that has involved the US more closely. With China, it is cloudy.

Geopolitics will have a more significant impact going forward.

What are some of the key drivers of the CDMO market?

The growth in biologics, vaccines and cell and gene space are huge drivers. Also, more companies became more conformable with some type of outsourcing. J&J manufactured its bulk Covid-19 vaccine but outsourced drug products to several of our members. They were comfortable with not owning that huge project, and never said, "We'll work with these CDMOs until we can build our fill-finish capacity." Smaller biotechs were getting more funding, which feeds into the CDMO sector, although that has dipped in the current interest landscape. The healthier the bio-startup world is, the healthier the CDMO market will be.

What will be PBOA's main priorities heading into 2023?

Keeping an eye on where the onshoring conversations go. With the new Congress in place, there may be tensions in terms of pandemic preparedness and how much the government is willing to spend to sustain manufacturing capacity. On the regulatory front, the FDA continues working on its Quality Management Maturity Initiative, and there are challenges regarding the data they want to collect and how they plan to use it. ■

Arda Ural

Americas Industry Market Leader, Health Sciences & Wellness
EY USA

How did your division help its customers in 2022?
2022 has been a transformative year for many of our clients. On the biotech side, the issue was the drop in valuations from the pandemic 'sugar high'. Our focus has been on divestments, portfolio optimization, and, from a functional perspective, technology and supply chain activity. Additionally, clients need to make sure their commercial potential is maximized so, on the customer and commercial side, patient services and reimbursement assistance are in high demand, in addition to M&A services. What we will see more of is the cash management challenges given the industry's need for it, with the topline eroding due to the upcoming loss of exclusivity wave driven by biologics. Pharma will be squeezed from multiple angles, so the industry will need a multifaceted effort to maintain margins.

What is your financial outlook for the industry in 2023?
I expect the market to remain quiet for the first half of the year, but we need to keep in mind that pharma needs new products with the topline eroding. For the first time, we are estimating US$1.4 trillion of cumulative firepower to deploy toward inorganic growth and *capex*. Pharma now has a balance sheet to afford acquisitions, but low valuations do not mean pharma will go on a buying spree, it has to make sense portfolio-wise.

How do you guide customers' ESG strategy?
We have an ESG health equity survey that demonstrated how health equity strategies are a priority for pharma. There is also a need for diversified clinical trials.

How do you plan on helping the industry in 2023?
We are going to help the industry digitalize, prepare for the innovation deficit due to expiring patents and improve strategies that lead to better M&A opportunities. Finally, we will work to enable the better operational, workforce, and financial resiliency. ■

Christiana Bardon

Co-Managing Partner
MPM | BIOIMPACT CAPITAL

What are the highlights for MPM Capital so far in 2023?
For those investors with fresh capital, we see this as an incredible buying opportunity. We raised our Oncology Impact Fund II in 2020 and our BioVentures Fund in 2022, and we are excited to be deploying capital into a buyer's market. For public market investments, we can now buy Phase 3 or commercial assets at the same valuations we normally pay for early-stage clinical assets. We see this as an exciting time to be investing in record-high levels of innovation at very attractive valuations.

How will the M&A environment shape in 2023?
I believe 2023 will be a big M&A year. First of all, big pharma is always ready and able to execute M&A given their tremendous cash flows and cash balances. The only question is whether there are mature, de-risked assets of interest for them to acquire. 2023 is different because there is a big crop of phase 3 and approved assets in the biotech industry. The difficult funding environment also supports M&A.

Which trends do you see settling in the market shortly?
I think one of the biggest trends will be obesity and obesity-related illnesses. We are about to launch a major category of GLPs drugs for the treatment of obesity. These drugs have incredible efficacy, leading to almost 30% weight loss for people with BMIs of 35 to 40. This will be transformative to the 140 million patients affected by obesity. Additionally, obesity-related illnesses such as NASH liver disease affects 10 plus million patients, and those patients also need to be treated to prevent liver cirrhosis and liver failure.

What areas will MPM Capital hone its investment around?
About our private investing, we continue to be excited about next-generation modalities such as circular RNA and the use of novel delivery technology for RNA. ■

Chris Garabedian

Chairman and CEO, **XONTOGENY,** and Portfolio Manager, **PERCEPTIVE XONTOGENY VENTURE (PXV) FUND**

How do you assess the current regulatory environment in the US?
The FDA is currently trying to encourage flexibility in the type of data they will consider, along with their willingness to discuss endpoints of understudied diseases for which there is no precedent. This is good for the industry.

How do you see 2023 unfolding for biotechs?
In 2023, we will see more companies reducing the workforce and extending their cash runway to survive to more meaningful data inflections. The market likely has hit its bottom.I don't expect a strong growth period for the sector to begin until 2024, at the earliest.

What will be the focus for Xontogeny and PXV in 2023?
We will be focused on providing strong strategic guidance and operational support to our existing investments. Following a long period of significant investment in early-stage firms, our industry needs to allow existing investments across the industry to mature and show signs of success before driving a large number of new investments in preclinical-stage projects. As such, Xontogeny will slow the pace of seed investments and our PXV Fund will skew toward investments at, or near, the clinical stage. ■

James Gale

Founding Partner and Managing Director
SIGNET HEALTHCARE PARTNERS

Are you focusing on any particular innovation, technology, or therapeutic area?
We pay careful attention to the generics and consumer health, and specialty pharmaceutical sectors because these constitute about 80 to 85% of total prescriptions written in the US. On the other hand, we continue working on new technologies on a partnership basis, coming together to create new therapeutics to treat previously unmet medical needs.

What is your outlook for dealmaking and M&A in 2023?
There is considerable overlap in the number of programs for a particular therapeutic indication. Will these companies be able to find buyers? Big pharma is favoring products that are in the market or late stage. They are also very selective because of the competitive landscape in a particular disease or treatment category. The decline in valuations of companies is also causing a price gap between buyer and seller. But, as sellers begin to accept the reality of lower valuations and possibly the need to do a transaction, M&A activity will likely start to pick up.

Where do you see your investment going next?
We are looking at both innovative companies in pharma services and CDMOs. Also, some specialty pharmaceutical companies are expanding and need capital. ■

Brian Scanlan

Operating Partner – Life Sciences
EDGEWATER CAPITAL PARTNERS

Can you give an overview of Edgewater?
2022 was a good year in terms of deals for Edgewater. We acquired GL Chemtec, a Canadian CDMO specializing in chemistry-based services for the development and scale-up of APIs. Our life sciences practice has a focus on three key areas. Number one is in the pharma chemicals space - small molecule batch organic chemistry companies that are doing APIs, intermediates, and regulatory starting materials – where we are focused on companies that have a unique or differentiated offering. Vertical two is more broadly pharma services - CRO, CDMO, CMO type organizations – where our focus is on companies that are involved in the research, development, or manufacturing of materials going into pharma supply chains. The third vertical encompasses the tools, reagents, and technologies side, such as product-orientated companies that are focused on tools and reagents used in chemical or bioprocessing, and in diagnostic applications, as well as materials such as functional excipients. We are casting a wide net within these three verticals, but see significant opportunity for consolidation within the reagents and diagnostics space as well as with smaller CRO/CDMO companies, particularly in North America given there are over 1,000 companies in this space that are down below 200 employees. ■

The Regulatory Landscape

Measuring Inflation Reduction Act (IRA) implications

Image courtesy of CordenPharma International

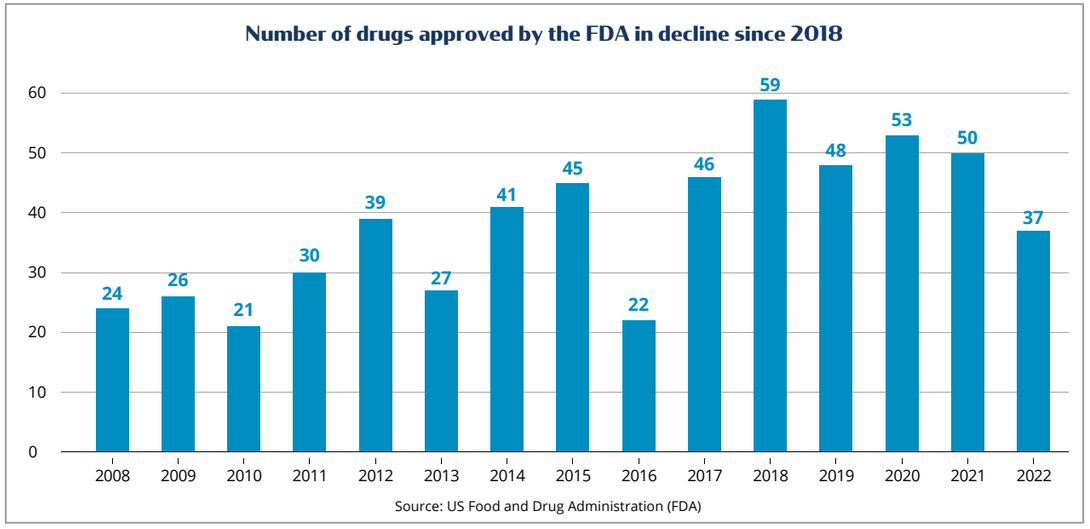
The regulatory environment is a key element in keeping the US the undisputed life sciences innovation leader globally. Over the years, legislation and regulations from Washington, DC, contributed to initiating and sustaining that leading position. Yet, industry leaders worry that recent policies will inhibit big pharma and biotech's ability to innovate. Indeed, as put by BioNJ president and CEO Debbie Hart: "A central pillar of the nation's hospitable environment for the life sciences ecosystem has been its strong, predictable and reliable intellectual property framework. Biomedical innovation is risky, as approximately nine out of 10 therapeutic candidates from biotechs never come to fruition."

The Biden administration's passing of the Inflation Reduction Act (IRA) in August 2022 felt like a shockwave for the US life sciences industry. In a groundbreaking fashion, the IRA includes measures that prevent increases in drug prices from surpassing inflation, reform the Medicare drug-pricing policy through price negotiations and includes a higher inflationary cap price. Big pharma publicly expressed concerns about the impact of the IRA on its sales and revenues, particularly anticipating less investment geared towards innovation. Overall, this means that US-focused companies will need to revise R&D investment, reassess revenue projection, and question their long-term pipelines. Donna LaVoie, president and CEO of LaVoieHealthScience, a strategy consulting firm, summarized: "The Inflation Reduction Act is a big deal. Drug approvals and pricing is top of mind and heading news lines. We are currently in an environment where the investors will want to understand the regulatory environment and reimbursement before investing."

Understanding the state of the life sciences industry in 2023 would be impossible without having a close look at the elephant in the room (or in the Act): the Prescription Drug Provisions section of the IRA. This section caught the industry short. Conversations with US decision-makers throughout the value chain all point towards pharma not expecting Medicare pricing negotiation in the near term. Briefly, the provisions will require the federal government to negotiate some drugs covered under Medicare from 2026, require drug companies to pay rebates if prices rise faster than inflation for drugs used by Medicare beneficiaries, and delay the implementation of the Trump Administration's drug rebate rule in 2027. The Congressional Budget Office estimates that the provisions in the law will reduce the federal deficit by US$237 billion until 2031.

Deloitte data shows big pharma collectively spent US$139 billion in R&D investment in 2022, a 2% decrease from 2021, but still above the US$100 billion mark the industry hit for the first time in the second year of the pandemic. The latter is a reminder of the importance of R&D – manufacturers developed a vaccine in nine months thanks to decades of work done in the mRNA field. Tyrone Brewer, president of US oncology at Janssen, a pharmaceutical company of J&J, recalled: "This would not have been possible without huge and continuous investment, and this is why policies that could harm R&D and innovation budgets are so key to address. The pandemic was a reminder: it is not a question of if, it is a question of when.".

Ultimately, the industry will look for the federal government to share the financial risks of taking drugs to market, either through incentives, subsidies, or tax breaks. This ever-changing regulatory environment coupled with increased enforcement provides a niche opportunity for legal and consulting firms to help clients navigate the IRA. After being acquired by RLDatix in 2022, Porzio Life Sciences, a compliance leader, took another dimension. The firm is now more established in the government pricing area and has kept adapting its offering as laws seldom change incrementally. When discussing the federal government's ability to negotiate drug prices through the IRA, John Patrick Oroho, president and general manager of Porzio Life Sciences, explained: "This is where innovator companies,



that spend a lot of money in R&D to get new drugs to market, have an issue; innovation money comes from profits from existing products. If the government is going to negotiate prices, the government is going to have to invest back in the market to split the risks."

Drug manufacturing, pricing, and approval: maintaining a competitive edge

The Biden administration launched a biomanufacturing and biotech strategy in September 2022 to secure a domestic supply chain of key drugs and make the US industry competitive against its Asian counterparts. The White House identified several areas of concern for the US pharma-manufacturing industry caused by decades of offshoring production. Data from the FDA shows that 75% of APIs supplying the US market come from overseas. To create jobs and counter Chinese competition, the key pharma players have been looking to the Biden administration to offer tax breaks to prompt more manufacturing in the US, and federal funding to cover the cost of loans. Initial efforts are encouraging: "We are starting to see a rise in policy initiatives to incentivize domestic manufacturing and reinforce the US' competitive edge. Policymakers and leaders in the pharmaceutical industry understand the importance of investing domestically", explained Janssen's Tyrone Brewer.

Remaining at the forefront of innovation implies competition on the international front in terms of new molecular entities' approval. 2022 was a relatively slower-paced year for the approval of drugs by the FDA. The agency gave its nod to 37 new entities in 2022, the lowest total since 2016, and a steep decrease compared with the 50 drugs approved in 2021. Regulators perhaps decided to remain on the conservative side after the controversy caused by the FDA's accelerated approval pathway and the walk back from giving Biogen's Alzheimer's disease treatment Aduhelm the green light in 2021. As 2023 unfolds with 14 approvals by the FDA up until May, industry leaders will assess if last year's dearth of approval was simply a cyclical glitch (like in 2016, when only 22 entities were approved between years when 45 and 46 were awarded), or if this decrease turns into a trend.

What is promising for future entities' approval is the FDA's push to clear its backlog of facility inspections. In November 2022, the Office of Regulatory Affairs stated that it had resumed routine domestic operations, and the high priority given to domestic inspections will likely contribute to decreasing timelines towards approval. Robert Poe, CEO of Olon Ricerca – whose Concord, OH facility was successfully inspected in 2019 – acknowledged the downstream challenge for manufacturers post-Covid-19: "The biggest challenge is that the FDA is understaffed and cannot do inspections as regularly as they could in the past, and this will take several years to address."

Drug pricing and approval are two interconnected issues that will undoubtedly remain at the forefront of discussions during board meetings in 2023. BioNJ estimated that provisions in the IRA regarding price-setting are projected to result in 135 fewer new cancer drug approvals and 551 fewer HIV/AIDS clinical trials by 2039. On the approval side, some biotechs have acknowledged the FDA's push to approve more drugs, particularly in the rare and orphan diseases space. Prashant Kohli, CEO of Acasti, a late-stage specialty pharma company advancing two phase 3 programs, said: "The FDA wants to see companies making investments in rare diseases to address unmet needs."

The passing of the IRA suggests pricing and public-private negotiations will likely remain the industry's biggest risks in 2023 and beyond. Overall, more risk-sharing among stakeholders, clarity on R&D spend, and public-private collaboration are needed ahead, as the industry – which has often been solely deemed as profit-driven – pushes toward a shared goal: innovative drugs mean new treatments and new hope for patients in need. ■

> We are always looking at new regulations in the US and worldwide: laws very seldom change incrementally, so we adapt our systems to reflect that.

John Patrick Oroho

President and General Manager
PORZIO LIFE SCIENCES

What were the synergies behind Porzio Life Sciences' acquisition by RLDatix?
We have already created our successful transparency systems and a global HCP system for life science companies. Critically, we built an analytics platform – Porzio Price Transparency Reporting (PTR) – a system to do price transparency reporting in the US, as 22 states have transparency requirements now. That continues to grow, and with that, we got more involved in the government pricing arena. We wanted to develop a government pricing and revenue management system that would allow us to gather federal government reporting requirements and federal price requirements in addition to the states. When two private equity firms approached us – one in the US and one in the UK, Five Arrows, part of Rothschild & Co – we started discussions, and as we went through the process, a portfolio company of Five Arrows firm called RLDatix entered the play, as the Datix part of the firm was born out of a UK law firm. With us being a subsidiary of a US law firm, they recognized similar patterns and went ahead with the acquisition.

How do you assess current collaboration between the life sciences and healthcare spaces?
Our business plan is simple: we find an area where there are expanding laws and new legislations. We build a database to track legislation there, analyze them, and understand how firms can comply state-wise and federal-wise. We can also advise companies on how they comply with transparency compliance worldwide. After the database, we build a system to automate the whole process. We are starting to see that healthcare and life sciences systems are increasingly merging. Major medical centers are partnering with biopharma to develop and commercialize products. This is exciting: healthcare globally is coming together, and RLDatix wants to be the governance risk and compliance provider of GRC systems and solutions.

Post-IRA, what is your outlook on the current regulatory environment in the US?
The government does not always have the best processes in place to make sure its investment is reaching the right beneficiaries. In a pandemic situation, the government focused on getting money out, prompting innovation, and allowing vaccines to developing quickly. The problem is that the money goes into the market so fast that the government can't monitor if it is going to the right places, causing fraud and abuse because they did not do the due diligence well enough.

It is a challenge for firms to operate in an ever-changing regulatory environment with increased enforcement. With the Inflation Reduction Act (IRA), the authorities want to empower the federal government to negotiate drug prices. This is where innovator companies, that spend a lot of money in R&D to get new drugs to market, have an issue: innovation money comes from profits from existing products. If the government is going to negotiate prices, the government is going to have to invest back in the market to split the risks.

What is long-term your growth strategy?
We now have a global reach. We were 50 people as a subsidiary of a law firm going against global firms like PWC, IQVIA, and S&P. We are now part of an organization of 19,000 people. RLDatix has a tech center in North Macedonia with 400 tech employees, and this is where the R&D of new systems takes place. We can build the next-generation system to stay ahead of the market without having to divert my team's attention.

Besides that, we plan to grow through acquisitions. RLDatix was worth US$20 million in 2015, and this fiscal year, they will be north of US$460 million. RLDatix also acquired iContracts, allowing us to offer a full suite of services. We also took over iCoach First, a leading coaching platform for life sciences firms in the US. Cloud9, another firm we took over, built a system called Intelligent Contract, which is a contract management system in the cloud that is now being used in the US. Now, the life sciences division alone is approaching 150 employees, and we hope that by this time next year we'll be 250 people in that division, with a couple of new product offerings by then. We are always looking at new regulations in the US and worldwide: laws very seldom change incrementally, so we adapt our systems to reflect that. ■

Donna LaVoie

President and CEO
LAVOIEHEALTHSCIENCE

How did 2022 unfold for LaVoieHealthScience (LHS)?
2022 was a good year for LHS, despite the market seeing an overall downturn in IPOs after unprecedented capital going into the sector. It was a year of reflection and looking at the portfolio of companies we support, and we are currently focusing on commercially minded companies as we see a significant number of them in the biopharma space getting closer to commercialization.

How has the post-pandemic and shifting regulatory environment impacted demand for LHS offerings?
We are increasingly seeing companies coming to us that want to fully interpret a message across various assets and platforms into a digestible story for capital, a strategic partner, or professional audiences. We develop integrated communications programs that make complex science more digestible and that build influence and awareness.

Which key themes currently stand out for LHS to incorporate into clients' strategic messaging?
In this environment of economic uncertainty, early-stage firms need to focus on development and capital.

One of the potential challenges public companies may encounter is aggressive moves by activist investors looking to leverage the economic turmoil for corporate takeovers. Companies should be ready to address hostile short-selling and unsolicited takeover bids, develop rapid responses to special meetings and activist demand, and vigorously engage with institutional shareholders, proxy advisory firms, and potential regulators.

What are your thoughts on the current regulatory environment in the US, and what are LHS' main goals for 2023?
The Inflation Reduction Act is a big deal. Drug approvals and pricing is top of mind. We are currently in a difficult environment where the investors will be cautious and really would want to understand the regulatory environment as well as reimbursement before investing in this space. LHS is evolving with the market and is investing in practice development, prioritizing our services, zoning in on commercially minded companies, and putting resources around that segment. We are also expanding into digital health. ■

John Pennett

Partner-in-Charge of the National Technology and Life Sciences Group
EISNERAMPER

What synergies did the partnership with TowerBrook unlock for EisnerAmper?
Approximately 18 months ago, EisnerAmper took on a private equity investor, TowerBrook Capital Partners, which provided us with capital and "supercharged" our organic and M&A growth strategy. Since then, we have done ten combinations and have added major new markets in Minnesota, Baltimore, Texas, Florida, New York, and Southern California. We have also added additional capabilities to our firm, including strengthening our private wealth advisory practice and expanding our team with many practitioners with different skill sets from across the country. The company currently has more than 3,000 employees and is using our three offices in India to continue sourcing talent, where we now have 600-plus people. Regarding capital markets, specifically IPOs, 2022 was a stabilizing year. In the couple of years before that, we participated in nearly three dozen IPOs. We caught a terrific IPO wave from 2020 to 2023. We are seeing a lot of new company formation and believe the IPO space will pick up again.

What is your outlook for firms going public, SPACs, and reverse mergers in 2023?
EisnerAmper has had a couple of companies who have completed the IPO process, but the environment has been difficult. They typically have not raised as much money as they had hoped to. There are private companies, pharma services companies, and revenue-producing companies that are looking for public vehicles, and we may see some reverse mergers into some of these fallen angels over the next year. Several companies went public too soon without a well-thought-out strategy over the last few years.

How do you view IPOs, M&As, and deal-making in the life science space in 2023?
Big pharma companies have an enormous amount of cash and are continuously looking for innovative products to help them fill their pipelines. They are starting to increasingly look at smaller biotech companies to fulfill that requirement. ■

ESTABLISHED AND EMERGING HUBS

"In 2022, we witnessed a greater number and diversity of vibrant life sciences markets emerge. While Boston, San Diego, and San Francisco remain the leading US markets, we are encouraging clients to think in terms of 20+ markets in the Americas that are significant."

Travis McCready,
Head of Life Sciences, Americas Markets,
JLL

Image courtesy of Kindeva Drug Delivery

The East and the West

Healthy competition driving progress

Image by anekoho at Depositphotos

Two complementary approaches have driven the US to its leading position in the global life sciences space. The first one, the "East Coast mindset", continues to roam from the benches of Harvard and Northeastern University to the labs in Cambridge: innovators make a discovery, pass the reins to a VC firm, and publish their studies back in the lab. The second one, the founder-led and tech-inspired model seen across California, implies pitching VCs, but ultimately running the business. More than ever, in 2022 entrepreneurs from both coasts have multiplied interactions with investors, developed collaboration with academia, and leveraged state-led funds to continue to bolster innovation.

The East Coast:
Massachusetts, New Jersey and Pennsylvania

Massachusetts

Massachusetts, home to 18 of the 20 largest global pharma firms, again ranked as a top place among life sciences regions globally in 2022. For the past 15 years, the work done by pharma firms, state authorities, and non-profits to develop the industry has been nothing short of outstanding. Since passing the Massachusetts Life Sciences Initiative in 2008, biopharma employment has almost doubled in the state, with a 96.5% total growth. Surfing on that trend, employment grew by 13% in 2022, with the life sciences industry now employing over 106,000 people. Pharma giants Takeda, Sanofi and Pfizer were the top three employers in the state in 2022, according to figures from MassBio.

Firms in Massachusetts have R&D running through their veins, and this will likely remain what pumps capital into their ventures in the year ahead. The state remains the top NIH-funded state per capita, with US$3.3 billion, while firms in the Boston area received 26% of all VC investment nationally. Massachusetts headquartered firms make up 16% of the US drug development pipeline. Newly promoted MassBio CEO and president Kendalle O'Connell detailed the state's growth path: "We have seen unprecedented levels of venture capital investment coming into Massachusetts headquartered companies, with nearly US$9 billion of VC investment in 2022 and US$13.6 billion in 2021. In 2022, lab and manufacturing space in Massachusetts totaled approximately 55 million square feet, with 15 million square feet coming online in 2021 alone."

A key component of Massachusetts' success has undoubtedly been the unique focus put on funding higher education and research institutes. In 2021, Harvard, Northeastern University and the Broad Institute were three of the 15 institutions that received a total of US$1.42 billion in NIH funding. Tim Jarrett, who leads the Life Lab at Harvard Innovation Labs, detailed this fruitful environment: "There is an extraordinary density of universities and academic institutions with great interconnectivity among them. This culture of collaboration and idea-sharing allows for an environment of proliferative innovation and faster advancement of science."

A 12-minute drive away from Harvard Innovation Labs, the College of Sciences, represented by Dean Hazel Sive, was deemed the "innovation capital of academia" by the latter, who also praised how the state's collaborative climate eases the process from discovery to commercialization: "The high concentration of universities in Massachusetts has led to a significant number of innovations that eventually turn into products."

New Jersey

In 1886, J&J relocated its lotion and bandage factory to New Brunswick, NJ. This move sparked the genesis of what has since been the greatest concentration of life sciences companies in the US. Today, with close to 4,500 pharma establishments, New Jersey retains its title of 'medicine chest of the world'. "In 2022 alone, companies with a footprint in New Jersey were responsible for nearly 50% of all new FDA approvals," stated BioNJ president and CEO Debbie Hart.

A key piece of the biopharmaceutical East Coast corridor, New Jersey is now aiming to be reckoned as a force within the innovation segment of the industry. Funding

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> To ensure that New Jersey maintains its leadership position, BioNJ will continue to work with State government to support industry and stave off onerous proposals.

Debbie Hart

President and CEO
BIONJ

What has BioNJ achieved in the past 12 months?
BioNJ has stayed laser-focused on our core mission, to help our members help patients and make sure that New Jersey is a robust life sciences ecosystem where innovation is supported, and patients can access that innovation. New Jersey remains a life sciences powerhouse, leading the way in medical innovation. The State stands out in its breadth of industry with employment concentration in three key industry subsectors – pharmaceuticals; research, testing and medical labs; and bioscience-related distribution – as well as a high concentration in a fourth subsector: medical devices and equipment. BioNJ continues to work diligently with our State partners to attract new companies, such as BeiGene, Gilead and Eisai. Over the last 12 months, we witnessed the groundbreaking of The Hub in New Brunswick and SciTech Scity at the Liberty Science Center. We ensure that entrepreneurs have the tools they need to flourish through our support of the activities of the New Jersey Commission on Science, Innovation, and Technology which has provided over 200 companies with more than $9M in grant funding in the past two years.

What will BioNJ's main public policy priorities be in 2023?
At the federal level, we believe that the recently passed Inflation Reduction Act (IRA) fell short in its attempt to solve the underlying issues driving higher patient out-of-pocket costs and that it threatens future medical innovation. Its price-setting provisions are projected to result in 135 fewer new cancer drug approvals by 2039, and 551 fewer HIV/AIDS clinical trials over a similar time.
We also have serious concerns about the role of pharmacy benefits managers (PBMs) on the cost of drugs and access to them. PBMs negotiate rebates and fees with drug manufacturers, create drug formularies, and reimburse pharmacies for patients' prescriptions. However, far too often, PBMs fail to pass along these manufacturer rebates and discounts to patients at the pharmacy counter. Just three PBMs, all owned by giant for-profit insurance companies, control approximately 80% of the entire PBM middleman industry in the US. State legislation requiring insurers and PBMs to share negotiated discounts and rebates at the pharmacy counter could save some New Jersey patients nearly US$1,000 each year.

Can you expand on the Health Equity in Trials Initiative and the MBA Business plan competition?
In 2022 we launched our Health Equity in Clinical Trials Strategic Initiative to help deepen the understanding of the safety and efficacy of medicines in under-represented populations. BioNJ's Health Equity in Clinical Trials MBA Business Plan Competition was designed to promote the next generation of diverse clinical trial innovators and to identify innovative approaches and successful models that can be used nationally to strengthen diversity in clinical trials and expand health equity.

How does the current regulatory environment impact investment in the industry?
The US is responsible for most new biopharmaceutical innovations. And while there are a variety of regulatory components in the US that have contributed to this massive wave of innovation, a recent pursuit of policies that will inevitably inhibit this innovation is worrying. A central pillar of the nation's hospitable environment for the life sciences ecosystem has been its strong, predictable, and reliable intellectual property framework. Discussions among international entities focused on weakening or outright sacrificing these IP protections, such as potentially expanding the TRIPS waivers, are concerning, as this would directly jeopardize the historically reliable IP protection framework. Finally, enabling the government to arbitrarily set the prices of medications will inevitably inhibit investment. The price-setting provisions of the IRA will result in fewer new drugs and disincentivize the industry from investing in diseases with large unmet burdens. Further, the discrepancy in how small molecule and biologic therapeutics will be targeted for price setting has already been seen to put a thumb on the scales of future investments between these two classes of medicines.

What must New Jersey do to remain a life sciences leader?
With nearly 4,500 biopharma establishments, including eight out of the top 10 global pharma companies, New Jersey is the "Medicine Chest of the World" leading the tri-state region with an annual economic impact of US$108.3 billion. In 2022 alone, companies with a footprint in New Jersey were responsible for nearly 50% of all new FDA approvals. To ensure that New Jersey maintains this leadership position, BioNJ will continue to work with State government to support industry and stave off onerous proposals. ■

> In 2022, Massachusetts received 25% of all biopharma VC funding in the US, and per capita we are still number one for NIH funding. We are also seeing new clusters emerge outside the traditional hubs of Kendall Square and Boston.

Kendalle O'Connell

CEO and President
MASSBIO

As the new MassBio CEO, what is your vision going forward?
The goal is to continue to support our 1,600 member companies so that they can continue to bring life-changing solutions to patients. We must maintain Massachusetts's economic competitiveness, as the state is the best place in the world for life sciences due to years of strategic investment and collaboration between our partners within industry, government and academia. In 2008, our government partners made a significant investment with the Life Sciences Initiative, a 10-year, US$1 billion investment in life sciences. We are at a time where we are poised for a third iteration of the Life Sciences Initiative and we must think about how we create a robust and diverse workforce to sustain the growth we have experienced recently.

What have been MassBio's main accomplishments in 2022?
We have successfully launched a new startup accelerator program, MassBioDrive, designed to advance breakthrough science while providing opportunities to innovators from all parts of the life sciences ecosystem. Our objective is to partner emerging companies with seasoned mentors and give them the fundamentals to take their ideas to fruition and do this through the lens of diversity, equity and inclusion (DE&I). MassBio announced our workforce training center in Dorchester, Massachusetts, which will open in late 2023. In the past few years, we have seen unprecedented levels of venture capital investment coming into Massachusetts headquartered companies, with nearly US$9 billion of VC investment in 2022 and US$13.6 billion in 2021. In 2022, lab and manufacturing space in Massachusetts totaled approximately 55 million square feet, with 15 million square feet coming online in 2021 alone.

What makes Massachusetts an attractive hub for biopharma?
Massachusetts has world-class academic institutions training the best and brightest to enter the industry, best-in-class hospitals, and the most robust R&D ecosystem, and there is an incredible collaboration between industry, government, and academia. In 2022, Massachusetts received 25% of all biopharma VC funding in the US, and per capita we are still number one for NIH funding. We are also seeing new clusters emerge outside the traditional hubs of Kendall Square and Boston.

From an employment perspective, over the past 15 years, the life sciences sector in Massachusetts has grown 131%. The inflection point of this growth was the launch of the Life Sciences Initiative in 2008, allowing tremendous development of the biopharma industry, which today employs over 106,000 individuals.

How do you assess the current funding environment for biotechs?
Funds are there, but investors are acting more cautiously. The average round size was smaller in 2022; US$35.3 million compared to US$53 million in 2021, while the number of companies in Massachusetts that received funding was higher, with 246 companies in 2022 compared to 236 in 2021. As there are more innovators looking for funding, companies will have to be smarter in their capital expenditures and be able to give more clinical data to investors to create confidence. I believe that we will see more M&A activity in the biopharma space in 2023 with the mission to create value.

Can you elaborate on MassBio's focus on diversity, equity and inclusion (DE&I)?
MassBio has long been a leader as it relates to diversity, equity and inclusion, and has worked proactively to integrate DE&I into every single initiative and program we offer. The key is to work with our members to help them elevate DE&I as a business priority. We have seen a tangible impact on supplier diversity and we have created a robust supplier diversity program through MassBioEdge, our purchasing consortium. In 2022, over US$31 million of spend was channeled to diverse-owned businesses through this program.

What are MassBio's main objectives for the next year?
We will continue to put in the necessary efforts to keep Massachusetts the best place in the world for life sciences. A key objective is ensuring that the legislature and our federal delegation understand the impact of the Inflation Reduction Act on our industry, particularly our emerging biotech community. We are excited about the launch of our workforce training center. Ensuring we are giving more residents a pathway into a career in the life sciences sector is a key objective. In 2023, we will also host our first-ever Align Summit, an early-stage investor conference that will run in parallel with our annual State of Possible Conference ■

> **The lifecycle of new product introduction into the market will now be shorter, as companies have fewer years to recover revenue as a result of the IRA.**

Joe Panetta

President and CEO
BIOCOM CALIFORNIA

Can you give an overview of Biocom California's main activities and achievements over the past year?
2022 was another year of growth for Biocom California across the state and our membership is now nearing 1,800 in total. A significant percent of the growth has been in the San Francisco Bay area, a huge life sciences cluster with approximately 2,400 companies. We have nine staff in the Bay and have grown our statewide team to 85. We also expanded our efforts to help companies locate sources of capital and connect with strategic partners. We recently moved into an expanded office to ensure we have room and capacity for the exponential growth we are experiencing, and have implemented more flexible work schedules and operations as a result of learnings during the pandemic. Over the past year, Biocom California has focused on how we can help our member companies in this post-Inflation Reduction Act (IRA) environment, along with addressing other regulatory challenges.

What is your outlook on the regulatory environment in the US moving ahead?
Our elected representatives in Congress were short-sighted in passing the IRA. It will have a detrimental effect on investment in innovation. Beyond large pharma, the bottleneck will slow the pace at which smaller companies can raise the capital they need to sustain their discovery and development efforts. Biocom California and our member companies are now beginning to focus on how we can ensure that there is a strong pipeline of early-stage, innovative products that small companies can develop and then partner with pharma companies.

Can you speak of the importance of the life sciences industry for California?
The life sciences industry has close to a US$400 billion economic impact on California and creates more than 400,000 direct jobs. Many states, including New Jersey, North Carolina, Massachusetts, and even Texas are extremely aggressive in bringing biotech into their regions, providing economic incentives in terms of both the capital to build facilities and cheap land, but nobody has the engine of innovation and the depth and breadth of life sciences workforce, talent, and experience that we have here in California.

The state could have a global presence. State leaders can ensure that there are connections to some of the key biotech clusters around the world. Doing this will place us a level above places like Maryland, North Carolina, and even to some extent Massachusetts. We are excited to see the development of universities and biotech communities in smaller-scale clusters like Riverside, where land and housing are less expensive. California is a powerhouse in terms of innovation and talent, and the clusters are well connected logistically; we need to do more to take that in hand and capitalize on it.

What therapeutic areas do you see becoming more in favor in 2023 and beyond?
Cell and gene therapy is an extremely exciting and attractive area for investment. California also renewed investment in regenerative medicine research with a US$5.5 billion influx of capital into the California Institute for Regenerative Medicine. We continue to see a growth in investment into neurodegenerative diseases, an area that has long been starved for funding. Another area that has grown as a result of Covid-19 is interest in developing diagnostics and therapies to treat infectious diseases.

What effort is Biocom California putting toward diversity, equity, and inclusion (DE&I)?
Biocom California recently appointed a new Director of DEI. When we develop products, we need to ensure we are testing across a diverse population during clinical trials. We also want to create opportunities for employment for people across the entire population, and one of our big areas of focus is to expand our workforce initiatives across the entire California community. We want to do more to interest students in the life sciences space and bring more diversity, experience, and thinking into the industry.

What will be the main point of focus for Biocom California heading into 2023?
Biocom California will focus on increasing California's global presence. We have an office in Tokyo and have signed memoranda of cooperation with biotech clusters in the UK, France, Sweden, and Australia. Over the past year, we have been active in exploring opportunities for partnership and membership of companies in India and Korea, two of the fastest-growing countries in life sciences. ■

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programs by the New Jersey Commission on Science, Innovation, and Technology sparked further early-stage activity, and moves by several giants in 2022 highlighted the investment attractiveness of the "Garden State": PTC Therapeutics, Insmed and Gilead all broke ground at new facilities last year.

Pennsylvania

Pennsylvania continues to lead the East Coast's efforts in terms of research, testing, and medical laboratory capabilities. Besides being the national leader in clinical trials, the Greater Philadelphia area also ranks amongst the top 10 life sciences markets in the US and is home to 15 major health systems.

Perhaps Pennsylvania's greatest strength is its talent pool. In an industry plagued by talent shortages, the state continues to attract scientists that lead the development of cell and gene therapies, for instance. With rents lower than the established hubs of the East and the West, the "Keystone State" offers appealing prospects for life science companies.

The Pennsylvania Biotechnology Center (PABC) attracts interest from other states, as about 45% of firms in their B+Labs come from the outside. The Center continues to spin out success stories: Capstan Therapeutics made a US$165 million raise in 2022, Aprea Therapeutics made a reverse IPO, and PABC was awarded a US$5 million NIH grant to boost its support to the life sciences ecosystem. Speaking about the grant, president and CEO Louis Kassa expressed: "I would love to see this grant continuing to propel the Greater Philadelphia region into the top five life sciences clusters," adding: "We have many good variables going for us in Greater Philadelphia – it is affordable, we have 88 universities and colleges within 50 miles, and our biggest strength is our talent."

Motivated governments, coupled with top academic institutions and expert innovators mean the East Coast is in good shape to maintain its leading global status. The region is also primely located next to New York, home to many VCs, hedge funds and financial institutions. With expenses remaining too high for most early-stage biotechs and institutions in the Big Apple, the peripheral areas will continue to benefit from that centralized investment.

The West Coast: California Dreaming

California outperforms the US – and many countries – across a wide range of industries. Between the Bay Area, Orange County, San Diego and Los Angeles, the life sciences industry in the 'Golden State' continues to surf on the Pacific waves of investment brought about by the pandemic: Investment in life sciences reached record levels in 2021, as VC investment, NIH, and NSF funding alone topped US$22 billion in 2021. Today, California is home to 3,766 biotechs and biopharmaceutical companies, and for several years now, has remained the national leader in NIH funding. Speaking of the impact of the life sciences industry on California's economy, Joe Panetta, president and CEO of Biocom California, detailed: "The life sciences industry has close to a US$400 billion economic impact on California and creates more than 400,000 direct jobs. Many states are extremely aggressive in bringing biotech into their regions, but nobody has the engine of innovation and the depth and breadth of life sciences workforce, talent, and experience that we have here in California."

California hosts multiple life sciences clusters across the value chain and its influence is felt around the world. Biocom California has an office in Tokyo, and in the past years signed memoranda of cooperation with biotech clusters in the UK, France, Sweden and Australia. Joe Panetta believes it is the state's responsibility to capitalize on the state's assets to shine on the global stage.

The relationship between incubators, academia and freshly graduated entrepreneurs is what makes the Californian ecosystem the epicenter for global innovation. Data from Statista shows that a total of 5,892 doctorates were awarded in California in 2021, with Texas in second place only accounting for 4,118. David Schaffer, executive director of QB3, a state-funded non-profit that promotes biosciences entrepreneurship across UC Berkeley, UC San Francisco, and UC Santa Cruz, currently supports early-stage firms composed of Ph.Ds notably, developing small molecule, protein, gene, and genome editing, and cellular therapeutics. Building from the ground up, Schaffer wants to go beyond the three universities part of QB3 to help spread knowledge of how to build incubator programs to help technology transition. Particularly with universities in the north of the state, he unveiled: "Conversations have started, and there are definite synergies, particularly in the therapeutics space with cell and gene therapies."

In conclusion, despite the growth of several hubs countrywide, the East and the West Coast will likely remain the epicenters of the life sciences industry in the US in the coming years. Access to talent, to infrastructure, and established pharma legislations make these hubs attractive for investors increasingly keen on de-risking all aspects of projects. Across the country, it is however clearer than ever that potentially life-saving discoveries should not be constrained to the ivory towers of academia, but rather be supported through public-private collaboration. ■

» I remain bullish on emerging markets like Boulder, Chicago, Salt Lake City, Dallas/Fort Worth, LA, and Seattle because they seem to have stable rates of these innovation inputs from within their respective markets that continue to invest in life sciences development.

Travis McCready
Head of Life Sciences, Americas Markets, JLL

«

From Ivory Towers to Incubators

Ground-breaking discoveries will ultimately need to be commercialized to reach patients in need. Sustaining the growth of incubators across the country and fostering a complete life sciences ecosystem through university-private partnerships will be key to continue turning knowledge into medical advances.

"It is challenging to successfully translate technology from an academic lab to a company, which is a complicated entity with many moving parts unfamiliar to academia. Universities spark innovations, but there is a complex ecosystem needed for those discoveries to translate into products that solve societal problems. We need well-educated people keen on taking risks and building companies, from scientists to clinicians to investors."

David Schaffer, Executive Director, QB3

"As an incubator space, we aim to provide an overlap and an environment where scientists and entrepreneurs can turn new ideas established or developed in academia into ideas that are ready to scale. Now more than ever, we are seeing large pharma putting significant focus and importance on external innovation and seeking out opportunities to partner with academics and early-stage ventures. As more incubators pop up, they create a space for ideas to be scaled rapidly, lowering the barrier to entry into the realm of strategic partnership."

Tim Jarrett, Site Lead, Pagliuca Harvard Life Lab, Harvard Innovation Labs

"I call Northeastern University 'the innovation capital of academia', and I joined this institution as I wanted to innovate in higher education. Northeastern has become a global university and today has various campuses across 14 different locations in the US, Canada, and Europe, which will continue to expand in the future."

Hazel Sive, Dean, College of Sciences, Northeastern University

"We are talking to universities and nonprofit research institutes to be part of creating an incubator ecosystem across regions. Another initiative is our Hatch Biofund, a US$50 million venture capital fund serving as a companion to the incubators and accelerators owned or managed by the PABC. This fund will not only help local startups accelerate their science but also help our deal flow and our national reputation of this model in how it can benefit other regions as well."

Louis Kassa, President, and CEO, Pennsylvania Biotechnology Center (PABC)

Growing Life Sciences Hubs

Beyond Boston and San Francisco: hubs putting their name on the map

Image courtesy of INCOG BioPharma Services

The life sciences industry continues to grow, and so does the demand for space to innovate in. While Massachusetts, California and New Jersey operate in a different league, recent years have witnessed structural changes in the areas covered by the life sciences industry. Emerging markets across the country have burgeoned as leading pharma firms search to grow, expand and relocate in the search for talent. For areas to put their names on the life sciences map, three key factors will come into play in 2023: access to a talent pool, funding that allows commercialization potential, and a strong real estate infrastructure that can support growth.

JLL is a commercial real estate firm that has focused on tracking commercial leasable space to map the growth and demand for space across the US. Noticing polarizing shifts in the real estate space in the US, Travis McCready, head of life sciences Americas market, explained: "We witness a greater number and diversity of vibrant life sciences markets emerging. We are encouraging clients to think in terms of 20+ markets in the US that are significant. This is a different way for the industry to think in terms of where to invest, where to build infrastructure, where to find great science, and where universities are creating great science that will be translated into commercial assets."

For growing hubs, the answer lies within. Macroeconomic shockwaves have slowed external investors' will to explore new hubs as they look for markets with a predictable rate of entrepreneurship and innovation, along with a cluster of commercial assets and a high concentration of capital. Yet, the current – and cyclical – environment does not deter Travis McCready's bullish stance on hubs like Boulder, Chicago, Salt Lake City, Dallas, Raleigh Durham, LA and Seattle: "They seem to have stable rates of these innovation inputs from within their respective markets that continue to invest in life sciences development."

» As we were carved out of 3M and already had an established workforce, coupled with Minnesota being the center of the medical device universe, it made sense location-wise for Kindeva to build a new world-class research center in the St. Paul area.

Milton Boyer, CEO, Kindeva Drug Delivery «

Accessing talent before unlocking capital

Along with access to capital, the next challenge to answer for growing hubs is access to talent. The proximity to known human capital and established universities remains a key driver in the decision-making process behind firms' geographic implementation decisions. As put by McCready: "Today, access to talent – more than access to capital – is the barrier to progress for emerging markets."

EisnerAmper's partner-in-charge of the national technology and life sciences, John Pennett, agreed: "Q1 2023 showed an extreme focus on building lab space in every major market where you have a major research university."

Case studies: Illinois, Indiana and Michigan

Illinois and Michigan are two examples demonstrating the importance of a local talent pool in an area's investment attractiveness. With roughly 1 million residents holding at least a bachelor's degree in science and engineering, the Chicago Metropolitan Area continues to climb the ranks of life sciences hubs. What could take the state to the next level in the next decade is the collaboration between philanthropists and academia. In March 2023, the Chan Zuckerberg Initiative announced the launch of a new biomedical research hub in Chicago, which kicks off a collaboration between the three most promising anchor institutions in the city: Northwestern University Illinois, the University of Chicago, and the University of Illinois Urbana-Champaign. Michigan's life science industry is among the fastest growing in the country. A key manufacturing hub during Covid-19, investment and medical endowment did not temper in 2022. Tom Ross, president, and CEO of Grand River Aseptic Manufacturing, a fast-growing CDMO in the fill-and-finish space in Grand Rapid, explained how the environment contributes to successful recruitment: "Having local universities and educational institutions such as Michigan State University, Grand Valley State University, and the Van Andel Institute in the same area as multiple medical and pharma facilities allows us to collaborate with people on the front line and helps with recruitment processes."

Looking ahead, "tier 2" states will increasingly look at focusing on their strengths rather than trying to be the next Boston or San Francisco. One key is developing local capabilities that are properly scaled for the market. Indiana leads the US in pharma exports, and in 2022, 25 firms committed to invest over US$2.8 billion, more than five times the amount for 2021, in the state, according to the Indiana Economic Development Corporation. With Catalent plotting a US$350 million expansion at its Bloomington, IN, facility, and new players like INCOG BioPharma designating Fishers, IN, as their home, signs are encouraging for the state. Cory Lewis, CEO of INCOG, detailed Indiana's appeal for manufacturers: "Indiana is a growing hub for several practical reasons: We have the second largest hub in the US for FedEx, plenty of warehouse distribution and warehouse capability, and you can access the entire continental US within a 5-hour flight."

Recognizing the state's competitive advantage for manufacturing capabilities, he added: "San Diego, San Francisco, and Boston are leaders on the R&D front. On the manufacturing side, bring it to Indiana!"

Finally, emerging hubs are where most greenfield opportunities are for manufacturers and pharma firms looking to grow their footprint nationwide. European manufacturers have long seen the potential of the US market, and in 2023, the Italian Dipharma Francis expanded its Kalamazoo, MI, facility by building kilo labs and quality control labs from the ground up. Basel-based CordenPharma is a leading CDMO for the development and manufacturing of complex modalities for APIs, lipid excipients, and drug products, which saw double-figure growth in sales in 2022. CordenPharma's CEO Michael Quirmbach said: "We are also considering greenfield opportunities, as we realize the importance of the US market." ■

Travis McCready

Head of Life Sciences , Americas Markets
JLL

What fundamental changes have you witnessed in the life sciences industry in 2022?
Whereas previously the industry was focused on ensuring there is enough supply capacity in terms of commercial leasable space to map to the growth and demand for space across the US, in 2022 we started to see many markets reach supply-demand equilibrium.

We also witnessed a greater number and diversity of vibrant life science markets emerge. While Boston, San Diego, and San Francisco remain the leading US markets, we are encouraging clients to think in terms of 20+ markets in the Americas that are significant.

With Big Pharma's high R&D revenues in mind, how do you picture deal-making in 2023?
It's estimated that R&D revenues held by the 20 largest pharma companies currently amount to nearly US$1 trillion in cash, and there is high anticipation to see this capital deployed to bolster the companies' external innovation. This will be a key signal of growth and opportunity for the sector. We have also witnessed a growing spirit of conservatism from dealmakers as they push for more clinical data and clinical assets before receiving subsequent, larger funding rounds or investments. These conditions combined are forcing biotechs to do more with less, particularly when it comes to real estate and infrastructure.

Which regional markets do you see as emerging life sciences hubs?
Large investors are still looking for the most predictable markets, with high concentrations of entrepreneurship, innovation, commercial assets, and skilled workforce. As a result, the smaller markets are seeing a bit of a slowdown.

What will be the growth priority for the life sciences division of JLL?
One area will be biomanufacturing. There has been tremendous growth in innovation in the number of clinical assets in regenerative medicine and RNA therapeutics entering the regulatory pipeline, and this is driving demand for biomanufacturing infrastructure worldwide ■

Louis Kassa

President and CEO
PENNSYLVANIA BIOTECHNOLOGY CENTER (PABC)

What are PABC's current objectives?
Our goal is to enter another market by 2024, and I am currently talking to three other regions about replicating our model there. We are also talking to universities and nonprofit research institutes to be part of creating an incubator ecosystem across regions. Another initiative is our Hatch Biofund, a US$50 million venture capital fund serving as a companion to the incubators and accelerators owned or managed by the PABC. This fund will not only help local startups accelerate their science but also help our deal flow and our national reputation of this model in how it can benefit other regions as well.

Lastly, the state awarded us a US$5 million grant in the winter of 2022, which has been an amazing opportunity for us as we are now able to encourage companies from other parts of the country to come to Philadelphia, either to be B+Labs or PABC, and offer them free lab space, C-suite hiring, staff hiring, cover their business expenses, IP expenses, and free equipment. This is a pilot program and if we can attract high-quality science and companies to Pennsylvania and create jobs, I would love to see this grant continuing, maybe at an increased amount, to propel the Greater Philadelphia Pennsylvania region into the top five life sciences clusters.

What will be the impact of the growing life science industry on the region?
We are growing as a cluster and, instead of having 400 jobs in Doylestown which we have now, we can have 4,000 shortly. We need to focus on working with the universities, high schools, and even middle schools to get more life science-specific programs into the schools so that we can develop the workforce here. I hope to continue seeing companies coming from across the country contributing to the significant growth of the greater Philadelphia area in life sciences. ■

DRUG DISCOVERY AND DEVELOPMENT

GBR SERIES • USA LIFE SCIENCES 2023

Image courtesy of CordenPharma International

"Precision medicine will be important for advancing diagnoses and treatment. In this new world, you will see more partnership with patients throughout their care. It is critical that the patient's voice is heard, and that programs are designed with a patient-centric approach."

Tyrone Brewer,
President, US Oncology,
Janssen Pharmaceutical Companies of Johnson & Johnson

Next Up in the Biopharmaceutical R&D Pipeline

Full steam ahead across many indications

Image courtesy of Pace® Life Sciences

From life-threatening illnesses to orphan, rare and chronic diseases, thousands of patients live with the hope that the life sciences industry will bring new medicines that will raise their standard of health, or even save their lives. A record-breaking 8,000 medicines currently in development, 74% of which are first-in-class, is a sign of hope. Among the most remarkable advances in recent years are harnessing the body's immune system to fight cancer through immune-oncology, tackling rare genetic disorders, a return to CNS focuses, and a range of CAR-T cell therapies driving unprecedented remission rates for cancer patients, and these will remain the therapeutic areas under the spotlight in 2023.

» A reemerging area today is central nervous system (CNS) diseases. For a while, this area was out of favor in the investment community due to many failures. Recently we have started to see some successes which give hope to populations with CNS. Another modality receiving attention is cell and gene therapy.

Mark A. Goldberg, CEO, Allucent «

Immuno-therapy and harnessing the power of the cell

Cell and gene therapies (CGT) remain among the fastest-growing areas of therapeutics in the US. With genomic medicine poised to drive drug development in the coming decades, several US firms are pioneering technology platforms in allogeneic cell therapy for oncology and in vivo gene therapy to address monogenetic diseases. Recent years have witnessed a significant uptick in cell and gene growth, with interest going beyond biotechs engineering CAR-T cell therapies; Biocom California recently established a Cell and Gene Therapy Committee.

Several factors are behind the forecast growth of the CGT market to US$10 billion by 2026: an uptick in clinical trials, more government funding for cancer research, and growing regulatory acceptance of CGT, with five therapies approved by the FDA in 2022 (Q4 2022 saw two gene therapies approved in the US, Hemgenix for hemophilia B, and Adstiladrin for bladder cancer). The FDA forecasts that by 2025, it will approve between 10-20 therapies annually. Regulators even created a "Super Office" in a push to shorten these drugs' time for approval. And a sneak peek at the pipeline of products in Phase 3 clinical trials suggests the number of approvals is likely to rise acutely in the coming months: 52 C&G (cell and gene) launches are expected in 2024, according to the FDA.

The industry is at a critical inflection point in the commercialization of CGT. California-based Sangamo Therapeutics is currently developing a Hemophilia A program with Pfizer and a clinical trial-stage CAR-Treg cell therapy for renal transplant. The firm has its finger on a novel technology that could revolutionize gene editing: Zinc finger (ZF) technology. Building on a pipeline of three late-stage assets – those that have investors' favor in these uncertain times – CEO Sandy Macrae explained: "Our proprietary zinc finger technology allows us to power a complete suite of genomic medicine capabilities, providing a unique approach to gene therapy, cell therapy, and gene editing."

Few technologies in the life sciences industry hold as much promise as CGT. This technology can target the underlying cause of a disease with curative potential. Daniel Palmacci heads the C&G division at Lonza, one of the world's largest CDMOs, and is bullish on the future of the field, with close to 3,726 products in development across the industry according to the American Society of Gene & Cell Therapy. He shared: "CGT presents perhaps the biggest hope in life sciences, as it can treat many indications such as cancer and genetic disorders effectively – and in some cases even have the potential to be curative."

When asked about the trends likely to shape the biopharmaceutical industry in 2023, Tyrone Brewer, president of US oncology at Janssen, was categoric: immuno-oncology will remain a key topic prompting further drug discovery. Leveraging the patient's immune system is a key capability to add to biopharma's core competencies, and Janssen appears to be pioneering that area. Brewer detailed that approach: "This focus is so essential to Janssen that we formed a dedicated multi-functional team entirely focused on immunotherapy research. This is a key area of development and innovation for Janssen and across oncology in the coming years."

As oncology and rare diseases remain the most targeted indications by gene therapies, the oncology area will likely continue to lead industry demand in the near term. "Oncology constitutes approximately 40% of dollars spent on R&D in the industry. This was thus a key focus area for us and one of our earlier acquisitions was SMS-Oncology, a Dutch oncology-focused CRO", explained Mark Goldberg, CEO of Allucent, a CRO supporting small and mid-sized biopharma firms.

Finally, mRNA has most lucratively been applied in Covid-19 vaccines, but as this pandemic page closes, mRNA therapeutics still hold promises to unlock other unmet medical needs. Before lawsuits play out between Pfizer/BioNTech and Moderna to settle disputes over mRNA vaccine patents, the RNA pipeline noticeably grew the most among other therapeutic areas throughout 2022, increasing by 17%. Manufacturers are closely watching those developments. Evonik's US$220 million investment in partnership with the government to develop new mRNA therapies is a testimony that the area remains relevant post-pandemic, as outlined by Paul Spencer, head of drug delivery and product at Evonik Health Care: "The investments we are making in North America to better improve the delivery of drugs are crucial. We believe mRNA therapeutics are transformative."

Next-generation therapies are poised to make a comeback in 2023. According to the Alliance for Regenerative Medicine, in 2022, developers of cell therapies, cell-based immune-oncology therapies, gene therapies, and tissue engineering therapies raised a total of US$6.4 billion and oversaw 2,093 active trials during the first half of 2022—less than half the US$14.1 billion of H1 2021. Today, about 20 gene therapies and 10 CAR-T treatments are pending approval in 2023, and more specialty therapies are on the horizon. Since the past year, the FDA has received more than 3,000 Investigational New Drug (IND) applications to study CGT in clinical trials.

Neurology candidates face setbacks, but CNS is back

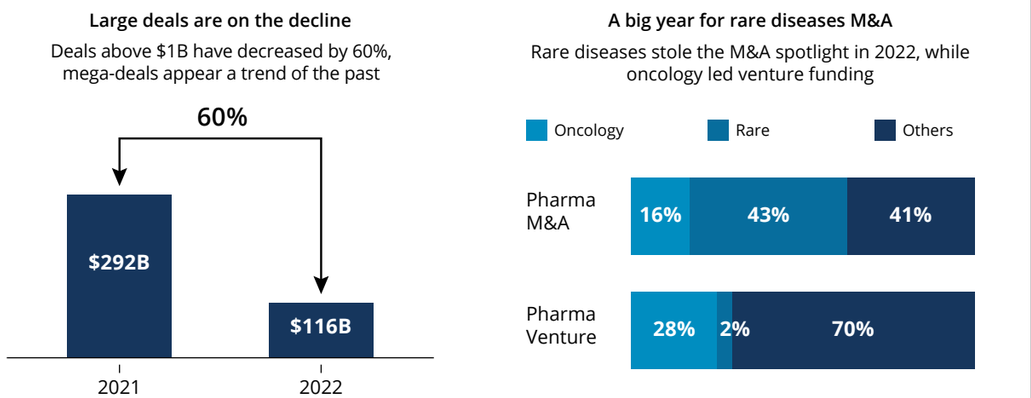
Like in 2022, Alzheimer's drugs topped the list of Evaluate Vantage's most anticipated releases of 2023. Big pharma and ambitious biotechs tackling neurodegenerative diseases have experienced ups and downs in recent years. In November 2022, Roche's gantenerumab failed to meet the primary endpoint in Phase 3 clinical studies, adding to turmoil and uncertainty among firms with Alzheimer ambitions. In early 2023, the FDA did not grant accelerated approval to Eli Lilly's Alzheimer's candidate, donanemab. The Phase 3 trial topline data read-out expected later in 2023 will be crucial for this therapeutic field. On the other hand, Eisai and Biogen's lecanemab unveiled a surprise win in a Phase 3 study, and in January 2023, lecanemab received FDA approval, with the candidate forecasted to amount to US$3 billion in sales by 2028.

Targeting brain receptors is incredibly complex, and with most biotechs experiencing clinical trial failures – such as Aptinyx's NYX-458 to treat Parkinson's – coupled with harsh economic conditions, some CNS firms have shifted their focus towards new therapeutic areas. Aphios develops CNS therapeutics and decided in 2022 to make a strategic shift towards Alzheimer's disease following lecanemab's approval. President and CEO Trevor P. Castor detailed his company's approach: "Instead of focusing on one cause, beta-amyloid plaques, we are looking at all the causes of Alzheimer's disease including beta-amyloid, tau entanglement, enzymatic changes but particularly inflammation in the brain. We are exploring how to address brain inflammation and how our genetic makeup changes as we age promoting more inflammation in the CNS.".

The severe unmet needs in the CNS space, coupled with a declining mental health picture post-pandemic in the US, make the need to leverage new technologies for breakthroughs ever more pressing. Emer Leahy, president, and CEO of PsychoGenics, noticed an increased interest in the firm's Cube Technology. In collaboration with Synovion, PsychoGenics is developing ulotaront, a TAAR1 antipsychotic for the treatment of schizophrenia and Parkinson's, which has the potential to be the first AI-discovered novel drug to be marketed. Leahy also pointed to a growing interest in psychiatric disorders and more receptiveness to phenotypic drug discovery. In her opinion: "The target-based approach to drug discovery has not been very successful in CNS in general, largely due to the complexity of the poorly defined conditions with multiple susceptibility genes, epigenetics, and the environment playing a role."

There is no doubt that CNS is back on investors' minds. Yet, industry leaders remain lucid regarding the necessary efforts to achieve fundamental knowledge of CNS diseases. More research, failures, and studies will be needed before breakthroughs revolutionize the lives of patients with neurodegenerative disorders. But the industry is committed to providing these patients with hope. ■

Trends shaping M&A and venture investments



Source: Deloitte

Sandy Macrae

CEO
SANGAMO THERAPEUTICS

Can you introduce Sangamo Therapeutics?
Sangamo Therapeutics specializes in genomic medicine. We have various ongoing projects, such as Hemophilia A in partnership with Pfizer, a wholly-owned project for sickle cell disease, and a CAR-Treg cell therapy for renal transplant, which is currently in clinical trials and progressing well. Additionally, we have a pipeline of projects targeting inflammatory bowel disease, multiple sclerosis, and diseases of the central nervous system (CNS). Our proprietary zinc finger technology allows us to power a complete suite of genomic medicine capabilities, providing a unique approach to gene therapy, cell therapy, and gene editing. We are strategically focused on developing genomic cures for serious conditions with high unmet patient needs and where our technology has the potential to create first- or best-in-class medicines.

Could you provide an update on the Hemophilia A program with Pfizer?
The phase 3 trial dosing is almost complete, and the results are to be presented in the first half of 2024. We have also been advised that they will be filing the Biologics License Application (BLA) in the second half of the same year. For our company, this program is a transformative moment.

What are the clinical advantages observed in the Phase 1-2 STAAR Study conducted for Fabry disease?
Patients with Fabry disease spend approximately five hours every other week for infusion, which can be quite challenging. Thus, the idea of potentially receiving a single infusion of gene therapy that frees them from the disease is a liberating and important factor that eases the burden of their condition.

Can you give an outlook on the future trends of data technologies and gene therapy?
Being the first gene editing company to use zinc finger technology, Sangamo's versatile technology enables us to power a complete suite of genomic medicine capabilities: gene activation or repression, DNA cleavage, base editing, site-specific integration, and epigenetic modification. Sangamo has the whole toolbox, enabling us to find the right tool for each clinical need. ■

Randy Milby

CEO
HILLSTREAM BIOPHARMA

Can you give an overview of Hillstream BioPharma and the company's main achievements in 2022?
Hillstream BioPharma is on a mission to transform the lives of patients with drug-resistant and devastating cancers through our cutting-edge drug development Quatramer technology: a tumor-targeting platform that allows us to leverage and exploit key tumor targets and novel emerging pathways to facilitate the delivery of potent drugs directly to the TME while sparing healthy tissue. Our most advanced candidate, the small molecule HSB-1216, targets ferroptosis, an emerging new anti-cancer mechanism resulting in iron-mediated cell death (IMCD) of drug-resistant cancers. We believe the future in drug-resistant cancers is using small molecules in addition to biologics and therefore we have added the biologic HSB-1940 to our portfolio, an anti-PD-1 novel biologic coated onto Quatramers, expected to enter the clinic in 2025. Our main achievement in 2022 was receiving FDA Orphan Drug Designation for HSB-1216 as a leading ferroptosis inducer to enter the clinic for the treatment of uveal melanoma, in addition to the Orphan Drug Designation for small-cell lung cancer. Our second drug candidate, HSB-888, also has the Orphan Drug Designation and a Rare Pediatric Disease Designation (RPD) for pediatric osteosarcoma. Additionally, we grew our patent portfolio and now have a world-class scientific advisory board which gives us a competitive edge as we navigate through the clinical and commercialization stages of development. Finally, we closed on a successful US$15 million IPO for our Nasdaq uplisting.

Why is Hillstream going to be not just a great story for investors, but also for patients?
We've reported in the past that in an active clinical pilot study, using our HSB-1216 to target solid tumors as a ferroptosis-inducing agent and novel investigational treatment, showed a 71% response rate and efficacy against devastating cancers, including triple-negative breast cancer and epithelial carcinomas. That's extremely powerful. ■

Emer Leahy

President and CEO
PSYCHOGENICS

What did growth look like for PsychoGenics in 2022?
There are three sides to PsychoGenics: a contract research organization (CRO), a drug discovery company, and partnerships. In the CRO, we work for companies on a fee-for-service basis utilizing disease models and extensive preclinical capabilities to help them identify treatments for all CNS conditions which include psychiatric disorders, neurodegenerative conditions, and orphan disorders. In 2022, we grew the CRO business by over 20%.

Our approach to drug discovery is phenotypic where we test compounds in mice and evaluate their behavioral responses with AI/ machine learning to extract complex behavioral signatures. Using this approach together with our library of diverse active compounds we initiated several discovery programs and identified development candidates for depression and agitation, now ready to enter IND tox studies.

Finally, our partnered programs also progressed, and we expect to hear shortly the outcome of multiple Phase 3 schizophrenia trials for Ulotaront, a compound discovered in partnership with Sunovion. We also extended our partnership with Karuna.

Can you touch upon the breakthrough potential of Ulotaront?
We discovered Ulotaront in partnership with Sunovion by screening a library of diverse compounds predicted to have CNS activity. The goal was to find a treatment for schizophrenia that did not target dopamine D2, which we did. Our work demonstrated that Ulotaront had a better side effect profile when compared to existing drugs, and had effects on negative symptoms (apathy, social withdrawal, flat affect), all effects that were confirmed in phase 2 clinical trial. The compound has been in Phase 3 trials for some time and is expected to read out this year. We are very excited about Ulotaront, as it has the potential to be the first AI-discovered novel drug to be marketed. ■

Trevor P. Castor

President and CEO
APHIOS CORPORATION

How did Aphios navigate macroeconomic challenges in 2022?
We concentrated on producing cannabidiol (CBD) and tetrahydrocannabinol (THC), and applying nanotechnology platforms to provide sustained release of these products. Our goal was to address unmet medical needs such as chemotherapy-induced peripheral neuropathic pain, substance use disorders (including opioid use disorder, alcohol use disorder, and marijuana use disorder), multiple sclerosis, and anxiety (some of which was caused by the Covid-19 pandemic).

Our approach is unique because we use SuperFluids to make our nanoparticles. These non-toxic gas-based fluids exhibit enhanced thermodynamic properties of solvation, penetration, selection, and expansion. This allows us to manufacture nanoparticles using an environmental-friendly 'green' technology.

How must the pharmaceutical industry evolve to become more sustainable?
Many companies prefer synthetic products because of perceived greater control over intellectual property and manufacturing, but plant-based products can be just as effectively covered by IP and manufactured well, and be less harmful to the environment. As the world warms up, we may see the emergence of tropical diseases in new areas.

What does Aphios want to continue achieving throughout 2023?
We have redirected our focus towards tackling Alzheimer's disease, taking a new approach now that Biogen's drug has been approved for Alzheimer's disease with certain limitations. Instead of focusing on one cause, beta-amyloid plaques, we are looking at all the causes of Alzheimer's disease including beta amyloid, tau entanglement, enzymatic changes, but particularly inflammation in the brain. We are exploring how to address brain inflammation and how our genetic makeup changes as we age promoting more inflammation in the CNS. Additionally, we are using our drug delivery platforms to find ways to get our drugs across the blood brain barrier and into the brain. We are continuing our work from last year on mRNA vaccines, employing double encapsulation to improve their bioavailability, shelf life, stability, and effectiveness. ■

Katrin Rupalla

CEO
YMMUNOBIO

Could you present Ymmunobio and key milestones?
We founded the company in 2021. We have identified gastrointestinal (GI) cancers as the top priority, as one in three cancer deaths are related to gastrointestinal cancer. Reasons for the high mortality include late diagnosis, current treatments not being very effective and there has been little innovation over the last decade in treating GI cancers. In response, we bought the patent family for two novel classes of antibodies CEACAM1/5 agonist and NPTXR antibodies, which have a strong scientific rationale for potentially treating GI cancers. We have conducted in vitro and in vivo preclinical studies and have established the proof of principle for both compounds. Based on our in vivo data for our lead CEACAM1/5 antibody YB-200 we have obtained orphan drug status from FDA for the treatment of liver cancer.

On of our main study focus has been how to attack cancer cells through the different, but complimentary mechanism of action – one being through stimulating the immune response and the other being direct cytotoxicity of cancer cells. We, therefore, explored the development of two monoclonal antibodies, one for immune-oncology (YB-200) and one for direct cytotoxicity (YB-800). ■

Prashant Kohli

CEO
ACASTI PHARMA

Can you give an overview of Acasti Pharma and the company's main activities in 2022?
Acasti is a late-stage specialty pharma company focused on developing drugs for rare and orphan diseases. We bridge unmet medical needs in target conditions with scientific breakthroughs in formulation and delivery methods of marketed compounds. Our focus is to improve the safety and efficacy profile of these compounds. We expect to start phase 3 for our lead program during the second half of 2023.

Since we repurpose marketed compounds, we benefit from FDA's 505(b)(2) regulatory pathway, which allows us to leverage clinical data from previous studies. We are thus able to advance these programs quickly and have already received orphan drug designations for three of our drug candidates.

Can you present Acasti's lead drug candidate and how they can benefit patients in the US market?
GTX-104, or nimodipine, lowers blood pressure and is used to treat patients who have experienced aneurysmal subarachnoid hemorrhage, or (aSAH). aSAH is bleeding over the surface of the brain in the subarachnoid space between the brain and the skull.

In the US, nimodipine is only available as an oral formulation and it can be difficult to administer to intensive care patients. Acasti has reformulated nimodipine into an intravenous infusion (IV). ■

Denis Dufrane

Co-Founder and CEO
NOVADIP

Can you present Novadip, your pipeline, and the 3M3 tissue regeneration platform?
Novadip Biosciences is a clinical-stage biopharmaceutical company founded to design, develop, and bring to the market a new class of regenerative tissue products to accelerate the healing of large bone defects and injuries in a single treatment. The 3M3 technology platform consists of a 3-dimensional, scaffold-free, extracellular matrix (ECM) utilizing differentiated adipose-derived stem cells (ASCs), to generate highly specific growth factors and miRNAs to restore the physiology of natural healing. The technology is based on adipose-derived stem cells, which are easily harvested from the patient's or donor's fatty tissue and when differentiated, have superior osteogenic properties compared to bone marrow-derived stem cells.

How do you plan on leveraging the €40 million raised in November 2022?
The funding will accelerate the clinical development of two of Novadip's investigational adipose stem cell (ASC)-derived tissue regeneration products: NVD-X3, an allogeneic cell-derived product that can provide accelerated, durable bone union in spinal fusion procedures and non-healing fractures, and NVD-003, an autologous cell-based product designed to provide a single treatment cure for patients with critical size bone defects such as congenital pseudarthrosis of the tibia (CPT). ■

Biotechs Fairing in 2023

After navigating tumultuous waters in 2022, biotechs share their forecast on the industry's health in 2023 and beyond.

"Despite less funding and M&A in 2022, the life sciences industry remains strong and capable of delivering scientific and clinical breakthroughs for important unmet needs, e.g., mRNA vaccines to address the Covid-19 pandemic. In the meantime, risk tolerance may be lower and expectations higher for companies seeking venture capital or acquisition."

Jason Kralic, Co-Founder and CEO, Tellus Therapeutics

"This period has certainly been challenging for the biotech industry, but we are doing remarkably well. In 2022, we finished enrollment in a Phase 2 Type 2 diabetes program, initiated our Phase 2b NASH program in the US, and had a very successful end-of-Phase 2 meeting with the FDA for the treatment of a rare liver disease called primary sclerosing cholangitis. We expanded the team and increased our headcount by 30%."

Liping Liu, Founder and CEO, HighTide Therapeutics

"This is a challenging time for the biopharma industry. Fortunately, we have several things going for us. We have a technology platform that can generate multiple products that address large market opportunities, we have established proof of clinical concept for two therapeutic assets and will be generating data from human studies within the next 12 months, and we have a cash runway through the end of 2024."

Denis Dufrane, Co-Founder and CEO, Novadip

"Our main achievement in 2022 was receiving FDA Orphan Drug Designation for HSB-1216 as a leading ferroptosis inducer to enter the clinic for the treatment of uveal melanoma, in addition to the Orphan Drug Designation for small-cell lung cancer. Our second drug candidate, HSB-888, also has the Orphan Drug Designation and a Rare Pediatric Disease Designation (RPD) for pediatric osteosarcoma. Additionally, we grew our patent portfolio and now have a world-class scientific advisory board which gives us a competitive edge as we navigate through the clinical and commercialization stages of development. Finally, we closed on a successful US$15 million initial public offering (IPO) for our Nasdaq uplisting."

Randy Milby, CEO, Hillstream BioPharma

"The best way to attract investment is with serious science and well-validated clinical mechanisms of action. An asset in the clinic with a well-described mechanism of action for how it works and peer-reviewed science, including NIH funding, helps with the validity. Ultimately, the proof is in clinical data. Reproducible safety data, good pharmacokinetics from a Phase 1 trial, and the description of a Phase 2 trial with hard endpoints that will hopefully separate the placebo from the drug candidate being tested will drive interest."

Hernan Bazan, CEO and Co-Founder, South Rampart Pharma

CONTRACT MANUFACTURING, SERVICES AND CHEMICALS

"It would take decades and add a huge cost to drugs to reshore the supply chain. Within the dosage form space, there is plenty of manufacturing capacity and room for expansion in the US. With APIs, it is a different story."

Gil Roth,
President,
Pharma & Biopharma Outsourcing Association (PBOA)

Image courtesy of CordenPharma International

The Industry's Growing Reliance on CDMOs

Towards more trust from the biopharmaceutical ecosystem

Image courtesy of Lonza

There is no slowdown in sight for America's ever-so-busy CDMOs. In recent years, the democratization of the outsourcing manufacturing model, consolidation of actors within the segment (there were 244 CDMO transactions between 2017 and 2021) and a shift from big pharma to smaller biotechs developing drugs and advancing pipelines, have established CDMOs as key players of the life sciences industry. And with the CDMO market forecast to grow at a CAGR of 11% until 2023 according to Market Data Forecast, that segment is likely to continue to outpace the growth of the pharmaceutical sector in the near term.

The onshoring conversation

The pandemic was a warning to the US that it did not have enough drugs for its population. In 2022, US CDMOs were first in line to highlight an almost taboo topic that the pandemic put back into the spotlight: the weakness of the US supply chain for essential medicines and components needed for the nation's health. Indeed, the pandemic showcased the brutal reality that most manufacturing for pharmaceuticals is done overseas, with numbers as high as 70% or 80% of global capacity in India, China, and Korea for some categories. As the pandemic highlighted weaknesses in multiple organizations in terms of their reliance on ineffective supply chains, cries for onshoring (or reshoring) manufacturing capabilities became louder in the aftermath of the Ukraine War in March 2022. Between Covid-19 and the war raging in Ukraine, US policymakers understood the limits of "friend-shoring": friends are not immune to natural or man-made disasters.

This offers opportunities throughout the pharma supply chain for companies based in North America. Playing to its onshoring strategy, Nivagen, for example, continues its push towards sterile injectable products. A 2022 financing of US$45 million will allow the firm to invest in a 63,500-square-foot state-of-the-art sterile manufacturing R&D facility in California. This will benefit the whole US value chain according to president and CEO Jay Shukla: "By reshoring product manufacturing, we will be able to streamline our supply chain, reduce manufacturing costs, and ultimately time to market for new product launches."

Geopolitics will undoubtedly have a more significant impact on the pharmaceutical industry going forward.

Coupled with changing regulations at the FDA level, the US is likely to see operations that flooded offshore being brought back inland in the near term. Hyderabad-based Aragen gathers 60% of its revenue in the US and capped off its stellar 2022 year by extending collaboration with Merck in September to help the pharma giant advance its therapeutic candidates pipeline. CEO Manni Kantipudi, who won the 'CEO of the Year Award' at the CPhI Pharma Awards 2022, detailed how health and geopolitical turmoils created synergies between US and Indian firms: "The pandemic and the Russia-Ukraine war have significantly impacted supply chain management globally. On the manufacturing side, we are seeing companies reallocating their investments from China and taking it back to the US or Europe. This had a ripple effect and as manufacturing companies in the US reached capacity, these CDMOs started collaborating with companies in India."

Bringing the manufacturing back to the US after decades of offshoring to Asia is a Herculean task, and one that is met by several industry leaders with skepticism. Working to advance the business interests of CDMOs, Gil Roth, president of the Pharma and Biopharma Outsourcing Association, would like to see more of the manufacturing occur in the US, but remained realistic regarding the task ahead: "It would take decades and add a huge cost to drugs to reshore the supply chain" he stated, adding: "Within the dosage form space, there is plenty of manufacturing capacity and room for expansion in the US. With APIs, it is a different story."

With rising tensions between leading powers, trade arm-wrestles, and ongoing conflicts, the current fully globalized supply model of the industry is likely to shift to a hybrid one. Pfizer CentreOne is the pharma giant's CDMO arm, and recently acquired Abzena's Sanford, NC, site to bolster its manufacturing capabilities. Leveraging the firepower from Pfizer, the CDMO remains a key piece of the US supply chain puzzle and assesses a shift in practices in the near term. As explained by Pfizer CentreOne's, global business development lead, Tom Wilson: "Instead of an increase in onshoring or localization, I see something inbetween happening, such as regionalization and diversification of key supply chains."

> We are partnering with US-based API manufacturers on options that may allow us to eventually produce APIs in-house, along our OSD and liquid manufacturing processes. This will allow us the flexibility to significantly reduce our cycle times, cost, safety stock, and most importantly, our supply chain.
>
> 
>
> **Tom Lewis,**
> **Vice President of Supply Chain and CDMO Management,**
> **Lannett Company**

New chemistry approaches

Applying sustainable practices can offer competitive advantages beyond the industry and the community in which CDMOs operate. In 2021, Boehringer and Novartis introduced the iGAL 2.0 for a greener future for manufacturing in compliance with the UN Sustainable Development goals. With an increasing amount of CDMOs being awarded high ratings from Ecovadis for their sustainability practices, today, science-based targets initiatives and metrics (such as full waste recycling, green power percentage, and low process mass intensity) are a given across high-revenue CDMOs like Aragen, CordenPharma or Pfizer CentreOne. The latter is deeply involved in green chemistry practices, namely, the ability to remove chemical steps and replace that within enzymatic reactions in API manufacturing.

One of the most telling success stories in green chemistry is Pfizer CentreOne's Enviero Progesterone. Enviero is a first-of-its-kind green chemistry progesterone. Celebrating its fifth anniversary, the green chemistry-driven API represents a step-change in progesterone processing efficiency and sustainability. By eliminating metal catalysts and the bulk of the organic solvents, environmentally damaging waste emissions have been

reduced by more than 70%. Talking about the widespread adoption of the compound and the broader industry push towards green chemistry, Tom Wilson, global business development lead at Pfizer CentreOne, detailed: "Green chemistry is a growing trend. That growth is translated by the transition from a premium offering to an expectation, to a foundation. In the US, we are starting to see that transition from premium to expectation."

With green chemistry becoming an expectation, synthetic organic chemists will see their role take another dimension in the future as CDMOs take on the task of making APIs green. "We are seeing a trend toward using synthetic organic chemistry to manufacture small molecules as these solutions provide precision at the production stage" explained Nick Shackley, SVP and COO of Veranova, a leading CDMO in the development of specialist and complex APIs.

Shockwaves from Europe

Beyond supply chain delays, the energy and military crisis in Europe prompted a spike in raw material costs across the pharmaceutical industry. But, in the spirit of not letting a good crisis go to waste, some noticed that the volatility in energy markets will offer opportunities down the line for manufacturers in the US. Canada-based GL Chemtec saw more demand for its services in 2022, and president Gamil Alkhami anticipates further work for US manufacturers as pharma clients will want to mitigate risks: "Europe's energy crisis and the ongoing conflicts in the region have prompted some customers to reach out to CDMOs in North America to reduce risk," he explained.

As more firms decrease their reliance on Asian markets, the US offers a variety of opportunities for manufacturers looking to be as close as possible to where the innovation happens. Dipharma, an Italian firm that recently completed the second phase of expansion at its Kalamazoo, MA, facility, sees 40% of its turnover coming from North America. Andrea Confetti, exclusive synthesis business unit leader, expanded on the reasons behind the US' competitive advantage: "There was a significant increase in energy and raw material costs which affected the economics of companies operating in our sector in Europe. Additionally, the supply of raw materials is still significantly dependent on the Chinese market."

Determining a strategic orientation

As CDMOs and CMOs adapt their offerings to meet ever-changing demand, key players seem to be embracing a digitalization push. US organizations like Scorpius BioManufacturing, INCOG BioPharma, and Adare Pharma Solutions all digitalized their Quality Management Systems (QMS) in 2022. Doing so reduces the potential for manufacturing mishaps, and, according to Adare's CEO Tom Sellig: "Upgrading our digital systems gave us a world-class platform to streamline our processes and allow us—both from a training and compliance standpoint and from a quality management standpoint— to up our game in a cloud-based system."

The pandemic, the onshoring conversations, and the outsourcing model have redefined the concept of contract manufacturing. In order not to replicate the mistakes from the past, some emerging players are intent on developing new manufacturing models that will guarantee access to key medicines for all populations. Roger Erickson, Interbiome's CEO and founder, deplored that the health of the median US citizen has been declining over the past 30 years despite the industry's technological prowess. He suggested: "We see a need to get into the foundational stages of small-scale drug manufacturing of both neglected and abandoned, yet still needed, drugs, which calls for the creation of a new CMO business focused on affordable sustainability."

Overall, signs point towards cautious optimism for the CDMO segment in 2023 and beyond. Whether active in the small or large molecules space, broad or limited patient populations, the current environment suggests CDMOs should pursue strategic relationships with big pharma (in other terms, follow the money). Pandemic-related factors aside, a significant portion of the heightened demand for CRO/CDMO services has been driven by VC-backed pharma firms. As analyzed by Brian Scanlan, operating partner at Edgewater Capital Partners, the private equity that acquired GL Chemtec in 2022: "If you are a small CRO/CDMO and have 100% exposure to VC-backed emerging biopharma, you might want to consider changing your strategy and getting some exposure to big pharma who are flush with cash." ■

»Our main mission is the execution of a >€200 million investment into *capex* projects that will bring additional capacity and technologies online to support pharma and biotech customers as their drug development projects progress.«

Michael Quirmbach

CEO and President
CORDENPHARMA INTERNATIONAL

What are the reasons behind CordenPharma's record 2022 year?

One of the reasons is the expansion of our business in the key areas of peptides, lipids, injectables, and highly potent and oncology. In 2022 we successfully supported the launch of several new medicines. Furthermore, CordenPharma has continued to make significant *capex* investments in technology and capabilities in the fields of peptides, lipids, and highly potent and small molecules, with most of them to be completed in 2023. For example, we launched strategic investments at our Caponago site with the construction of a GMP LNP manufacturing suite and the installation of a third commercial aseptic fill and finish line. This led to additional capabilities in terms of injectables and LNP manufacturing and uniquely positions us to offer end-to-end capabilities from initial lipid supply to LNP formulation development and final fill and finish.

Can you speak of the strategy behind CordenPharma's decision to expand its peptide and oligonucleotide manufacturing capacity?

CordenPharma aims to continue expanding in the US and is constantly looking for acquisition opportunities for manufacturing sites, particularly in key biotech hubs such as Boston, MA. We are also considering greenfield opportunities. CordenPharma made a US$60 million investment into our CordenPharma Colorado facility in Boulder, CO, to support a multi-year agreement for the contract manufacturing of a large-volume commercial peptide, as well as to further strengthen both our large and medium-scale peptide manufacturing capacity.

We also recently decided to move back into the oligonucleotide manufacturing space in CordenPharma Colorado, as it has similarities to peptide manufacturing with significant market demand from customers asking for capacity. CordenPharma is uniquely positioned to offer end-to-end solutions for peptides and oligonucleotides from sophisticated formulation development using lipids excipients especially suited for Lipid NanoParticle (LNP) molecules encapsulating mRNA and other xRNA-based vaccines, to fill and finish sterile injectable drug products.

Are there any technology platforms currently attracting more demand than others?

In terms of peptides, because there are currently more molecules reaching the market, larger quantities are required than a few years ago. As there are only a few companies who can handle this large-scale peptide manufacturing, CordenPharma is perfectly positioned to answer this demand with our world-class site in Colorado, which has space to expand and the capability to handle the extremely large volume of solvents required for the purification of multi 100 kgs of the peptide.

Can you touch upon the Science Based Targets initiative (SBTi), and your focus on driving down global emissions across the company?

The SBTi partnership independently assesses and approves companies' targets in line with strict criteria, helping to support best practices for ambitious climate action in the private sector. The initiative is a collaboration between the Committee for Development Policy, the UN, and the WWF. Sustainability is our responsibility as a CDMO and has always been important to CordenPharma. Astorg's emphasis on ESG has amplified the company's strong focus in this regard. Our mission to reduce our carbon footprint will contribute towards real sustainability as a company, something that is becoming increasingly important for both investors and customers today. We are currently working on our roadmap and have already set some ambitious targets which we will announce next year. We are gathering the data now, as we want our targets to be science-driven and realistic, so it has real value in the long run.

What are CordenPharma's main goals and ambitions for 2023 and beyond?

These are very exciting times for CordenPharma. Our biggest site in the US is in Boulder, CO, which is an extremely competitive environment. We attract and retain talent by offering a good salary, but also an environment where people have a purpose and can grow within the company. CordenPharma has a good reputation, offers career progression opportunities, and has a collaborative company culture. My outlook for the industry is very positive. I think pharma companies will continue to outsource, so the need for contract manufacturing will grow as more biotechs emerge. Our main mission is the execution of a >€200 million investment into *capex* projects that will bring additional capacity and technologies online to support pharma and biotech customers as their drug development projects progress. ■

For every challenge, we have a set of tools we can leverage to create optimized solutions beyond taste masking.

Tom Sellig

CEO
ADARE PHARMA SOLUTIONS

What was the decision-making process behind selecting Veeva Vault Quality Suite to harmonize Adare's quality systems?
Bringing in Veeva Vault Quality Suite gave us a world-class platform to harmonize our quality systems across the organization, streamline our processes, and allow us—both from a training and compliance standpoint and from a quality management standpoint—to up our game in a cloud-based system. Many of our pharma clients are already familiar with Veeva, and it provides much better access to faster reporting and better diagnostic tools to ensure we are staying ahead of the curve in terms of our quality systems.

Have any areas of product development prompted more demand than others in 2022?
We are seeing demand in several key areas. Pediatrics is one great example where unpleasant taste is a major barrier to adherence and, as many companies are looking to expand into pediatrics or looking to expand their patents, we have seen increasingly more requests to support taste masking using our microencapsulation and controlreleased technologies. We are also seeing demand for traditional things like bioavailability and support for geriatric patients, and with the Frontida acquisition, we can leverage even more tools to support a wide range of capabilities. Pediatric and geriatric patients many times have difficulty swallowing drugs and we are using our technologies to come up with unique and creative solutions for this challenge.

What differentiates Adare's proprietary tastes masking platforms and what is driving growth in the taste masking market?
We work on a wide range of APIs that have taste challenges such as bitterness or they need sweetening or flavoring. We have several microencapsulation technologies and capabilities to address these needs, from uniformly coating solid particles to creating a physical barrier for improving the taste or the release profile of a product.

For every challenge, we have a set of tools we can leverage to create optimized solutions beyond taste masking. For example, whether it is low solubility or high potency, we are seeing a range of different types of bioavailability challenges. Our solid-solution or solid-dispersion Diffucaps technology platform enhances solubility by preserving a drug's amorphous form, helping address the faster onset of action and minimizing food effects amongst others.

What are the challenges and opportunities for CDMOs in the US in 2023?
The changes in regulations around FDA inspections offer both challenges and opportunities. The agency is now able to do more unannounced inspections as well as more remote types of audits. We have already seen an increasing number of CDMOs, in particular in emerging markets like India, which are receiving warning letters and 483s, which is resulting in opportunities for onshoring and customers bringing back their production to US or Europe.

There continue to be general supply chain challenges, but fortunately, Adare has a global supply chain team which allowed us to continue to meet demand and not have too many difficulties along the way. In terms of funding, we have not seen any of our clients having major challenges, whether it is through IPOs, M&A, or additional fundraising. The decision-making might be slightly slower, but companies that have creative and breakthrough solutions can attain funding.

What are Adare's main goals for 2023?
2022 was another great year for Adare Pharma. In 2023, we look forward to both organic and inorganic growth. Adare has an active investment plan and strategy that encompasses all our sites, and the company continues to invest in new capacities and capabilities to offer an even broader suite of solutions to our customers. We are currently scaling our long-acting injectable capability at our Lenexa facility in Kansas. We are also currently going through a major operational excellence initiative which is helping us to reduce costs and operate more efficiently and are also spending significant time on our ESG strategy. As these initiatives come to fruition or get to a steady state, we will then start to look at our longer-term plan which includes several M&A targets as we continue to grow the business. The client experience journey is one of our important strategies for the year, and we are off to a great start in 2023 and are looking forward to continued growth and expanding our business. ■

AFC's core technology differentiators include energetic chemistry, high potency manufacturing, and extensive chromatographic separation capabilities.

Jeff Butler

President
AMPAC FINE CHEMICALS, AN SK PHARMTECO COMPANY

Can you give an update on AFC's activities and key milestones achieved in 2022?
2022 was a great year for AMPAC Fine Chemicals (AFC) and SK pharmteco. The company expanded both geographically and in terms of capabilities – specifically in the US, with significant investment at all our manufacturing sites as well as AMPAC Analytical. We are proud to have successfully activated and qualified our new large-scale commercial production facility in Virginia.

Additionally, we proactively invested in our technologies, equipment, and personnel to launch a "Complex Molecule Chemistry & Engineering Center" in California, supporting the rising demands for therapies with complex chemistry, synthesis, and purifications. Together, these facilities further cement AFC as a leader in solving complex chemistry challenges as it relates to impurities in chromatography.

Are there any technological areas that currently prompt more demand from customers?
AFC's core technology differentiators include energetic chemistry, high potency manufacturing, and extensive chromatographic separation capabilities. These technologies support many new therapies with higher purity standards and challenging impurity and synthesis. AFC has decades of experience in continuous processing technology as it relates to energetic chemistry. While continuous processing is well known at the large-scale commercial stage, AFC also has the unique capability to provide validated GMP synthesis at small to medium scales. This helps bridge the gap for customers rather than having to make that big jump between small-scale clinical to commercial.

Traditionally, AFC has focused on late-stage clinical and commercial development projects; however, we are now supporting projects in earlier stages, especially those that utilize our core technologies. Our key differentiator is the speed and flexibility at which we deliver solutions – which is critical to support the increasing clinical demands following the pandemic.

Can you speak to AFC's sustainability initiatives?
AFC and SK pharmteco have been committed to sustainability for many years and have been recognized for our advancements in green chemistry.

We are also focused on the social side. Some of our recent initiatives include STEM education programs at schools and collaborating with universities to develop core talent for the industry.

How are new technologies helping improve services in the life sciences industry?
We believe we can better serve our customers through digital processes. Having an increased focus on data allows us to improve processes while maintaining speed and flexibility to deliver products on time and in full. Capitalizing upon SK pharmteco's digitalization capabilities, we will continue to advance our processes for the small molecule side, as well as the cell and gene side with our sister companies. We have a strong commitment to cybersecurity to ensure that the data we generate is secure and that our customers have access to what they need so they can leverage it to continue to improve their processes.

What is your assessment of the supply-demand dynamics of high-potency APIs, and broader trends for CDMOs in the US in 2023?
High potency work is increasing in all therapeutic areas. It is important to continue to be at the forefront providing a reliable supply of material to the clinic and patients. AFC continues to invest in capabilities that can support the production of high potency materials. We ensure we have the proper engineering controls in place and the process chemistry technologies to support our customers from grams up to metric tons.

We expect to see a rise in clinical demand post-pandemic, as capital markets free up and customers again start to move their clinical candidates forward. However, there are still supply chain challenges resulting from the pandemic. Being agile and flexible to respond to changing dynamics is critical. Good CDMOs have developed alternative supply chains and redundancy. Companies and industries are also starting to look at onshoring production to Western supply chains. Together AFC's sites in California, Virginia, and Texas, along with SK pharmteco's global network, allow us to develop customized supply chain solutions that best fit customer needs.

What are AFC's growth strategy and objectives for 2023 and beyond?
AFC's ambition is to continue to expand and grow to support our customers at all scales and locations with speed and agility. We will continue to strengthen our core competencies, while also expanding into new focus areas, such as in oligonucleotides and lipids. ■

> **Experienced CDMOs can provide companies with access to new formulation and technology methods that improve the bioavailability of difficult-to-formulate compounds.**

Jan Kengelbach

CEO
AENOVA GROUP

What have been Aenova's highlights in 2022?
2022 was a challenging year for many companies, including CDMOs. The resilience of a business, however, is exhibited best in times of higher pressure. Above all, our promise to customers is high quality and high delivery reliability. We worked incredibly hard in operations, procurement, and all support functions to keep delivery up and to serve customers and patients around the world. We also invested in 40% higher inventory levels to ascertain delivery, but everyone had to get used to longer lead times, as suppliers could not deliver sufficient raw materials on time.

About four years ago, we designed a new growth strategy. First, each site had to become a center of excellence for a certain technology, and second, in each site we made the investment decisions to either expand existing capacities or extend the technology offering. In total, there are 15 new growth platforms at Aenova now, of which eight are commercially online. We created a brand-new sterile fill and finish area (including biologics) for prefilled syringes and RTU vials at our Latina Site, Italy. The breadth of new technologies that we have put online include the new high-potent API facility at our Regensburg site, Germany, the hot melt extrusion and templated inverted particles at our Sisseln site, Switzerland, and the dry powder inhaler/micro-dosed capsule filling in our Münster site, Germany.

Can you expand on Aenova's focus on micro-dosed capsule filling and dry powder inhalation?
Our development team developed – together with one of our customers – a first-to-market dry powder inhaler generic in the global strive to find more affordable solutions to treat severe respiratory diseases and COPD. This is an attractive market for generic players, as many of the originator drugs in that space are coming off the patent cliff. Expert knowledge to deliver the required aerosolization with a particle size of 1-5 µm over the entire shelf-life is not for everyone, and we can both provide the development services as well as cost-competitive manufacturing.

What are the key takeaways from Aenova's white paper on "innovation in drug formulations"?
Innovation is particularly important for the world's preferred solid oral dosage forms. However, for most innovative compounds, traditional approaches to solid dosage formulation do not work because they do not solve the challenges of bioavailability and solubility. Over 80% of drug candidates show low aqueous solubility. However, experienced CDMOs can provide companies with access to new formulation and technology methods that improve the bioavailability of difficult-to-formulate compounds.

What is your outlook for the main trends likely to drive the CDMO space in 2023?
Above all, there is an unprecedented increase in demand across all dosage forms and therapeutic areas to an extent that we haven't seen after two years of abnormality, first reduced demand for medication as part of the pandemic, and second reduced supply availability due to geopolitical crises. This drives organic growth rates at Aenova of over 20%, and it is hard to install all the required capacity in a timely fashion, as equipment manufacturers have a long lead time.

As costs have gone up due to inflation last year, manufacturing prices had to follow, and that means certain products are not viable anymore, and customers will have to exit products or markets. This will put the health authorities and public payors under pressure, as they will have to secure supply from fewer players. Ultimately, patients will suffer, until governments and relevant authorities understand that pricing must be allowed to move with inflation.

What will be the main priorities for Aenova in 2023?
Above all, we need to deal with the unprecedented demand. But that is not enough, as we need to build the pipeline for the next wave of growth, which we see in providing more state-of-the-art, flexible aseptic manufacturing, and concomitant development services.

The strategic role of our Greensboro site is to be a packaging hub both for bulk made in Aenova's EU sister sites sold into the US or as well as for third-party US customers. It is also a preferred partner for complex manual packaging and kitting operations. We have transformed the site to prescription drug packaging, including serialization and aggregation, and invested in new lines to increase capacity. But clearly, Aenova will have to make strategic acquisitions in the North American market one day. ■


AC


RF

Andrea Confetti & Roberto Fanelli

AC: Exclusive Synthesis Business Unit Leader
RF: Catalogue APIs BU Deputy Manager
DIPHARMA FRANCIS

How did 2022 unfold for Dipharma?
AC: In Q1 2022, the Russia-Ukraine war drastically affected the European business environment. There was a significant increase in energy and raw material costs which affected the economics of companies operating in our sector in Europe. Additionally, the supply of raw materials is still significantly dependent on the Chinese market and there were several events, mostly related to the pandemic, which affected the supply chain and resulted in supply and logistic delays. Yet, in 2022 Dipharma was still able to deliver the forecasted revenue for our consolidated products and services, and we also managed to acquire new businesses creating a pipeline able to take over the maturity of some other products and projects.

Can you speak to Dipharma's product portfolio and the demand dynamics the company experiences?
RF: Dipharma has a historical portfolio of APIs and CDMO services developed based on identified market trends and our innovative technical and operational capabilities. The US market is one of the most significant for Dipharma: North American sales contribute approximately 40% of the company's overall turnover. We sell our generic APIs worldwide depending on the patent situation and our market positioning in a given country or region. One important element in selecting new generic APIs is the PIV strategy, which helps enhance readiness to be the first filer or supplier in the market. Our experience in developing proprietary chemical processes and alternative solutions to support the generic API industry has been instrumental in rapidly expanding our CDMO activities in particular in the US and European markets.

What investments has Dipharma recently made in the R&D, innovation, and technology space?
RF: A relevant example of our recent investments is the completion of the second phase of expansion at our Kalamazoo facility, in Michigan. It consists of an additional 2,000 sqft, mostly dedicated to the Quality Control laboratory and the warehouse supporting our new CGMP kilo lab line completed in 2020.

We recently expanded our Research and Development Center for small molecules at our Headquarters located in Baranzate, close to Milan, Italy. We have an R&D team of approximately 80 researchers, employed in Italy and the US, where nearly 50% have a Ph.D.

Another important achievement has been the approval by the Italian Medicines Agency (AIFA) in 2022 of a second line of production in our state-of-the-art CGMP pilot plant located in Mereto di Tomba (IT). We doubled our capacity to process projects for customers, both in the generics and CDMO arena, while enhancing operational safety and isolation technologies. This new line includes four reactors for a total of 2.4 m3 capacity and a filter-dryer equipped with a continuous liner discharge, allowing for a full closed-system handling approach from beginning to end.

What are the main challenges and opportunities for CDMOs heading into 2023?
AC: Increasingly, customers want to minimize the number of players involved in their development-to-commercialization process, as project transfer takes significant time, investment, and resources. Dipharma's ability to cover the whole lifecycle of a molecule is a key value add for our customers and we support them from pre-clinical to commercialization. Regulatory agencies are becoming more stringent.

Sometimes customers acquire innovative molecules from other partners and then require our experience to come up with proposals on new or more efficient chemical processes often generating novelty and intellectual property protection. Finally, more pharmaceutical companies are focused on sustainability, not only their own but also that of their partners. Dipharma is proud to have obtained a silver medal from EcoVadis, which means being in the top 25% of all the organizations they survey.

What will be Dipharma's main goals for 2023?
AC: To continue growing our CDMO business, we are reinforcing our position both in the European and North American markets, using our wider technological platform, state-of-the-art capabilities, and our proximity to clients.

RF: We are continuously investing and upgrading to maintain a certain level of sustainability and quality of all our services. Our strategy is to grow our API portfolio and make products available to all the markets we operate in. ■

This expansion will allow Prince to more than double its headcount, increase manufacturing capacity, and offer additional ready-to-use products and sterilization services to the market.

Daniel Prince

CEO
PRINCE STERILIZATION SERVICES

How did 2022 unfold for Prince Sterilization Services?
Prince is a critical manufacturer in the supply chain of pharmaceutical wares that must meet stringent regulatory quality requirements. 2022 was a terrific year for us: We had the grand opening of our facility in Pine Brook, NJ, our revenue grew by 55%, and we transitioned from a small to a medium firm. The facility work included a US$25 million and 25,500 sq/ft renovation and expansion. This expansion will allow Prince to more than double its headcount, increase manufacturing capacity, and offer additional ready-to-use products and sterilization services to the market, ultimately allowing us to better support our global network of pharmaceutical and medical device customers. We won the Small Manufacturer of the Year award from the New Jersey Manufacturing and Extension Program, and we are pleased to also share that Prince Sterilization was just selected as an ACG NJ 2023 Honoree.

Can you present Sterikit and the market demand for the product?
SteriKit is a sterile, ready-to-use (RTU) kit containing pharmaceutical-grade vials, stoppers, and seals that are strategically packaged to drive customer efficiencies and reduce waste. The industry demand for RTU pharmaceutical components continues to grow. With the continued global rise in labor and utility costs, companies are now more than ever strategically looking at options to streamline their manufacturing output by focusing their attention on core competencies. Finally, the recent growth in the production of small-batch, personalized and high-value medicines, the adoption of advancements in filling equipment, and increased regulatory scrutiny all contribute to the increased adoption of RTU. The market is growing very fast for these reasons.

Can you expand on your latest sustainability and innovation investments?
In addition to our leadership and innovation within the RTU pharmaceutical componentry space, our company is also a leader in safe and environmentally friendly pharmaceutical and medical device sterilization. Today, we offer the market steam and dry heat sterilization options. We are excited to announce that in 2023 we will also be one of the first companies to offer contract hydrogen peroxide vapor sterilization for customers that require low-temperature sterilization options.

What are the trends likely to shape the sterilization market in 2023?
The global sterilization market has been growing steadily over the past few years, and several drivers have contributed to this growth. Governments around the world have implemented stringent regulations to ensure the safety and efficacy of medical devices and pharmaceutical products. These regulations require that products be sterilized before they can be used, creating a significant market for sterilization equipment and services. The increase in the number of surgeries being performed globally has led to a rise in demand for sterilization products and services. Surgical instruments and medical devices need to be sterilized before use to prevent infections, and this has created a significant market for sterilization equipment and services. The development of new and more effective sterilization technologies has also contributed to the growth of the global sterilization market. For example, low-temperature sterilization technologies, such as hydrogen peroxide gas plasma sterilization and ethylene oxide sterilization, have become increasingly popular due to their effectiveness and efficiency.

What will be the key priorities for Prince in 2023 and beyond?
We are going to be almost 10 times larger in terms of facility size, so managing growth will be key. Everything in our facility is custom, so we are now making sure that our equipment is validated and ready to go. We are at the beginning of executing the expansion. 2024-2025 will be about optimizing and looking at the next steps: a different line, a different continent, who knows? We plan to stage and manage growth to continue to provide quality and dependable services to our clients. We will enter into a limited number of capacity agreements that commit our facility to manufacture for our client an agreed volume of business over an agreed term. We will also continue to serve our Purchase Order-bound clients with our practice of agreed schedules and costs. ■

Milton Boyer

CEO
KINDEVA DRUG DELIVERY

Can you give an overview of Kindeva Drug Delivery (Kindeva) and the company's main achievements in 2022?
Kindeva Drug Delivery has a rich 100+ year history. It was formerly 3M Drug Delivery Systems that were composed of three different entities — US manufacturing, UK manufacturing, and research and development. These three groups were put together to form Kindeva, which launched in May 2020 as an independent company on the heels of an Altaris Capital Partners buyout, which is our private equity sponsor. In 2021, Altaris purchased Meridian Medical Technologies from Pfizer. In December 2022, we closed on the combination of these two companies to create a leading CDMO focused on drug-device combination products.

What synergies did the combination of Kindeva and Meridian create?
Meridian is the innovator of autoinjector technology and a market leader in manufacturing emergency autoinjectors, while simultaneously expanding aggressively in the pre-filled syringe and traditional sterile fill-finish space. This, combined with Kindeva's core competency in inhalation devices, including metered dose inhalers (MDIs), as well as significant transdermal and intradermal capabilities, allows us to offer our customers comprehensive solutions relative to primary drug delivery platforms. Essentially, overnight, we became one of the top 15 global CDMOs, but more importantly, we are a top five CDMO concentrated in this drug delivery space.

What are the main drivers behind the growth of the drug delivery market?
The shift to biologics is driving some of the growth from a top line due to its greater efficiency and being a higher-value product. Self-administration of medicines is also something people are becoming increasingly comfortable with and therefore are looking for device platforms that enable independence of administration.

The evolution of smaller batches of high-value products also lends itself well to contract to manufacture as the facility investment versus outsourcing is not always practical at a smaller scale. ■

Robert Poe

CEO
OLON RICERCA BIOSCIENCE

Can you detail the synergies unlocked since the acquisition by Olon S.p.A in 2017?
Olon Ricerca Biosciences, from Italy, operates a broad range of specialty chemical manufacturing with total revenues of around US$580 million p/a. This was a strategic buy, as our site in Concord, OH, is focused more on early-stage development up to phase 2 to keep clients up to phase 3 towards commercial manufacturing. We started unlocking synergies in 2022, as our site was able to operate on its own, and we began working more closely with Olon's regulatory affairs group. Most of our clients are in the smaller and mid-size end of pharma companies. We have over 300 active DMFs in the organization. Olon's overall business is approximately 60% generic and 40% CDMO work. We are working to shift this closer to a 50/50 stance.

Can you expand on Olon's education and corporate sustainability initiatives?
The research program we launched will primarily be focused on Italy, but we recently found out that we could apply for a blanket visa to move people easier to the US. We currently have one intern within Olon USA, the group that does generic sales in the US. We are looking at bringing people from Italy, Spain, or India to our site. The program is very interesting; it takes a recent graduates and brings them exposure to the different services Olon offers. From a sustainability standpoint, the goal is to reduce energy consumption by 60%, use regenerated water, and increase recycled waste by 50% by 2025. In 2022, Olon invested at five of the 11 sites in solar panels to increase its focus on renewable energies.

What is the goal for 2023?
Olon works with lots of big pharma customers, whereas ORB is on the development side and focuses more on smaller players. One goal is working as a team to take on the earlier stage projects and allow the bigger group to take more projects into commercialization. ■

Cory Lewis

CEO, President and Co-Founder
INCOG BIOPHARMA SERVICES

Can you introduce INCOG BioPharma Services (INCOG) and the key milestones since the firm's creation?
INCOG offers drug product fill finish contract manufacturing. In December 2020, we purchased a 16-acres and, in December 2021, we took occupancy in our 90,000 sq/ft facility. By May of 2022, we installed our first OPTIMA multi-use filling line, which can fill close to 40 million units of vials, syringes, or cartridges per year. Wrapping up Q1 in 2023, we are now above 80 employees with a facility that is cGMP production ready and actively manufacturing commercial PPQ batches. Additionally, we are kicking off an expansion with a second high-speed syringe/cartridge filling line that is due to be installed in 2024, moving our capacity to 140 million units per year. We are complementing the line with additional equipment that supports automated inspection, and we continue to make investments in device assembly capability to support auto-injectors and pen systems. Our services also support Development, QC, Inspection/Labeling/Packaging, Device Assembly, and Storage.

How do you see 2023 shaping up for US-based CDMOs?
A challenge for biopharma firms is making sure products aren't drastically impacted by supply constraints and logistic challenges. CDMOs need to provide manufacturing and supply redundancy to biopharma companies. As for the global economy, we will see a slowdown in biopharma investment. That is beneficial for CDMOs as biopharma companies will continue to advance their molecules, but slow down their investment to manufacture in-house.

What makes Indiana an attractive emerging hub for the life sciences industry?
Since selecting Fishers, IN in September 2020, there have been eight additional life science companies who have committed to investing over US$750 million here. Indiana is a growing hub for several reasons: we have plenty of distribution and warehouse capability, and you can access the entire continental US within a 5-hour flight. Indiana leads the US in pharmaceutical exports, and Eli Lilly announced US$2.1 billion expansion in Indiana. ■

Tom Ross

President and CEO
GRAND RIVER ASEPTIC MANUFACTURING

Can you expand on your latest investment in cutting-edge modular technology?
For a few years now, we have committed ourselves to implement complete isolator-based technology. One of the most exciting areas we are working on is our flexible-filling technology, which is the Bausch+Ströbel VarioSys modular vial and syringe/cartridge filler with SKAN Isolator. The modular design and multi-component flexibility of the VarioSys offer a wide range of benefits while maintaining aseptic processing. This is the type of technology investment we are keen to expand. Furthermore, we are continuing to use disposable technology for the optimal quality of products for our clients.

How do you assess the strength of Michigan as a hub for pharma firms?
There is a significant amount of investment and medical endowment in this area. Having local universities and educational institutions such a Michigan State University, Grand Valley State University, and the Van Andel Institute in the same area as multiple medical and pharma facilities allows us to collaborate with people on the front line and helps with recruitment processes. During Covid-19, we were able to add the workforce needed almost instantly due to this community. GRAM implemented an employee referral program with great reputation values that helped create opportunities for our team and community career-wise. We also partnered with the state economic development group and the local economic development group.

How do you see CDMOs thriving in 2023, and what is going to be GRAM's main goal this year?
For the industry, I anticipate continuous investment in leading technologies and commitment to the highest level of quality. From a challenge perspective, I would say the biggest challenge will be the supply chain, as the lead times and components are still longer than they were. On GRAM's side, we are looking to grow our workforce and sustain our hybrid-work model, which these days is essential when attracting talent. ■

Jonathan Hunt

Managing Director and CEO
SYNGENE INTERNATIONAL

How did 2022 unfold for Syngene?
We have made good progress in our strategic focus areas, especially in the biologics and commercial manufacturing business. Syngene started as a company focused on discovery research. Over the last 29 years, we have expanded our scientific expertise enabling us to offer integrated services across the full range of discovery, development, and manufacturing. Today, we are well established in the contract research market with a strong emerging presence in development and manufacturing services.

Where do you forecast increased demand in 2023?
Our customers' businesses are evolving, and their requirements are changing. They look at us and see a company of long history, enormous scale, and depth of capability, and they partner with us because we know things that they don't know and we can add value. Overall, the demand environment remains broadly positive, and I am confident that we will continue to grow as we keep a close eye on the evolving trends and continue to invest in digitization, capability building, and additional infrastructure development. ■

Robert Lee

President - CDMO Division
LUBRIZOL LIFE SCIENCE, HEALTH

Can you touch upon the firm's latest technological investments?
The pandemic forced us to look at our overall business, so we focused on our core competencies; sterile manufacturing (CTM and FDP), the formulation of low water-soluble APIs, and long-acting implants and depots. Nano-milling is a go-to technology if the API has the appropriate physicochemical characteristics, and of course, our new excipients.

How active are you in the field of topical ophthalmics?
Ophthalmics is an exciting area, and we are increasing our focus on ophthalmic products. There are client-centric innovations out there – micro dose devices and long-acting drug delivery systems/devices. From a formulation perspective, you can potentially create differentiated dosage forms by nano-milling if you have a water-insoluble compound that allows you to increase the bioavailability or homogeneity of the API. Lubrizol's excipients business provides polyacrylic acid polymers that are useful in this ophthalmic space. It is about delivering the API where you want it to be and improving the residence time on the target tissue. With that, we are well-positioned to serve the industry through ophthalmic formulation development, clinical trial material, and so on through to commercial manufacturing. ■

Tim Tyson

Chairman and CEO
TRIRX PHARMACEUTICAL SERVICES

How does TriRx serve the life sciences industry?
TriRx is a global CDMO with a presence in North America and Europe, serving all major markets. We serve the animal and human health sectors for both small and large molecules and offer comprehensive services that encompass late-stage development, technical services, primary and secondary commercial manufacturing of several dosage forms as well as biotech API production. Animal health is a promising yet underdeveloped and fragmented marketplace with significant potential for high-value creation.

What is going to be the growth strategy for TriRx in 2023?
We plan to increase our volume by maximizing the utilization of our current facilities and expanding our capabilities in high-demand markets. Our most important growth strategy is to deliver on our commitments to current customers. We are focused on developing additional business at all of our existing sites. Additionally, we will seek appropriate bolt-on acquisitions to complement our existing business. As a group of highly skilled professionals, we are well-positioned to serve a growing and fragmented marketplace. ■

Adopting a Proactive Stance

CDMOs will play a vital role in bringing CGT and mRNA technologies to market

Image courtesy of Dipharma Francis

CDMOs have a crucial responsibility in mitigating future pandemics and bringing new therapies to life. Two therapeutic areas are poised to see incremental growth over the coming decade: Cell and gene therapies (CGT), and mRNA technologies. For the former, the pace of the development of therapies in recent years has been astounding, with thousands of candidates in the pipeline. Now is the time to increase the scale of commercialization of CGT products to accelerate patient access. The promise of mRNA technologies has been demonstrated during the Covid-19 pandemic, with vaccines reaching the market in record time. Contractors and the US government together are now looking at the future and investing heavily in the strengthening of vaccine preparedness.

Making the future of medicines a reality

The potential of CGT to tackle previously untreatable illnesses is limitless, but the road toward standardization of these technologies remains long. There currently are 27 cell and gene therapies licensed by the FDA (as of April 2023), and about 3,726 products currently in the pipeline, according to Lonza. For CGT developers considering regulatory hurdles, limited technical knowledge, and aggressive investor timelines, translating a drug from a biological concept to a scalable treatment can be the largest challenge in achieving commercial success. This is where CDMO divisions that specialize in CGT can make a difference.

The key step in successful CGT relies on the safe and efficient delivery of genetic material into the target cells, which is carried out by packaging it into a suitable vector. Lonza's cell and gene division is amongst the most capable worldwide. In 2022, the Swiss company expanded its CGT development space at its Houston, TX, facility. Its process development team has more than doubled since 2020, making the Basel-HQed CDMO uniquely positioned to leverage tools such as their Nucleofector Technology and Cocoon Platform to industrialize and scale up the CGT manufacturing processes.

Being a relatively new technology, CGT requires expertise in manufacturing novel modalities, whether it is in the autologous, allogeneic, or viral vector fields. But now that the safety of these therapies has been proven and mandated by the FDA – which, by approving PDUFA VII in 2022, will ensure the continuous review of new drug and biologic license applications – the future will be about technology transfers and development. As put by Daniel Palmacci, president of Lonza's Cell and Gene division: "In the past, the main challenge for CGT was to prove safety and efficacy. That is now reversed; developing processes that are commercially viable and appropriate for robust manufacturing is the biggest challenge the industry faces right now."

Infrastructure will undoubtedly remain a challenge for developers trying to bring CGT to market. Indeed, the personalized nature of CGT requires multi-phase manufacturing, patient-specific lots, and personalized quality control using advanced rapid microbial detection. From cleanrooms on demand to consulting services, Azzur Group helps clients implement good practices and approaches to CGT manufacturing. And it seems that this indication will remain a driver of the firm's planned growth across several US states in 2023-2024. Michael Khavinson, managing partner and CEO, explained:

"In the CGT field, technologies are so new that they require niche expertise. This is where we come in and offer that hybrid model where we offer the cleanrooms and the services outside of it, such as handling the raw materials."

Looking ahead, the operational scale needed to meet the high demand for CAR-T (chimeric antigen receptor, a cell therapy to treat cancer) therapies will require a larger manufacturing footprint. The highly manual nature of manufacturing autologous CAR-T therapies also suggests CDMOs will increasingly hunt for talent coming out of the US leading universities to, ultimately, rewrite the future of medicine.

Ensuring future preparedness

Between the NIH, the Biomedical Advanced Research and Development Authority (BARDA), and the Department of Defense (DoD), approximately US$31.9 billion were invested in mRNA vaccine research and procurement during the heat of the pandemic, according to BMJ. Building on the largest ever public investment for a disease, the government, CDMOs, and service providers in the US have dedicated a high level of capital to meet future health-related challenges and ensure vaccine preparedness.

The risks taken in pursuing mRNA technology for Covid-19 vaccines played a significant role in mainstreaming mRNA as a platform. The medical upside could be revolutionary: Regenerative medicines offer the prospect of having personalized vaccines on the horizon. Evonik, which has continued manufacturing mRNA therapies since the pandemic, and BARDA have jointly invested US$220 million in the firm's new lipid production facility in Tippecanoe, Indiana, for mRNA-based therapies in the US. According to Stefan Randl, head of drug substance at Evonik Health Care, this investment was prompted by a strategic need at two levels: "To strengthen the US' vaccine preparedness and to expand our lipid offerings and services for new mRNA therapies beyond Covid-19 vaccines."

Lipid nanoparticle manufacturing is an essential component of the production of mRNA therapies, and the US continues to remain the ideal playground for global CDMOs advancing these technologies. Michael Quirmbach, CEO and president of CordenPharma, saw the firm's large *capex* investments unfold with success in 2022 and announced a US$60 million investment at the firm's Boulder, CO, facility for early 2023. Building on the firm's capabilities to answer the world's future lipid and peptide challenges, he shared: "CordenPharma is uniquely positioned to offer end-to-end solutions for peptides and oligonucleotides from sophisticated formulation development using lipids excipients especially suited for Lipid NanoParticle (LNP) molecules encapsulating mRNA and other xRNA-based vaccines."

Covid-19 served as a proof of concept for these types of therapies and their potential to be distributed on a large scale. Biotechs and pharma firms will need CDMOs' know-how and capabilities to scale manufacturing up to unleash the power of genes, cells, and regenerative medicines on the pathway to commercialization. ■

Real word applications of cell and gene therapies

Gene therapy

Luxturna®, the first approved gene therapy, used AAV vectors to replace mutant RPE65 genes to improve vision in patients with RPE65-associated blindness.

Cell therapy

CAR-T Therapies (like Yescarta®, Abecama®, and Kymriah®) use genetically modified T-Cells to display CARs. CARs function as artificial T-cell receptors that target CAR-Ts to specific biomarkers associated with disease like cancer.

Source: CG Life

> We want to pioneer a commodity utility approach for needed areas of pharmaceutical manufacturing, and make that available as a sustainable platform that any country can start with and innovate from.

Roger Erickson

CEO and Founder
INTERBIOME

What makes Interbiome's CMO model unique?

We started with a systemic point of view, and we entered the CMO business with the thought of utilizing a CMO facility in the best way to best serve the NIH, the FDA, and patients. That led us to several conclusions about the many opportunities to use CMOs in more ways than only a commercial business, by overlapping the nexus of both policy and business. Markets run autonomously when there is stability but are very dependent on policy changes. We are at a time when we see huge changes in the industry. In the past 20 years, the US outsourced much of its pharmaceutical capacity to Asia, and we are now seeing this trend reverse. In the past decades, we also had the reemergence of gene therapy licensing. Now it is increasingly possible to do genetic profiling and provide individualized medicines. These factors are turning the CMO industry upside down.

The bottom line is that despite all the recent pharmaceutical innovations, the health of the median US citizen has declined in the past 30 years. This leads to opportunities to look at neglected niches in drug manufacturing. We see a need to get into the foundational stages of small-scale drug manufacturing of both neglected and abandoned, yet still needed, drugs, which calls for the creation of a new CMO business focused on affordable sustainability. We need to transition a small portion of the industry to the equivalent of a nationwide, commodity utility model. To start, we have plans to create two specialty manufacturing facilities within Maryland. Multiple US agencies are interested in having our utility approach distributed across the country, for resiliency.

Must innovation be managed to improve median health?

We need multidisciplinary feedback to select net innovation from unproductive churn. This is where reviewing a broader range of data has helped. Health = Baseline minus Damage plus Repair. If we do not maintain basic health, repair costs aren't sustainable, and uncoordinated innovation becomes a threat to human health. A purely market-driven life sciences industry inevitably becomes a health repair industry that eventually forces us to think about what we can do better. Historically, biology involves more than 80% avoidance behavior and prevention, and less than 20% repair.

I expect the industry to move towards prophylactics in the coming years. We have known about Type-1 Diabetes for nearly 100 years, yet today we are approaching 90% Type-2 Diabetics, which is nearly completely preventable. Yet the focus of reimbursement policy is to repair rather than avoiding Type 2 Diabetes. That is an unproductive approach. The increasing incidence of NASH is another example that is almost entirely preventable, yet we are not interacting and coordinating enough to approach that task productively. No matter how many drugs we invent to repair NASH, the impact will be overwhelmed by the food and beverage industry - unless other policies change. I think sweeping changes in the role of the life sciences (and other) industries in population health will gradually occur. Today, too much of pharmaceutical innovation is necessary but not sufficient, and prone to unproductive patterns of investment.

Why will your model be a success in the future?

Beyond the changing role of drug manufacturing on population health, we are seeing continuous changes in the intersection of business and policy. Two topics come up repeatedly: all countries need to sustain both a minimal capacity and a minimal workforce so that the two together can help manage national and regional resilience, not just transient profits. Interbiome has no illusions about solving all the problems we mentioned, yet we see the need for a foundation or reserve level of drug-manufacturing capability that can survive and re-expand faster after a downturn. Every country in the world needs such a model – there is no reason why any country should be without critical pharmaceutical commodities. We want to pioneer a commodity utility approach for needed areas of pharmaceutical manufacturing and make that available as a sustainable platform that any country can start with and innovate from. ■


MK


RS

Manni Kantipudi & Ramesh Subramanian

MK: Chief Executive Officer
RS: Chief Commercial Officer
ARAGEN LIFE SCIENCES

Can you highlight Aragen's main achievements in 2022?

MK: Personally, winning the "CEO of the Year" award at the CPhI Pharma Awards 2022 is a testament to all the achievements Aragen has accomplished. Due to the great efforts of our technical and enabling teams, the company has seen tremendous growth and we have more than doubled our headcount and revenue in the last four years. In December 2021, Aragen acquired Intox, enabling us to now offer safety assessment solutions from a GLP-certified facility for submission to regulatory agencies such as the USFDA, USEPA, EMA, and others globally. We commissioned a new R&D facility at our Vizag campus, which already has a manufacturing facility. We initiated the construction of a biologics manufacturing facility in Bangalore, India, which we expect to be complete within the next 18 months. We have made great strides in terms of ESG and have signed the Science Based Targets initiative. We also became an Associate member of the Pharmaceuticals Supply Chain Initiative. We received a Silver rating from EcoVadis for our sustainability initiatives and are rated amongst the highest in India and the top 12% globally out of approximately 200,000 companies.

What does the demand from the life science industry in the US currently look like?

MK: Approximately 60% of Aragen's business comes from the US. Our customers include pharma, biotech, life sciences, animal health, and crop protection companies that are looking to outsource their R&D and manufacturing work. We see the trend of many US/EU pharma and biotech companies reallocating investments from China to India. They are not essentially exiting China but reallocating part of their investments to India, especially on the discovery side – chemistry, biology, and to an extent biologics. On the manufacturing side, we are seeing companies reallocating their investments from China and taking it back to the US or Europe. This had a ripple effect and as manufacturing companies in the US and Europe reached capacity, these CDMOs started collaborating with companies in India.

RS: During the slowdown in the markets, Aragen took the opportunity to look at our strategy and vision for the next five years. Our strategy is to be a partner of choice for companies on their journey from early-stage development through to clinical proof-of-concept – Phase 2B. In this effort, we are operationalizing a state-of-the-art formulation manufacturing facility in our Mallapur campus at Hyderabad, by April 2023. We are also setting up a biological manufacturing facility in Bangalore.

Can you speak to Aragen's approach to environment, health, safety, and sustainability?

MK: We have signed up with various organizations globally in our commitment to achieve a net zero target by specific dates. Not only are we members of the global Science Based Targets initiative (SBTi) and GRI South Asia Charter on Sustainability Imperatives, but we have also set ourselves a target to reduce CO2-eq emissions intensity by 20% and water consumption by 30% by 2025, and achieve zero waste disposal to landfill by 2025.

How does Aragen lever digitalization?

MK: We have implemented a "Go Digital" strategy to take us to make Aragen a digital CRO. Over the next two years, we will focus on three main initiatives. First, we are working on manufacturing automation and digitalization that will help us not only in data collection and analytics but also in going paperless and reducing the chances of human errors. Secondly, we will focus on digitalizing the customer experience by implementing smart tools that allow customers to interact better and more seamlessly with us in real time and in a secure environment. Thirdly, we will digitalize and automate our labs to improve efficiencies.

Where do you see growth opportunities in 2023?

MK: In terms of our five-year plan, the first three years will be focused on Aragen's ability to assist clients from concept to commercial. The next two years will be focused on extending our capabilities in terms of commercial and we are already investing in drug products and biologics manufacturing toward a commercial scale. Overall, I believe the virtual biotech model is here to stay and companies will increasingly look at CRO/CDMO companies for assistance in taking drugs from discovery to commercialization.

RS: Aragen believes that "in every molecule is the possibility for better health" and by treating every project with urgency and focus, we look to discover and develop medicines for our collaborators that make a positive impact on patients. ■

Tom Wilson

Global Business Development Lead
PFIZER CENTREONE

Can you present Pfizer CentreOne and the group's role within Pfizer?
Pfizer CentreOne is Pfizer's integrated CDMO. We are multidisciplinary specialists, and as such we are active in the biological drug substance arena, mammalian, sterile injectables, oral solids, cell and gene therapy, as well as APIs and intermediates.

Which of your development and manufacturing capabilities attract more demand?
Growth drivers remain within complex precision therapies, and this is where we are uniquely placed to succeed. We also have a successful track record in API and intermediates, high-potency products, and an ability to work with challenging technology platforms like laser drilling.

What recent innovation are you most excited about?
Continuous flow API is interesting, but green chemistry is the most fascinating innovation aspect these days. With green chemistry, the ability to remove chemical steps and replace that within enzymatic reactions is an amazing next step in API manufacturing. A flagship example is our first-of-its-kind API in that area, Enviero Progesterone. By eliminating metal catalysts, it reduces our carbon footprint, energy consumption rates, and water requirements.

What is the ambition for Pfizer CentreOne in 2023?
I believe we are entering a golden age of manufacturing. We want to continue to make Pfizer's capabilities available and bring these resources as well as the knowledge of our scientists to our customers so they can get their innovations to patients. This is our fundamental mission. What scientists can create with new medicines is impressive. As we get into precision medicines, therapies, parallel trials, and getting medicines to patients faster, that will require CDMOs to work together, and this is where our growth will come from. Science continues to evolve and improve patients' lives. This is a rising tide that will raise all ships. In conclusion, manufacturing is becoming "sexy" again. ■

Daniel Palmacci

President, Cell & Gene Division
LONZA

What were the drivers behind Lonza's Cell and Gene Division's double-digit growth in 2022?
Lonza's cell and gene division excels in industrializing what comes out of the lab, making a scalable, robust product with consistent safety qualities. We have significant expertise and coverage, with six sites – three of which are in the US in Houston (Texas), Portsmouth (New Hampshire), and Lexington (Massachusetts), alongside three in Singapore, Siena (Italy), and Geleen (Netherlands). While the US remains the epicenter of the worldwide cell and gene market and is critical to our business, we also have the benefit of diversification and capacity across three continents. On the technology side, we are uniquely positioned to leverage tools such as our Nucleofector Technology and our Cocoon Platform to industrialize and scale up the CGT manufacturing processes, and ultimately help our customers to manage risk and cost.

What is unique about Cocoon and Nucleofector?
The Cocoon platform and the 4D Nucleofector system are two of our products that address different manufacturing challenges facing the CGT industry. The Cocoon integrates multiple steps in the CGT manufacturing workflow. Bringing automation to this space will reduce costs and provide therapy developers with scalable manufacturing solutions for their patient-specific therapies. The integration and automation of unit operations also presents opportunities to bring manufacturing closer to patients at the point of care, avoiding costly logistics and long manufacturing turnaround times.

Nucleofector Technology was introduced as the first efficient non-viral transfection method for primary cells and hard-to-transfect cell lines. It allows for high transfection performance. We also developed MODAMES for cell and gene therapies. This next-generation platform allows for electronic batch record execution and enables parallel processing with track and trace capability, which in turn can maximize cell and gene production capacity. Across our technologies, we aim to use digitalization to manufacture novel therapies in a compliant and robust manner. ■

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Our partners benefit from our market intelligence and cost-splitting, and we attain the manufacturing capability and resources. We will continue to grow our partnership model now that we are expecting to double our revenue.

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Jay Shukla

President and CEO
NIVAGEN PHARMACEUTICALS

How has Nivagen Pharmaceuticals, Inc. (Nivagen) grown in 2022?
Nivagen is moving towards more sterile injectable products. We received first-to-file approvals by the FDA's 180-day CGT (Competitive Generic Therapy) exclusivity in 2022, and we are expecting four more approvals before Q3 2023. We raised US$45 million in debt financing to build a 63,500-square-foot state-of-the-art sterile manufacturing R&D facility in California. We have started building our sterile manufacturing unit which will produce prefilled syringes, ready-to-use aseptic and terminally sterilized IV bags and cartridges, and we are hoping to complete the manufacturing construction by December 2023. Although we will continue manufacturing oral and topical products in partnership, our current long-term goal is to focus on the hospital market. There is still limited competition in the sterile injectable space compared to the oral space, and we can thus be extremely cost competitive in producing these products locally.

What will the cash flow from the US$45 million in financing unlock in 2023
The construction of our new sterile manufacturing unit will allow us to onshore our production capabilities. By reshoring product manufacturing, we will be able to streamline our supply chain, reduce manufacturing costs, and ultimately time to market for new product launches. It will also allow us to provide CDMO services to pharma companies who want to hire us as a contract manufacturer for IV bags, prefilled syringes, or cartridge manufacturing. We will be able to provide complete research, analytical formulation development, regulatory support, and experience in filing applications to existing manufacturers and biotech companies. We are looking at more complex generics such as complex injectables, sustained-release microspheres, and nanotechnology. We are also expanding into 505(b)(2) programs and have submitted eight new applications with this regard where we are focusing on dual chamber IV bags, prefilled syringes, and repurposing existing molecules for new indications. Our new facility will give us significant flexibility in terms of what we can develop in-house and how we cater to the CDMO market.

Can you expand on Nivagen's strategy of growth through partnerships and the advantages of the acquisition and licensing model?
Nivagen has established distribution channels, sales and marketing teams, and vendor agreements with customers and government agencies in all US states, and we also work as an extended sales and marketing team for foreign manufacturers who want to sell into the US market without having a physical presence in the country. We will only partner with companies that have robust supply, a quality system that will withstand FDA inspection, and that is financially strong enough to enter the US market. In terms of co-development, we will co-invest with partners in R&D programs and our partners will have the manufacturing rights while we keep the distribution rights. This is a win-win situation: our partners benefit from our market intelligence and cost-splitting, and we attain the manufacturing capability and resources. We will continue to grow our partnership model now that we are expecting to double our revenue.

How do you assess the current regulatory and generics landscape environment in the US?
The regulatory environment is becoming increasingly stringent, and more parameters are being included. Our biggest setback was the delay in the FDA inspecting our facility, but now that the FDA has started doing the inspections and approving the facility, we hope to see our approvals coming in more rapidly.

Generics have saved the healthcare system and consumers billions of dollars, and as more products are entering the market, prices are decreasing. At the same time, there is a consolidation in the wholesale business and not all the savings are passed to consumers as there is a middleman who picks a significant amount of the savings. This is however changing, and as more price transparency comes into play, more savings will be passed on to the consumer.

What are Nivagen's key priorities for the next year?
We want to significantly grow our CDMO business, especially for manufacturing aseptic and terminally sterilized IV bags, prefilled syringes, cartridges, and dual chamber bags. We hope to be successful in the products we are awaiting approval for, commercializing our approved products, as well as significantly expanding into the hospital market. Having three revenue streams, we hope to double our revenues by the end of 2023. ■

Contractors, Manufacturers, and Lab Services with Unique Offerings

The below companies have invested in unique offerings to meet the needs of customers accross all segments of the life sciences industry.

"While continuing our project pipeline work, in 2022 Vici decided that we will evolve as a CDMO moving forward, adding value to our clients. We saw a significant need in the market for these services, especially from smaller companies with only a few molecules in their pipeline and pre-clinical companies that are not serviced well by larger CDMOs."

Anish Dhanarajan, Co-Founder and CEO, Vici Health Services

"Currently, we are working with two major customers in the green chemistry field, where we are helping to develop environmentally conscious materials. By reducing the amount of waste or chemical waste in the process, we can save the environment and energy that would have been used to dispose of that waste."

Gamil Alkhami, President, GL Chemtec International

"Veranova's skilled team possesses over a decade of experience developing for linking small molecule payloads to polymers in support of antibody-drug conjugates (ADCs), and as the complexity of molecules continues to grow, we are using a multi-step synthesis combining complexity and high potency to put all the pieces together as a basis for ADCs."

Nick Shackley, Senior Vice President and Chief Commercial Officer, Veranova

"Early-phase stage biotechs are concerned about funding research capabilities, so they are planning on capital raises. For us, it is about building enough cleanrooms to service the demand for new products coming through development pipelines in time."

Michael Khavinson, Managing Partner and CEO, Azzur Group

"The Department of Defense's (DoD) Chemical and Biological Defense (CBD) Small Business Innovation Research (SBIR) program awarded us an SBIR contract to continue developing a combination product of atropine and scopolamine. We recognize the threat of chemical and biological warfare to soldiers, and this grant allows us to develop products that start in the lab by executing the appropriate animal model studies to determine the dose and efficacy of that combination products."

Mike Radomsky, President, CMC Pharmaceuticals

"CRL's E-Rapid Transfer Port (ERTP) has recently gained additional popularity due to the aseptic trend to isolate and minimize any type of interaction inside the sterile environment. Initially, our ERTP product was more geared towards the nuclear industry, but in recent revisions, we have adapted it to the pharmaceutical market."

Chris Gooding, Vice President and General Manager, Central Research Laboratories

"Our most recent acquisitions were two consulting firms. One, formerly known as BioPharma Global, provides consulting services primarily for FDA submission and CMC support and specializes in assisting foreign companies with submitting their products to US regulatory bodies. The other acquisition was Meridian BioGroup, also a consulting firm providing localized services. These acquisitions aim to expand our services to provide more comprehensive solutions to Pace clients. In the past, we had to refer clients elsewhere for consulting services, but now we can offer a complete package of end-to-end services."

Greg Kupp, President, Pace Life Sciences

"We make equipment for radiopharmaceuticals, and we have gained recognition for that. In addition, we have also expanded our role to include distributing radiopharmaceuticals, with a focus on automating the process. Automation is essential in radiopharmaceuticals, as human intervention must be limited to protect workers from radiation exposure."

Luciano Calenti, Founder and CEO, ACIC Pharmaceuticals

"BFS technology is attractive from a respiratory and ophthalmic perspective, but beyond that, we have seen increased demand for our services specifically in the diagnostic space. Covid-19 shone the light on home diagnostic care and the use of reagents to complete home tests and kitsFrom a drug pricing reform perspective, BFS is a cost-effective way to manufacture pharmaceutical products."

Paul Josephs, President and CEO, Woodstock Sterile Solutions

"About 90% of the medicines consumed daily in the US are generic and most of these products are supplied by overseas manufacturers. There is high demand for low-cost high-quality products and we can eliminate complexities in the supply chain as well as our dependence on foreign-supplied medicines by increasing generic drug manufacturing capabilities in the US."

Tim Crew, CEO, Lannett Company

"Scorpius works closely with CDMO clients to develop effective regulatory drug development strategies for advanced biological therapies. Our Kansas facility will be built in accordance with our San Antonio facility to ensure that we can go from pre-clinical to commercialization employing similar platform technologies and minimizing any compliance or technology challenges that may arise."

Mike Fiske, Vice President, Manufacturing Sciences, Scorpius BioManufacturing

"Polymers mainly used for contraceptive or hormone replacements are growing, such as local drug delivery in the ocular space or in oncology, particularly in the past 18 months. The widespread adoption of polymers for several industries is driving solid growth in the coming years. We can extrude very tight-tolerance products, which is key in this space."

Tony Listro, VP, Technology and Site Lead, Sever Pharma Solutions

"In 2022, our growth focus has been in the areas of over-the-counter (OTC) drugs, dietary supplements, and solid-dose Rx pharmaceuticals, which will continue to be a focus for us as we move forward into 2023."

Jeff Reingold, COO, Contract Pharmacal Corp (CPC)

Chemicals and Service Providers

Keeping up with growing demand and changing requirements

Image courtesy of Evonik

The increased number of chronic diseases, lifestyle-related disorders, and more awareness towards well-being is pushing up the demand for medicines, which is driving growth for the excipients segment of the pharmaceutical industry. Excipients are crucial to the formulation of drug products. They enable the safe delivery of drug substances and can answer challenges such as oral drug candidates' poor aqueous solubility and/or permeability. In other words, novel excipients are needed to support pharmaceutical innovation. For chemical and service providers in 2023, shifting consumer demands, navigating price increases for raw materials, and necessary innovations will remain top-level topics during board meetings.

The innovation drive coupled with ever more stringent regulations means drug molecules, both small and large, remain harder to formulate. From emerging dosage forms in the biopharma space to advances in the supplement subsector, chemical firms have increasingly relied on partnerships to come up with innovative solutions to meet demand. Supporting the pharmaceutical market with functional excipients like EUDRAGIT and RESOMER, Evonik Health Care also contributes to reducing firms' risks, particularly with APIs and functional excipients used with small molecule products. The firm leveraged brains from two leading US universities – Santa Barbara and Stanford – to develop technologies to support the biotech and pharma industries.

One of the most groundbreaking developments to follow will undoubtedly be sustainable chemical synthesis. Using the power of water, Evonik Health Care, along with Professor Bruce Lipshutz of Santa Barbara, is pioneering a sustainable technology for the industrial-scale production of pharma intermediates and APIs: 'Chemistry in water'. Stefan Randl, head of drug substance, described how this technology can result in waste reduction during chemical production: "The idea is to move away from organic solvents to aqueous-based reactions; simply put, it is using water to reduce the footprint of chemical synthesis.".

On the firm's strategy of collaboration with academia, he expanded: "Evonik Health Care is active in developing innovative excipients and formulations. One example is our partnership with Stanford University on innovative DNA/mRNA delivery technologies based on polymers as an alternative to lipids. We have great connections to the academic landscape and are always looking at interacting with strong universities in the US."

Across that segment of the industry, chemists are working towards reducing the usage of solvents and ensuring molecules are made sustainably. James Bruno, owner of Chemical and Pharmaceutical Solutions, expanded on some of the techniques the industry is moving towards: "We need to dispose of waste responsibly, especially with potent substances like cancer drugs, steroids, or hormones. We now use thermal oxidizers to burn such waste, or we dispose of it in bio ponds instead of dumping it."

Several indicators point towards a bright future for chemical providers in the US. The focus at the pharmaceutical and governmental level on decreasing foreign reliance on specialty chemicals, along with the life science industry's growing reliance on CDMOs, will allow providers (particularly European firms) to further expand their footprint in the US market. France-based Roquette, one of the largest excipients suppliers in the world, broke ground at its US$25 million Innovation Center near Philadelphia, PA, on 19 April 2023. Paul Smaltz, VP global business unit pharmaceuticals, explained the decision-making process behind the location choice: "We chose Philadelphia as the location for the facility as this is where many of our customers already conduct their new drug development research, and so we knew we would be right where our customers needed us."

Overall, chemical providers continue to provide customers with innovative, sustainable and safe solutions to address society's ever-changing needs. Taking geopolitical shifts, rising costs, and heightened regulatory standards into account, companies with a portfolio of advanced technologies, a strong CGMP manufacturing network in the West and innovative chemistry approaches will succeed in securing pharma firms' peace of mind in the near term. ■

» Our industry will continue to have to rely on China for various chemicals as the Western world has no more the capacities, equipment, and resources to restore all our needs. Western markets need to become more independent in the field of strategic chemicals.

Jean-Marie Rosset,
Head Platform Pharma, WeylChem

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Stefan Randl & Paul Spencer

SR: Head of Drug Substance
PS: Head of Drug Delivery & Product
EVONIK HEALTH CARE

Can you highlight Evonik Health Care's main initiatives undertaken in North America in recent years?

PS: At Evonik, the service is designed to help clients get products to market faster by moving in both directions along the value chain, from the key excipients all the way to finished drug products for certain markets. In 2020, we acquired Wilshire in New Jersey, which was focused on plant-based excipients. That year we also bought another biodegradable polymer business called LACTEL, from Durect.

SR: On the drug substance side, the Lafayette, IN, site acquisition was a leap forward for our capabilities. It holds the world's largest capacity for HP-APIs, a class of APIs that is growing at a fast pace. The US is a key market for us, it is where Evonik Health Care has some of our largest sites, and it is close to our major customers, which is why we recently moved the Drug Substance headquarters to the US. Our Tippecanoe site will remain a site of high investment. We are currently manufacturing lipids for BioNTech's Covid-19 vaccine and other mRNA therapies in our plants in Germany. Together with the support of the US government, we will invest US$220 million in Lafayette so it becomes a world-scale lipid manufacturing facility to strengthen the US' vaccine preparedness and to expand our lipid offerings and services for new mRNA therapies beyond Covid-19 vaccines.

How important will the US market be for Evonik Health Care in the coming years?

PS: The US is where innovation happens. The US leads innovation, so if you are not heavily invested there in pharma, you are in trouble. Lots of our clients are shifting their production from Asia, so the US will remain critical to Evonik Health Care's growth.

SR: On the manufacturing side, there are concerns about supply security in the US, particularly considering the competition with and dependency on China. Smaller biotechs that are more prevalent in the US often like to see manufacturing close to their premises, at their doorsteps, and big pharma has been keener on manufacturing domestically.

What is Evonik Health Care's competitive edge in the field of drug delivery?

PS: There is no threat that we become a pharma firm. A lot of drug delivery firms do so, as with the drug delivery model, you almost must become a pharma firm to get the appropriate valuations in the US. We do not need to worry about that, we are B4B. Evonik Health Care also brings supply security to the table.

SR: Evonik Health Care is very active in developing innovative excipients and formulations. One example is our partnership with Stanford University on innovative DNA/mRNA delivery technologies based on polymers as an alternative to lipids.

Can you speak to the importance of sustainability for Evonik Health Care?

SR: Our ambition is to be carbon neutral concerning Scope 1 and 2 emissions by 2030. We do a lot of recycling of the solvents that we use; we also piloted a program of recovery of metals, which we have now brought to a commercial scale. Using an Evonik membrane allows us to concentrate palladium in an organic waste stream, which is then shipped offsite to an external partner for recovery of the palladium. Also, we strive to improve the sustainability of our processes through chemical development. Among others, we use "Process Mass Intensity" as a measure for sustainability, which looks at the input vs the output of your process. Finally, we are developing innovative technologies. We work with Professor Lipshutz from Santa Barbara University on a technology called "Chemistry in Water": the idea is to move away from organic solvents to aqueous-based reactions.

What will be the growth priorities looking ahead?

PS: We believe mRNA therapeutics are transformative. We made the investment in 2016, and the investments we are making in North America to better improve the delivery of drugs are crucial: beyond building a new, large plant for lipids, it is designed with multiple lines that can run several products consecutively. It is a transformative investment. We are focused on the future toward personalized medicine, and we believe that our capabilities of being able to quickly customize in all aspects along the value chain will make us a strong partner for pharma in such areas as cancer therapies. ■

NEW TECHNOLOGIES

"With new technologies, with new machine learning with AI, we have to put the data in front of the person who talks to the family, and make sure that they have the information they need and the tools they have to make a more informed choice."

Alec Ford,
CEO,
Karius

Image by lucado at Adobe Stock

Leveraging AI for Drug Discovery

Accelerating drug discovery for a faster, smarter future

Image courtesy of QB3 Bakar Labs

The future of life sciences is hurtling towards a digital revolution where the emphasis on immediacy has become crucial for the pharmaceutical, biopharmaceutical, and medical technology value chain.

"New technologies are needed following the realization of the rigidity of the supply chain during the pandemic along with the need to onshore or reshore manufacturing," asserted Rajiv Anand, founder and CEO of Quartic.ai. "The other catalyst will be the IRA, giving the industry two headwinds that can only be dealt with through technology."

Quartic.ai has developed a platform that applies machine learning algorithms to identify the potential efficacy of drug candidates. The system analyzes data from various sources, such as gene expression, protein interactions, and chemical structure. The program also provides insights into the mechanism of action of potential drugs, which can help researchers design better treatments.

Providing prompt and efficient solutions to patients is the sector's current main challenge and objective. In this context, innovation has emerged as a leading contributor to speeding up processes and reducing costs, thereby broadening the range of potential solutions for preventing and addressing diseases.

Although the industry has historically shown a slow adaptation to changes, the Covid-19 pandemic has been the catalyst for accelerating the sector toward greater automation of processes. Human skills and technology are merging their functions to provide personalized solutions for patients in need. The nuances of data, cloud technology, Software-as-a-Service (SaaS) systems, artificial intelligence (AI), and machine learning (ML) algorithms are empowering life sciences companies' success and better health outcomes.

"There is a practical reason that the application of AI in drug discovery and development has been slow to be adopted," explained Raymond Vennare, CEO of Predictive Oncology, a platform that uses AI to develop personalized cancer treatments by analyzing genomic and clinical data to identify the most effective treatments. "Until there was a critical mass of evidence, at least as applied to drug discovery, scientists were cautious. Regulatory compliance has always been an issue. Until the FDA was able to understand how best to evaluate and regulate as a medical device and decision support tool, it would have been virtually impossible to develop drugs using that technology."

Powering actionable data

New technologies have transformed many industries, and drug discovery is no exception. Biopharmaceutical companies are leveraging data to enhance site selection for clinical trials, as well as supply chain oversight, with impressive results. According to Deloitte's last Global Life Sciences Outlook, the total investment in digital therapeutics in 2023 has topped US$600 million. Despite the challenges in terms of financing, geopolitics and regulation, companies like Quartic.ai, Predictive Oncology, WhizAI, and Apprentice.io are leading the way in leveraging AI for drug discovery and development.

One of WhizAI's focuses has been on making information and analytics easily accessible and consumable for people in various roles, such as marketing, sales and finance. WhizAI has developed a generative AI machine learning model called Narratives that can not only create charts but also describe their content. "This simplifies the process of understanding and using the data, allowing users to quickly tap into valuable insights," posited Rohit Vashisht, co-founder and CEO of WhizAI.

AI offers several benefits over traditional drug discovery methods. "AI has been embraced, as is seen with a lot of the deals being done now. AI is so broad; it can be leveraged throughout the drug discovery process to assess genomic data and find new targets, to find novel treatments and improve the properties of compounds using computational chemistry, to mine the literature to generate new hypotheses, as well as supporting systems and operations to improve workflow and efficiency," highlighted Emer Leahy, president and CEO of PsychoGenics.

However, despite these benefits, there are still challenges to sourcing AI in drug discovery. "There is hype around AI that led to several claims that are not yet validated. Our phenotypic approach has been validated: We have clinical data on multiple compounds that confirm the pre-clinical predictions we made," expanded Leahy.

PsychoGenics has taken a different line to drug discovery, using a phenotypic approach that focuses on the behavior of cells, tissues and organisms in response to drugs.

Developing and deploying AI-powered drug discovery tools requires careful consideration of both regulatory and ethical factors, and also needs the availability of high-quality data for successful implementation. Nonetheless, these obstacles are exciting opportunities for researchers to develop innovative solutions and unlock the highest potential of AI in drug discovery. ■

Nicole Berry

Head of Region—Americas
ILLUMINA

Could you provide an overview of Illumina?
Illumina is a leading player in the rapidly expanding genomics industry. While we operate globally, the majority of our business is based in the Americas and is especially expanding in Latin America. Our focus is on driving technical innovations and promoting accessibility to enable the advancement of research and clinical adoption of genomic applications.

What are the specificities of Next-Generation Sequencing (NGS)?
This technology platform can be used to decode and analyze the genetic elements of any living organism. Recently, there has been an increase in demand for this technology as more biotech and biopharma companies seek to better understand the genetic code and how to leverage it. Precision medicine is using an individual's genomic makeup to inform their clinical care. Genomics serves as a high-resolution molecular map for understanding biology and informing healthcare. Oncology is a prime example of how understanding the genomics of diseases can help advance personalized treatments and improve patient outcomes. Illumina's technology platforms are used to sequence patients' tumors, providing clinicians with information to inform pre-disposition, treatment selection, prognosis, and relapse.

Could you provide an overview of NovaSeq X and the industry demand for this product?
We are thrilled about NovaSeq X, a technology we have been developing for over five years by more than 1,500 scientists and with more than 40 patents filed reltated to its technology innovations. This is not just a new instrument platform, but also includes a brand new chemistry called XLEAP-SBS, the newest generation of our SBS chemistry that runs on the instrument. This technology provides higher throughput and accuracy and reduces the cost of sequencing - allowing customers to run more samples, increase sequencing depth for greater sensitivity and achieve greater breadth of analysis through multi-omics analysis. NovaSeq X enables our customers to pursue projects at a scale not previously thought possible, and that work will unlock the next generation of groundbreaking genomic discoveries. ■

Denise Juliano

Group Vice President, Life Sciences
PREMIER INC.

Can you introduce Premier Inc.?
Premier is a leading healthcare improvement company, uniting an alliance of more than 4,400 US hospitals and health systems and approximately 250,000 other providers and organizations to transform healthcare. Premier has integrated data and analytics, collaboratives, supply chain solutions, consulting, and other services available to healthcare organizations, enabling better care and outcomes at a lower cost. In July 2022, Premier's Performance Services business rebranded as PINC AI. We sell technology and data to hospitals, healthcare systems and life sciences organizations, and as part of PINC AI Applied Sciences, we get the opportunity to research alongside these organizations. The PINC AI Applied Sciences team works on prospective, retrospective and improvement science research as well as clinical trials to help close gaps in care, accelerate evidence into practice and implement workflow solutions to hardwire sustainable change.

What are the latest innovations you have invested in to advance healthcare solutions in digital medicine?
We applied technology-enabled tools and data ontologies in the field of oncology. What we found was disparate care, so we have focused efforts towards helping health systems standardize practices among the various patient touchpoints. This can be accomplished through early patient identification. PINC AI data combined with natural language processing (NLP) technology is well suited for uncovering details that can help identify which risk factors and clinical signs and symptoms are most predictive of subsequent disease development. Part two is building a qualitative ideation system with the healthcare system to help us design what that work looks like and identify pain points. Then, we can design the research project and see how well patients adhere to the care pathway. Finally, we find out if we improved the behaviors of the clinicians, and patients, publish those results, and scale those learnings across the rest of the Premier membership. ■

Technology for Patient Centricity

Placing patients at the heart of healthcare

Image courtesy of Janssen

Patient-centricity has emerged as a paramount aspect of the US life sciences industry. Patients are now seen as active participants in their own health journeys, and their individual needs and preferences are being considered more than ever before.

New technologies have played a significant role in driving this shift towards patient-centricity. They can provide patients with greater convenience and autonomy and enable healthcare providers to deliver more personalized care by tailoring treatment plans to each patient's unique needs. From wearables and remote monitoring devices to patient portals and AI-driven insights, these technologies are helping to transform healthcare into a more adapted experience where patients' cells and genetic predispositions provide key information for better long-term outcomes. This streamlines administrative tasks for both patients and healthcare providers while fostering increased collaboration and engagement between the parties.

According to CorEvitas, one of the pioneer companies in the real-world evidence (RWE) space in the US, precision medicine has always been a crucial area for the pharmaceutical industry, primarily in R&D to help develop better drugs and to improve diagnostic tests. "Many of our bio samples are also used by diagnostics companies to improve diagnostic tests," detailed Ray Hill, CEO.

Illumina, leading the development of DNA sequencing and genome technologies, has also highlighted the importance of patient's data to expanding genomics, inform pre-disposition and improve treatment. "This technology platform can be used to decode and analyze the genetic elements of any living organism, including humans, plants and animals. Recently, there has been an increase in demand for this technology as more biotech and biopharma companies seek to better understand the genetic code and how to leverage it," seconded Nicole Berry, head of Americas Region for Illumina.

AI is being used to analyze vast amounts of patient data and identify patterns and trends that would be difficult for humans to detect, thereby facilitating pre-clinical discovery, improving the accuracy and usability of data, as well as the effectiveness of medical solutions. "The final goal is to allow humans to focus on what they do best, bringing creativity and specialization to the industry," posited Angelo Stracquatanio, CEO and co-founder of Apprentice.io, a cloud-based platform for pharmaceutical manufacturing.

Karius, a life sciences company that uses next-generation sequencing technology to identify over 1,000 pathogens from a single blood sample, acknowledged that there is still a need for a doctor to have personal contact with patients to get specific data. "With new technologies, with new machine learning and with AI, we have to put the data in front of the person who talks to the family and make sure that they have the information they need to make a more informed choice," said Alec Ford, CEO of Karius.

Premier Inc. plays a critical role in the healthcare industry, uniting an alliance of more than 4,400 US hospitals and health systems and approximately 250,000 other providers to co-develop long-term innovations that reinvent and improve the way care is delivered to patients nationwide. Premier applies technology-enabled tools and data ontologies in the field of oncology to help health systems standardize practices among the various patient touchpoints. This can be accomplished through early patient identification. Premier's recently launched PINC AI™ data combined with natural language processing (NLP) technology is well suited for uncovering details that can help identify which risk factors and clinical signs and symptoms are most predictive of subsequent disease development. "A tangible example is a study we did in the New York market. We had a hypothesis that people were getting lung scans because of Covid-19. Based on the radiology report, many people could have incidental pulmonary nodules (IPN), which could be an indication of early-stage lung cancer," stated Denise Juliano, group vice president, life sciences of Premier Inc. "By applying NLP technology, we were able to identify patients with IPNs and flag them for intervention before potential lung cancer progression."

Managing patient data poses several challenges, including data privacy and cybersecurity concerns, particularly when using cloud technology. The healthcare industry grapples with inaccessible, fragmented and unorganized data, which can lead to misinformation. To combat this, Truveta and Pfizer are collaborating to establish accurate data systems.

Truveta was founded with a mission to use available data efficiently for the benefit of the healthcare and life sciences industry. The company unites health systems from different parts of the US, all committed to sharing de-identified data to support researchers in their quest to find cures more rapidly, expedite clinical trials, improve patient care and outcomes, and promote equity in healthcare.

One of the primary objectives for the upcoming years is to develop strategies for sampling to ensure that patient populations are diverse and representative. Partnering and training are essential components for future progress, and the US life sciences industry is adapting to these new requirements to overcome the challenges. While technology can enhance care precision, collaboration between humans and technology is necessary to provide the best possible care to patients as the industry looks toward the future. ■

Towards a Growing Adoption Rate of New Technologies

Historically a slow industry in terms of adopting new technologies, a circumstance of events is changing that paradigm.

"There is a practical reason that the application of AI in drug discovery and development has been slow to be adopted. First, companies had to believe that it works. So, until there was a critical mass of evidence that it worked, at least as it applied to drug discovery, then scientists were cautious, if not skeptical."

Raymond Vennare, CEO, Predictive Oncology

"Daily complete de-identified datasets can have a profound impact in helping the life science industry find cures faster and can enable every clinician anywhere to be an expert so they can diagnose patients more quickly and recommend the best treatment. I think that at some point someday we will see families having access to this data so they can make the most informed decisions about their care."

Terry Myerson, CEO, Truveta

"New technologies are needed following the realization of the rigidity of the supply chain during the pandemic along with the need for onshore or reshore manufacturing. The other catalyst will be the IRA, giving the industry two headwinds that can only be dealt with through technology."

Rajiv Anand, Founder and CEO, Quartic.ai

"Something needs to change about how care is provided to cancer patients. If we practiced cancer treatment the same way we do infectious diseases today, by testing treatments and hoping one of them will address the malignancy that you have, it would be unsustainable. We have got to get health professionals to that next step to reach the answer to that question."

Alec Ford, CEO, Karius

"Pharma has traditionally been a lagger in terms of technology adoption. But we do have customers implementing new factories and automating most of their processes. This is a giant leap for future-proofing manufacturing processes. Healthcare is a patient-driven environment where shortages are not acceptable."

Steve Tallant, Senior Director, Solution Marketing Group at Systech, a solutions division of Markem-Imaje

"The 21st Century Cures Act, signed into law in the United States December 2016, laid the groundwork for a regulatory push for RWE and essentially directed the FDA to collaborate with the industry in developing a plan to use RWE more directly. The regulatory trend, the pharma push, and the patient trend have accelerated and increased the demand for RWE, and the US$4 billion-plus market continues to grow 12% annually."

Ray Hill, CEO, CorEvitas

"Beyond analytics, there are many other exciting applications for AI, such as generating content and creating synthetic data for research. As we continue to explore the possibilities of AI, we are only scratching the surface of what it can do."

Rohit Vashisht, Co-Founder and CEO, WhizAI

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