

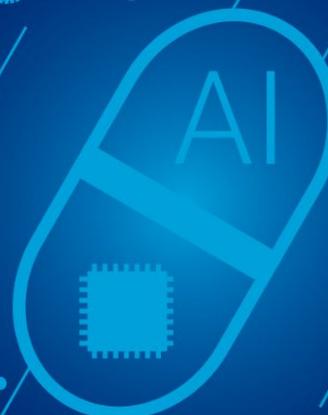
DEEP
PHARMA
INTELLIGENCE

Artificial Intelligence for Drug Discovery Landscape Overview

Teaser
Q1 2022



www.deep-pharma.tech



Artificial Intelligence for Drug Discovery Landscape Overview Q1 2022

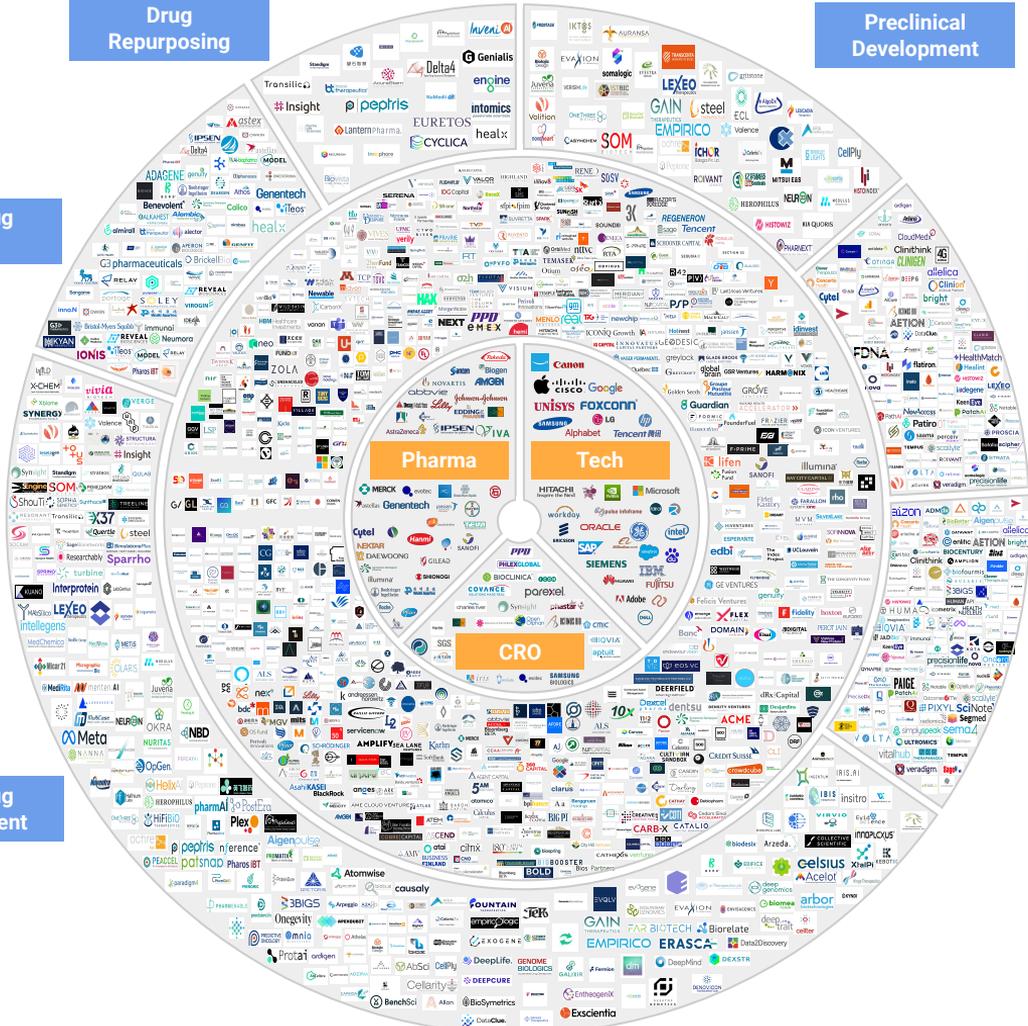
Drug Repurposing

Preclinical Development

AI Companies - 495
Investors - 1120
Corporations - 100

End-to-end Drug Development

Clinical Development

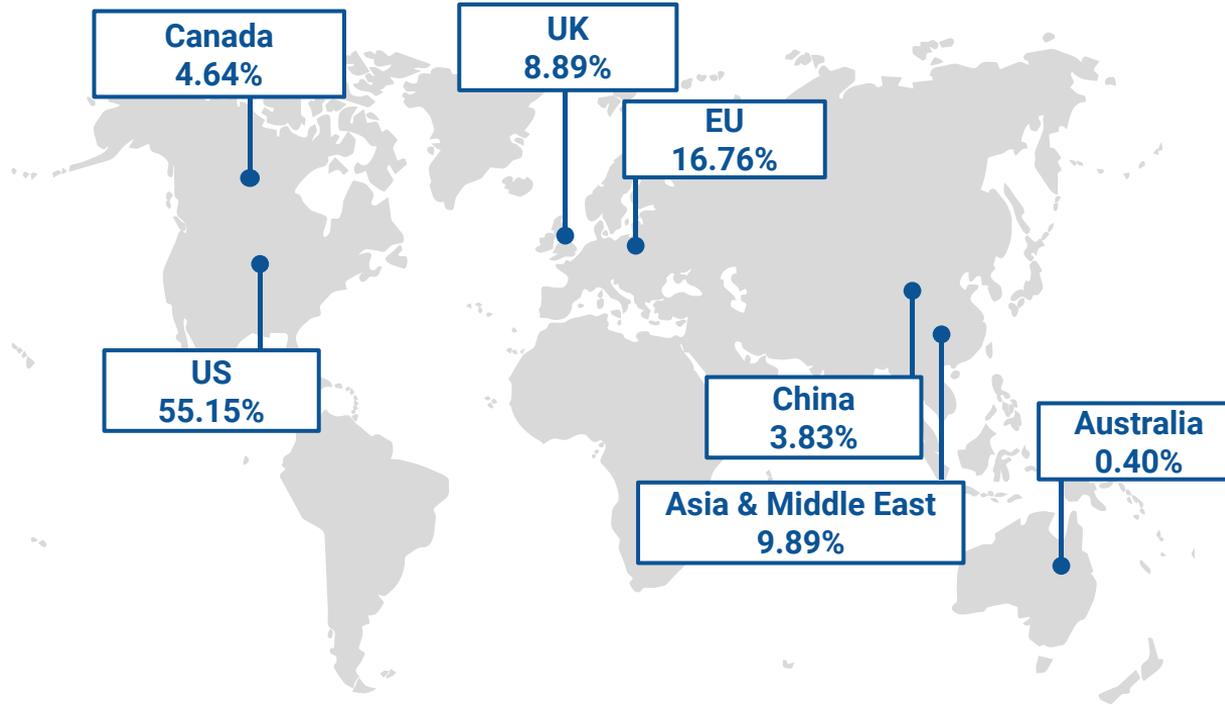


Data Processing

Early Drug Development

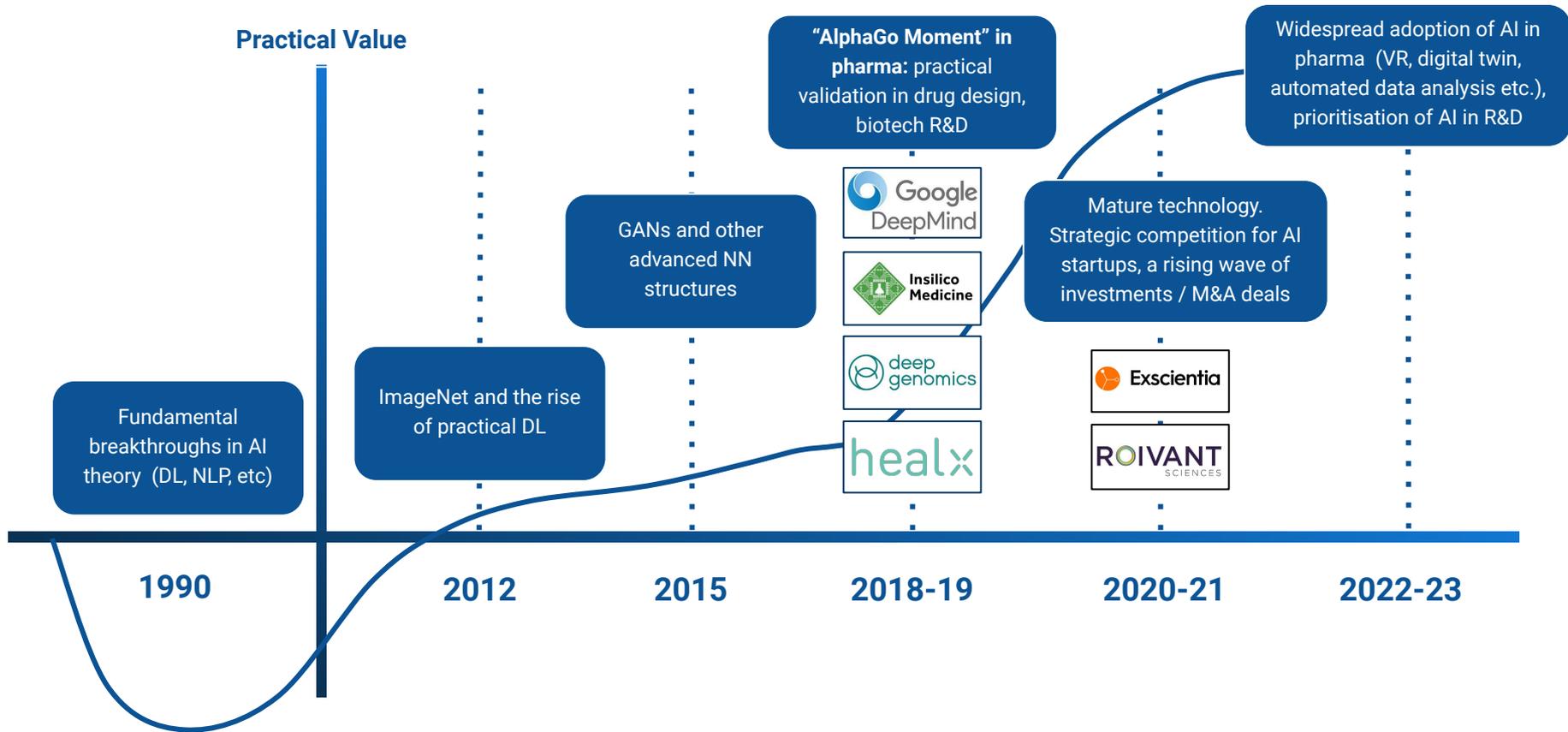


470 AI Companies: Regional Proportion

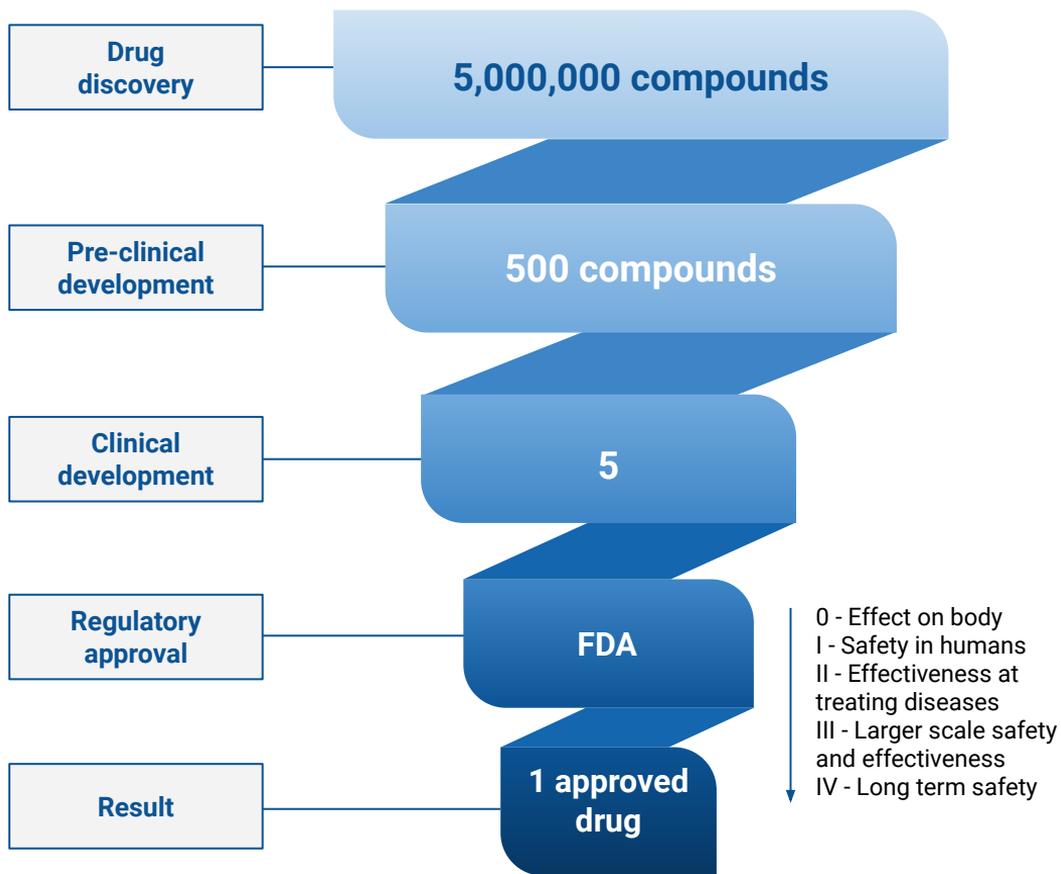


The US is still firmly in the lead regarding its proportion of AI for Drug Discovery companies. Interestingly, Asia and the Middle East continue to expand usage of AI technologies in the Pharmaceutical Industry. The ratio of companies that use AI for Drug Development in the UK and European countries is decreasing compared to the Asian market. The Asia-Pacific region continues to aggressively increase the number of AI for Drug Discovery Companies, particularly in China, and this tendency will probably maintain.

Pharma's "AlphaGo Moment"



Pharma Efficiency: Challenges



10 years + \$2.6 bln = 1 new drug

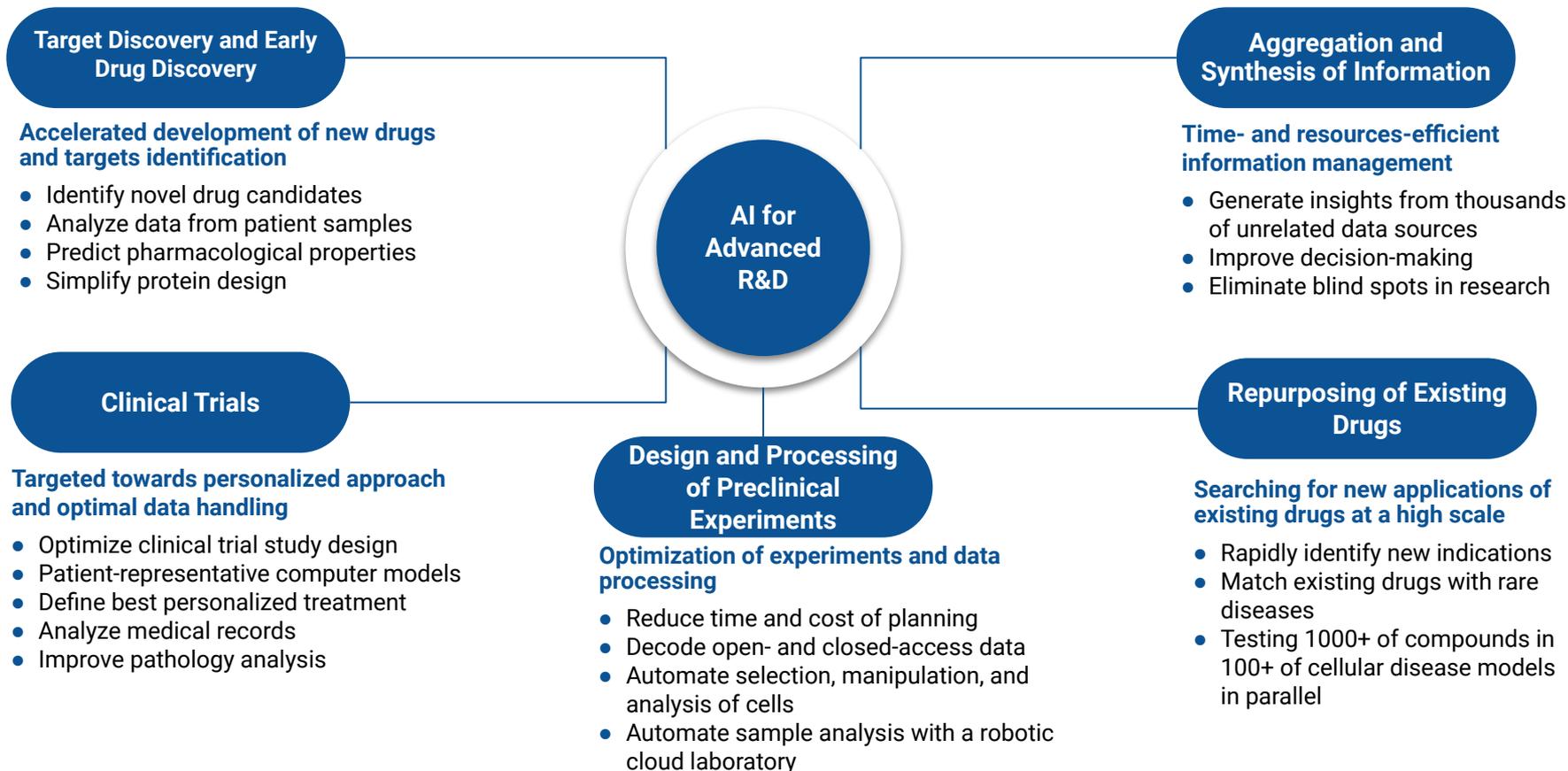
It takes on average over 10 years to bring a new drug to market. As of 2014, according to Tufts Center for the Study of Drug Development (CSDD), the cost of developing a new prescription drug that gains market approval is approximately \$2.6 billion. This is 145% increase, correcting for inflation, comparing to the same report made in 2003.

The pharmaceutical industry is in a terminal decline, and the returns on new drugs that do get to market do not justify the massive investments that Pharma currently puts into R&D anymore.

The solution to this problem comes from three key strategies:

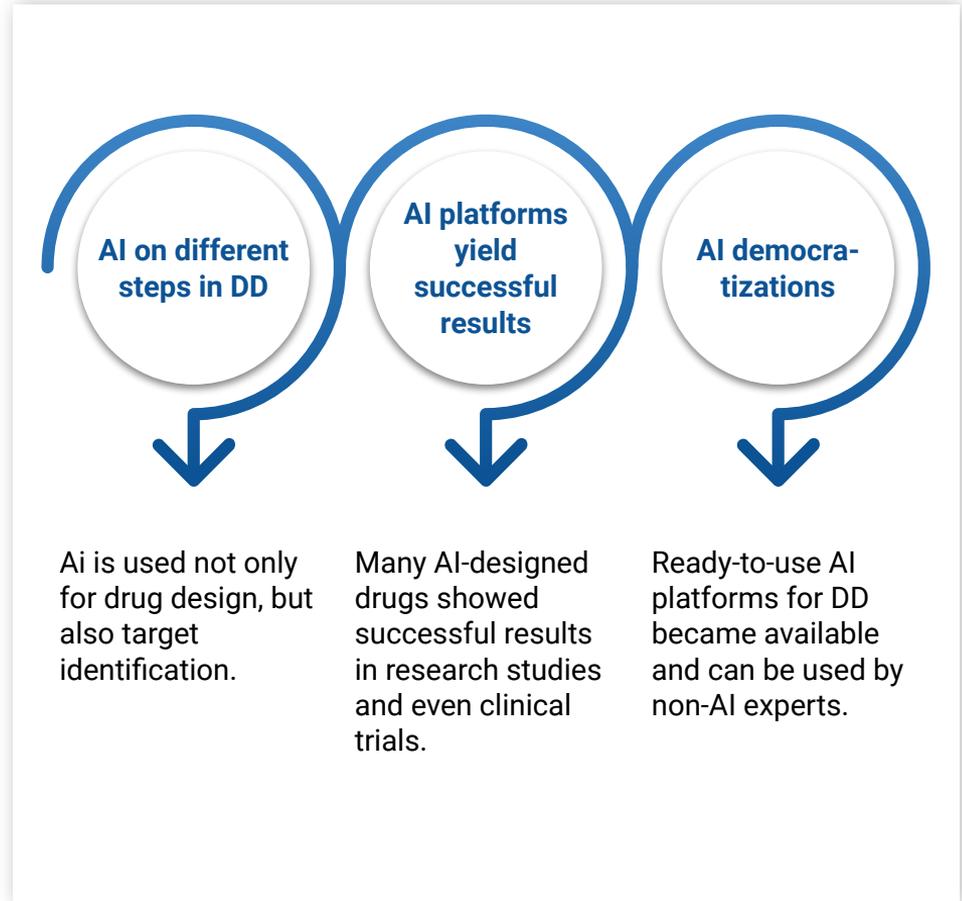
- evolution of business models towards more collaboration and pipeline diversification early
- implementation of AI as a universal shift towards data-centric drug discovery
- discovery of new therapeutic modalities (biologics, therapies etc.)

Application of AI for Advanced R&D to Address Pharma Efficiency Challenges



Key Technology Takeaways

1. AI is regarded by some top executives at big pharma (**GSK and others**) as **a tool to uncover not only new molecules, but also new targets**. Ability of deep neural networks to build ontologies from multimodal data (e.g. “omics” data) is believed to be among the most disruptive areas for AI in drug discovery, alongside with data mining from unstructured data, like text (using natural language processing, NLP).
2. There is **a considerable trend for “AI democratization”** where various machine learning/deep learning technologies become available in pre-trained, pre-configured “of-the-shelf” formats, or in relatively ready-to-use formats – via cloud-based models, frameworks, and drag-and-drop AI-pipeline building platforms (for example, KNIME). This is among key factors in the acceleration of AI adoption by the pharmaceutical organizations – where a non-AI experts can potentially use fairly advanced data analytics tools for their research.
3. **Proof-of-concept projects keep yielding successful results** in research studies, and in the commercial partnerships alike. For example, companies like Recursion Pharmaceuticals, Insilico Medicine, Deep Genomics, and Exscientia achieved important research milestones using their AI-based drug design platforms.



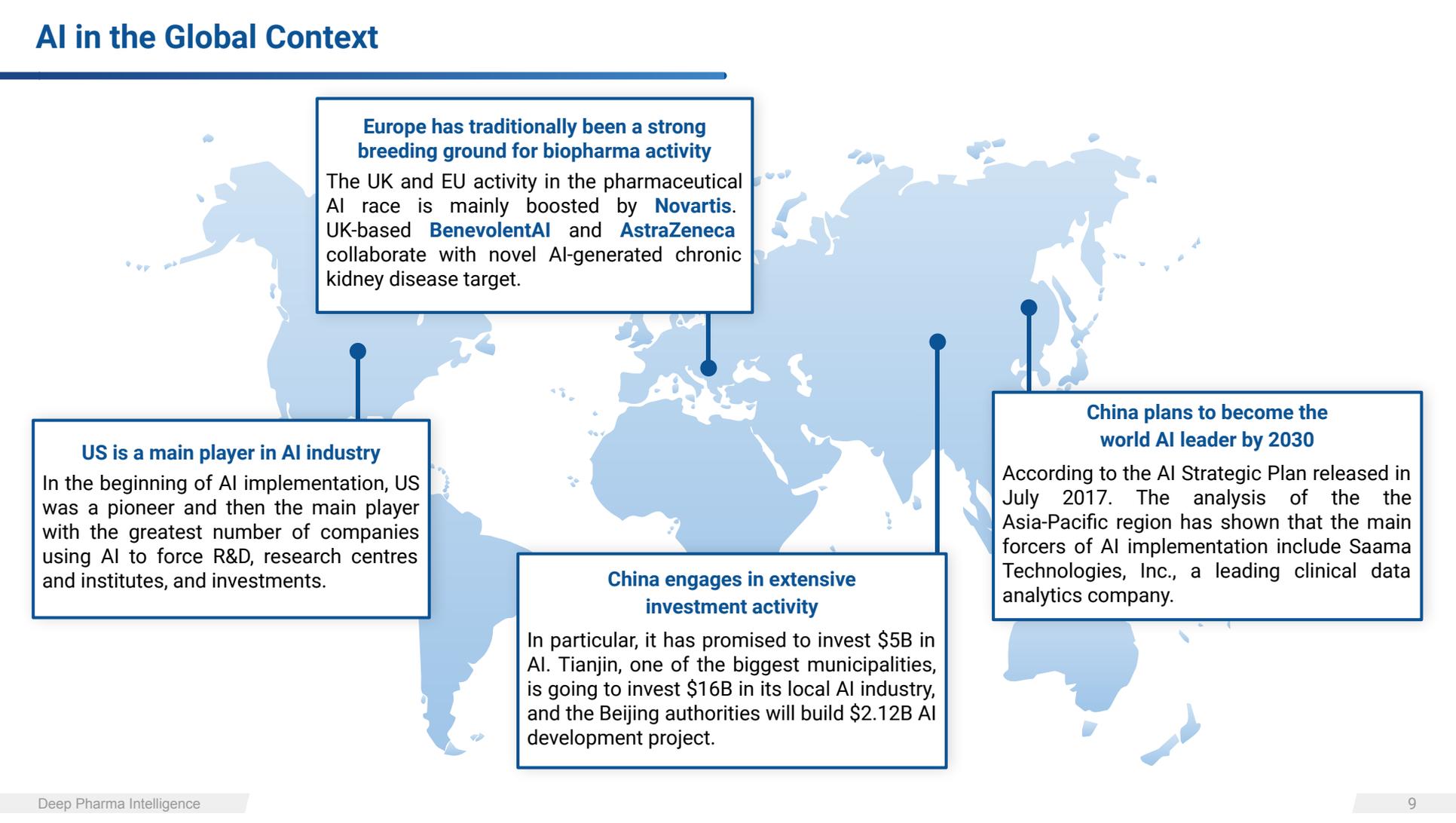
Obstacles That Still Remain

- 1. Global shortage of AI talent** continues to be a serious challenge for the biopharma industry, repeating the trend from our previous reports. While big pharmaceutical companies invest substantial capital in recruitment of AI specialists, still the majority of them are acquired by large tech corporations (Google, Amazon, Alibaba, Tencent, Baidu etc.) However, a growing wave of specialized university programs and courses, geared towards data science and AI application, is projected to address this issue to certain extent in the coming years.
- 2. Lack of available quality data is still a challenge for the unleashing full potential of deep learning technologies.** Numerous variations of deep learning (DL) are believed to be the most lucrative area of AI for applications such as drug discovery and clinical research. The key challenge is that DL algorithms are “data-greedy”, while big data in biotech is not always well-versed for modeling, or is inaccessible due to privacy reasons.
- 3. Ethical, legal, and regulatory issues for AI adoption in the pharmaceutical sciences.** This set of challenges is related to the previous point, but also includes other questions – AI explainability, patentability of AI-generated results, non-optimal regulations in various countries, slowing down the progress and adoption of AI technologies in general, and in the pharmaceutical industry in particular.

AI in Biotech Challenges



AI in the Global Context



Europe has traditionally been a strong breeding ground for biopharma activity

The UK and EU activity in the pharmaceutical AI race is mainly boosted by **Novartis**. UK-based **BenevolentAI** and **AstraZeneca** collaborate with novel AI-generated chronic kidney disease target.

US is a main player in AI industry

In the beginning of AI implementation, US was a pioneer and then the main player with the greatest number of companies using AI to force R&D, research centres and institutes, and investments.

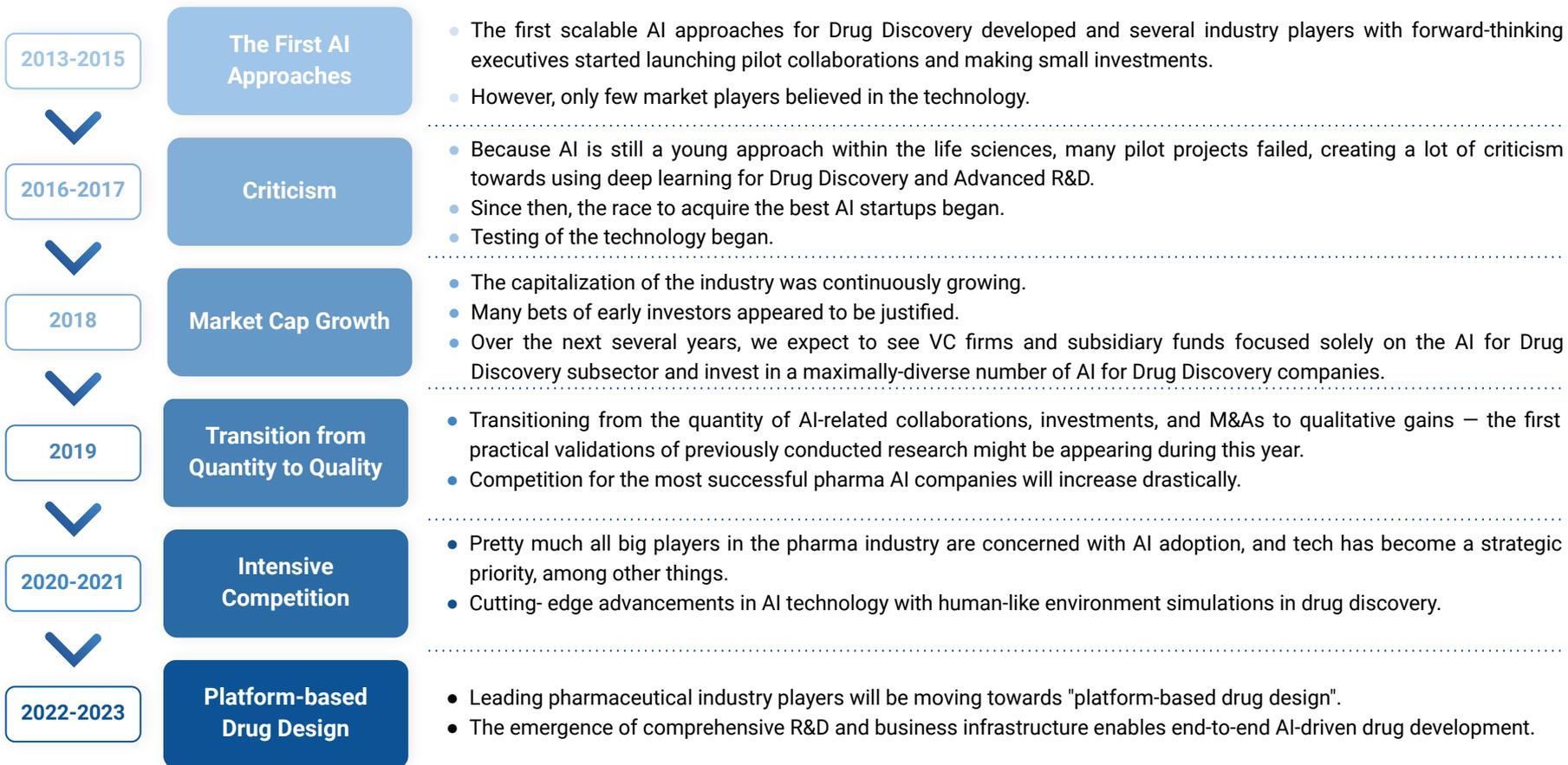
China engages in extensive investment activity

In particular, it has promised to invest \$5B in AI. Tianjin, one of the biggest municipalities, is going to invest \$16B in its local AI industry, and the Beijing authorities will build \$2.12B AI development project.

China plans to become the world AI leader by 2030

According to the AI Strategic Plan released in July 2017. The analysis of the the Asia-Pacific region has shown that the main forcers of AI implementation include Saama Technologies, Inc., a leading clinical data analytics company.

AI for Drug Discovery Market Timeline



Top-50 AI in Pharma Investors



San Francisco

 **BVC**
San Francisco, California, US

 **Founders Fund**
San Francisco, California, US

 **Foresite Capital**
San Francisco, California, US

 **DCVC**
San Francisco, California, US

 **Alexandria Venture**
San Francisco, California, US

 **Obvious Ventures**
San Francisco, California, US

 **LFC**
San Francisco, California, US

 **DCVC Bio**
San Francisco, California, US

Mountain View

 **Y Combinator**
Mountain View, California, US

 **GV**
Mountain View, California, US

Palo Alto

 **AME Cloud Ventures**
Palo Alto, California, US

 **Alexandria Venture Investments**
Pasadena, California, US

New York

 **OrbiMed**
New York, New York, US

 **Bristol-Myers Squibb**
New York, New York, US

 **Perceptive Advisors**
New York, New York, US

 **Lux Capital**
New York, New York, US

 **Two Sigma Ventures**
New York, New York, US

 **Casdin Capital**
New York, New York, US

Menlo Park

 **New Enterprise Associates**
Menlo Park, California, US

 **Andreessen Horowitz**
Menlo Park, California, US

 **Felicis Ventures**
Menlo Park, California, US

 **Khosla Ventures**
Menlo Park, California, US

 **OS Fund**
Park Ridge, Illinois, US

 **ARCH Venture Partners**
Chicago, Illinois, US

Other States

 **Bill & Melinda Gates Foundation**
Seattle, Washington, US

 **Lili Ventures**
Indianapolis, Indiana, US

 **SOSV**
Princeton, New Jersey, US

 **Celgene**
Summit, New Jersey, US

 **T. Rowe Price**
Baltimore, Maryland, US

 **Revolution**
Washington, District of Columbia, US

 **EPIC Ventures**
Salt Lake City, Utah, US

Massachusetts

 **General Catalyst**
Cambridge, Massachusetts, US

 **SR One**
Cambridge, Massachusetts, US

 **Third Rock Ventures**
Boston, Massachusetts, US

 **F-Prime Capital**
Cambridge, Massachusetts, US

Manhattan Beach

 **B Capital Group**
Manhattan Beach, California, US



 **Inovia Capital**
Montréal, Quebec, Canada



 **EASME**
Brussels, Brussels
Hoofdstedelijk Gewest, Belgium



 **Novo Holdings**
Hellerup, Hovedstaden, Denmark



 **EDBI**
Singapore, Central Region



 **SoftBank Vision Fund**
London, England, The UK

 **Amadeus Capital Partners**
London, England, The UK



Beijing

 **ZhenFund**
Beijing, China

 **Baidu Ventures**
Beijing, China

 **Sequoia Capital China**
Beijing, China

Shanghai

 **WuXi AppTec**
Shanghai, China

 **Lilly Asia Ventures**
Shanghai, China

 **6 Dimensions Capital**
Shanghai, China

 **GT Healthcare Capital Partners**
Central, Hong Kong Island, Hong Kong

 **Baillie Gifford**
Edinburgh, Edinburgh, The UK

 **Octopus Ventures**
London, England, The UK

Selected Pharma AI Deals

AI Companies	Pharma Corporations	AI Companies
		
		
		
		
		
		

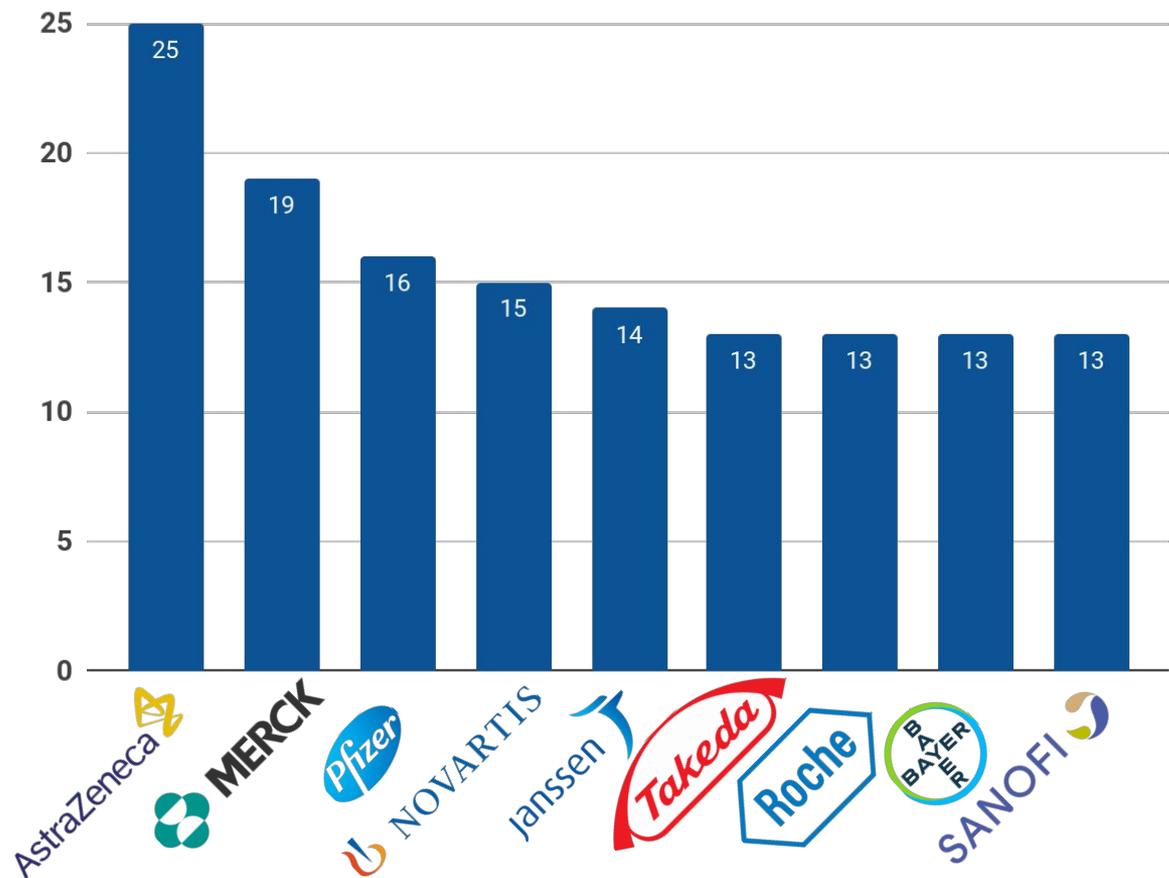
Note: the central column (red) defines the pharmaceutical corporations and side columns (blue) defines AI companies that have collaborations with pharma companies from the central column.

Selected Pharma AI Deals

AI Companies	Pharma Corporations	AI Companies

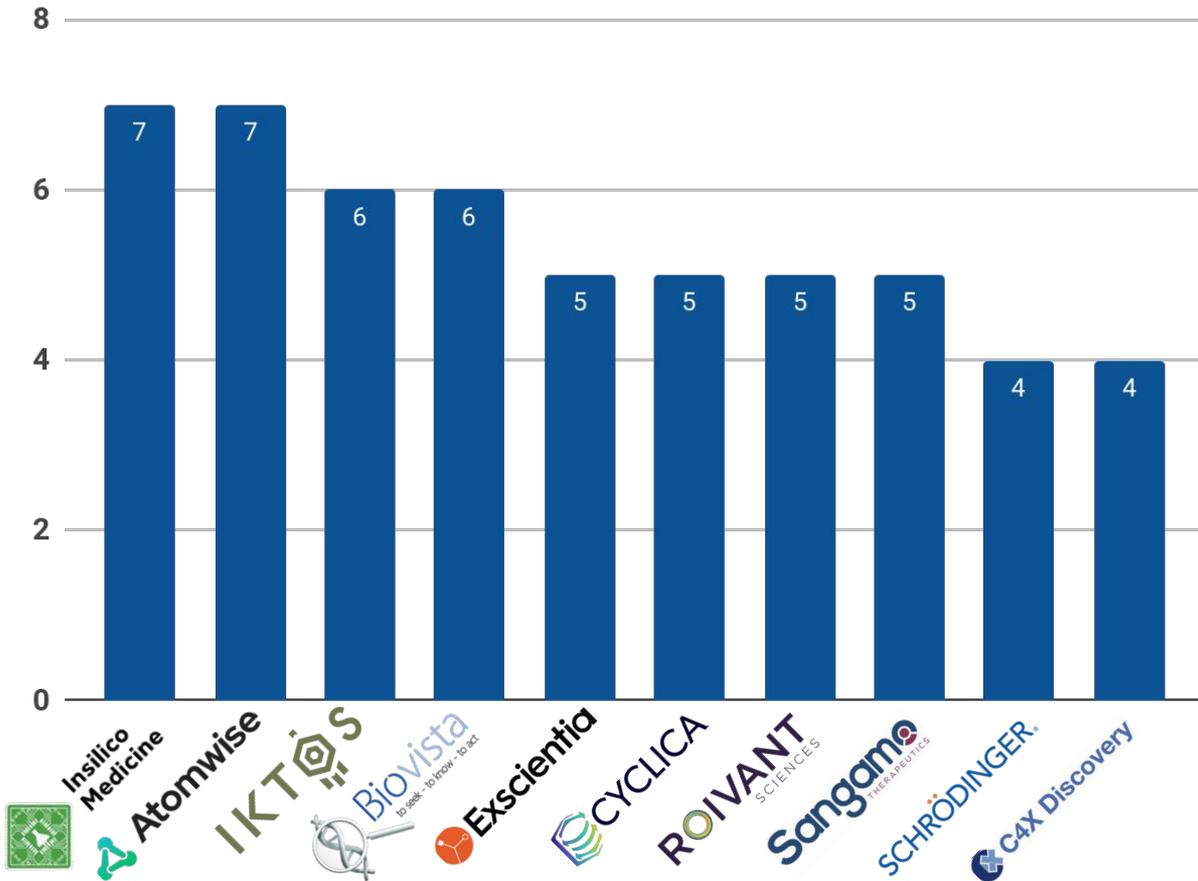
Note: the central column (red) defines the pharmaceutical corporations and side columns (blue) defines AI companies that have collaborations with pharma companies from the central column.

Leading Pharma Corporations by the Number of Pharma AI Deals in 2021 - Q1 2022



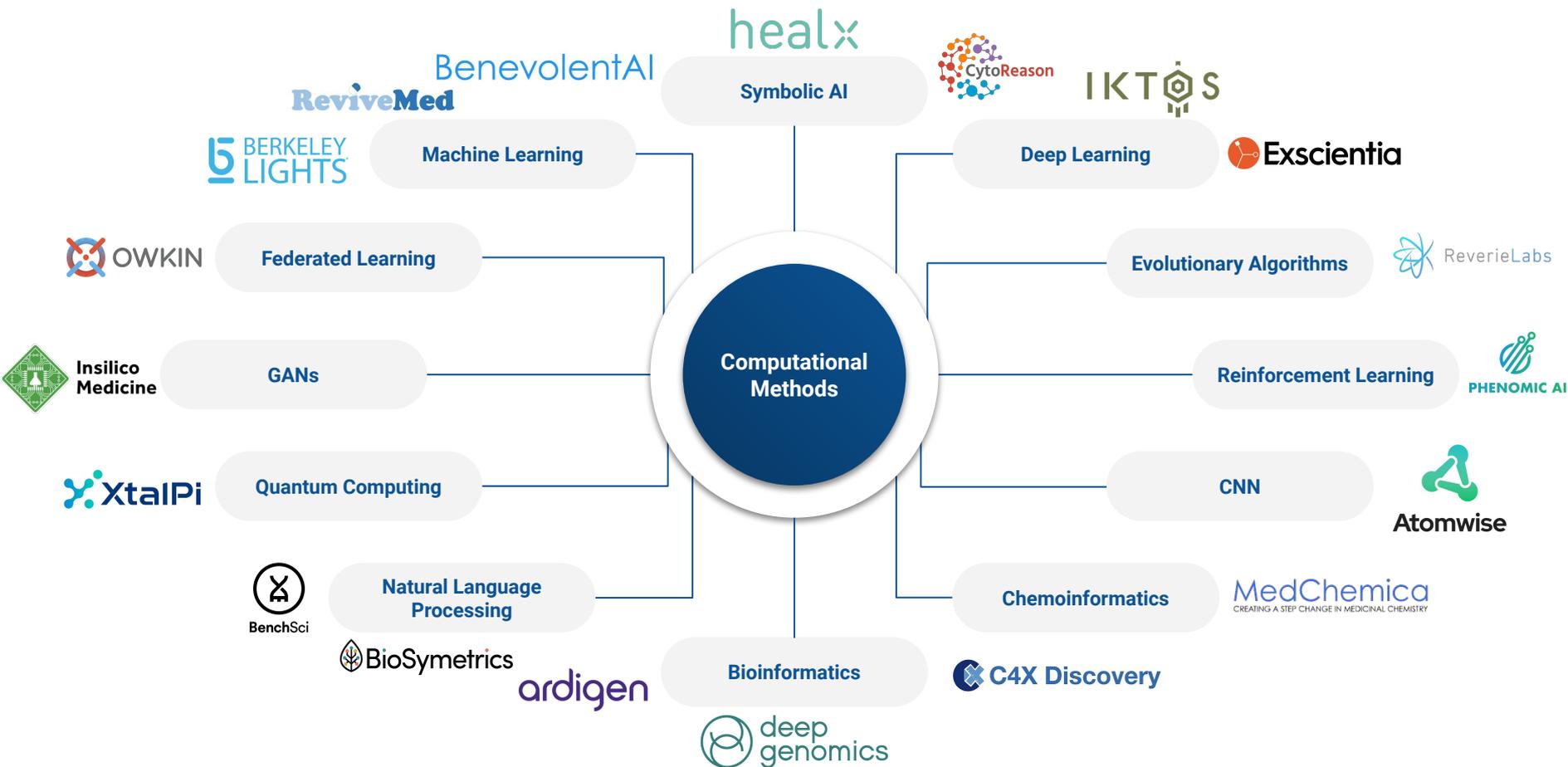
- The leading Pharma players by the amount of major industry partnerships are **AstraZeneca** and **Merck**.
- These companies demonstrate increasing commitment to probing the grounds in the AI space – by investing into internal programs, as well as partnering with external AI vendors to pilot programs in drug discovery and other research areas.
- The most common type of deals are **true partnerships** and **saving the costs deals**.
- The leading big pharma brands are increasingly open to partnerships with AI startups and corporations to get competitive edge, and mitigate **the problem of declining R&D efficiency**.

Top-10 AI and Tech Partners by Number of Major Pharma AI Deals in 2021 - Q1 2022

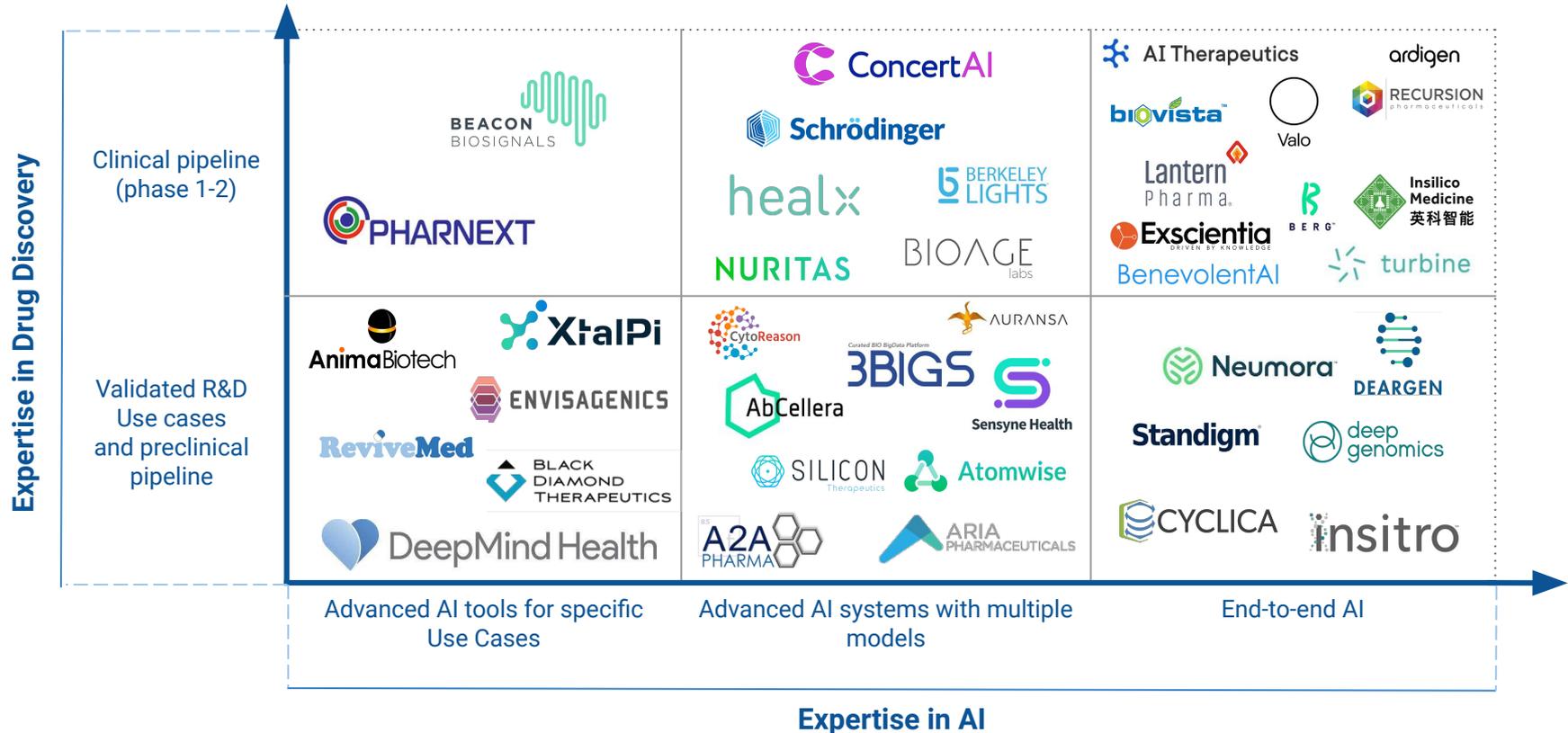


- The leading AI players by the amount of major industry partnerships are **Insilico Medicine and Atomwise**.
- **The biggest number** of AI in Drug Discovery deals was conducted by **Insilico Medicine**.
- The company is an **end-to-end**, AI-driven pharma-technology company that accelerates drug development by proprietary **platform across biology, chemistry and clinical development**.
- All of the deals concluded with this company were categorized as the ones aiming at **saving costs and increasing operational efficiency** due to the character of the services provided.

Computational Methods Used by the Most Advanced AI Companies

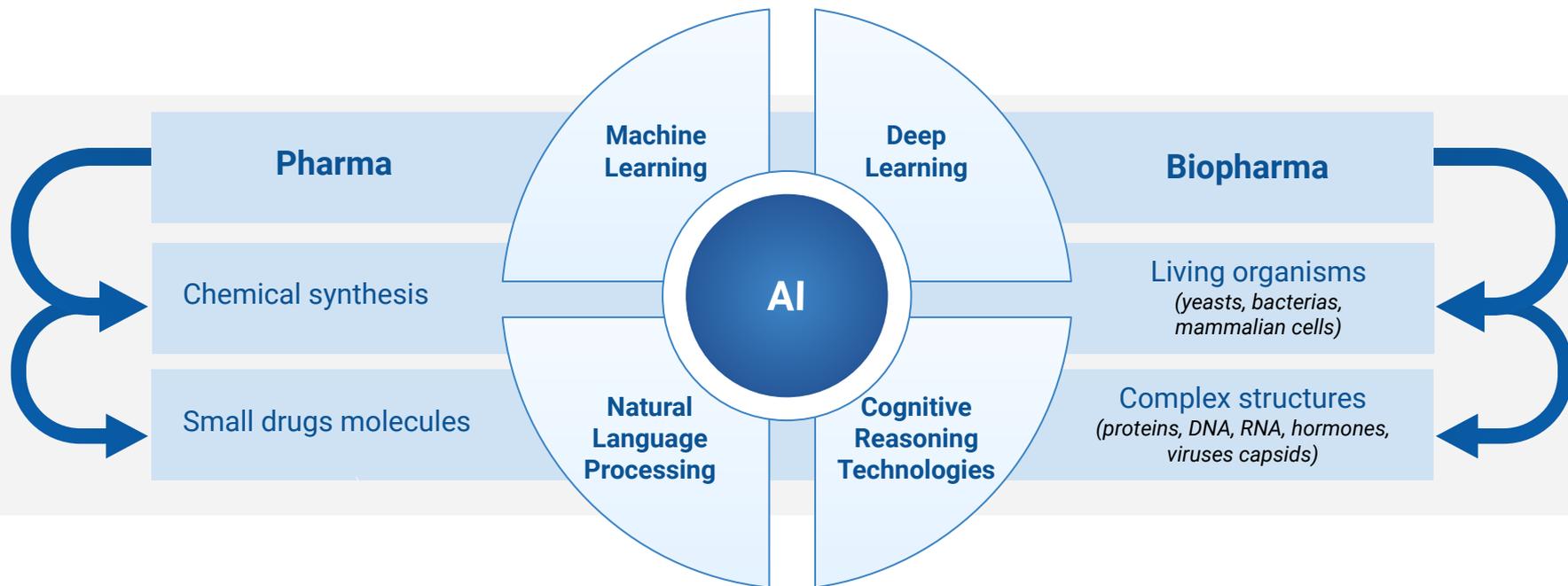


Comparison of Top-40 Leading AI for Drug Discovery Companies Expertise in Drug Discovery R&D

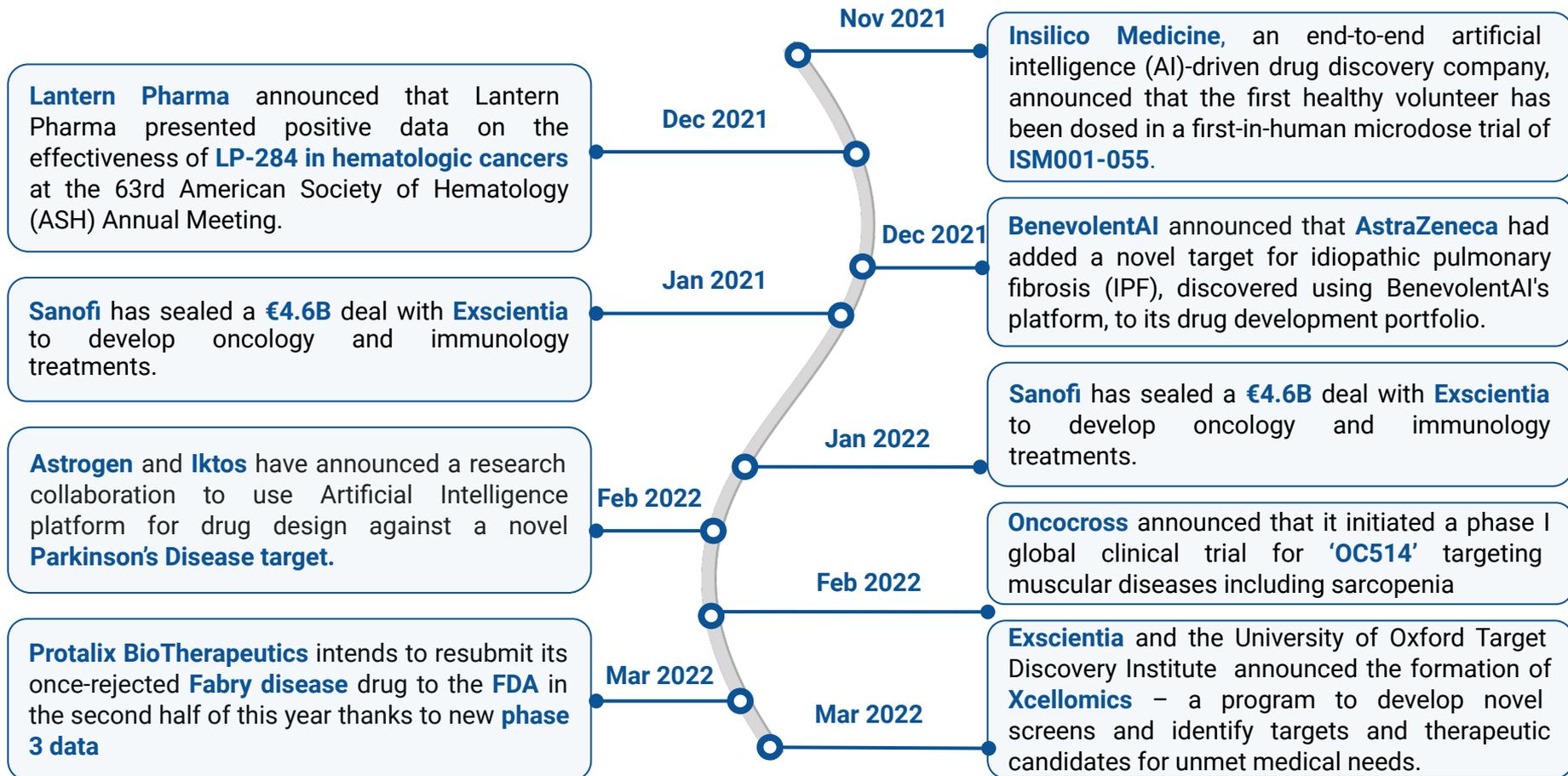


Introduction to Most Innovative R&D Approaches of AI in Biopharma

Biopharma utilizes living organisms (such as yeasts, bacteria, mammalian cells) which are capable to produce complexly structured products as proteins, hormones, RNA and DNA products, viruses capsids. Whereas Pharma relies on a classical chemical synthesis producing small drug molecule. However both industries may benefit of AI-driven applications. To develop new small drug molecules or biologically-derived products, AI-driven data processing serves as a tool that allows to minimise time consuming biological testings while helping to select the most promising products to test.



Selected Pharma AI Industry Developments Q1 2020 – Q1 2022



Major Observations for Q1 2021-Q1 2022: Key Business Takeaways



The segment of pharmaceutical AI continues consolidation with the increasing number of later stage mega-rounds, including XtalPi and Insitro (both \$400M), Generate Biomedicines (\$370M), Exscientia and Insilico Medicine (both \$255M), and Arbor Biotechnologies (\$215M). The AI start-up pack is clear leaders with significant resources, financial leverage, technical edge, and laggards with fewer finances, technology, and scientific assets. Notably, the BioTech business adopts a new robust trend of taking firms public through SPACs (SPACs). Recently, Roivant Sciences, an AI-driven firm, exited through SPAC. Roivant's consolidated cash position will be about \$2.5B on September 30, 2021.



The pharmaceutical AI business is “heating up”, becoming a profitable area for expert biotech investors as well as investor groups looking to diversify their portfolios with high-risk/high-reward firms. The total amount invested in AI in Pharma in 2021 has quadrupled from \$4,7M to \$12,73M. A growing number of proof-of-concept breakthroughs confirm that AI technology has matured enough to provide tangible value to pharma and contract research organizations (CROs).



Due to quickly growing proof of AI tech feasibility and innovation potential, big pharma and **contract research organizations are actively competing for AI collaborations**. Valo Health started partnership with Charles River Laboratories to accelerate preclinical drug discovery using Valo's small molecule Drug Discovery platform. Exscientia has signed a research collaboration with Sanofi and received an investment of \$100M to develop potential drug candidates for cancer and immune-mediated diseases.

Major Observations for Q1 2021-Q1 2022: Key Business Takeaways



The global COVID-19 pandemic prolongs the rise of **the overall biotech and drug discovery sectors**. During 2021 we have observed over 100 medium and large funding rounds for biotech and drug design companies, especially those focused on antiviral therapies and vaccines.



In 2021, **10 companies that use AI for DD reached IPO status**. New York-based Roivant Science closed its IPO in October and raised \$611M. Exscientia, a pharmatech company that uses an end-to-end AI platform to design and discover new drugs launched IPO the same day as Roivant Science and raised \$350M. The vast majority of companies started gaining IPO status after 2018, marked by a growth of 136.0% during the last four years and we expect this trend growth to continue.



When some of the companies complete IPOs in the nearest future, it will attract a significant number of **non-biotech investors to enter the Life Sciences sector**. The prospects of this trend are already vivid: big tech companies enter partnerships with both innovative start-ups and pharma companies to consolidate resources, mainly in personalized medicine, cell and gene therapy, and molecule prediction software. Some of these companies even open subsidiaries harvesting AI in Drug Design (like Isomorphic Labs from Google).



The growing industry traction, reflected in the increasing number of R&D partnerships between big pharma and CROs with AI startups, is a sign that the market is maturing for rapid increase in M&A activity in the nearest future. Despite the crisis, AI-in-Pharma publicly traded companies present YTD growth with reaching **\$110B of cumulative capitalization as of December 30, 2021**.

Deep Pharma Intelligence is producing regular analytical reports on major areas of high-potential in the pharmaceutical and healthcare industries, maintaining ratings of companies and governments based on their innovation potential and business activity in the BioTech space, and providing strategic consulting and investment intelligence services to top-tier clients, including major investment funds and banks, family offices, insurance companies, government organizations, and big pharma companies among others. The company is a joint venture between the two highly specialized UK-based market intelligence hubs in Pharma / BioTech space:



Pharma Division of Deep Knowledge Analytics (PD-DKA), a specialized subsidiary of Deep Knowledge Analytics (DKA), the leading analytical entity specifically focused on deep intelligence of the high-potential areas in the pharma industry, including artificial intelligence (AI) for drug discovery sector.

Deep Knowledge Analytics Pharma Division serves as the main source of investment intelligence and analytics for AI-Pharma, a specialized index hedge fund for the AI in the drug discovery sector. PD-DKA's insights are frequently covered by top media such as Forbes and the Financial Times, and are acknowledged by top pharma executives.

Recently, MIT named this division a top technology think-tank, acknowledging the AI ranking framework it developed.

Bio
Pharma
Trend

BPT Analytics (BiopharmaTrend) - a rapidly growing analytical portal and media resource, dedicated to tracking emerging companies (startups/scaleups), innovations, investments, and trends in the pharma and biotech space.

BiopharmaTrend's reports and articles were referenced by Deloitte, Forbes, and other high profile media and consulting companies.

BiopharmaTrend is a media partner to a number of top-tier conferences and symposia in preclinical and clinical research, and healthcare research.

Overview of Proprietary Analytics by Pharma Division of Deep Pharma Analytics

Proprietary Reports

There are a few 40+ page reports delivering practical answers to these specific questions in order to optimize the short and long-term strategies of biopharma corporations and other institutions related to the industry, with a newly updated edition being released each quarter, incrementally increasing the precision, practicality and actionability of its technological and financial analysis.

Our reports are supported by our rapidly developing data mining engine, data visualization platform and analytics dashboards.

The value our reports can deliver:

- Deep analysis of the deal-making prospects in the biotech and healthcare tech space, identification of top mini-trends and larger tendencies in innovations and technology adoption (e.g. AI, blockchain, eHealth tech, longevity biomarkers, new therapeutics and therapies etc.)
- Tangible forecasts on the 3-5 years horizon, providing an overview of future scenarios of the development of various technologies in the pharma industry
- Practical guides for adopting various technological solutions and best practises, vendor profiling and contract research strategy building
- Analysis of key market players in the emerging and high-growth areas of the pharmaceutical and biotech industries.

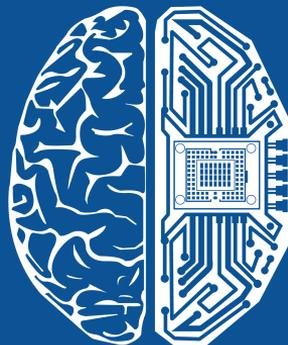
The parties who gain early access to these reports will have deep expertise on how their strategic agendas can be optimized in order to leverage novel research, new technologies, and emerging market opportunities, and stay competitive in a rapidly-changing technological environment, and taking into account shifting global priorities and trends.

Deep Pharma Intelligence: Analytical Dashboard



Our company is building a sophisticated cloud-based engine for advanced market and business intelligence in the pharmaceutical and healthcare industries. It includes data mining engine, infrastructure for expert data curation, and advanced visualization dashboards, including mindmaps, knowledge graphs, and 3-dimensional visualizations.

Visit our dashboard to learn more: platform.dkv.global/dashboards/ai-for-drug-discovery



[Link to the Report: deep-pharma.tech/ai-for-drug-discovery-q1-2022](https://deep-pharma.tech/ai-for-drug-discovery-q1-2022)

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