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Artificial Intelligence for Drug Discovery

Landscape Overview
Q1 2022

www.deep-pharma.tech

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Introduction

This 190-page **"Artificial Intelligence for Drug Discovery Landscape Overview Q1 2022"** report represents the eleventh issue of market analytics focused on the Artificial Intelligence (AI) application in the pharmaceutical research industry.

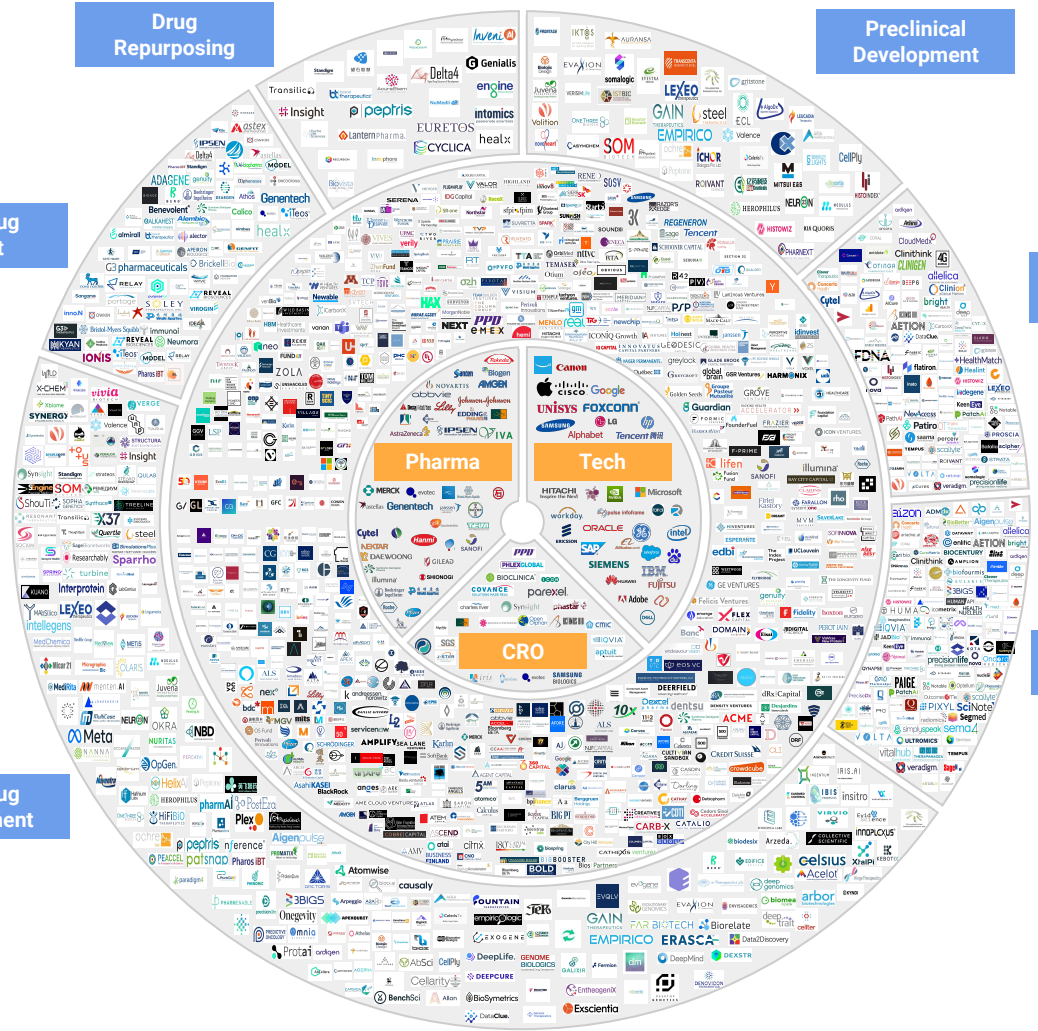
The primary goal of this series of reports is to give a complete picture of the industry environment in terms of AI usage in drug discovery, clinical research, and other elements of pharmaceutical research and development. This overview highlights recent trends and insights in the form of helpful mind maps and infographics and gauges the performance of prominent players who shape the industry's space and relationships. It can help the reader comprehend what is going on in the sector and potentially predict what will happen next.

Since the last edition, data has been significantly updated to reflect the fast-paced market dynamics and an overall increase in pharmaceutical AI investment and business development activities. The listings of AI-biotech businesses, biotech investors, and pharmaceutical organizations have been expanded to reflect the pharmaceutical industry's rising interest in sophisticated data analytics technology.

Alongside investment and business trends, the report also provides technical insights into some of the latest AI applications and research achievements.

Artificial Intelligence for Drug Discovery Landscape Overview Q1 2022

AI Companies - 495
Investors - 1120
Corporations - 100



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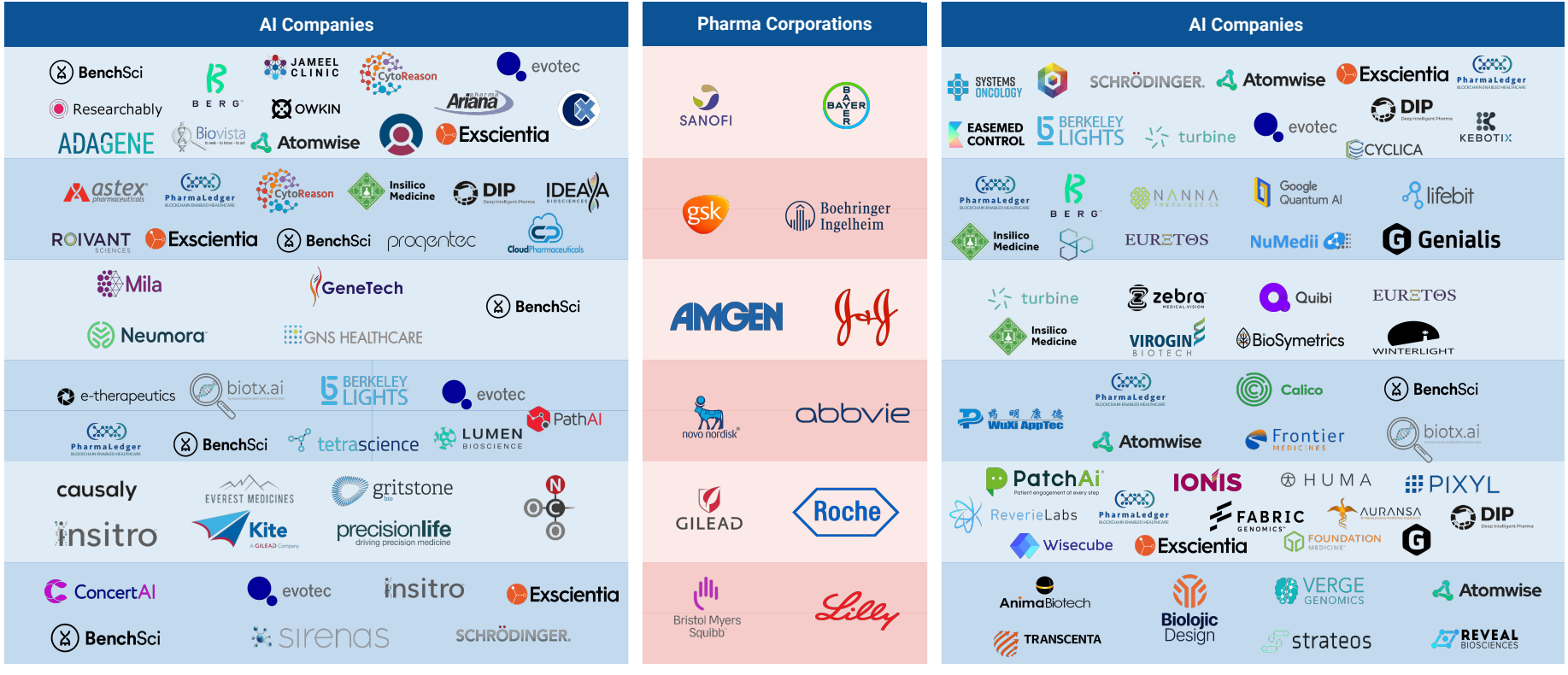
Selected Pharma AI Deals

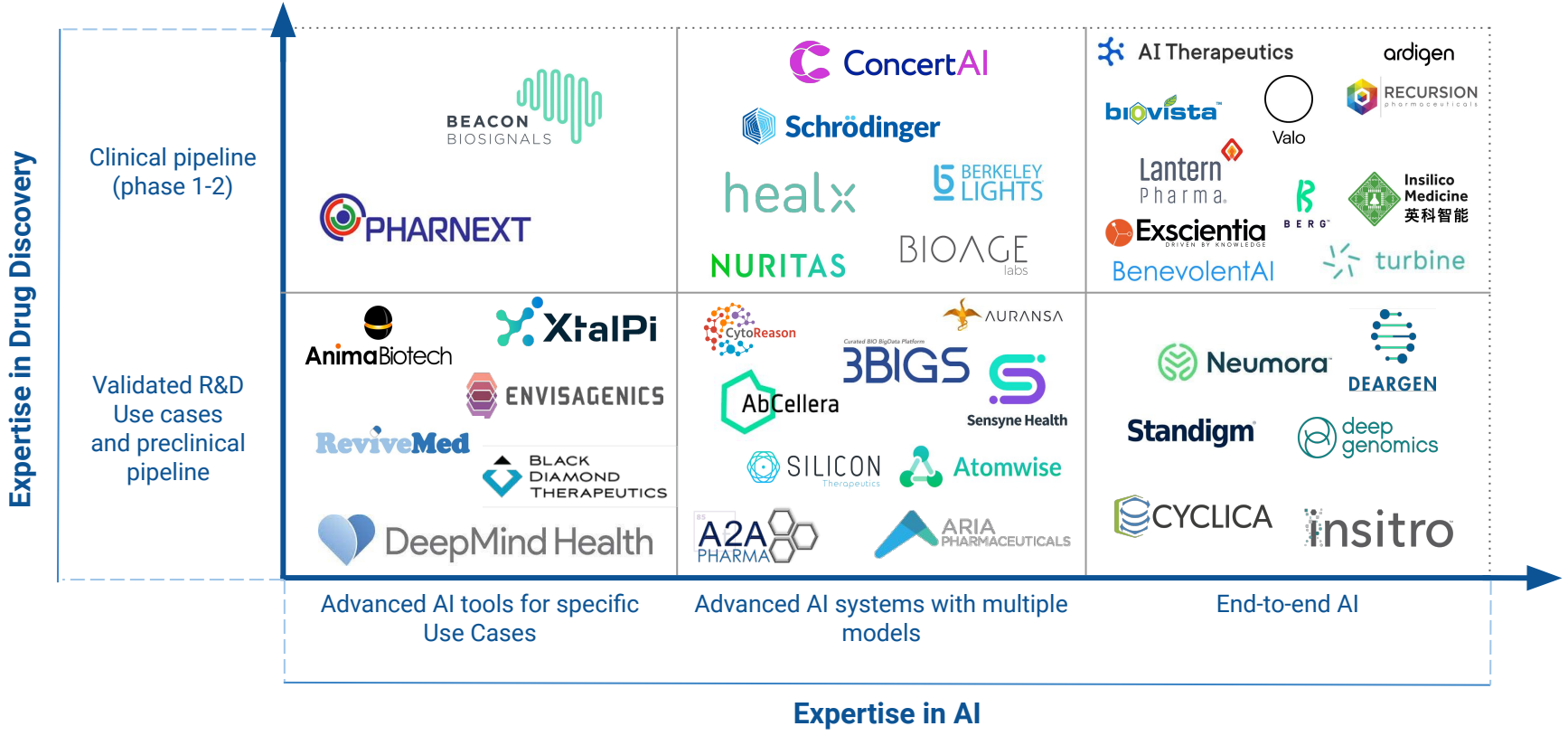
Note: the central column (red) defines the pharmaceutical corporations and side columns (blue) defines AI companies that have collaborations with pharma companies from the central column.

Selected Pharma AI Deals



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.

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



40 Leading Companies in AI for Drug Discovery Sector

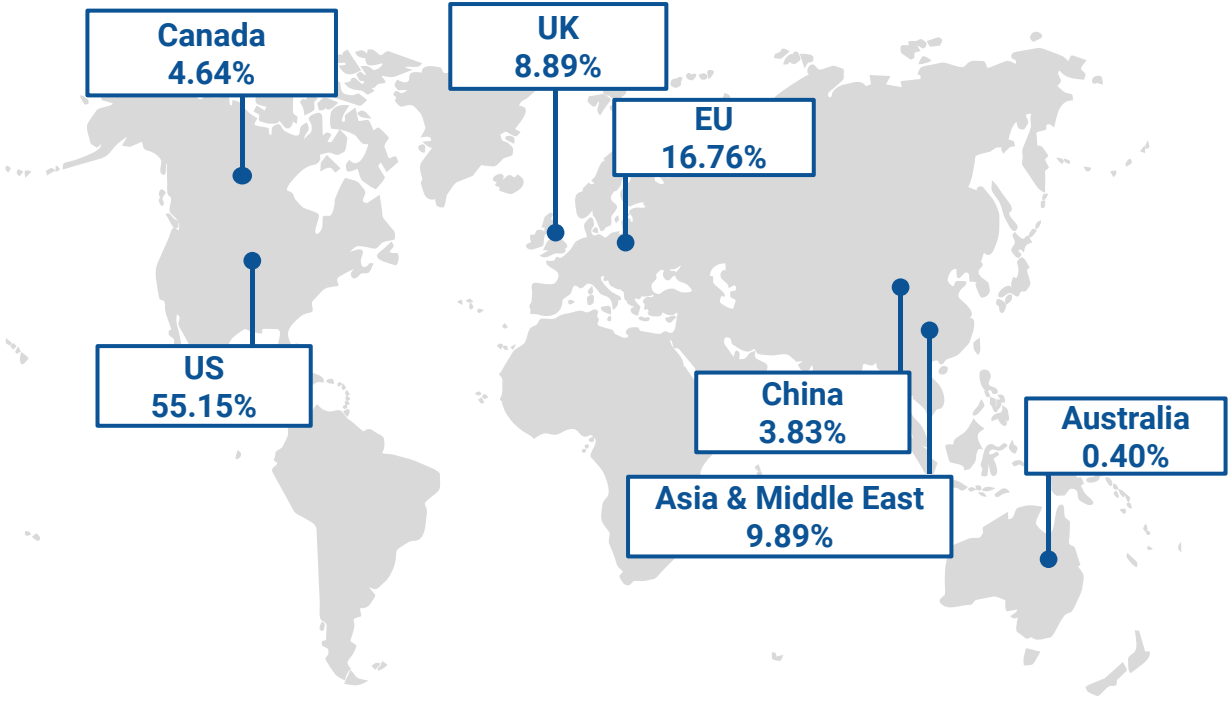
1	3BIGS
2	A2APharma
3	AbCellera
4	AI Therapeutics
5	AnimaBiotech
6	Ardigen
7	AriaPharmaceuticals
8	Atomwise
9	Auransa
10	Beacon Biosignals
11	Benevolent AI
12	Berg
13	Berkeley Lights
14	Bioage Labs
15	Biovista
16	Black Diamond Therapeutics
17	ConcertAI
18	Cyclica
19	CytoReason
20	Deargen
21	DeepGenomics
22	DeepMindHealth
23	Envisagenics
24	Exscientia
25	Healx
26	Insillico Medicine
27	Insitro
28	Lantern Pharma
29	Neumora
30	Nuritas
31	Pharnext
32	Recursion
33	ReviveMed
34	Schrodinger
35	SensyneHealth
36	Silicon
37	Standigm
38	Turbine
39	Valo
40	XtalPi

50 Leading Investors in AI for Drug Discovery Sector

1	Casdin Capital
2	GV
3	Y Combinator
4	Perceptive Advisors
5	Alexandria Venture Investments
6	DCVC
7	SoftBank Vision Fund
8	Khosla Ventures
9	Andreessen Horowitz
10	EU EASME
11	8VC
12	ARCH Venture Partners
13	Bill & Melinda Gates Foundation
14	Foresite Capital
15	SOSV
16	T. Rowe Price
17	ZhenFund
18	AME Cloud Ventures
19	F-Prime Capital
20	Felicis Ventures
21	Founders Fund
22	General Catalyst
23	Obvious Ventures
24	OrbiMed
25	B Capital Group
26	DCVC Bio
27	Lifeforce Capital
28	Lilly Asia Ventures
29	Lux Capital
30	New Enterprise Associates
31	Tencent
32	Wuxi App Tech
33	Baidu Ventures
34	EDBI
35	Novo Holdings
36	Tried Rock Ventures
37	Amadeus Capital Partners
38	Amgen Ventures
39	6 Dimensions Capital
40	Baillie Gifford
41	GT Healthcare Capital
42	Inovia Capital
43	OS Fund
44	Revolution
45	Two Sigma Ventures
46	Sequoia Capital Channel
47	Bristol-Myers Squibb
48	EPIC Ventures
49	Celgene
50	Octopus Ventures

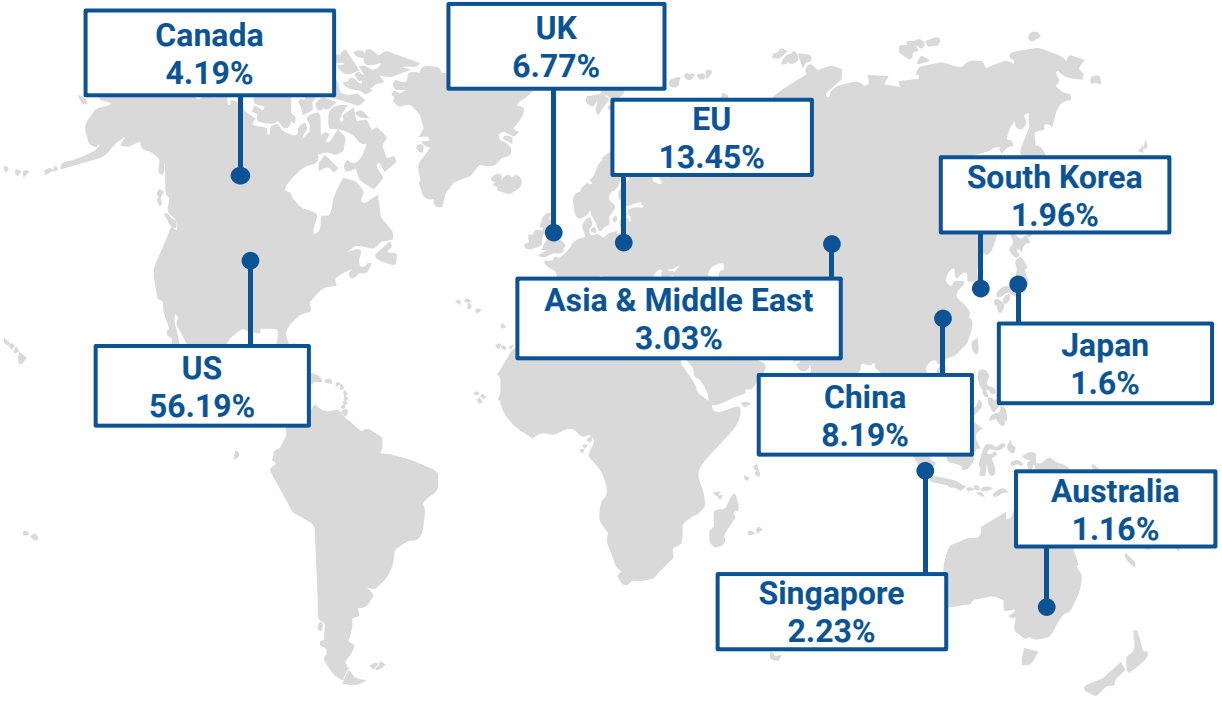
Sources: *Investment Digest AI in Pharma*

495 AI Companies: Regional Proportion



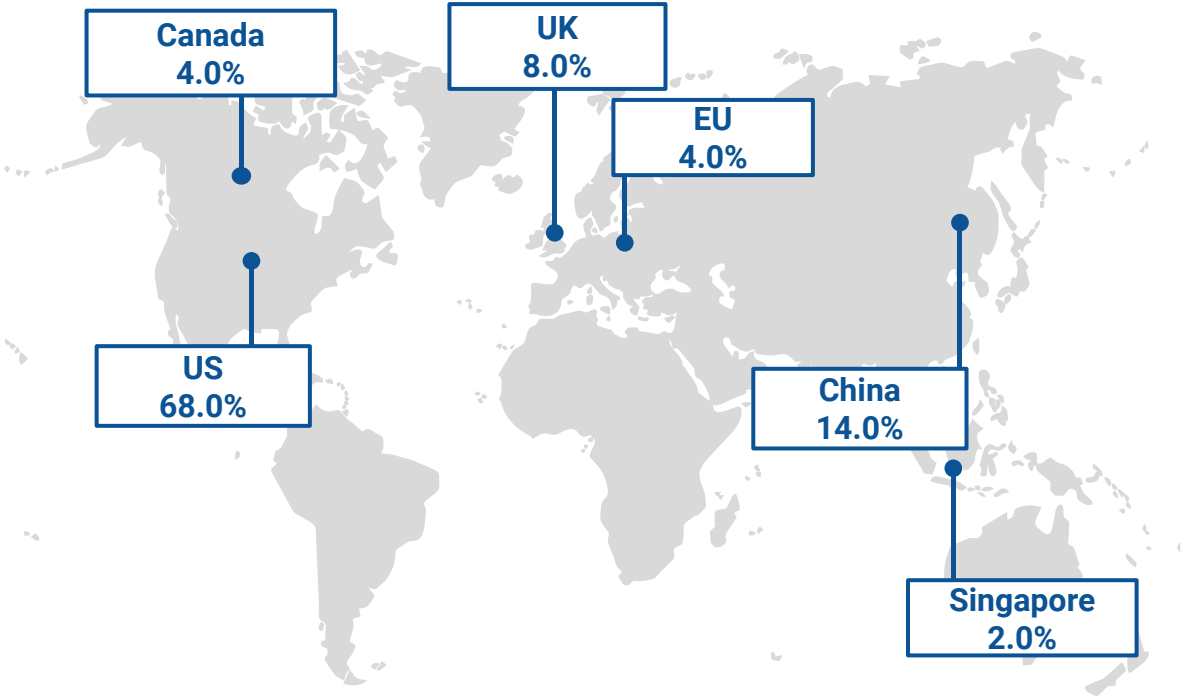
The US is still firmly in the lead regarding its proportion of AI for Drug Discovery companies. Interestingly, Asia and the Middle East continue to expand usage of AI technologies in the Pharmaceutical Industry. The ratio of companies that use AI for Drug Development in the UK and European countries 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.

1120 Investors: Regional Proportion



The United States continues to lead the rest of the world in terms of artificial intelligence for companies and funds that invest in Drug Discovery. This is reasonable, given that more than a half of the world's AI for Drug Discovery companies have their headquarters in USA. Comparing with previous periods of 2021, we can observe significant growth of the number of investors in China, as well as in US as Europe. Thus, together with UK these regions are leaders by the number of investors in AI in Drug Discovery companies.

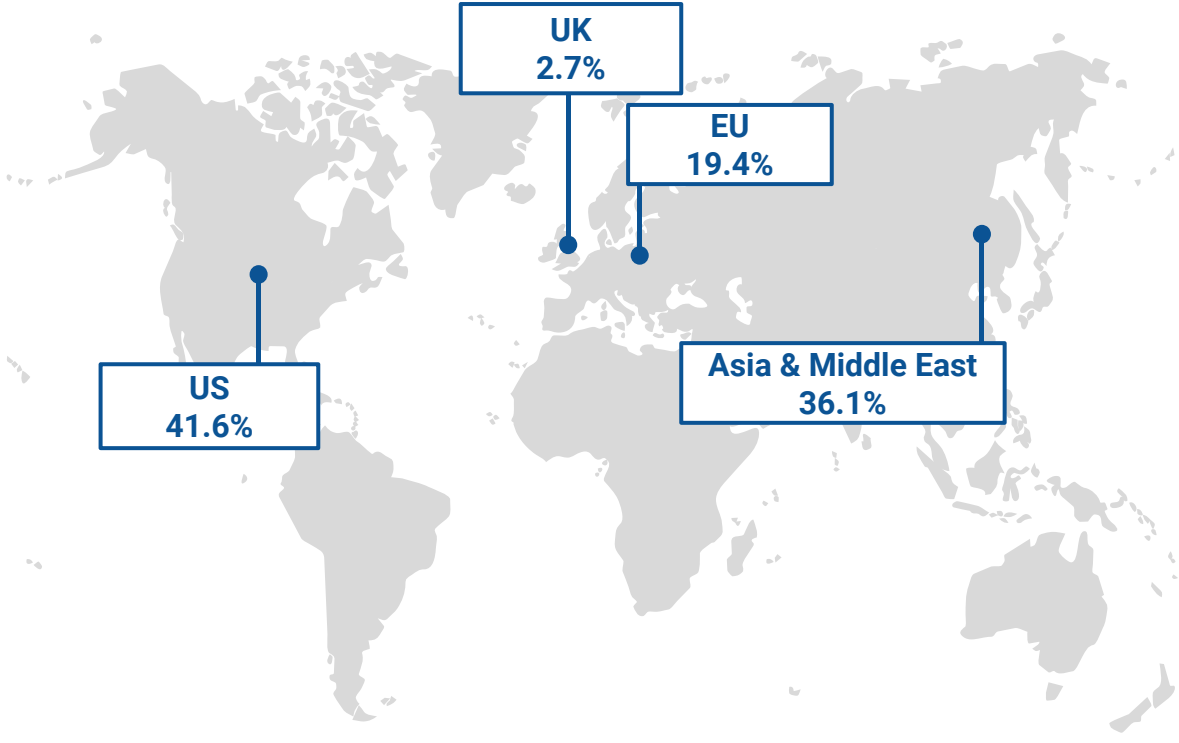
50 Leading Investors: Regional Proportion



The United States continues to lead the rest of the world in terms of artificial intelligence for companies and funds that invest in Drug Discovery. This is reasonable, given that more than a half of the world's AI for Drug Discovery companies have their headquarters in USA. During 2021 we can observe significant growth of the number of investors in Asia, mainly in China, Hong Kong and Singapore. The USA, the UK, Canada and EU remain to be leaders by the number of investors in AI in Pharma companies.

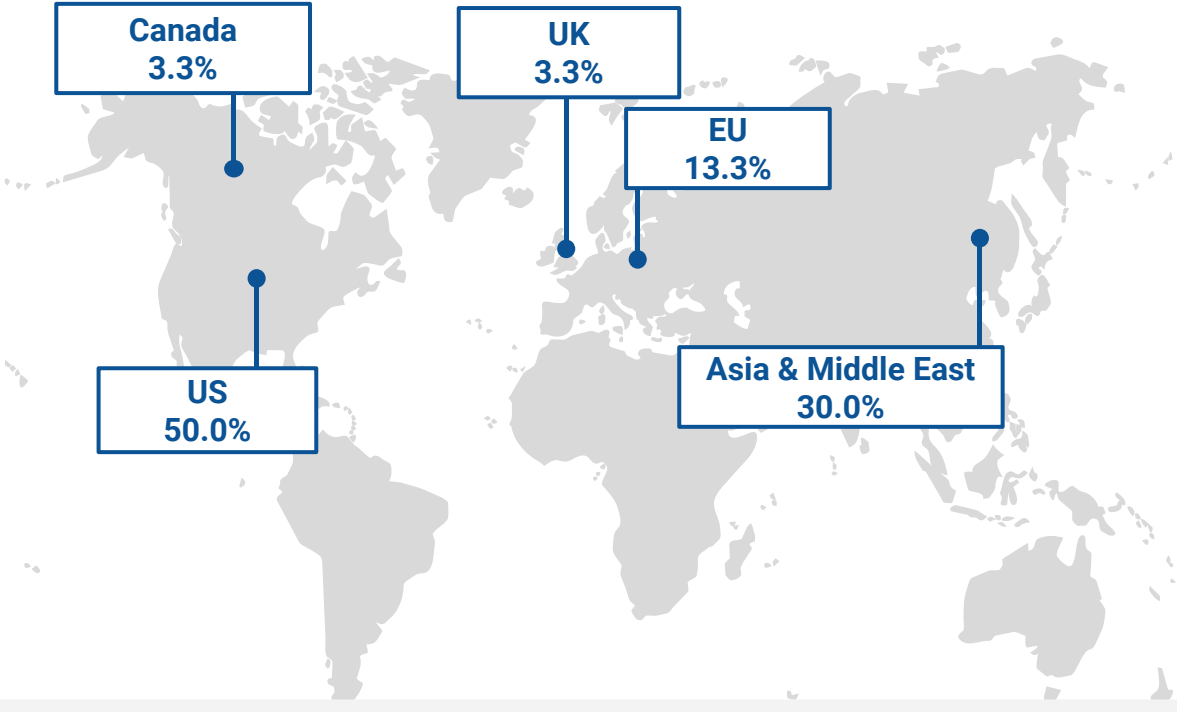
Sources: *Investment Digest AI in Pharma*

36 Pharma Corporations Applying Advanced AI in Healthcare and Drug Discovery



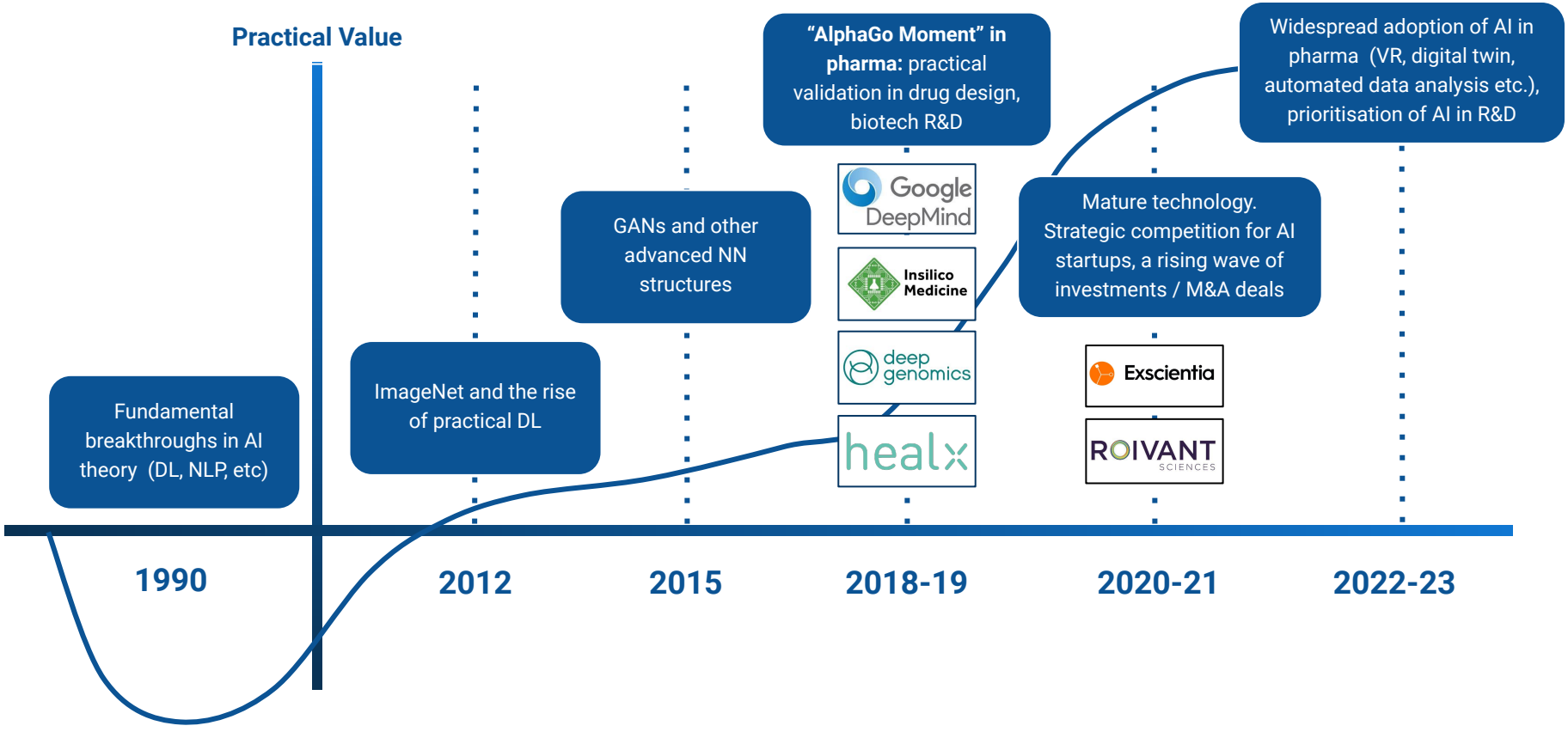
The industry is seeing an increasing level of regional diversification. Whereas historically the US has dominated the AI for Drug Discovery race in terms of the number of AI companies, the volume of investments and number of industry specialized conferences, from 2019 we are seeing an increased level of activity from the UK, Switzerland and China.

30 Leading Tech Corporations: Regional Proportion



The US is the leader according to the number of tech corporations applying advanced AI in healthcare and drug discovery. EU leads the world in terms of the number of Chemical Corporations. The second biggest figure can be observed in Asia while the EU is in the third place. This is sensible within the context of the recent increase in the chemical industry in EU that overweight the US and Asian markets of chemical substances and related products. A lot of these chemical corporations are participating in cooperation and partnerships that are aimed at drug discovery and are related to pharmaceutical issues.

Pharma's “AlphaGo Moment”



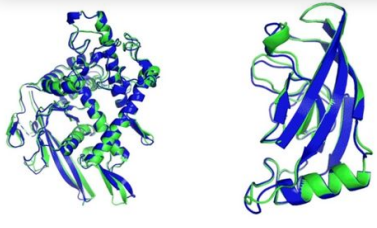
Notable Breakthroughs in AI for Pharma

2019

Deep Genomics AI-driven platform predicted novel target and oligonucleotide candidate for Wilson disease in under 18 months.

2020

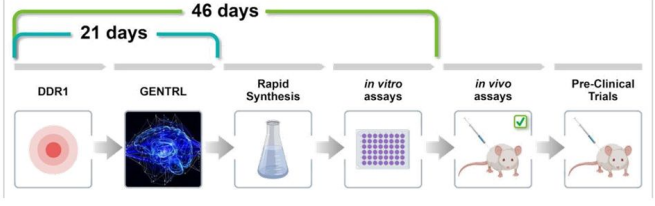
DeepMind's AlfaFold learns to predict protein's 3D shape from its amino-acid sequence, a 50 year-old grand challenge in biology.



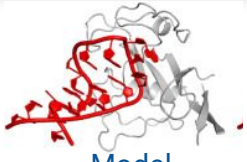
Experimental Result
Computational Prediction

2021

Insilico Medicine applied generative adversarial network-based system GENTRL for rapid identification of potent DDR1 Kinase inhibitors within 21 days.



The University of Washington has developed a deep learning model, "**RoseTTAFold**", that calculates protein structure on a single gaming computer within 10 minutes.



Model

Experiment

Technological Advancements Defining the Market

2021

Insilico Medicine achieved industry-first fully AI-based Preclinical Candidate. Initial hypothesis was build via DNN analysis of omics and clinical datasets of patients. After that company used its AI PandaOmics engine for target discovery, analyzing all relevant data, including patents and research publications with NLP algorithms. In the next step Insilico has applied its generative chemistry module (Chemistry42) in order to design a library of small molecules that bind to the novel intracellular target revealed by PandaOmics. The series of novel small molecules generated by Chemistry42 showed promising on target inhibition. One particular hit ISM001 demonstrated activity with nanomolar (nM) IC50 values.

Insilico Medicine 英科智能

Preclinical candidate Selected (PCC)

Insilico → Traditional Approach

Disease Hypothesis & Target Identification	Target-to-hit	Hit-to-lead	Lead optimization and Candidate Validation
1 week	2 months	4 months	11 months
< $ 50k N/A	$ 200k $ 94M	$ 400k $ 166M	$ 200k $ 414M
Up to Decades	1 year	1.5 years	2 years

Phase 1 → Phase 2 → Phase 3 → Submission to launch

When optimizing ISM001, Insilico managed to achieve increased solubility, good ADME properties, and no sign of CYP inhibition — with retained nanomolar potency. Interestingly, the optimized compounds also showed nanomolar potency against nine other targets related to fibrosis. The efficacy and a good safety of the molecule led to its nomination as a pre-clinical drug candidate in December 2020 for IND-enabling studies. The phase I clinical trial for the novel drug candidate is planned for December 2021.

Source: *Insilico Medicine*

Executive Summary

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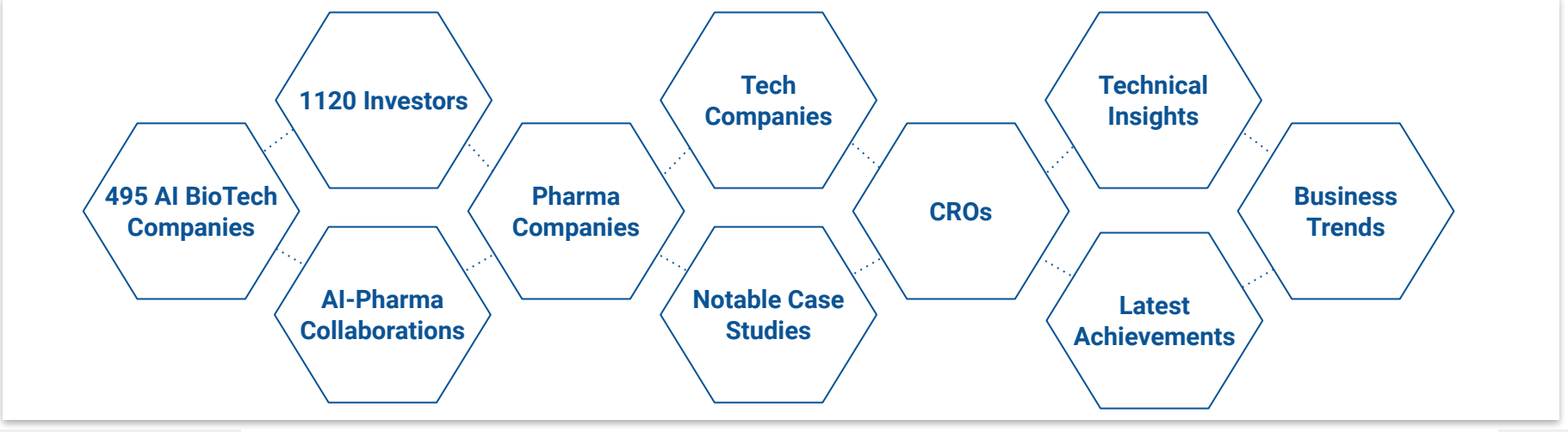
Report at a Glance

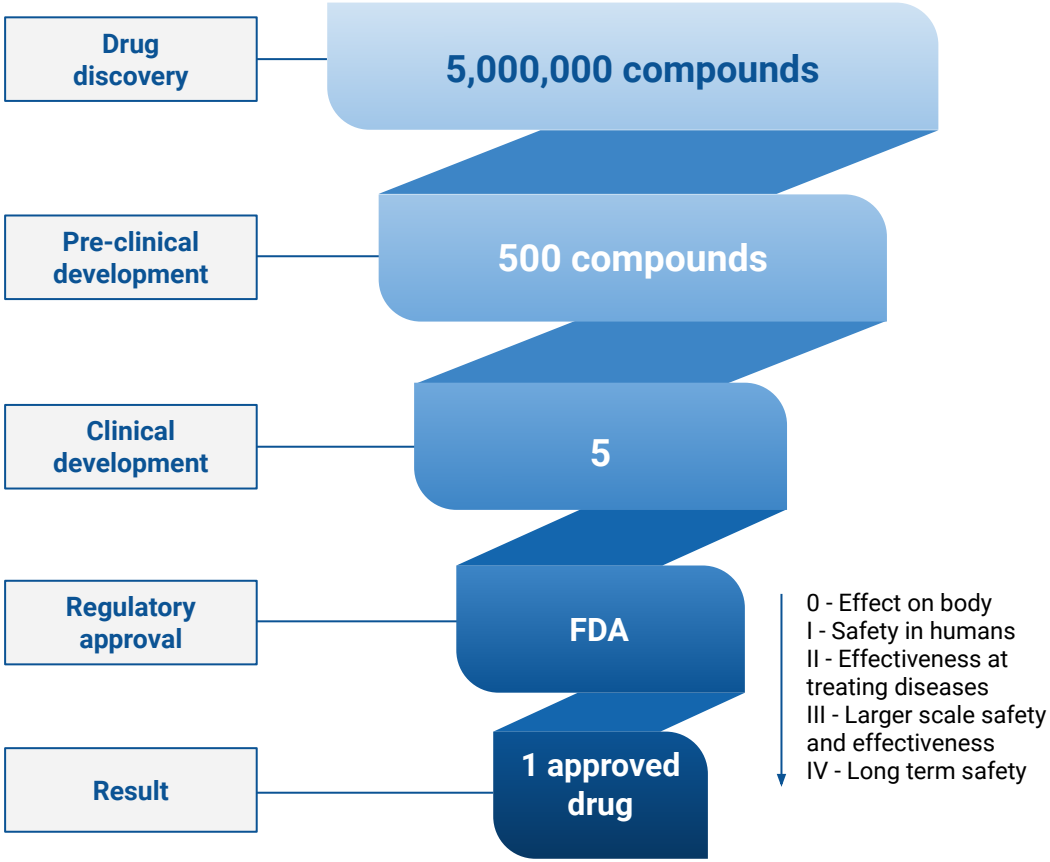
This **190-page** "**Artificial Intelligence for Drug Discovery Landscape Overview, Q1 2022**" report marks the installment in a series of reports on the topic of the Artificial Intelligence (AI) application in pharmaceutical research industry that DPI have been producing since 2017.

The main aim of this series of reports is to provide a comprehensive overview of the industry landscape in what pertains adoption of **AI in drug discovery, clinical research and other aspects of pharmaceutical R&D**. This overview highlights trends and insights in a form of **informative mind maps and infographics** as well as benchmarks the performance of key players that form the space and relations within the industry. This is an overview analysis to help the reader understand what is happening in the industry nowadays and possibly give an idea of what is coming next.

Alongside investment and business trends, the report also provides technical insights into some of the latest achievements in the AI application and research.



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.

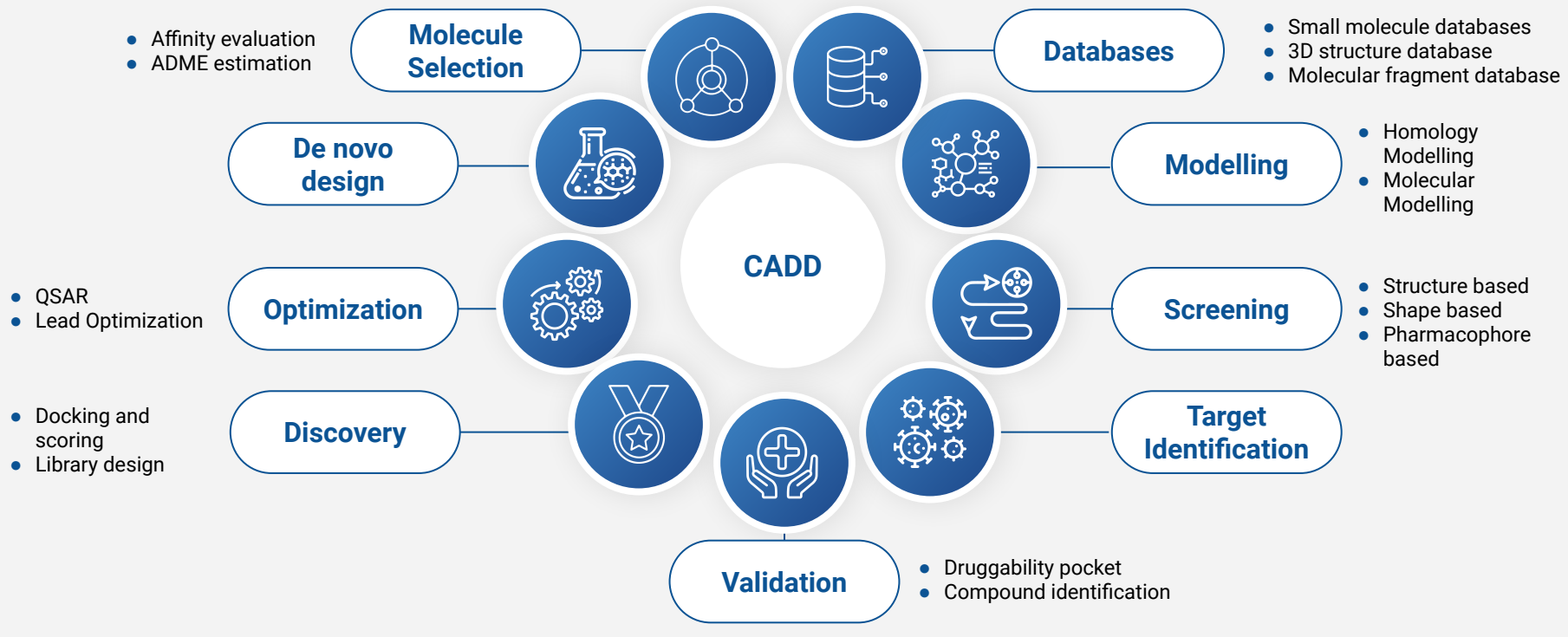
The solution to this problem comes from three key strategies:

- 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.)

Source: *Conflict of Interest in Medical Research, Education, and Practice*, *medinicenet.com*

Computer-aided Drug Design

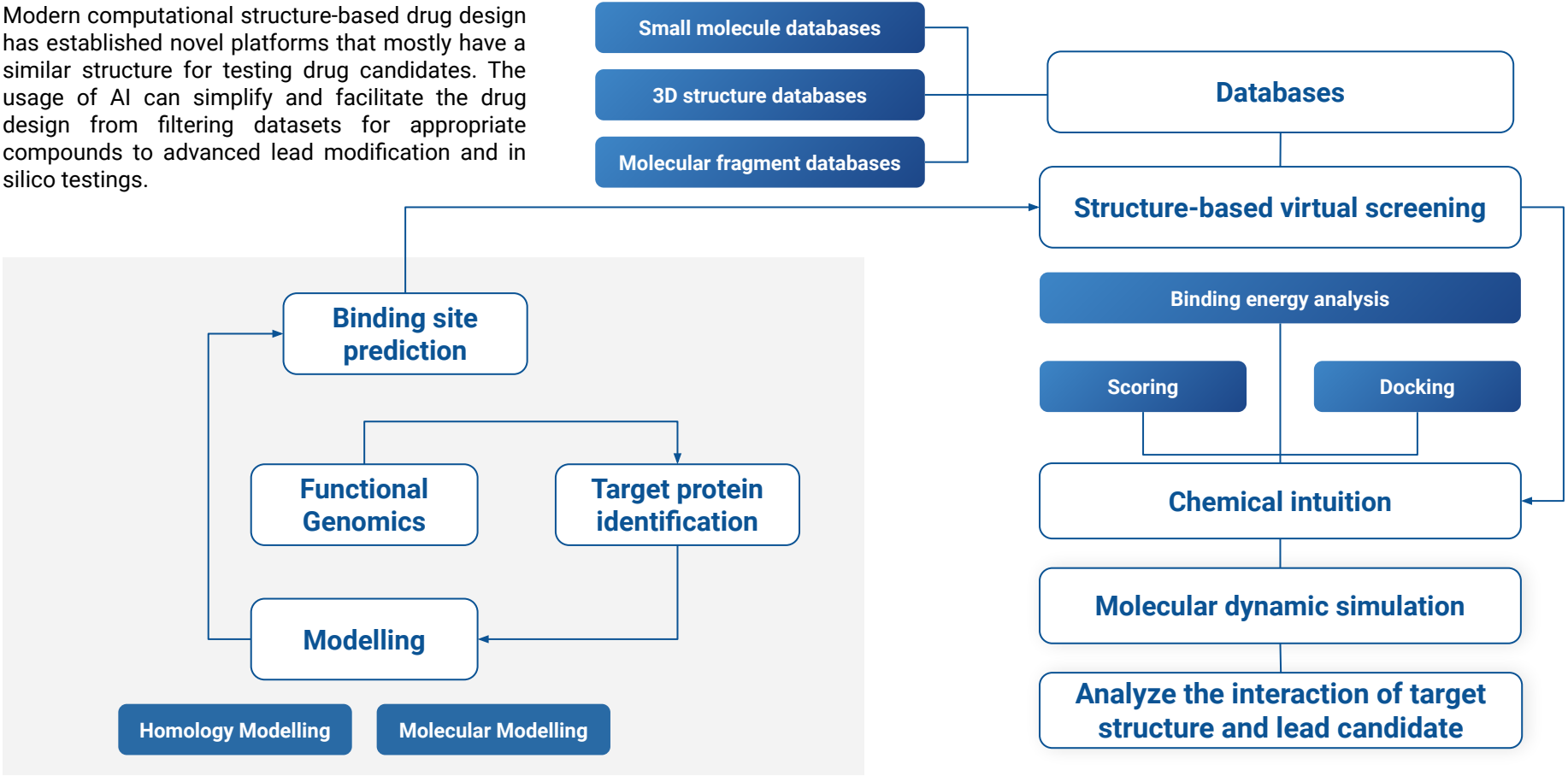
Today's task for the pharma industry is to create a cheap and effective solution for drug development, companies apply various computational methods to reach that goal. **Computer-aided drug design (CADD)** is a modern computational technique used in the drug discovery process to identify and develop a potential lead. CADD includes computational chemistry, molecular modeling, molecular design and rational drug design.



Sources: *Advantages of Structure-Based Drug Design Approaches in Neurological Disorders.*

Computer-aided Drug Design

Modern computational structure-based drug design has established novel platforms that mostly have a similar structure for testing drug candidates. The usage of AI can simplify and facilitate the drug design from filtering datasets for appropriate compounds to advanced lead modification and in silico testings.



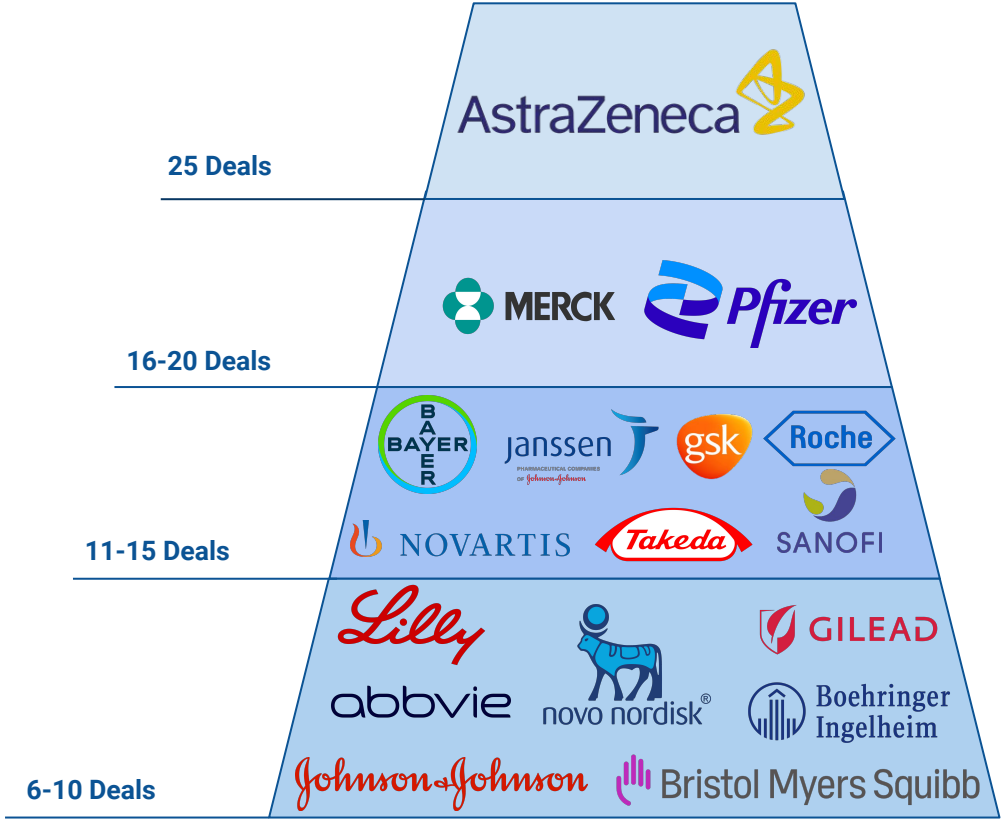
Sources: *Advantages of Structure-Based Drug Design Approaches in Neurological Disorders.*

Big Pharmas' AI-focused partnerships till Q4 2021

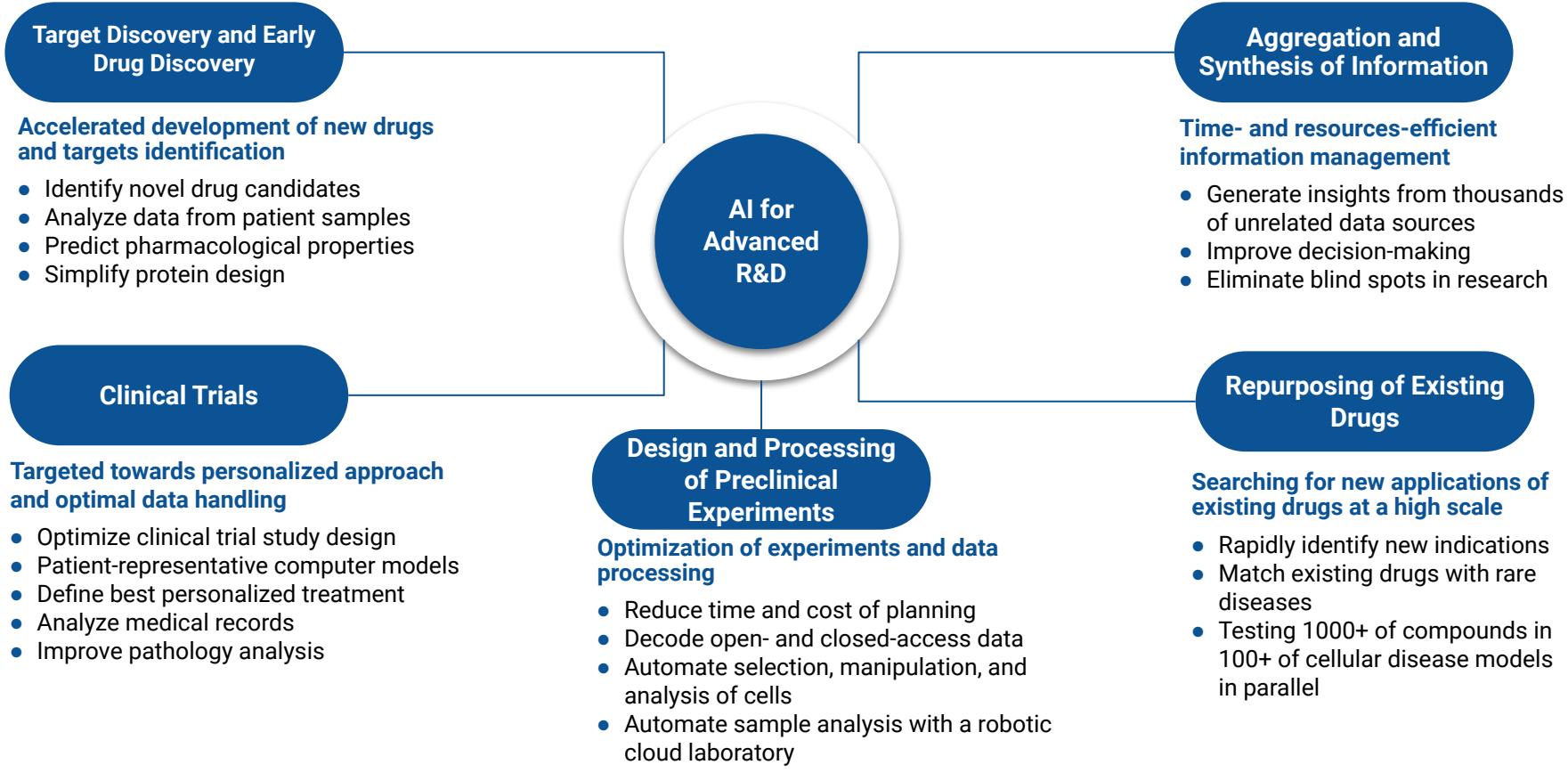
In this report we have profiled **470 actively developing AI-driven biotech companies**. A steady growth in the AI for Drug Discovery sector can be observed in terms of substantially increased amount of investment capital pouring into the AI-driven biotech companies (**$2.28B in HY 2020** against **$2.93B in HY 2021**), the increasing number of **research partnerships between leading pharma organizations and AI-biotechs, and AI-technology** vendors, a continuing pipeline of industry developments, research breakthroughs, and proof of concept studies, as well as exploding attention of leading media and consulting companies to the topic of AI in Pharma and healthcare.

Some of the leading pharma executives increasingly see AI as not only a tool for lead identification, but also a more general tool to boost biology research and identify new biological targets and develop novel disease models.

The main focus of AI research for today is still on small molecules as a therapeutic modality.



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



Business Activity

The business activity has been increasing in the pharmaceutical AI space over **Q1 2021 - Q1 2022**, judging by an increased number of transactions and partnership announcements in this period.

The most significant deals and collaborations in include:

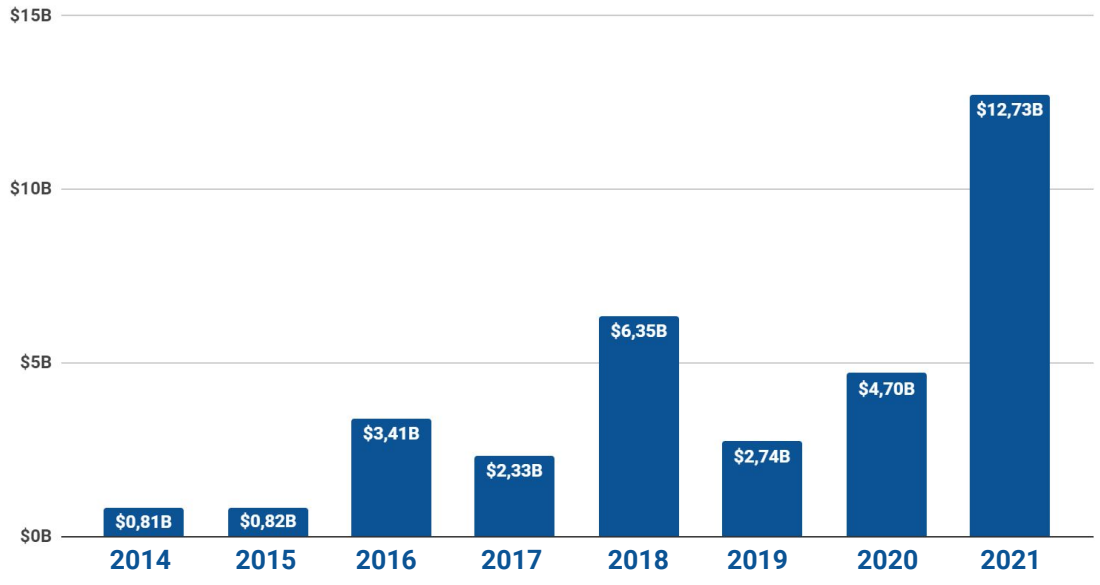
insitro, CASDIN CAPITAL, CPP INVESTMENT BOARD	**Insitro** has raised $400M for machine learning-powered drug discovery efforts. The financing was led by the **Canada Pension Plan Investment Board** with additional backing from **Andreessen Horowitz**, **Casdin Capital**
Valo, KDT KOCH DISRUPTIVE TECHNOLOGIES	**Valo Health** announced the final closing of its Series B at $300M, including a $110 million investment from Koch Disruptive Technologies (KDT). This brings the overall funding of Valo to over $450M to accelerate the creation of life-changing drugs
AMGEN, Mila	**Amgen** — **Mila** partnership that permits Amgen to expand its knowledge of AI and deep learning by interacting and engaging with experts in Mila's unique ecosystem
Pfizer, IKTOS	**Iktos** announced the application of its AI technology for *de novo* design for selected **Pfizer** small-molecule discovery programs
zebiAI, RELAY THERAPEUTICS	**ZebiAI Therapeutics** — **Relay Therapeutics**: Relay bought ZebiAI for $85M upfront and a further $185M in potential milestone payments
SILICON Therapeutics, ROIVANT SCIENCES	**Roivant** — **Silicon Therapeutics**: Roivant bought Silicon for $450M along with its physics-based platform for in silico small-molecule drug design. This platform will be integrated with Roivant's machine learning developments

Business Activity

SCHRÖDINGER. NVIDIA.	**Nvidia** and **Schrödinger** have partnered to increase the speed and accuracy of Schrödinger's molecule prediction software
BenevolentAI AstraZeneca	**BenevolentAI** and **AstraZeneca** have extended their partnership to achieve collaboration milestone with novel AI-generated chronic kidney disease target
Lantern Pharma. ACTUATE THERAPEUTICS	**Lantern Pharma** and **Actuate Therapeutics** have entered into collaboration to generate novel intellectual property that will be jointly owned by the companies
AION LABS	**AstraZeneca, Merck, Pfizer** and **Teva** formed **AION Labs**, the innovative lab that will create and adopt **AI technology** to **transform the process of drug discovery**
Exscientia SANOFI	**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
Valo charles river	**Valo Health** started partnership with **Charles River Laboratories** to accelerate preclinical drug discovery using Valo's small molecule DD platform
Generate:Biomedicines AMGEN	**Generate Biomedicines,** an AI driven drug development company specializing on protein and peptides therapeutics raised $370M on series B funding round, after which entered the collaboration with **Amgen**

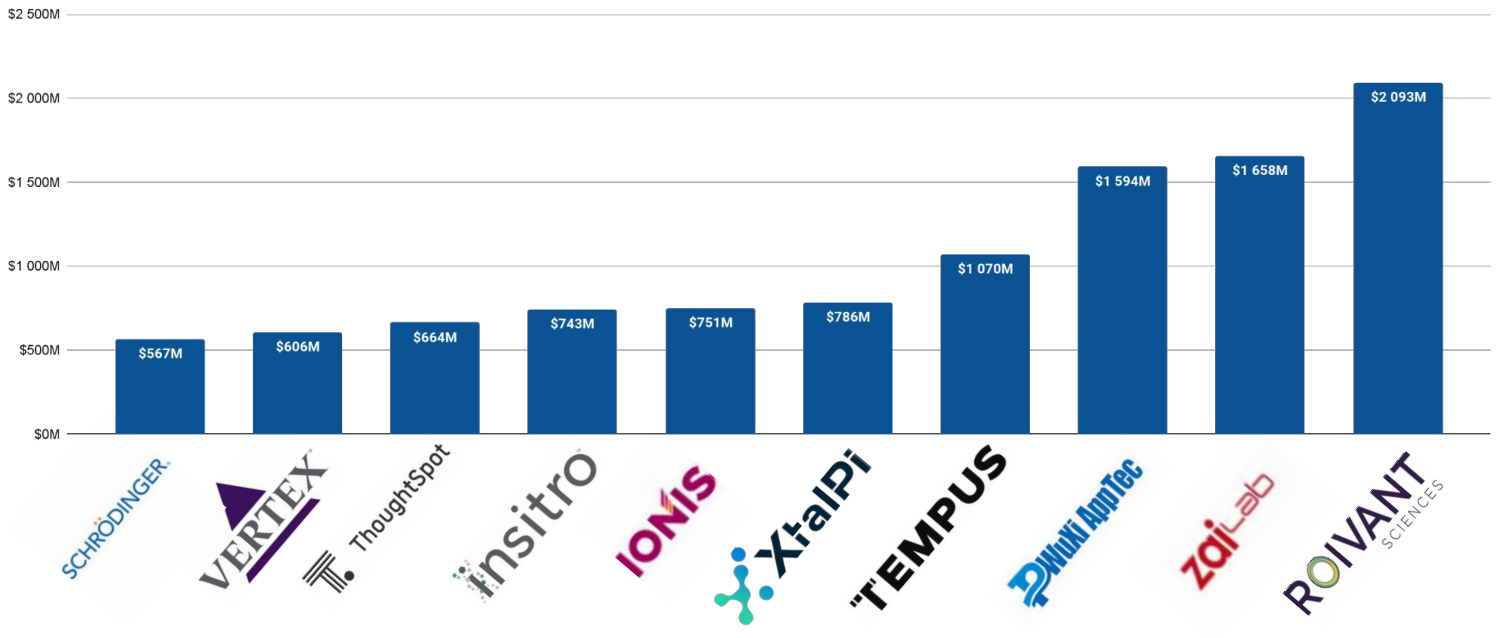
Partnerships like these provide a huge effect on Pharma industry and are needed in case if a company intends to become a leader in the ongoing competition.

Dynamics of Investments in AI in Pharma



There has been a substantial increase in the amount of capital invested in AI-driven pharma companies **since 2014.** During the last seven years, the annual amount of investments in **452** companies has increased by almost **16 times** (to **$12.73B** in total as of December 2021). In 2020, the flow of investments increased by **40%** compared to the previous year. The estimated amount of investments in the AI in Pharma sub-sector of the Longevity industry is about to triple this year compared to 2020 which identifies strong investors' (foremost VCs) interest in this field regardless of risks.

Top 10 AI in Pharma Companies by Total Investments in 2021



The chart shows the top 10 AI-driven drug discovery companies sorted by the **total funding** raised by the end of 2021. **Roivant Sciences**, a leader in artificial intelligence and precision medicine, is now at the top of the list. Having completed the business combination with **Montes Archimedes Acquisition Corp, Roivant Sciences** has the total funding raised to **$2.09B**. Zai lab , chinese provider of transformative medicines could finance **$0.8B** in capital market.Tempus, Insitro and ThoughtSpot are new companies due to late-stage mega-rounds during the 2021.

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.

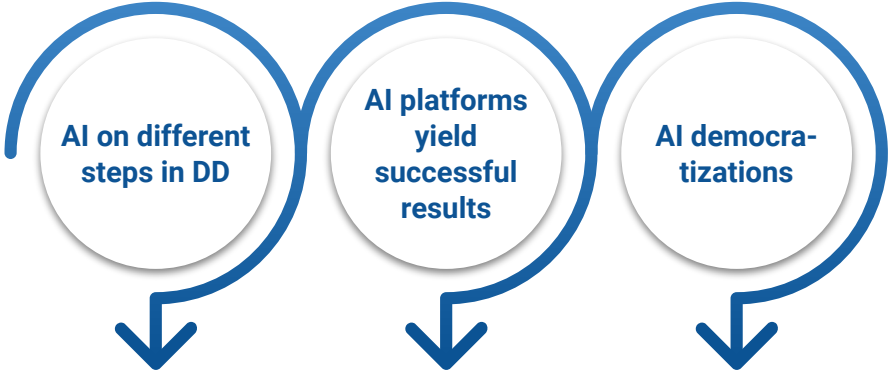
In 2021, **10 companies that use AI for DD reached IPO status**. New York-based Roivant Science closed its IPO in October and raised $611M. Exscientia, a pharmatech company that uses an end-to-end AI platform to design and discover new drugs launched IPO the same day as Roivant Science and raised $350M. 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**.

Key Technology Takeaways

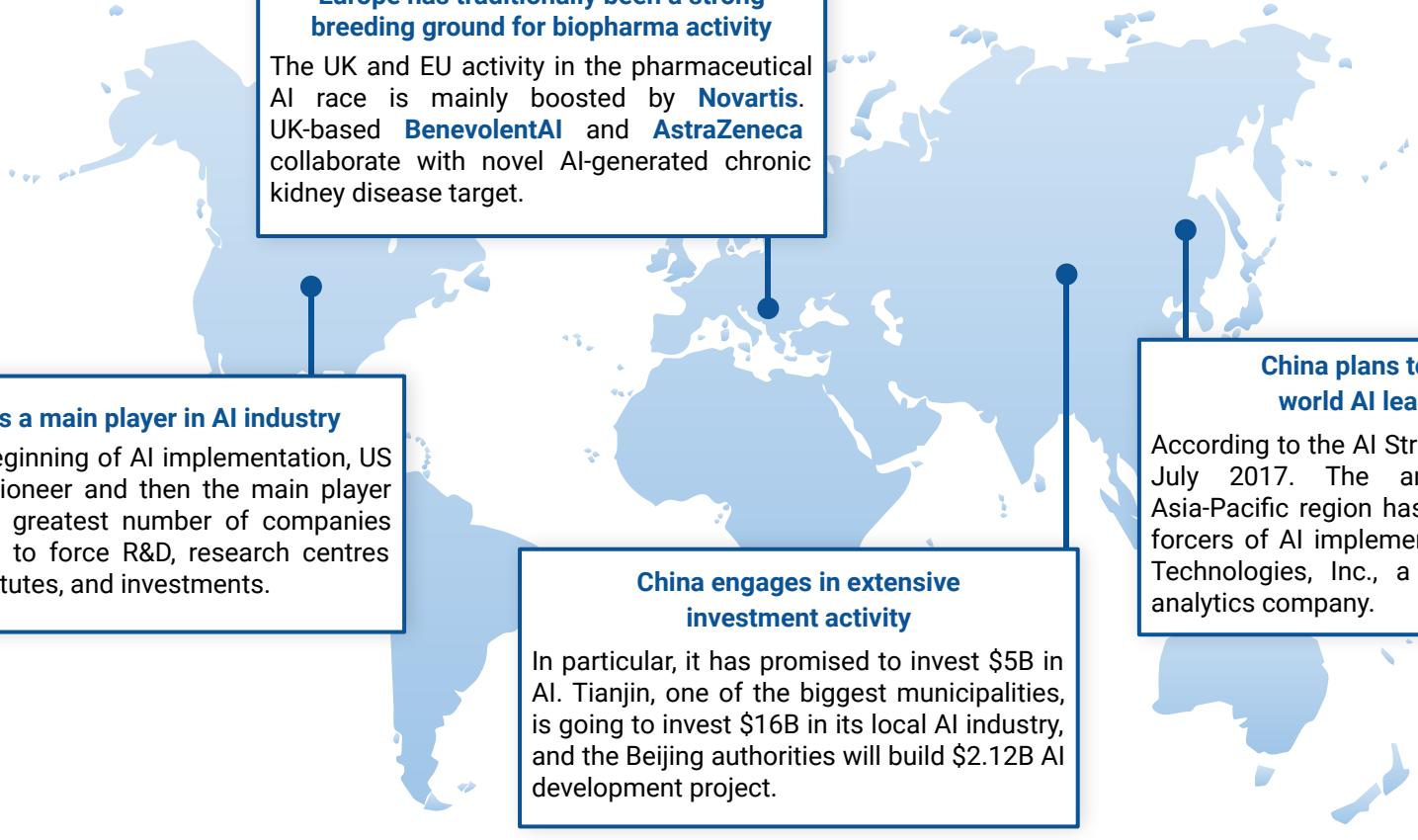
1. AI is regarded by some top executives at big pharma (**GSK and others**) as **a tool to uncover not only new molecules, but also new targets**. Ability of deep neural networks to build ontologies from multimodal data (e.g. "omics" data) is believed to be among the most disruptive areas for AI in drug 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 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.

Business Activity: Overview

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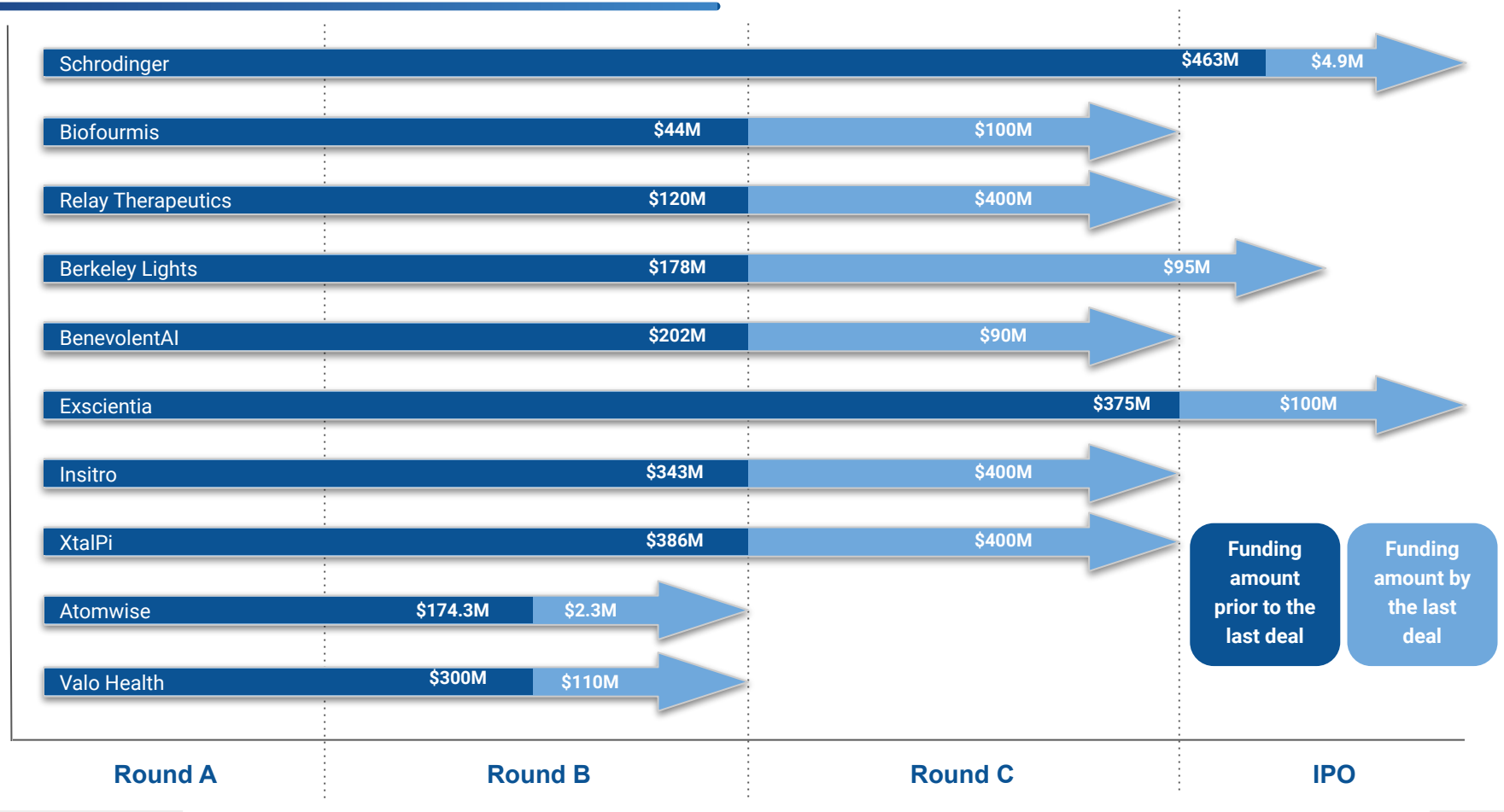
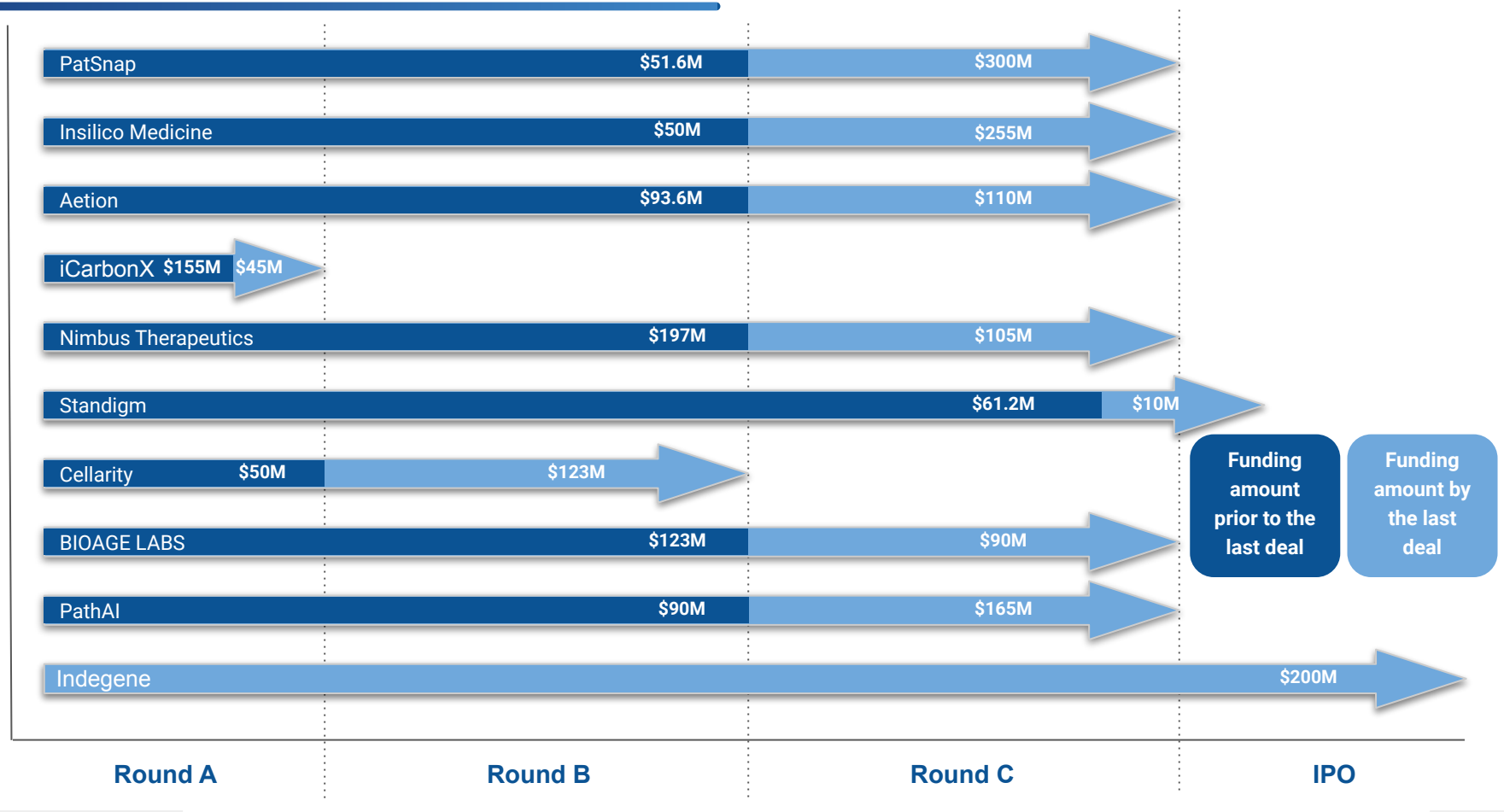
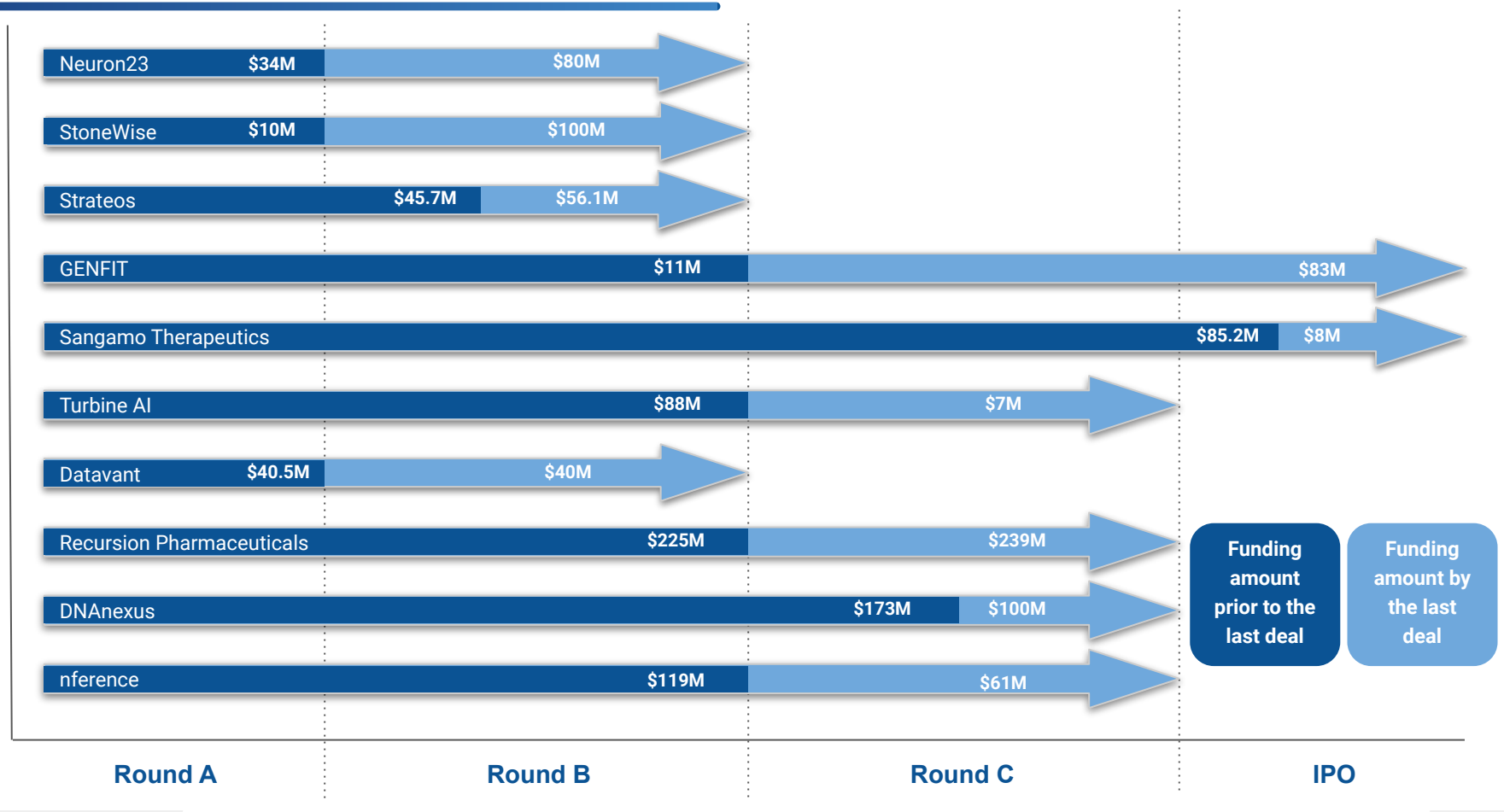
Leading Companies by Amount and Stage of Funding



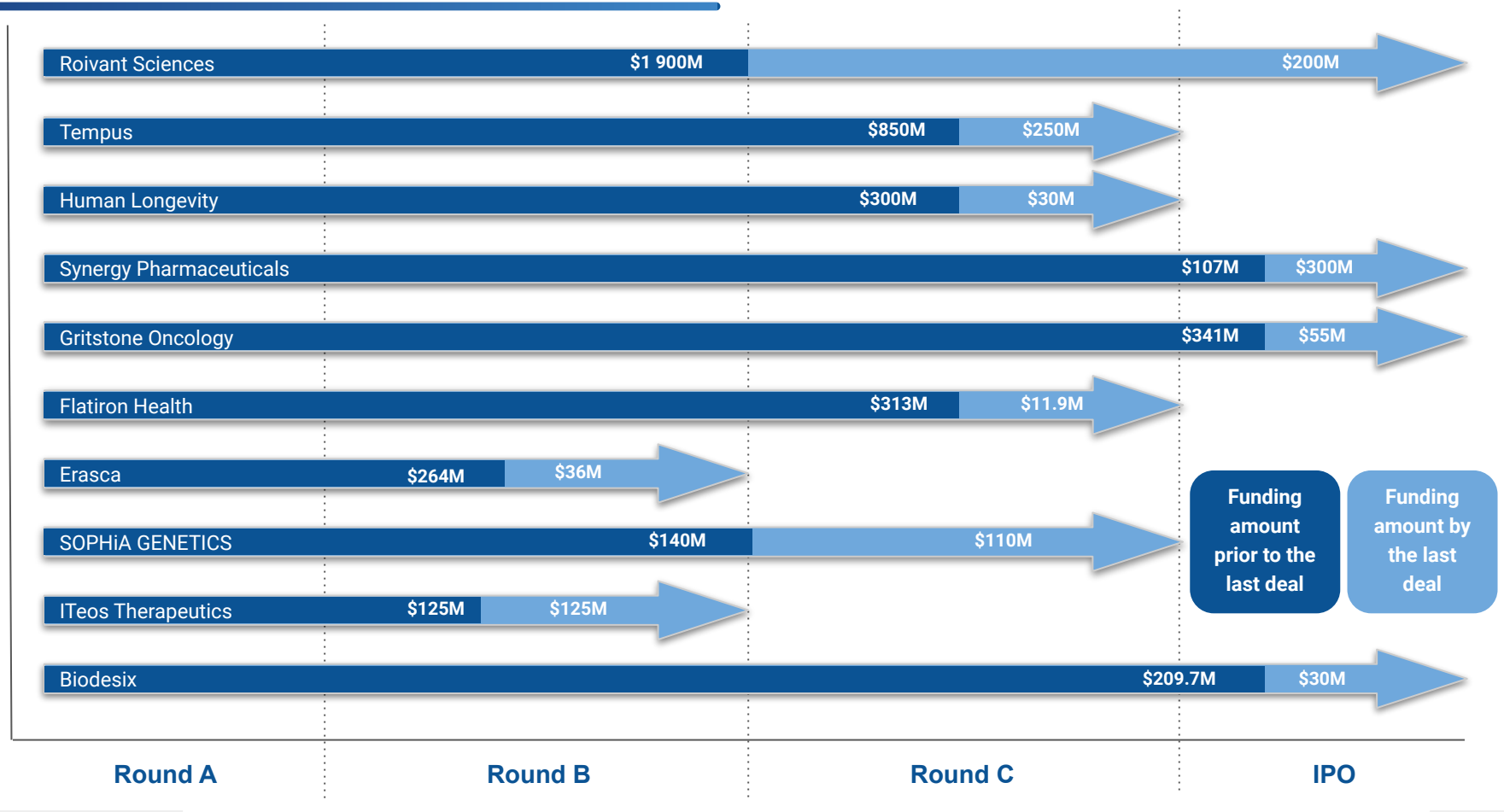
Leading Companies by Amount and Stage of Funding



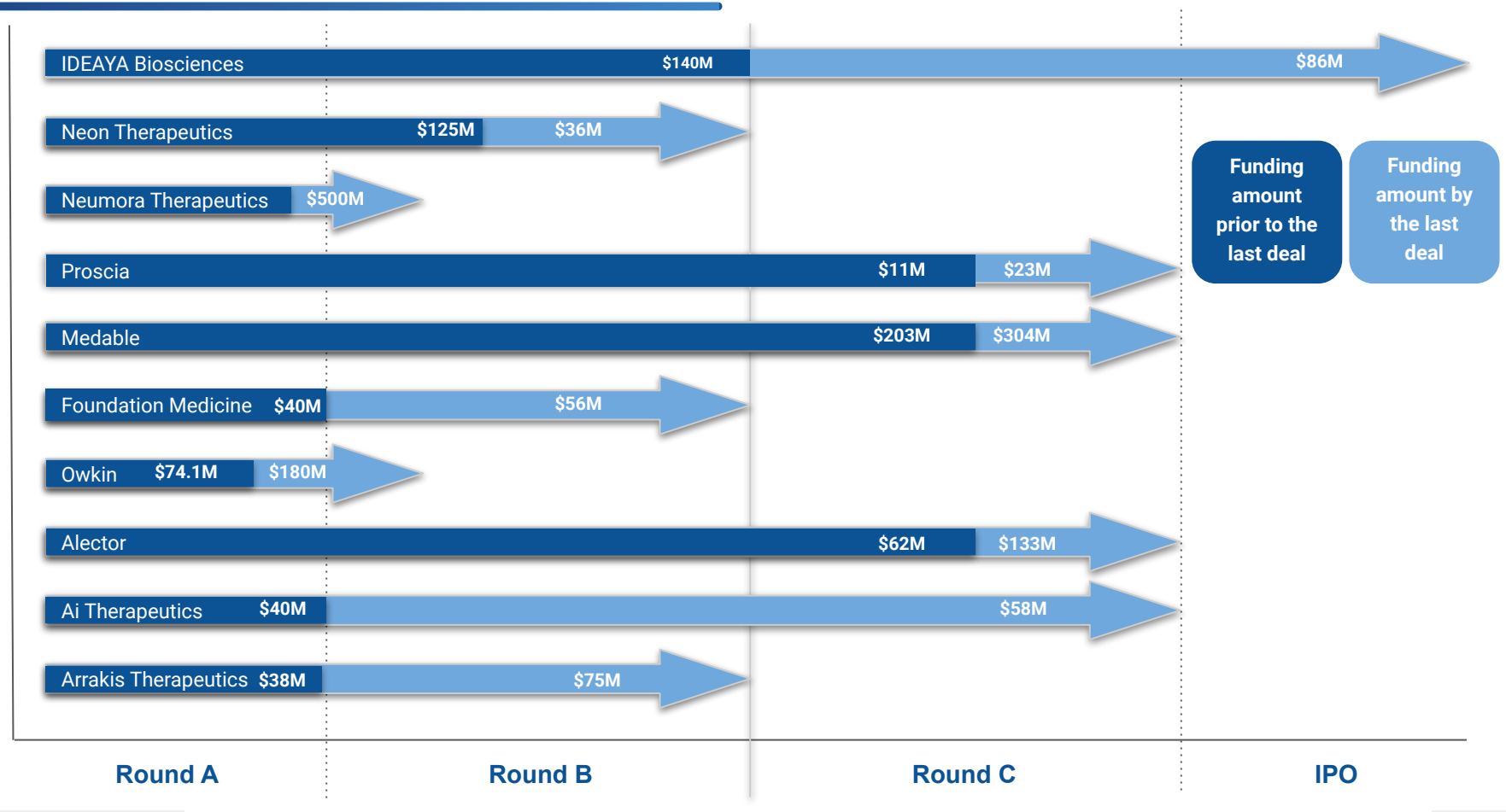
Leading Companies by Amount and Stage of Funding



Leading Companies by Amount and Stage of Funding



Leading Companies by Amount and Stage of Funding



AI for Drug Discovery Market Timeline

2013-2015	The First AI Approaches	• The first scalable AI approaches for Drug Discovery developed and several industry players with forward-thinking executives started launching pilot collaborations and making small investments. • However, only few market players believed in the technology.
2016-2017	Criticism	• Because AI is still a young approach within the life sciences, many pilot projects failed, creating a lot of criticism towards using deep learning for Drug Discovery and Advanced R&D. • Since then, the race to acquire the best AI startups began. • Testing of the technology began.
2018	Market Cap Growth	• The capitalization of the industry was continuously growing. • Many bets of early investors appeared to be justified. • Over the next several years, we expect to see VC firms and subsidiary funds focused solely on the AI for Drug Discovery subsector and invest in a maximally-diverse number of AI for Drug Discovery companies.
2019	Transition from Quantity to Quality	• Transitioning from the quantity of AI-related collaborations, investments, and M&As to qualitative gains — the first practical validations of previously conducted research might be appearing during this year. • Competition for the most successful pharma AI companies will increase drastically.
2020-2021	Intensive Competition	• Pretty much all big players in the pharma industry are concerned with AI adoption, and tech has become a strategic priority, among other things. • Cutting- edge advancements in AI technology with human-like environment simulations in drug discovery.
2022-2023	Platform-based Drug Design	• Leading pharmaceutical industry players will be moving towards "platform-based drug design". • The emergence of comprehensive R&D and business infrastructure enables end-to-end AI-driven drug development.

50 Leading Investors in Pharmaceutical AI

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50 Leading Investors in AI for Drug Discovery Sector

1	Casdin Capital
2	GV
3	Y Combinator
4	Perceptive Advisors
5	Alexandria Venture Investments
6	DCVC
7	SoftBank Vision Fund
8	Khosla Ventures
9	Andreessen Horowitz
10	EU EASME
11	8VC
12	ARCH Venture Partners
13	Bill & Melinda Gates Foundation
14	Foresite Capital
15	SOSV
16	T. Rowe Price
17	ZhenFund
18	AME Cloud Ventures
19	F-Prime Capital
20	Felicis Ventures
21	Founders Fund
22	General Catalyst
23	Obvious Ventures
24	OrbiMed
25	B Capital Group
26	DCVC Bio
27	Lifeforce Capital
28	Lilly Asia Ventures
29	Lux Capital
30	New Enterprise Associates
31	Tencent
32	Wuxi App Tech
33	Baidu Ventures
34	EDBI
35	Novo Holdings
36	Tried Rock Ventures
37	Amadeus Capital Partners
38	Amgen Ventures
39	6 Dimensions Capital
40	Baillie Gifford
41	GT Healthcare Capital
42	Inovia Capital
43	OS Fund
44	Revolution
45	Two Sigma Ventures
46	Sequoia Capital Channel
47	Bristol-Myers Squibb
48	EPIC Ventures
49	Celgene
50	Octopus Ventures

Sources: *Investment Digest AI in Pharma*

Top-50 AI in Pharma Investors

San Francisco

- **8VC** — 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
- **Lifeforce Capital** — 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

Illinois

- **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

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

- **SoftBank Vision Fund** — London, England, The UK
- **Amadeus Capital Partners** — London, England, The UK
- **Baillie Gifford** — Edinburgh, Edinburgh, The UK
- **Octopus Ventures** — London, England, The UK

Sources: *Investment Digest AI in Pharma*

Top-50 Investors in AI Companies

INVESTORS	INVESTMENTS OVERALL	AI FOR DRUG DISCOVERY COMPANIES	INVESTED IN
Casdin Capital	20	20	Absci, Alector, Arzeda, Beacon Biosignals, Celsius Therapeutics, Clover Therapeutics, Exscientia, Gritstone Oncology, Fabric Genomics, Flatiron Health, Foundation Medicine, Lunit, Insitro, Paige, Recursion Pharmaceuticals, Relay Therapeutics, Sema4, ShouTi, SomaLogic, Treeline Biosciences
GV	30	16	Alector, Arrakis Therapeutics, Celsius Therapeutics, DNAnexus, Gritstone Oncology, IDEAYA Biosciences, Insitro, Flatiron Health, Foundation Medicine, Owkin, Relay Therapeutics, Schrödinger, Strateos, Treeline Biosciences, Ultromics, ZappRx
Y Combinator	24	15	Arpeggio Bio, Athelas, Atomwise, CloudMedx, Coral Genomics, HistoWiz, iLabService, Menten AI, Notable Labs, Ochre Bio, PostEra, Reverie Labs, Segmed, Stratos, Verge Genomics
Perceptive Advisors	13	13	Absci, Alector, Black Diamond Therapeutics, Champions Oncology, DNAnexus, Icosavax, IDEAYA Biosciences, Neuron23, Saama, Sema4, Soma Logic, Relay Therapeutics
Alexandria Venture Investments	12	12	Arrakis Therapeutics, Celsius Therapeutics, Deep Genomics, GNS Healthcare, Gritstone Oncology, IDEAYA Biosciences, Immunai, Insitro, Fountain Therapeutics, LEXEO Therapeutics, Neuromora Therapeutics, Veralox Therapeutics
DCVC	17	10	AbCellera Biologics, Asimov, Atomwise, Auransa, Empirico, Frontier Medicines, Strateos, Unlearn.AI, Frontier Medicines, X-37
SoftBank Vision Fund	11	10	Biofourmis, Datavant, Deep Genomics, Exscientia, Insitro, PatSnap, Relay Therapeutics, Roivant Sciences, XtalPi
Khosla Ventures	13	9	Arpeggio Bio, Atomwise, BIOAGE LABS, Fountain Therapeutics, Deep Genomics, Menten AI, Ochre Bio, Scipher Medicine, ThoughtSpot
Andreessen Horowitz	13	8	Aria Pharmaceuticals, Asimow, BigHat Biosciences, BIOAGE LABS, Erasca, Flatiron HealthGenesis Therapeutics, Insitro
EU Executive Agency for SMEs	10	8	Acellera, CellPly, Cytox, Genialis, Genome Biologics, Iris.ai, Optellum, Quibim

Top-50 Investors in AI Companies

INVESTORS	INVESTMENTS OVERALL	AI FOR DRUG DISCOVERY COMPANIES	INVESTED IN
8VC	10	7	BigHat Biosciences, Coral Genomics, Immunai, Model Medicine, Notable, ProteinQure, Unlearn.AI
ARCH Venture Partners	15	7	Arbor Biotechnologies, Generate Biomedicines, Glympse Bio, Erasca, Hangzhou Just Biotherapeutics (Just China), Insitro, Treeline Biosciences
Bill & Melinda Gates Foundation	13	7	Atomwise, Evotec, Exscientia, Foundation Medicine, Novartis, Schrödinger, Takeda
Foresite Capital	7	7	Aetion, Alector, DNAnexus, Generate Biomedicines, Insitro, Relay Therapeutics, Wave Life Sciences
SOSV	24	7	A2A Pharmaceuticals, Gatehouse Bio, Guided Clarity, Mendel.ai, Stelvio Therapeutics, Strados, Synthace
T. Rowe Price	8	7	Arbor Biotechnologies, Generate Biomedicines, Genesis Therapeutics, Insitro, Sema4, SomaLogic, Tempus
ZhenFund	9	7	AccutarBio, Deep Intelligent Pharma, HistoWiz, Spring Discovery, uBiome, Xbiome, XtalPi
AME Cloud Ventures	15	6	Asimov, Atomwise, Auransa, BigHat Biosciences, BIOAGE LABS, Molecule.one
F-Prime Capital	6	6	Adagene, BenchSci, Insilico Medicine, Notable, Neuromora Therapeutics, Owkin
Felicis Ventures	15	6	BIOAGE LABS, Genesis Therapeutics, Juvena Therapeutics, LabGenius, ProteinQure, Spring Discovery

Top-50 Investors in AI Companies

INVESTORS]	INVESTMENTS OVERALL	AI FOR DRUG DISCOVERY COMPANIES	INVESTED IN
Founders Fund	10	6	AbCellera Biologics, Datavant, Emerald Cloud Lab, Notable Labs, Roivant Sciences, DeepMind
General Catalyst	11	6	Athelas, Beacon Biosignals, PathAI, Spring Discovery, Swoop, ThoughtSpot
Obvious Ventures	9	6	ConcertoCare, Inato, LabGenius, Medable, Recursion Pharmaceuticals
OrbiMed	10	6	AbCellera, Alector, Erasca, Insilico Medicine,Treeline Biosciences, XtalPi
B Capital Group	5	5	Aetion, Atomwise, Insilico Medicine, Notable Labs, HiFiBiO
DCVC Bio	6	5	Empirico, Frontier Medicines, Totus Medicines, Unlearn.AI, X-37
Lifeforce Capital	7	5	Clover Therapeutics, Notable Labs, PostEra, TARA Biosystems, Verge Genomics
Lilly Asia Ventures	8	5	Gritstone Oncology, Hangzhou Just Biotherapeutics (Just China), Insilico Medicine, ShouTi, Transcenta
Lux Capital	11	5	Alife, Auransa, LabGenius, Recursion Pharmaceuticals, Strateos
New Enterprise Associates	9	5	Aetion, Black Diamond Therapeutics, Champions Oncology, Tempus, Vertex Pharmaceuticals

Top-50 Investors in AI Companies

INVESTORS	INVESTMENTS OVERALL	AI FOR DRUG DISCOVERY COMPANIES	INVESTED IN
Tencent	7	5	Atomwise, Brainomix, iCarbonX, PatSnap, XtalPi
WuXi AppTec	9	5	Arrakis Therapeutics, Verge Genomics, Schrödinger, Engine Biosciences, WuXi AppTec
Baidu Ventures	6	4	Atomwise, Engine Biosciences, Kebotix, Insilico Medicine
EDBI	6	4	Aetion, Biofourmis, Engine Biosciences, Erasca
Novo Holdings	8	4	Evotec, Exscientia, Kebotix, Tempus
Third Rock Ventures	7	4	Celsius Therapeutics, Foundation Medicines, Insitro, TARA Biosystems
Amadeus Capital Partners	8	3	Antidote.me, Healx, Quibim
Amgen Ventures	6	3	Aetion, Alector, GNS Healthcare
6 Dimensions Capital	5	3	Engine Biosciences, IDEAYA Biosciences, iTeos Therapeutics
Baillie Gifford	6	3	Flatiron Health, Recursion Pharmaceuticals, Tempus

Top-50 Investors in AI Companies

INVESTORS	INVESTMENTS OVERALL	AI FOR DRUG DISCOVERY COMPANIES	INVESTED IN
GT Healthcare Capital Partners	6	3	Exscientia, GT Apeiron Therapeutics, Ultromics
Inovia Capital	6	3	BenchSci, LabGenius, ProteinQure
OS Fund	8	3	Aria Pharmaceuticals, Arzeda, Emerald Cloud Lab
Revolution	6	3	Amplion, NeuScience, Tempus
Two Sigma Ventures	8	3	Exscientia, PathAI, Recursion Pharmaceuticals
Sequoia Capital Channel	13	3	Deep Intelligence Pharma, PathAI, XtalPi
Bristol-Myers Squibb	5	2	Exscientia, PathAI
EPIC Ventures	6	2	Recursion Pharmaceuticals, Unlearn.AI
Celgene (BMS' subsidiary)	8	2	Arrakis Therapeutics, GNS Healthcare
Octopus Ventures	6	2	Antidote.me, eTherapeutics

Big Pharma’s Focus on AI

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AI and Pharma Collaborations in 2021-2022

Jan

Merck and **Philips** partner to advance **AI-based personalized fertility treatment**

Feb

Roche Italia has joined forces with **PatchAi** to launch a **virtual platform for cancer** patients.

Mar

Pfizer's small-molecule programs will apply **Iktos'** AI-driven de novo design software.

Apr

AstraZeneca is teamed up with **NVIDIA** and the **University of Florida** on new **AI research projects** aimed at boosting drug discovery and patient care.

May

Exscientia has signed up **BMS** for its **AI-based drug discovery platform**. The value of a deal could be as much as $1.2 billion.

Jun

GSK announced an 18-month collaborative research agreement with AI company **Progentec**.

Jun

Insilico Medicine entered into a collaboration with **Teva** to utilize Insilico's machine learning technology.

Jul

Eli Lilly and **Verge Genomics** partnered to create new drugs for the treatment of amyotrophic lateral sclerosis using AI for drug development

AI and Pharma Collaborations in 2021-2022

Aug

Insilico Medicine and **Westlake Pharma** announce cooperation relationship on accelerating the innovative drugs R&D for novel coronavirus.

Sep

Japan's **Summit Pharmaceuticals International** (**SPI**) partners with **CytoReason** to integrate its **machine learning platform** into the Japanese **clinical drug discovery sector**.

Oct

Poolbeg Pharma launches AI programme with **Eurofins Genomics**.

Dec

Roche and **Genentech** will use **Recursion's** platform for drug discovery in neurobiology and oncology fields

Jan

Merck and **AbSci** partnered to produce enzymes using AbSci's AI platform in a deal worth up to **$610 million**

Jan

Exscientia collaborated with **Sanofi** to develop potential drug candidates for cancer and immune-mediated diseases

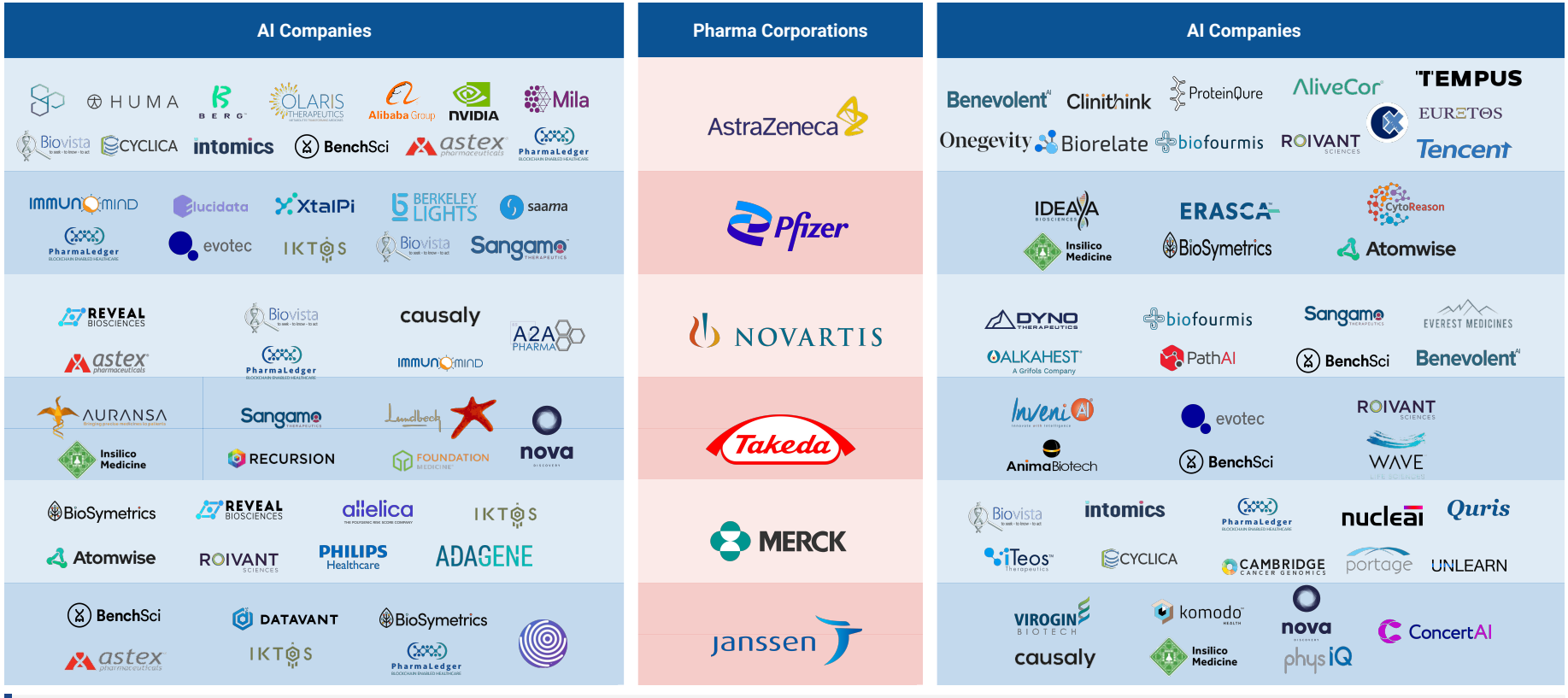
Jan

Amgen collaborated with **Generate Biomedicines** to create protein therapeutics for five clinical targets. **Amgen** will pay potentially up to **$1.9 billion** in this collaboration for a novel AI driven platform

Feb

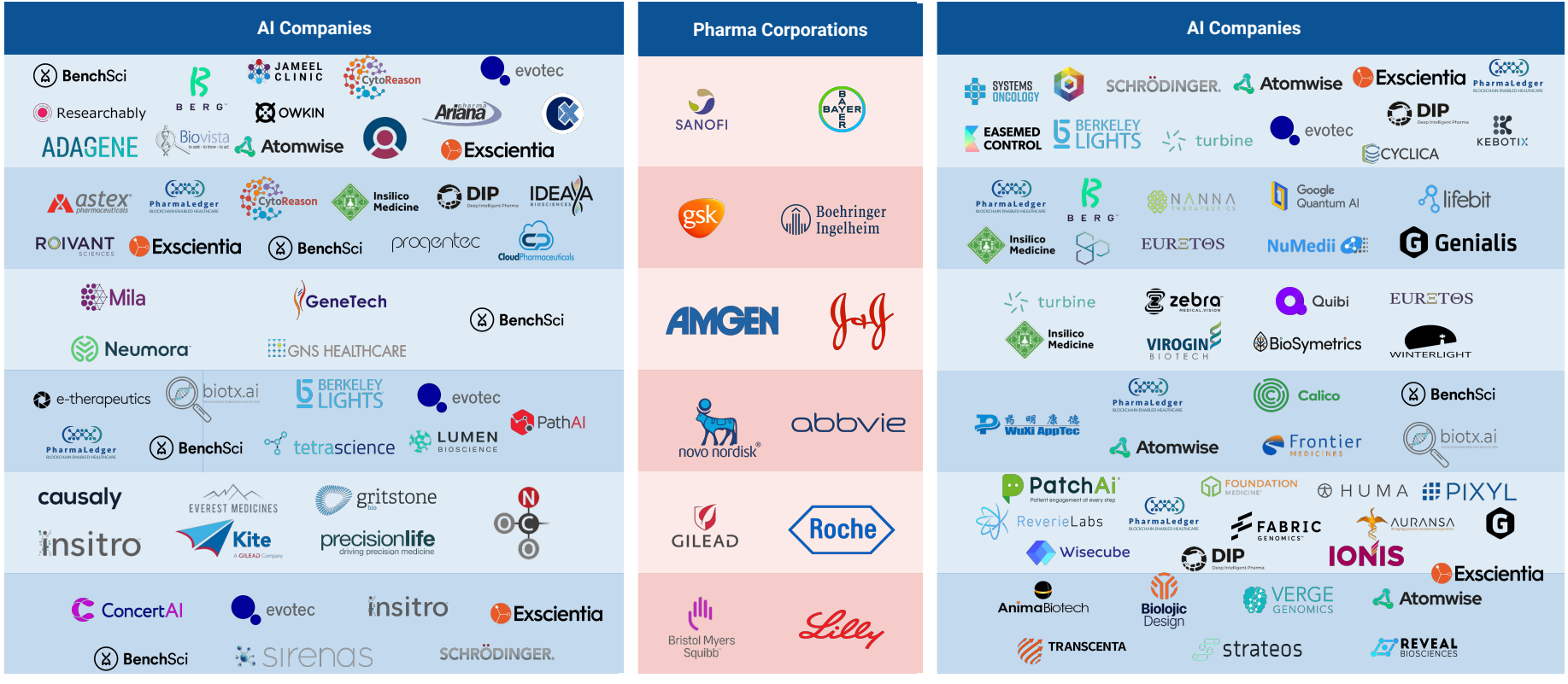
Bayer, Aalto and **HUS** expanded collaboration to apply artificial intelligence to support clinical drug trials

Selected Pharma AI Deals



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.

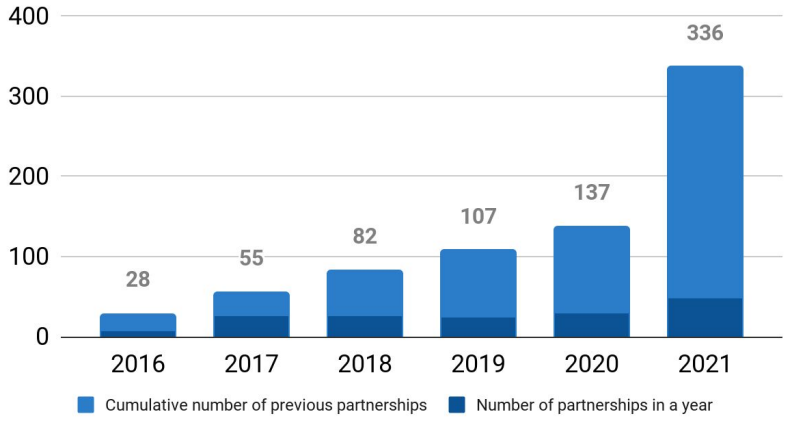
Selected Pharma AI Deals



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.

A Growing Number of Collaborations Involving AI for Drug Discovery

Increasing number of partnerships between Pharma and AI Companies over the last 6 years



The rising interest of leading pharma and contract research organizations towards AI-driven biotech startups is a major driver for the area to become more attractive for investors, since the industry is becoming well-suited for successful exit strategies in future.

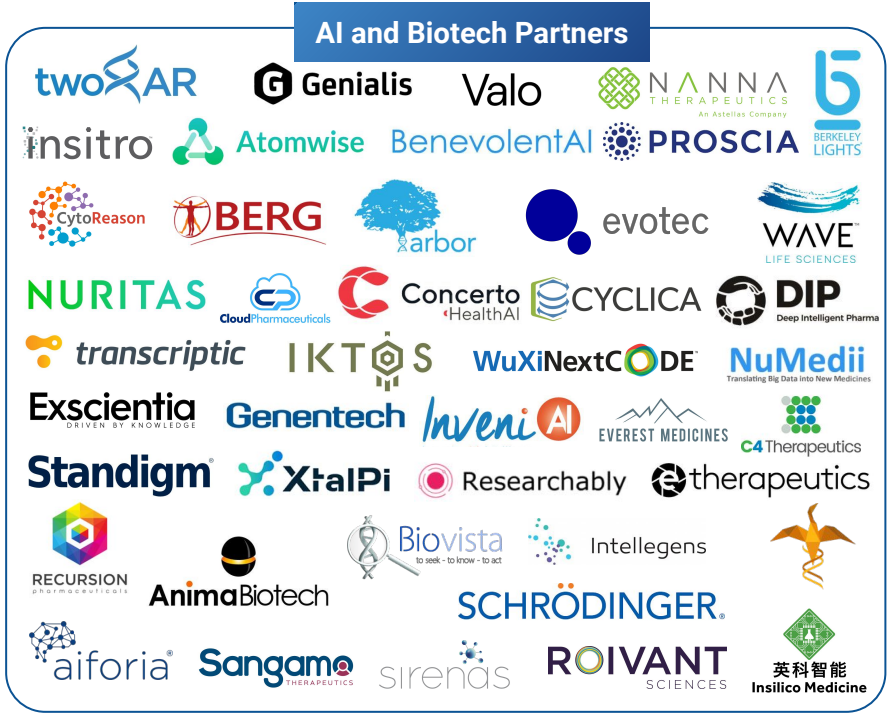
Summarizing industry observations over the last five years, we can observe a fundamental shift in perception of top executives at leading pharmaceutical organizations about the need of advanced AI technologies. Since 2015, there has been an obvious shift in the perception from skepticism and cuasious interest, all the way to a realization of a strategic role AI has to play in the emerging "data-centric" model of innovation. This change in perception was underpinned by a number of factors:

- a wave of proof-of-concept studies and research breakthroughs in a wide range of AI application use cases
- a number of commercial successes and successfully reached milestones, involving AI as a central element of research
- substantial advances in democratizing AI technology, where machine learning and deep learning algorithms become available at scale to non-AI experts
- decent increase in the overall understanding of AI "mechanics", due to increasing efforts in the education and professional development with a focus on AI-driven tools and approaches

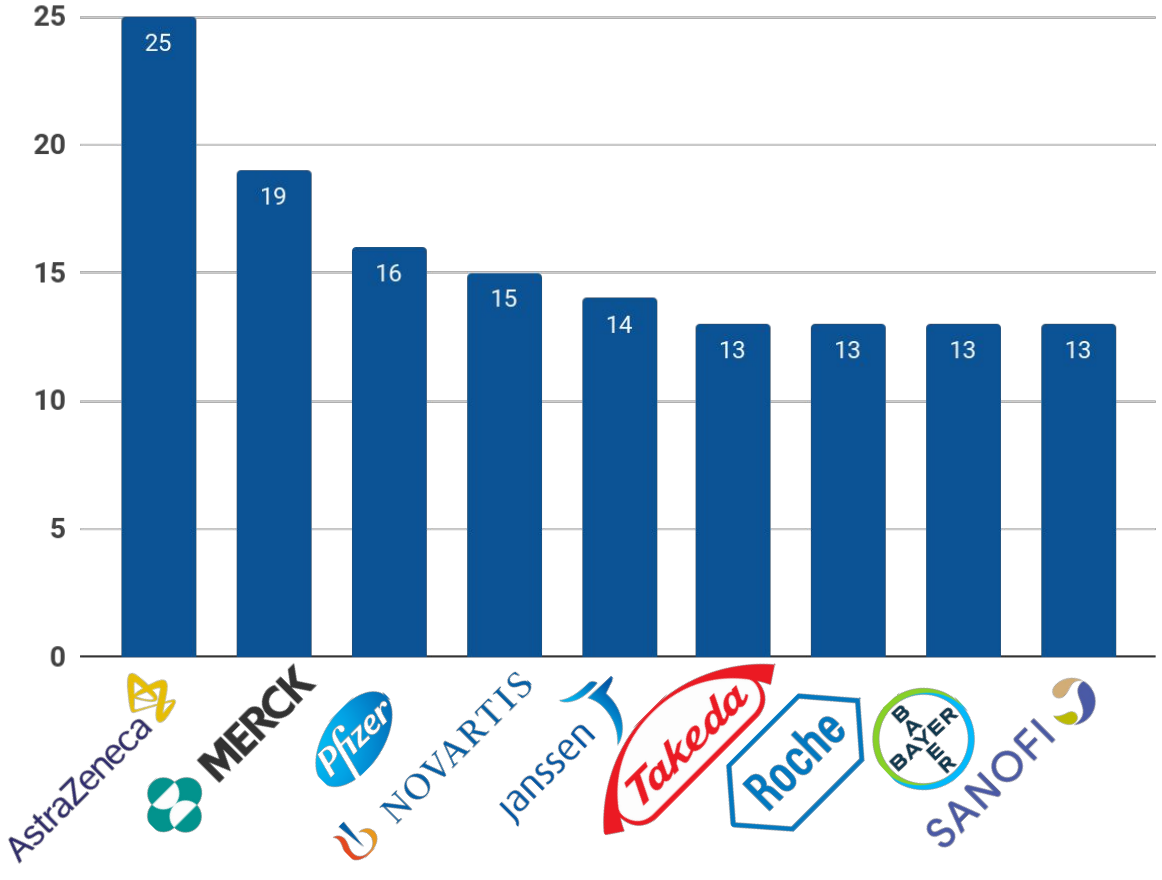
Pharmaceutical companies of all sizes start competing for AI-expertise, talent, and partnerships. In this report we summarize some of the most high-profile such collaborations, involving top-20 pharma giants. Even though, we can see a clear uprising trend in the number of collaborations, focused on AI-drug design, and other aspects of data mining and analytics.

Sources: *Investment Digest AI in Pharma*

Corporation and AI-companies Participating in the Pharma AI Deals

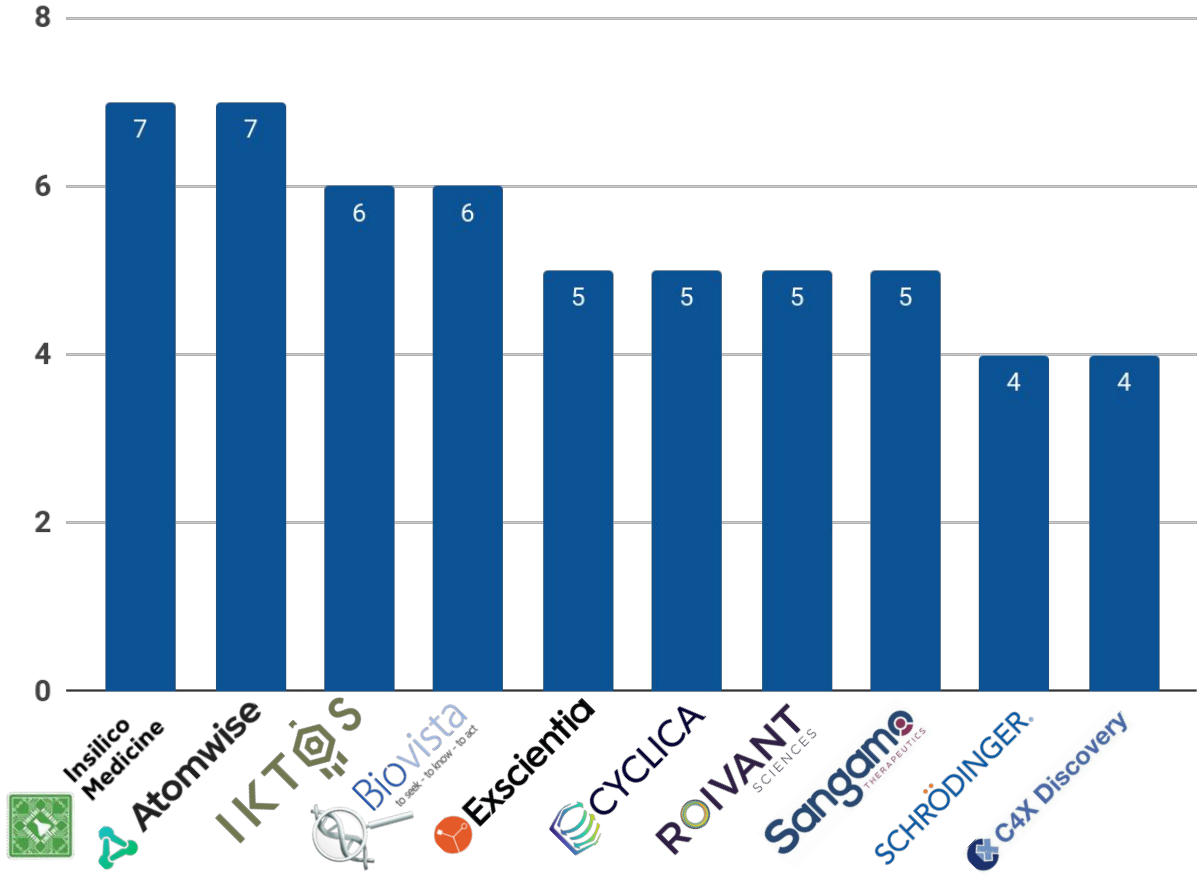


Leading Pharma Corporations by the Number of Pharma AI Deals in 2021 - Q1 2022



- 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.

AI in Pharma Publicly Traded Companies

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AI in Pharma Publicly Traded Companies

Connecticut

BioXcel Therapeutics (BX2)
Branford, Connecticut, US

Massachusetts

Relay Therapeutics (RLAY)
Cambridge, Massachusetts, US

ITeos Therapeutics (ITOS)
Cambridge, Massachusetts, US

Colorado

Biodesix (BDSX)
Broomfield, Colorado, US

Evolutionary Genomics (FNAM)
Lafayette, Colorado, US

Texas & Utah

Lantern Pharma (LTRN)
Dallas, Texas, US

Recursion Pharmaceuticals (RXRX)
Salt Lake City, Utah, US

New York

Schrödinger (SDGR)
New York, New York, US

California

Alector (ALEC)
San Francisco, California, US

Berkeley Lights (BLI)
Emeryville, California, US

Biomea Fusion (BMEA)
Redwood City, California, US

Gritstone Oncology (GRTS)
Emeryville, California, US

IDEAYA Biosciences (IDYA)
San Francisco, California, US

Sangamo Therapeutics (SGMO)
Richmond, California, US

Nord-Pas-de-Calais

GENFIT (GNFT)
Loos, Nord-Pas-de-Calais, France

Hong-Kong

Regent Pacific Group
Hong-Kong

Deep Longevity
Acquired for $4M by Regent Pacific Group

London

Cotinga Pharmaceuticals (COTQF)
London, England, UK

Manchester

C4X discovery (C4XD.L)
Manchester, Manchester, UK

Glasgow

DeepMatter Group (DMTR.L)
Glasgow, Glasgow City, UK

Oxfordshire

eTherapeutics (ETX.L)
Hanborough, Oxfordshire, UK

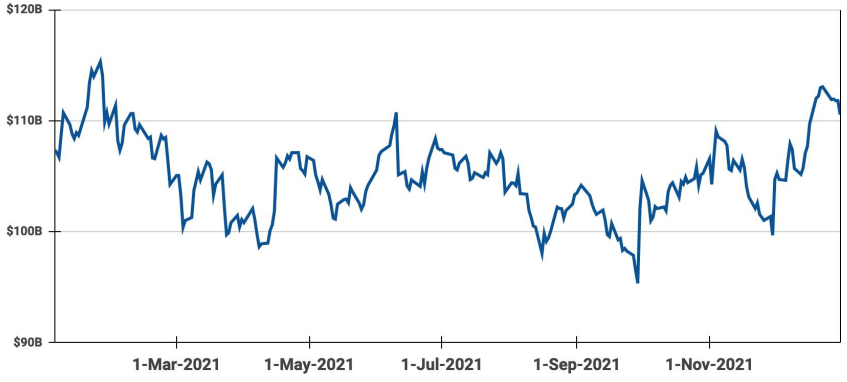
Sensyne Health (SENS.L)
Headington, Oxfordshire, UK

Renalytix AI (RENX)
Penarth, Oxfordshire, UK

Sources: *Investment Digest AI in Pharma*

AI in Pharma Publicly Traded Companies

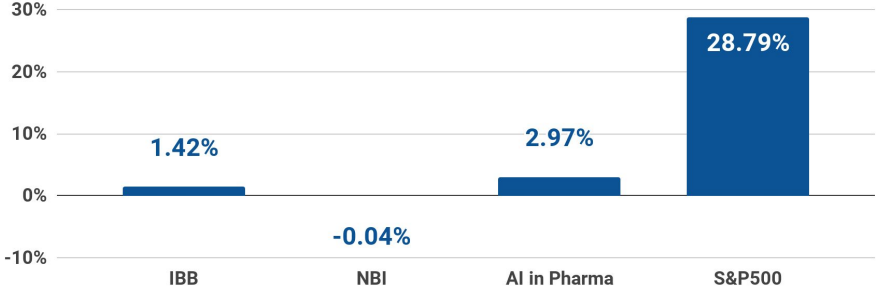
Cumulative Capitalization of Publicly Traded AI-in-Pharma Discovery Companies, 2020-2021, $ Billion



Despite the crisis and high volatility, AI-in-Pharma publicly traded companies present growth **reaching $110B of cumulative capitalization as of December 31, 2021**. A huge leap in comparison with the capitalization presented in AI-in-Pharma Investment Digest Q3 2021 occurred after adding Vertex Pharmaceuticals and Astellas Pharma companies to the list. Two companies from our list have announced closing of IPO in Q4 2021: **Exscientia** and **Roivant Sciences**.

The largest companies by market capitalization are **Recursion, Exscientia and Relay Therapeutics**.

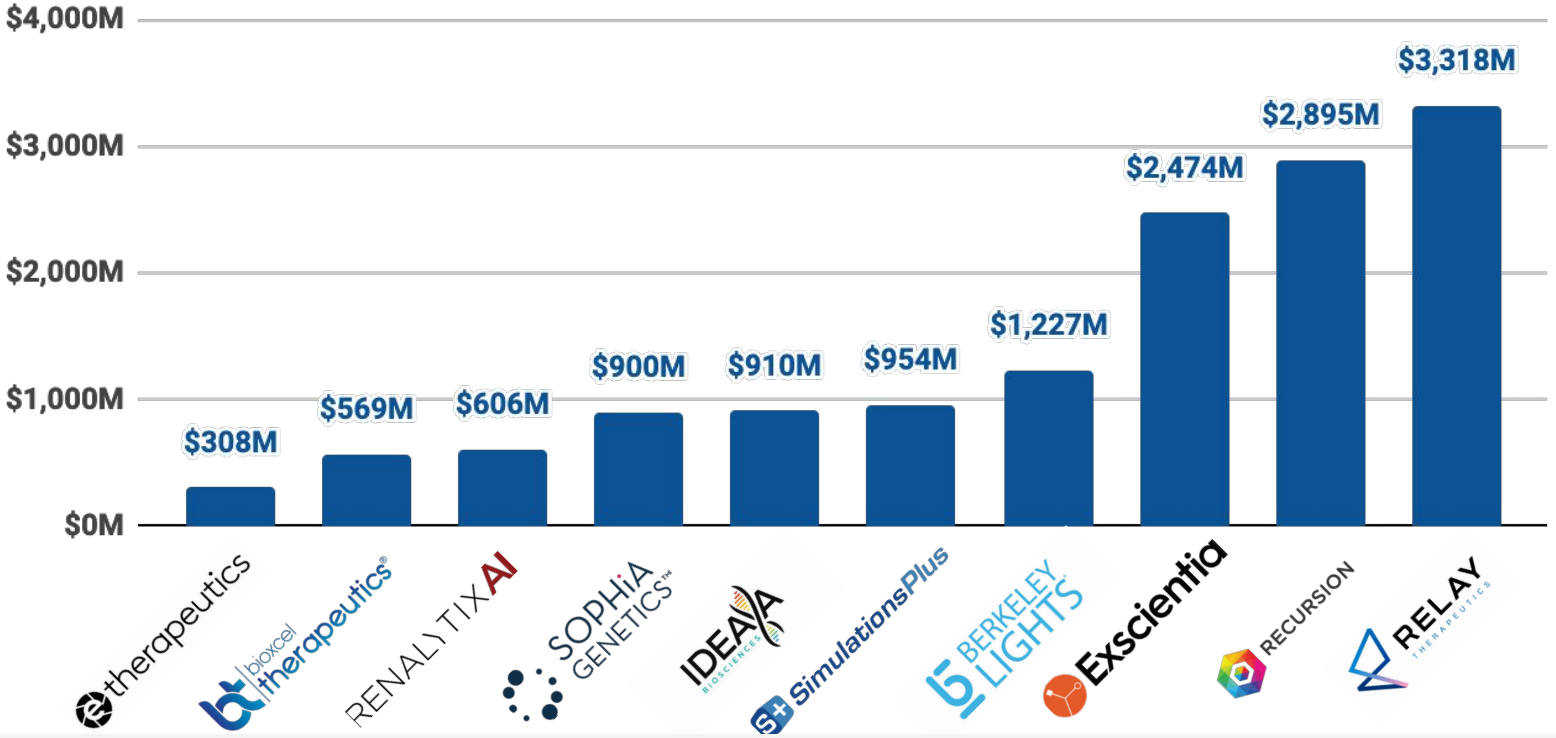
Market Capitalization Growth During 2021



It's essential to measure the performance of publicly traded AI in Pharma companies via comparison with major market benchmarks such as IBB, NBI and S&P 500. The cumulative market capitalization dynamics of AI in Pharma corporations outperformed YTD NASDAQ Biotechnology Index (NBI) and iShares Biotechnology ETF (IBB). However, S&P 500 gained solid 28.79% which placed it at the first place.

Sources: *Investment Digest AI in Pharma*

Top-10 AI-Driven Publicly Traded Pharma Companies by Market Capitalization in 2021



The chart presents the **Top-10 AI-driven drug discovery** public companies arranged by market capitalization as of end of December 2021. **Relay Therapeutics**, the developer of an allosteric drug-discovery platform intended to apply computational techniques to protein motion holds the first place with **$3.3B** of market capitalization.

Sources: *Investment Digest AI in Pharma*

AI in Pharma IPOs in 2021

In 2021 new public companies have successfully closed their IPOs. As for now, almost all these companies are showing a slight decline, which is typical for new pharmaceutical companies, especially with the negative net income. All IPOs took place in the USA. All companies have beta smaller than 1 (although positive), which means that AI in pharma stock prices move following the general market, yet the degree of such “movements” is lower. Major adverse market events in 2020-2022 did not significantly affect AI in pharma sector. The industry’s features remain to play a designative role in the overall market volatility.

Name	Country	Funding Amount, $M	IPO Date	Capitalization, $M	Valuation at IPO, $M	IPO Share Price, $	Current Share Price, $	EV/EBITDA	Net Income, $M
Evaxion Biotech	USA	30	04.02.21	64.56	489	10.00	3.03	-2.61	-24.53
Biomea Fusion	USA	153	15.04.21	157.52	463	17.00	4.72	0.99	-41.57
Recursion Pharmaceuticals	USA	465.4	16.04.21	1170	2748	18.00	7.80	-4.07	-186.48
Erasca	USA	300	16.07.21	1350	1800	16.90	8.65	-6.60	-122.76
SOPHiA GENETICS	USA	250.2	22.07.21	552	234	18.45	7.66	-3.43	-73.68
Exscientia	UK	474.4	01.10.21	2470	2.9	22	14.32	-15.09	-66.44
Roivant Sciences	USA	2100	01.10.21	3610	7.3	9.35	4.54	N/A	-1.060

Sources: *Investment Digest AI in Pharma*

Fundamental Analysis of AI in Pharma Public Companies

- Compared to its peers, EVAXION has the lowest market capitalization and Enterprise Value making Evaxion cash burden is less than its peers.
- Evaxion market capitalization is continuously increasing due to the expectation of advancing clinical trials.
- As of June 2021, Evaxion's cash position of $18.8 million is expected to be sufficient to fund key clinical programs into 2022.

- Due to the U.S. Food and Drug Administration (FDA) having cleared the company's Investigational New Drug application to begin a Phase I trial of BMF-219, Biome draws attention from investors.
- The company has expanded team and in-house research capabilities to support long-term growth and clinical and preclinical development plans.
- As of June 30, 2021, the Company had cash, cash equivalents, restricted cash, and investments of $203.0 million.
- The clinical developments of the company should enhance it financial positions.

- Compared to its peers, Recursion Pharma is the one that has a huge revenue growth with 120% in 2021 (LTM). The 74% revenue growth in 2020 makes the company's market position even better.
- One of the reasons that the company wasn't able to reach positive EBITDA is that the company expanded the total number of research and development programs from 37 to 48 as well as its operations to Canada.
- As of June 30, 2021, Recursion's cash and cash equivalents were $632.7 million.

Sources: *Investment Digest AI in Pharma*

Fundamental Analysis of AI in Pharma Public Companies

- Berkeley's revenue grew to $77.8 million for 2021(LTM), representing a 21% growth.
- Berkeley Lights continues to expect full year 2021 revenue to be in the range of $90 million to $100 million, representing 40% to 56% growth over the full year of 2020.
- Berkeley kept gross margin above 65% in the last 3 year.
- On the contrary of revenue growth, we saw that Berkeley's market capitalization is decreasing significantly with -57%. The main reason for the decrease in market cap is that the company gave guidance for 2021 in the range of growth between 40% and 56% over the prior year. From investors point of view BLI's growth is about to stumble.

- Relay's revenue goes steady with expectation of 2% growth in 2021.
- Relay has acquired ZebiAI in April 2021 which affected $134.9 million in expenses.
- Despite the acquisition, the company is projected to reach 50% of the gross margin in 2021, continuing its great performance from 2020, when the margin reached 100%.
- As institutional investors increased their shares in Relay, company's market capitalization increased 3% in 2021 (LTM).
- As of June 30, 2021, cash, cash equivalents and investments totaled approximately $671.2 million.
- The Company expects its current cash and cash equivalents will be sufficient to fund its current operating plan into 2024.

Sources: *Investment Digest AI in Pharma*

Fundamental Analysis of AI in Pharma Public Companies

SCHRÖDINGER

- Total Revenue is $120 million in 2021 (LTM), expected an increase of over 12% compared to 2020.
- Gross profit is expected to reach over $62 million in 2021 with a gross margin over 62%.
- The company's expenses are projected to scale due the development of its internal drug discovery programs. Operating expenses reached $42.3 million in Q2-2021, compared to $30.7 million in Q2-2020.
- Although Schrödinger is expected to maintain its revenue growth rate, it's definitely expected to grow faster than the wider industry.

SOPHiA GENETICS™

- The company's total revenue for the second quarter of 2021 was $10.2 million compared to $5.9 million for the second quarter of 2020, representing a 72% increase. This increase was primarily driven by new customers onboarding onto the platform. Another reason is the usage rates improvement across existing customers.
- SOPHiA Genetics full year revenue for 2021 expects to be greater than $39 million, representing growth of over 37% compared to the prior year period.
- The decline in gross margin was primarily attributable to increased computational and storage-related costs and negative FX movement. However, the company kept its margin above 60% in the 3 years.

ERASCA™

- The company has successfully closed its $345 million upsized IPO in July 2021.
- A few reasons that the company has a $2.3 billion market capitalization:
    1. Nominated ERAS-3490 Development Candidate;
    2. Dosed First Patient in HERKULES-1 Study;
    3. Dosed First Patient in FLAGSHP-1 Study;
    4. Executive Leadership Team.

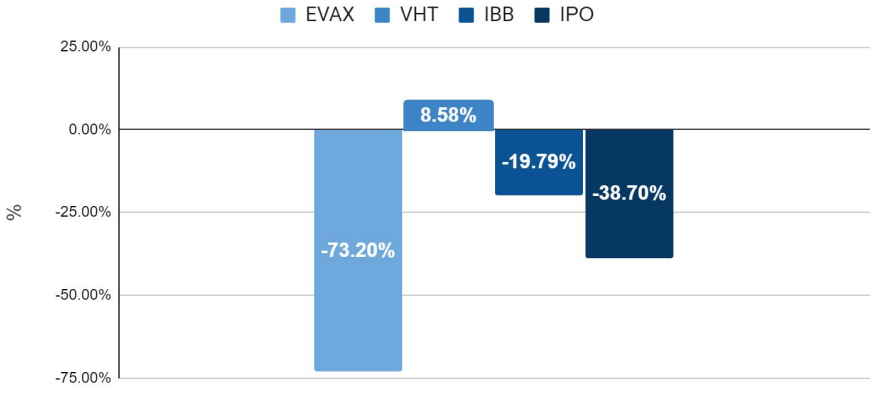
Sources: *Investment Digest AI in Pharma*

Evaxion Biotech

EVAX's stock price has been approaching peak growth thanks to newly-created Chief Scientific Officer role strengthens Evaxion's leadership team.

Ticker	Mean Daily Return	Volatility of Daily Returns	Growth after IPO	Capitalization, $M
EVAX	-0.42%	7.35%	-73.20%	65.56M

Evaxion Biotech is devoted to the discovery and development of vaccines against cancer and infectious diseases. IT is a clinical-stage AI-immunology™ platform company decoding the human immune system to discover and develop novel immunotherapies to treat cancer and infectious diseases.
The graph below depicts a comparative performance of EVAX and 3 ETFs starting from 15.03.2021: Vanguard Health Care Index Fund ETF (VHT), iShares Nasdaq Biotechnology ETF (IBB), Renaissance IPO ETF (IPO).



Sources: *Investment Digest AI in Pharma*

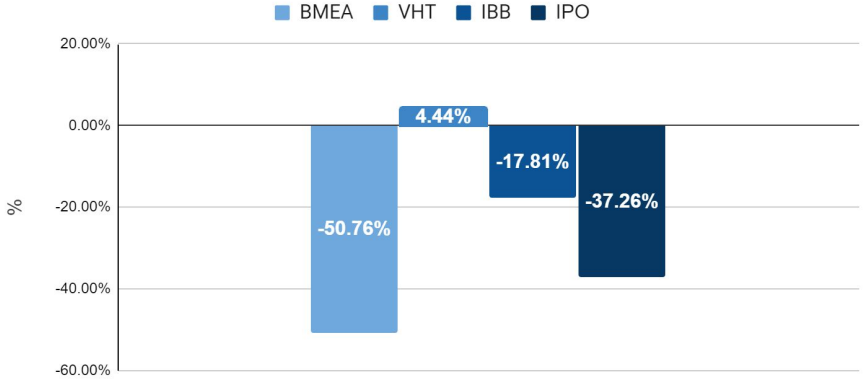
Biomea Fusion

Biomea Fusion is a precision oncology company developing novel small molecules that target aggressive forms of cancer. Biomea Fusion has a development portfolio that targets specific gene alterations which occur in the DNA of patients that translate into key drivers of tumor growth.

The graph below depicts a comparative performance of BMEA and 3 ETFs starting from 16.04.2021: Vanguard Health Care Index Fund ETF (VHT), iShares Nasdaq Biotechnology ETF (IBB), Renaissance IPO ETF (IPO).

Owing to its IPO, Biomea held unrestricted cash and short-term investments of $198.6 million and no debt. The company is on pace to burn only $30 million in 2021.

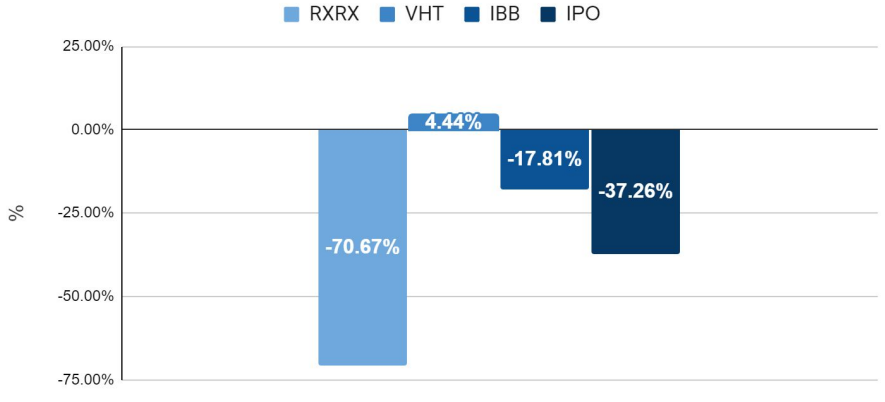
Ticker	Mean Daily Return	Volatility of Daily Returns	Growth after IPO	Capitalization, $M
BMEA	-0.5%	5.01%	-50.76%	157.52M



Sources: *Investment Digest AI in Pharma*

Recursion Pharmaceuticals

Recursion Pharmaceuticals operates as a clinical-stage biotechnology company decoding biology by integrating technological innovations across biology, chemistry, automation, data science, and engineering to industrialize drug discovery.
The graph below depicts a comparative performance of RXRX and 3 ETFs starting from 16.04.2021: Vanguard Health Care Index Fund ETF (VHT), iShares Nasdaq Biotechnology ETF (IBB), Renaissance IPO ETF (IPO).



The Institutional investors have recently added to their stakes in the company. Rockefeller Capital Management L.P and Citigroup Inc are among them.

Ticker	Mean Daily Return	Volatility of Daily Returns	Growth after IPO	Capitalization, $B
RXRX	-0.68%	5.88%	-70.67%	1.17B

Sources: *Investment Digest AI in Pharma*

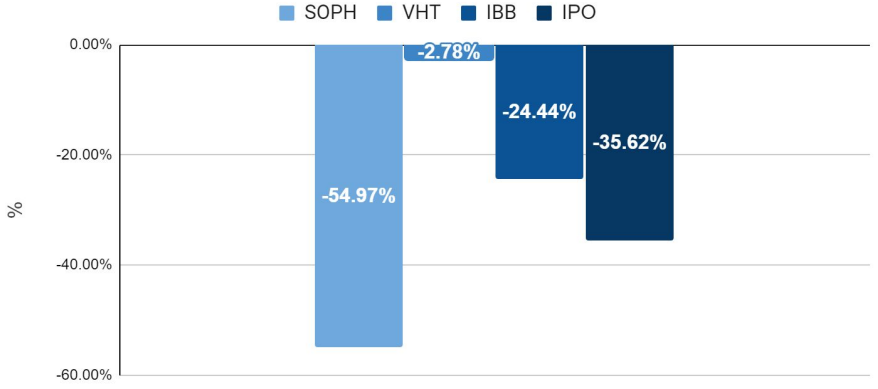
SOPHiA GENETICS

SOPHiA™
SOPHiAGENETICS.COM

SOPHiA GENETICS is a healthcare technology company dedicated to establishing the practice of data-driven medicine as the standard of care and for life sciences research. It is the creator of a cloud-based SaaS platform capable of analyzing data and generating insights from complex multimodal data sets and different diagnostic modalities.
The graph below depicts a comparative performance of SOPH and 3 ETFs starting from 23.07.2021: Vanguard Health Care Index Fund ETF (VHT), iShares Nasdaq Biotechnology ETF (IBB), Renaissance IPO ETF.

SOPH is operating in a growing industry, but the proposed IPO terms looked pricey for analysts. Nevertheless, the stock price has risen since then.

Ticker	Mean Daily Return	Volatility of Daily Returns	Growth after IPO	Capitalization, $B
SOPH	-0.41%	4.91%	-54.97%	0.552B

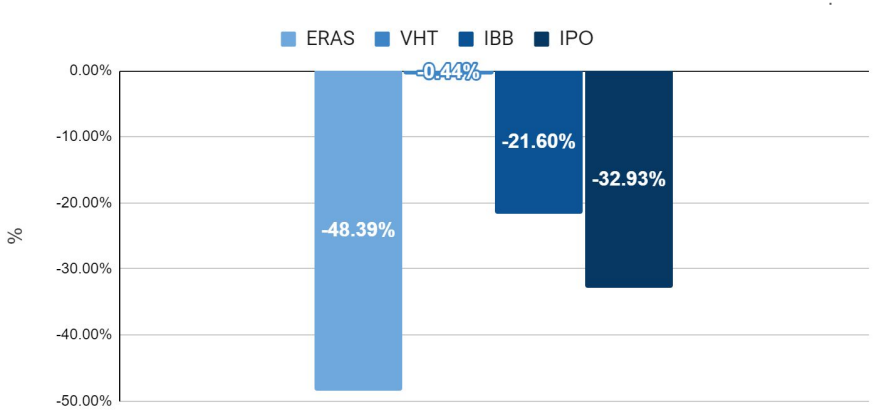


Sources: *Investment Digest AI in Pharma*

Erasca develops oncology drugs intended to provide precision oncology options. The company's drugs are being developed through multiple discovery programs for undisclosed targets that are biological drivers of cancer and are pursuing additional opportunities for pipeline expansion through academic and biopharmaceutical collaborations, providing patients with new potential solutions to not just treat but cure cancer.
The graph below depicts a comparative performance of SOPH and 3 ETFs starting from 16.07.2021: Vanguard Health Care Index Fund ETF (VHT), iShares Nasdaq Biotechnology ETF (IBB), Renaissance IPO ETF.

Fierce Biotech has named it as one of 2021's "Fierce 15" biotechnology companies, identifying Erasca as one of the industry's most promising biotechnology companies.

Ticker	Mean Daily Return	Volatility of Daily Returns	Growth after IPO	Capitalization, $B
ERAS	-0.26%	4.5%	-48.39%	1.35B



Sources: *Investment Digest AI in Pharma*

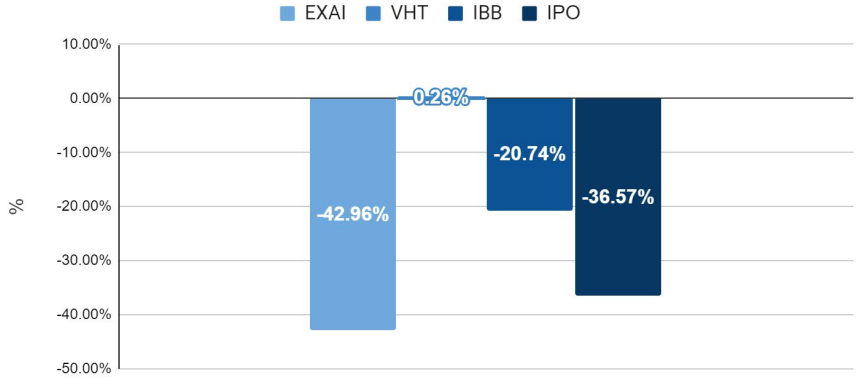
Exscientia

Founded in 2012, Exscientia was the first company to automate drug design and have an AI-Designed molecule enter clinical trials, as a full stack AI drug discovery company.

Ticker	Mean Daily Return	Volatility of Daily Returns	Growth after IPO	Capitalization, $B
EXAI	-0.49%	6.51%	-42.96%	2.47B

EXAI brought the first drug developed entirely by AI into clinical trials last year and has received a tremendous amount of interest in recent months. In fact, EXAI leveraged this success into two back-to-back VC rounds. EXAI just raised $109M in its Series C round back in March. And it followed that up with a $225M Series D round in April – less than two months later.

Estimation of monthly return by FF5F model in November showed that EXAI is overpriced by market and its monthly return reduces during December.
The graph below depicts a comparative performance of EXAI and 3 ETFs in Q1 2022 (starting from 01.10.2021).



Sources: *Investment Digest AI in Pharma*

Roivant Sciences

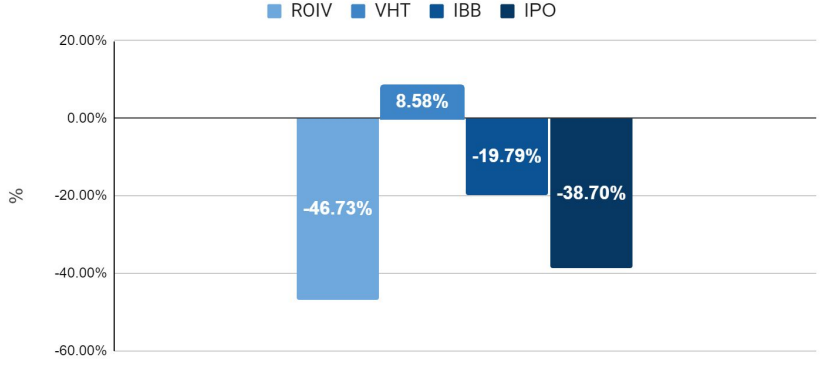
ROIV awaits potential approval by the U.S. Food and Drug Administration (FDA) for Dermavant's tapinarof in treating plaque psoriasis and has experimental drug in a phase 3 study for treating atopic dermatitis.

Ticker	Mean Daily Return	Volatility of Daily Returns	Growth after IPO	Capitalization, $B
ROIV	-0.26%	4.35%	-46.73%	3.61B

Founded in 2014, Roivant Sciences develops transformative medicines faster by building technologies and developing talent in creative ways, leveraging the Roivant platform to launch "Vants" - nimble and focused biopharmaceutical and health technology companies.

Based on estimation ROIV underpriced so after decline in Nov, stock price start increasing on the last month of 2021.

The graph below depicts a comparative performance of ROIV and 3 ETFs in Q1 2022 (starting from 15.03.2021): Vanguard Health Care Index Fund ETF (VHT), iShares Nasdaq Biotechnology ETF (IBB), Renaissance IPO ETF (IPO).



Sources: *Investment Digest AI in Pharma*

Top AI in Pharma Best-Promising Companies in 2021

Schrödinger, **Berkeley Lights** and **Relay Therapeutics** constitute the group of promising companies selected for analysis. They are new to the market (their IPOs closed in 2020). Therefore, their future might change significantly. Moreover, they have decent multi-target pipelines of novel therapeutics to address unmet medical needs. The companies are expected to translate their proprietary insights and technical solutions into effective therapeutics.

Currently, the companies have a firm market position and thus receive high expectations from investors.

Name	Country	Funding Amount, $M	IPO Date	Capitalization, $B	Valuation at IPO, $M	IPO Share Price, $	Current Share Price, $	EV/ EBITDA	Net Income, $M
Schrödinger	USA	562.3	02.05.2020	2.36	819	17.00	35.90	-19	-100.393
Berkeley Lights	USA	208.5	17.07.2020	0.466	1355.2	19.00	7.34	-5.48	-71.72
Relay Therapeutics	USA	520.0	16.07.2020	2.76	1736	20.00	34.88	-11.49	-363.872

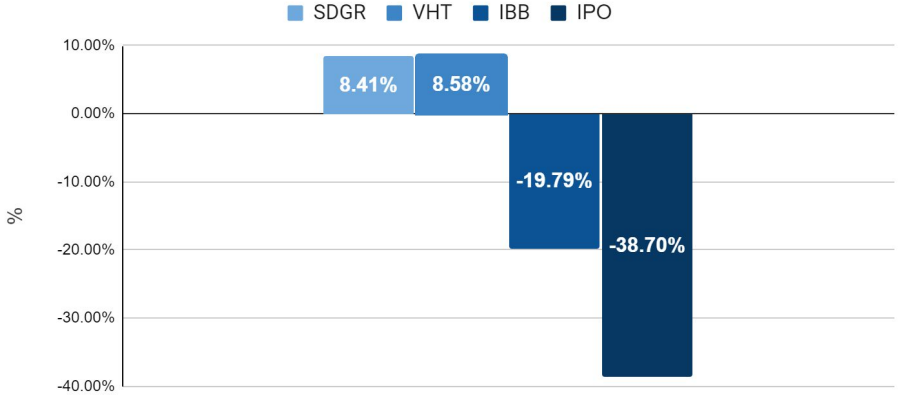
Sources: *Investment Digest AI in Pharma*

Schrödinger

According to the analyst, compared to the current share price, the company appears a touch undervalued at a over 20% discount to where the stock price trades currently.

Ticker	Mean Daily Return	Volatility of Daily Returns	Growth after IPO	Capitalization, $B
SDGR	-0.37%	3.68%	8.41%	2.36B

Schrödinger's industry-leading computational platform facilitates the research efforts of biopharmaceutical and industrial companies, academic institutions, and government laboratories worldwide. Schrödinger also has wholly-owned and collaborative drug discovery programs in a broad range of therapeutic areas.
The graph below depicts a comparative performance of SDGR and 3 ETFs: Vanguard Health Care Index Fund ETF (VHT), iShares Nasdaq Biotechnology ETF (IBB), Renaissance IPO ETF (IPO).



Sources: *Investment Digest AI in Pharma*

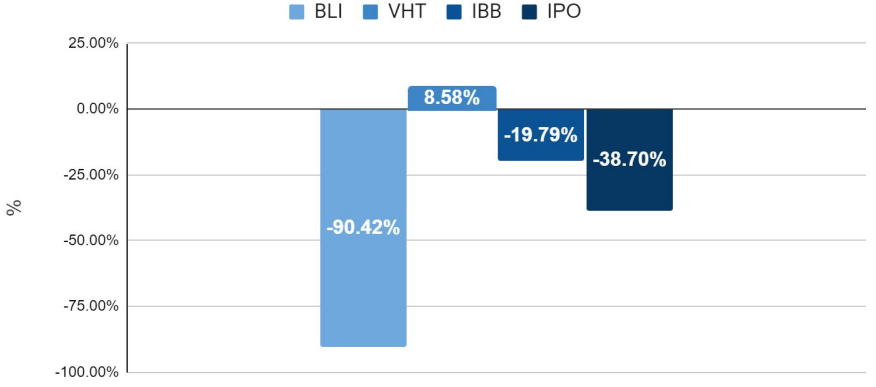
Berkeley Lights

Shares of Berkeley Lights have been surging consistently after revenue results in Q3-2021. The company reported its largest revenue placement estimated between the range of $24m to 24.3m – a 33% growth year-over-year.

Ticker	Mean Daily Return	Volatility of Daily Returns	Growth after IPO	Capitalization, $B
BLI	-0.84%	5.65%	-90.42%	0.46B

Berkeley Lights is a leading Digital Cell Biology company focused on enabling and accelerating the rapid development and commercialization of biotherapeutics and other cell-based products for the customers. The Berkeley Lights Platform captures deep phenotypic, functional and genotypic information for thousands of single cells in parallel.

The graph below depicts a comparative performance of RXRX and 3 ETFs starting from 15.03.2021: Vanguard Health Care Index Fund ETF (VHT), iShares Nasdaq Biotechnology ETF (IBB), Renaissance IPO ETF (IPO).



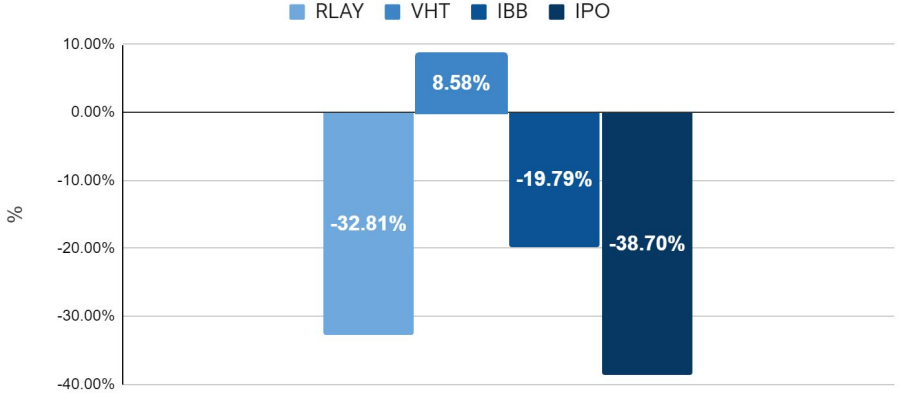
Sources: *Investment Digest AI in Pharma*

Relay Therapeutics

93.9% of RLAY shares are owned by institutional investors which indicates endowments, large money managers and hedge funds believe a stock will outperform the market.

Ticker	Mean Daily Return	Volatility of Daily Returns	Growth after IPO	Capitalization, $B
RLAY	-0.2%	4.07%	-32.81%	2.76B

Relay Therapeutics is a company focused on precision oncology and rare genetic diseases. Their proprietary Dynamo platform puts protein motion, at the heart of the drug discovery process. It uses advanced machine learning to identify potential novel target binding sites and to predict and design potentially the most effective molecules.
The graph below depicts a comparative performance of RXRX and 3 ETFs starting from 15.03.2021: Vanguard Health Care Index Fund ETF (VHT), iShares Nasdaq Biotechnology ETF (IBB), Renaissance IPO ETF (IPO).

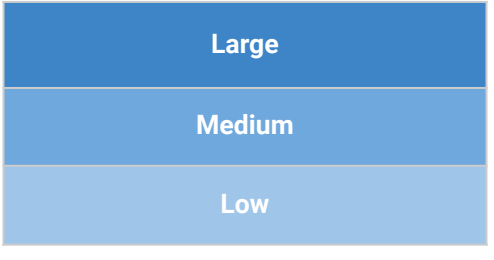


Sources: *Investment Digest AI in Pharma*

AI in Pharma Corporations Financials

Company	Capitalization, $M	Mean Daily Return	Volatility of Daily Returns	Estimated Monthly Return	Actual Monthly Return	IBB Beta	S&P 500 Beta	Total Funding Amount, $M	Operating Margin	EV/EBITDA	Net Income, $M
Gritstone Oncology	394	-0.20%	5.58%	-3.15%	-13.10%	0.37	9	396	-155.99%	-1.85	-75.08
Lantern Pharma	77.54	-0.31%	4.26%	5.48%	23.81%	0.70	1.32	68.70	0.00%	-0.58	-12.36
Alector	1074	0.00%	5.71%	4.85%	-9.49%	1.15	1.34	194.50	-18.04%	-16.55	-36.33
Relay Therapeutics	3292	0.02%	4.19%	5.67%	44.35%	N/A	1.34	520.00	-7 464%	-12.74	-363.87
Schrödinger	2235	-0.28%	3.67%	-12.47%	6.94%	0.98	1.14	567.20	-80.80%	-18.91	-100.39
Sensyne Health	5.20	-7.49%	9.00%	2.75%	-33.55%	0.68	0.87	37.25	-450.76%	-0.41	-34.83
Berkeley Lights	412	-0.65%	5.44%	10.26%	7.09%	1.37	N/A	272.60	-82.90%	-5.83	-71.72

AI in Pharma corporations tend to be more volatile than average publicly traded company. For most of the corporations, daily returns are positive and abnormal compared to the market. More volatile stocks are usually characterized by higher betas (both calculated for IBB index and for S&P 500). AI in Pharma segment is definitely a segment of growth stocks with the investors focused on the prospects of the companies rather than on the dividends.



Sources: *Investment Digest AI in Pharma*

AI in Pharma Corporations Financials

Company	Capitalization, $M	Mean Daily Return	Volatility of Daily Returns	Estimated Monthly Return	Actual Monthly Return	IBB Beta	S&P 500 Beta	Total Funding Amount, $M	Operating Margin	EV/EBITDA	Net Income, $M
Biodesix	55.08	-0.79%	5.54%	-10.85%	-17.89%	1.29	1.43	289.70	-72.14%	-0.98	-43.16
C4X discovery	94.93	-0.05%	3.21%	8.74%	17.69%	0.14	0.18	8.71	-104.45%	-8.84	-3.844
DeepMatter Group	8.41	-0.75%	6.32%	-5.76%	-11.63%	1.08	0.37	N/A	-216.97%	-2.60	-2.621
eTherapeutics	183.35	0.18%	4.28%	14.72%	21.17%	0.11	0.97	98.50	-640.16%	-19.97	-4.122
GenFit	198.88	0.03%	4.51%	14.68%	24.84%	1.24	0.83	93.69	-1048.54 %	-5.61	-39.152
Biomea Fusion	132.77	-0.45%	4.91%	-14.26%	-28.59%	0.53	0.32	56.00	0.00%	0.89	-41.57

Market capitalization of some AI in Pharma corporations (such as Schrödinger) exceeds **$6B** whereas other companies are priced in the range of dozens of millions of dollars - the difference in the valuation is immense. There is no strong correlation between operating margin or net income and market capitalization - the valuation of the corporations still being unprofitable can exceed billion of dollars.
Selling shares to investors allows them to maintain their cash burn ratios on an acceptable levels.

Large
Medium
Low

Sources: *Investment Digest AI in Pharma*

AI in Pharma Corporations Financials

Company	Capitalization, $M	Mean Daily Return	Volatility of Daily Returns	Estimated Monthly Return	Actual Monthly Return	IBB Beta	S&P 500 Beta	Total Funding Amount, $M	Operating Margin	EV/EBITDA	Net Income, $M
BioXcel Therapeutics	466.57	-0.17%	4.51%	-5.89%	-0.17%	1.04	1.03	N/A	0.00%	-3.05	-106.93
Evolutionary Genomics	4.41	0.59%	13.97%	-5.89%	-11.76%	-0.45	-0.07	1.5	0.00%	-5.15	-2.794
IDEAYA Biosciences	436.49	-0.22%	3.87%	2.48%	-7.14%	1.79	1.47	226.10	-179.91%	-4.41	-49.760
ITeos Therapeutics	1247	0.08%	4.14%	-5.47%	-1.68%	1.09	0.73	249.74	71.03%	1.50	214.52
Recursion Pharmaceuticals	1136	-0.46%	5.70%	-1.16%	-5.64%	1.48	1.22	465.38	-1795.78%	-4.06	-186.479
Sangamo Therapeutics	834.524	-0.20%	3.33%	7.98%	5.40%	1.50	1.14	93.20	-165.62%	-3.51	-178.286
Renalytix AI	231.687	-0.45%	4.05%	1.66%	-20.00%	1.47	1.05	76.40	-1971.62%	-3.85	-42.402
Evaxion Biotech	68.45	0.03%	8.06%	7.58%	4.69%	0.90	0.96	17.00	0.00	-1.69	-24.53

Market capitalization growth of AI-driven Pharma corporations exceeds that of the entire market and general BioTech Industry indices represented as S&P 500 index and IBB, respectively. The difference is that compared to the general market, the AI-driven pharma market segment is more volatile. The distribution of the returns in the segment of AI-driven pharma companies is right-skewed, which differentiates it from the vast majority of stock indices and segments.

Large
Medium
Low

Sources: *Investment Digest AI in Pharma*

Top Publicly Traded Companies Related to AI-Pharma

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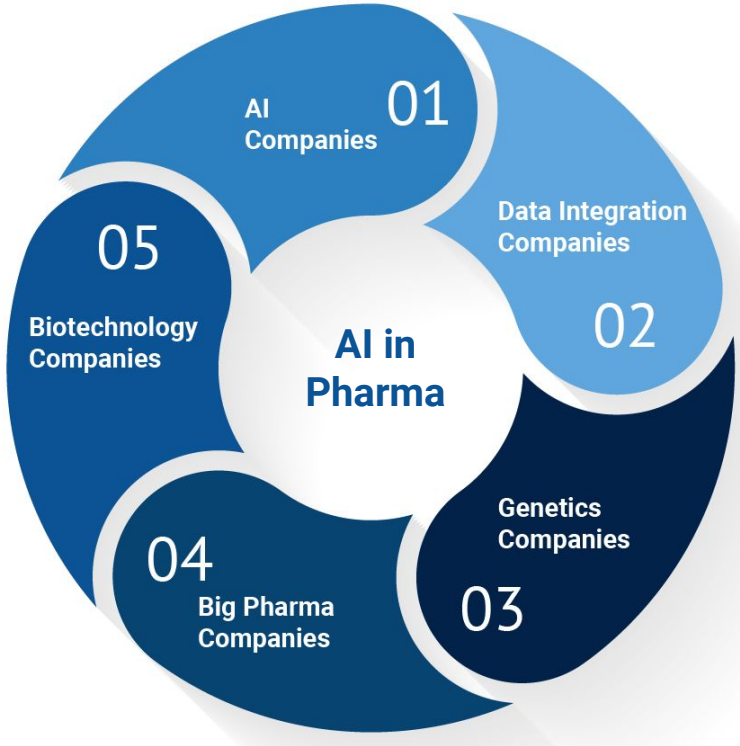
Companies Related to AI-Pharma

AI in pharma sector is an integral part of the contemporary pharmaceutical industry. AI-Pharma sector, defined broadly, is not limited to AI companies, but includes also pharma, tech, chemistry corporations, and CROs that are engaged in collaborations with AI startups, including but not limited to: Mergers & Acquisitions, scientific researches, partnerships, and so on. Hence the companies chosen are better to be described as AI-related or AI-aiming than AI-based solely.

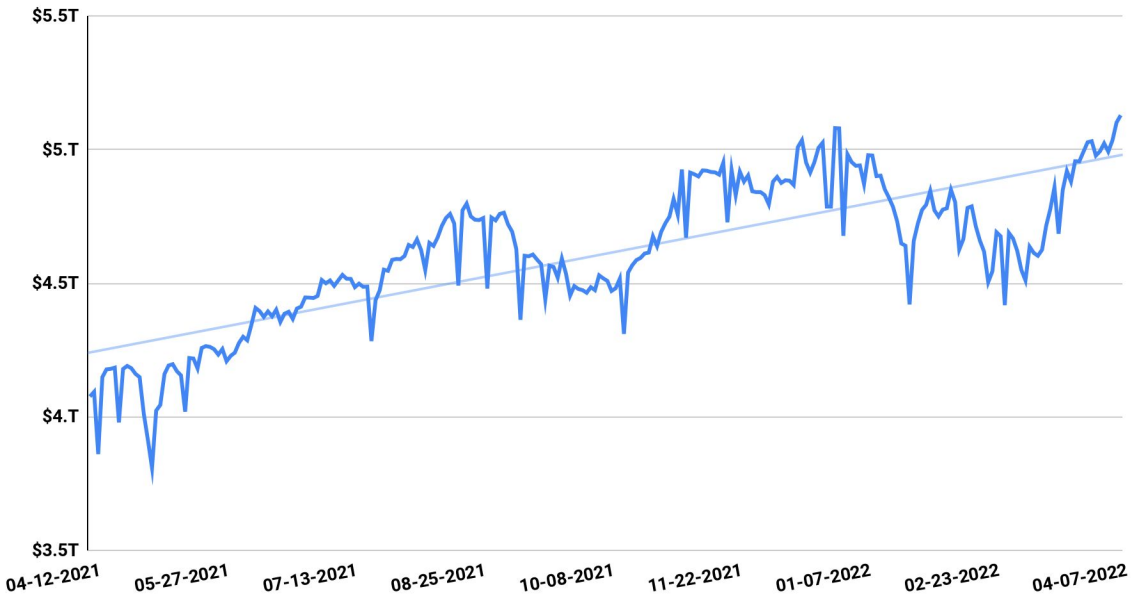
The number of new partnerships between pharma companies and AI companies is ever increasing across the whole industry. On the one hand, AI-focused companies may spend a few years developing all software and tools which pharma companies do not have. On the other hand, large companies, mainly public ones, have solid understanding of their science, extensive experience in the industry and regulatory field, and they are ready to share the risk.

In this chapter we introduce the list of top corporations related to AI-Pharma that were selected based on the analysis of their R&D, financials, and collaborations with the most promising and advanced AI-Pharma startups.



Publicly Traded Companies Related to AI-Pharma

Cumulative Capitalization of Publicly Traded Companies Related to AI-Pharma, 2021-2022, $ Trillion

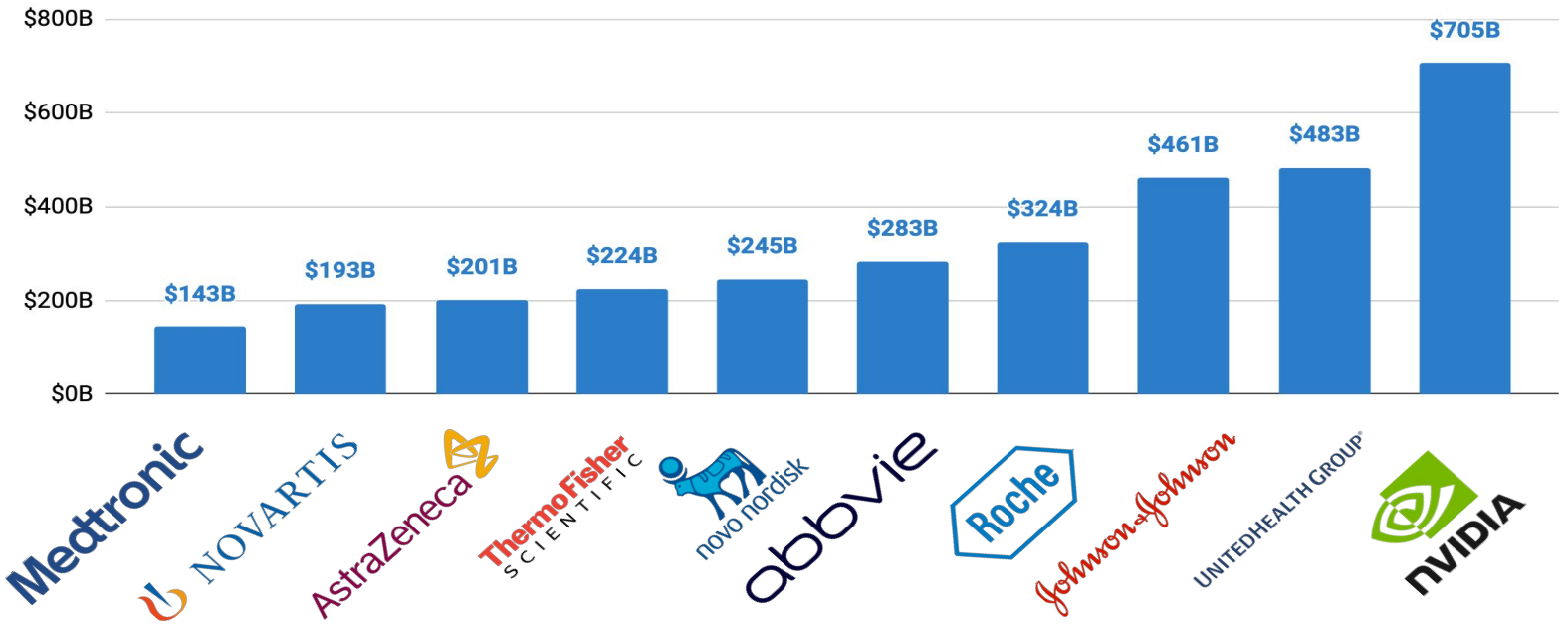


Driven to some extent by the COVID-19 pandemic, publicly traded companies related to AI-Pharma demonstrated significant growth, **reaching $5.13T** industry capitalization as of the end of Q1 2022. Investors' interest is being shifted towards industries of this nature.

We see significant potential for **Artificial Intelligence** in the Pharmaceutical Industry. The **Expected Compound Annual Growth Rate** for this is market is projected to be **around 40% over the next 3 years**. The Biotechnology Industry is poised to witness a quantum leap soon, mainly because of the impact of Artificial Intelligence on biomedicine R&D. Many transactions are being announced, including Parexel's **acquisition for $8.5B**, that indicates growing awareness of the disruptive potential in this sector for ones having the right means for participation. COVID-19 will continue to push valuations and M&A activity in the sector.

Sources: *Investment Digest AI in Pharma*

Top 10 Publicly Traded AI-Pharma Related Companies by Market Capitalization in 2022



The chart represents the top-10 public companies that ended up in our portfolios according to their market capitalization. **Johnson and Johnson, United Health Group and NVIDIA** top our list, accounting **50.5%** of the capitalization of all companies included. Despite the performance decline that Vertex Pharmaceuticals have had in the past year, it still ended up at our top. During the last year and a half period of pandemic, AstraZeneca has being raised the capitalization by more than **11 times**, reaching **$181B.**

Sources: *Investment Digest AI in Pharma*

Top Publicly Traded Companies Related to AI-Pharma

Roche Holding (RHHBY) — Roche Holding AG offers pharmaceutical products for treating anemia, cancer, cardiovascular, central nervous system, dermatology, hepatitis B and C, HIV/AIDS, inflammatory, autoimmune and other diseases. The company widely implements data-driven solutions, for example Roche has acquired Viewics, Inc. Viewics focuses on business analytics for laboratories, taking data from a variety of sources and extracting it to make faster data-driven decisions in operating processes in the labs.

Novo Nordisk (NVO) — Novo Nordisk is a healthcare company, engages in the research, development, manufacture, and marketing of pharmaceutical products worldwide. It operates in two segments, Diabetes and Obesity care, and Biopharm. Novo Nordisk actively implements different AI in Pharma solutions, its foundation awards DKK 138 million under its new data science and artificial intelligence initiative.

Astrazeneca (AZN) — Astrazeneca discovers, develops, manufactures, and commercializes prescription medicines in the areas of oncology, cardiovascular, renal and metabolism, respiratory, infection, neuroscience, and gastroenterology worldwide. Astrazeneca uses advancing genomics research with AI and big data, AI is already being embedded across companies R&D both for research and experiment optimization.

AbbVie (ABBV) — AbbVie is one of the so-called Big Pharma companies. The company uses AI not only for direct development but also for its own enhancement: Abbelfish Machine Translation and AbbVie Search are built for accelerating and scaling the work of the company' researchers, reducing the time it takes to discover and deliver transformative medicines and therapies for patients.

Top Publicly Traded Companies Related to AI-Pharma

Berkeley Lights (BLI) — Berkeley Lights is a leading Digital Cell Biology company focused on enabling and accelerating the rapid development and commercialization of biotherapeutics and other cell-based products for the customers. Besides 2 unique optofluidics system, Berkeley Lights is known for antibody discovery and cell lines development that definitely requires the usage of AI-powered algorithms and technical solutions.

DeepMatter Group (DMTR) — DeepMatter Group Plc operates as a big data and analysis company. It offers DigitalGlassware platform to deliver applications resulting in optimized chemicals, materials, and formulations in various areas, such as pharmaceutical research, fine chemicals, scientific publications, and teaching. The company develops and commercialises cheminformatics software to handle, store, and retrieve chemical structures and reactions for application in pharma; and tools for the production of synthesis planning and reaction prediction solutions, as well as engages in the automatic extraction of scientific information from text and images.

Pharmaceutical Product Development (PPD) — Pharmaceutical Product Development is another big CRO company. PPD ended up in our portfolio for a great reason, collaborating with Happy Life Tech for AI support, the company aims to create Data Science-driven Clinical Research Solutions in China to enhance global drug development.

Charles River Laboratories (CRL) — Charles River Laboratories is a well-known Contract Research Organization (CRO) specializing in research and drug development. CRL uses the AtomNet™ platform, which is a deep convolutional neural network created for structure-based drug discovery. The company also works with the Valence Discovery Platform for Hit-to-Lead acceleration and optimization and provides all research services considering these platforms.

Top Publicly Traded Companies Related to AI-Pharma

Agilent (A) — Agilent is one of the biggest Biotech companies providing technical solutions for the Pharmaceutical industry. Lots of company' technical solutions already have built-in or support different type of AI algorithms. Also, Agilent and Visiopharm co-promote advanced digital Precision Pathology Solutions.

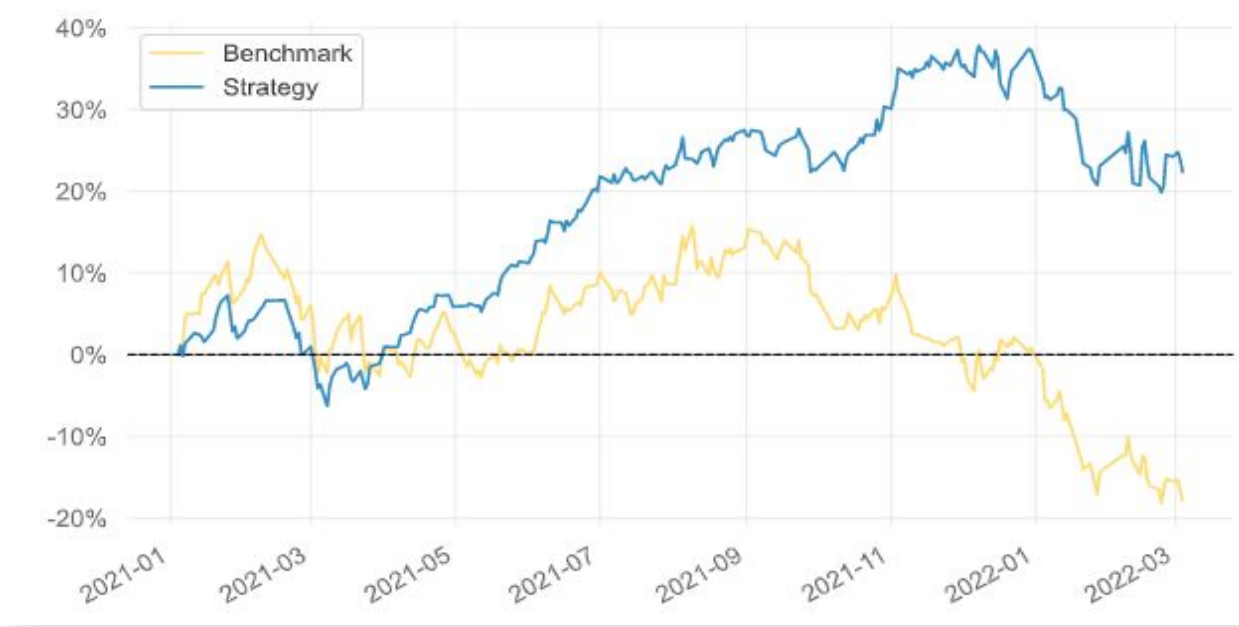
Thermo Fisher Scientific (TMO) — Thermo Fisher is another, even bigger, Biotech company that is specializing in technical solutions, providing also a wide range of other services. "The connected Lab" is a good example of AI-enhanced services providing by the company, creating solutions for enhanced in-Lab performance via AI-based info-gathering and analysis. AI-based processing tools are now also available in Thermo Scientific Amira-Avizo Software and PerGeos Software.

Johnson and Johnson (JNJ) — Johnson and Johnson is considered o be among the TOP-3 biggest Pharmaceutical companies in the world, therefore not only implementation but also investing in AI in Pharma is provided by the company. In 2020, J&J announced an investment in Datavant Holdings, which is working to help healthcare organizations unite data across institutions to enhance medical research and patient care. Another JJI partner, Aetion Inc., analyzes electronic medical records, insurance claims, patient registries and lab results to generate healthcare-related decisions.

Almirall (ALM) — Almirall is a leading skin-health focused global pharmaceutical company, that has some recent collaborations with Iktos for the creation of generative modelling AI technology for quick identification of molecules with multiple bioactivity and drug-like criteria.

Performance of Optimized Portfolio

InvestTech Advanced Solutions' analytics used four different strategies during the creation of portfolios: Equally Weighted (Balanced), Minimum Variance, Capitalization-Weighted, Sharpe Ratio-based.



Metric	Strategy	Benchmark
CAGR%	18.98%	-15.56%
Sortino	1.82	-0.87
Kurtosis	1.41	0.1

As a result of our analysis, 50000 portfolios were simulated where obtained optimized ones. Capitalization-Weighted Portfolio showed performance in 22.37% of Cumulative Return against Benchmark NBI(Nasdaq Biotechnology Index) over shown the period.

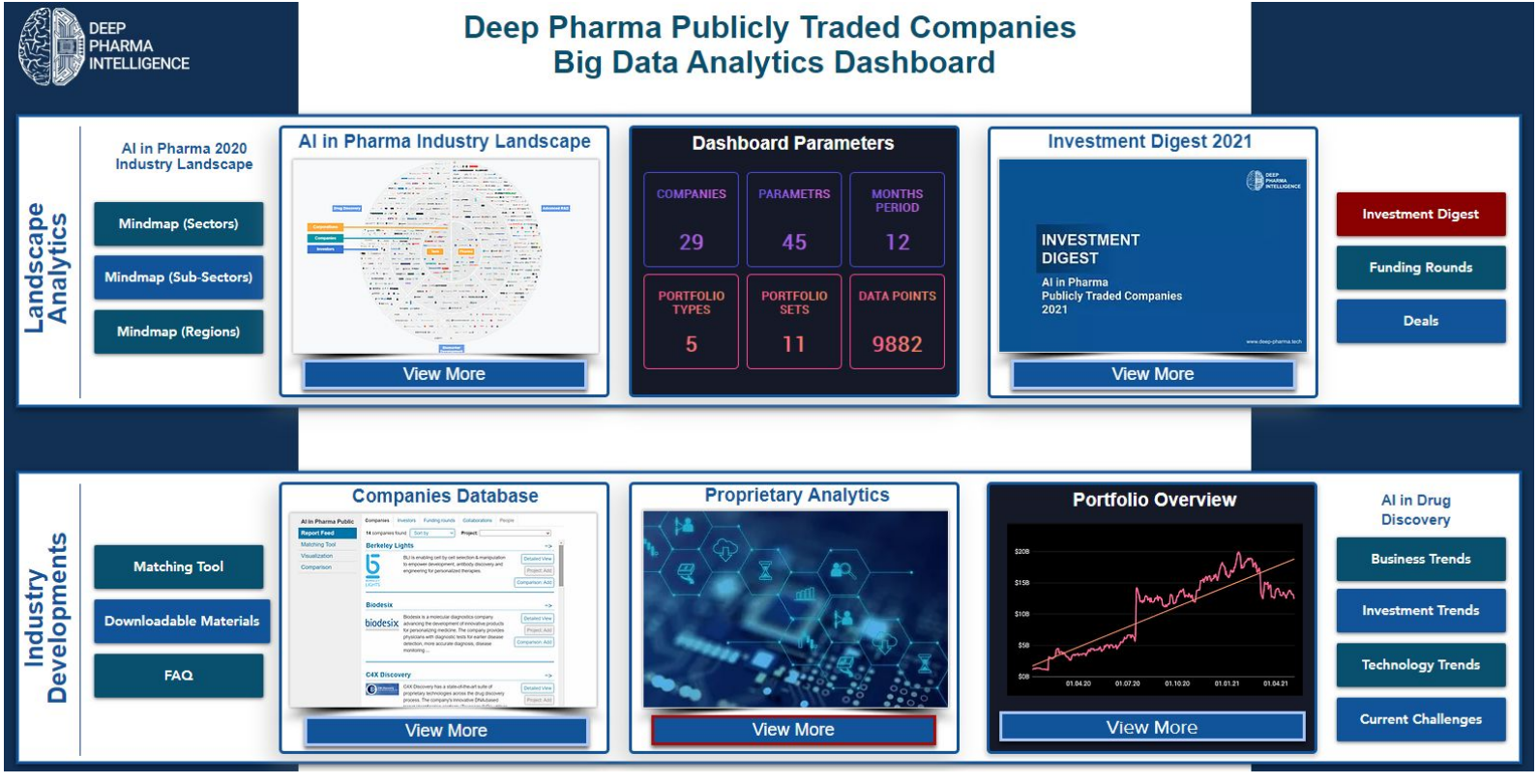
Sources: *Investment Digest AI in Pharma*

Conclusions

- The **AI in Pharma sector** have been experienced **significant growth** over the past year. This could be clearly seen by the overall dynamics of the chosen companies.
- Despite common misconception, **AI in Pharma includes not only SaaS-specialized companies**, Big Pharma, as well as top-CRO companies should be included in this list among other newcomers.
- Due to the market's significant growth, **all portfolios shows remarkable results, indicating valid investment opportunities**. At the same time such opportunities, i.e. possibilities, **shouldn't be replaced with certainty**.
- There are plenty of companies that should be considered as promising ones, **which shows both market dynamics and investment expediency**.
- Best performance is shown by **Sharpe ratio-based portfolios**, our Balanced portfolios have outperformed all classical Capitalization-based portfolios showing higher investment expediency.
- The overall performance of different investment waging strategies shows that all types of investors, both risk averse and risk-seeking, will find enough opportunities for themselves.

Sources: *Investment Digest AI in Pharma*

Deep Pharma Intelligence: Upcoming Projects and Analytical Tools



[Deep Pharma Publicly Traded Companies Big Data Analytics Dashboard]

AI for Advanced R&D: Applications and Use Cases

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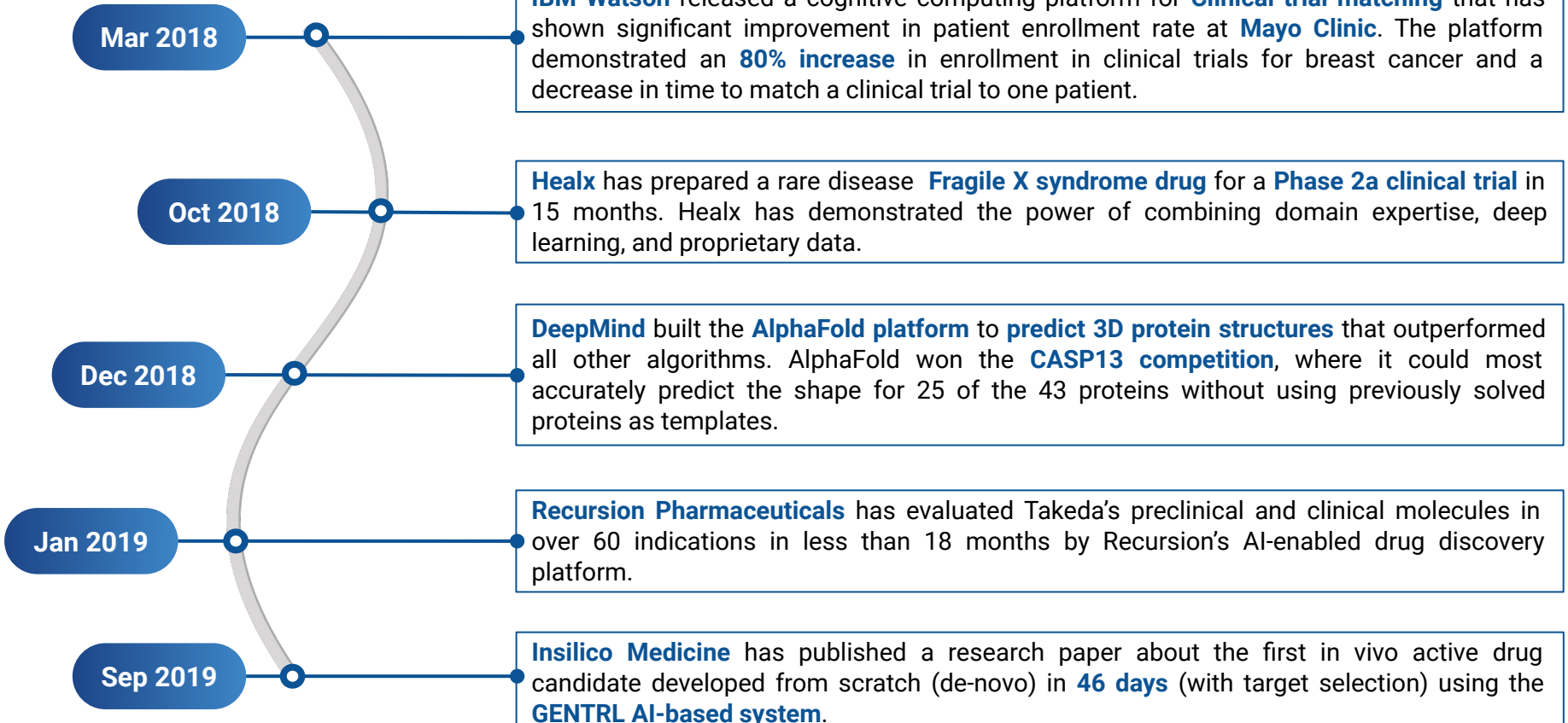
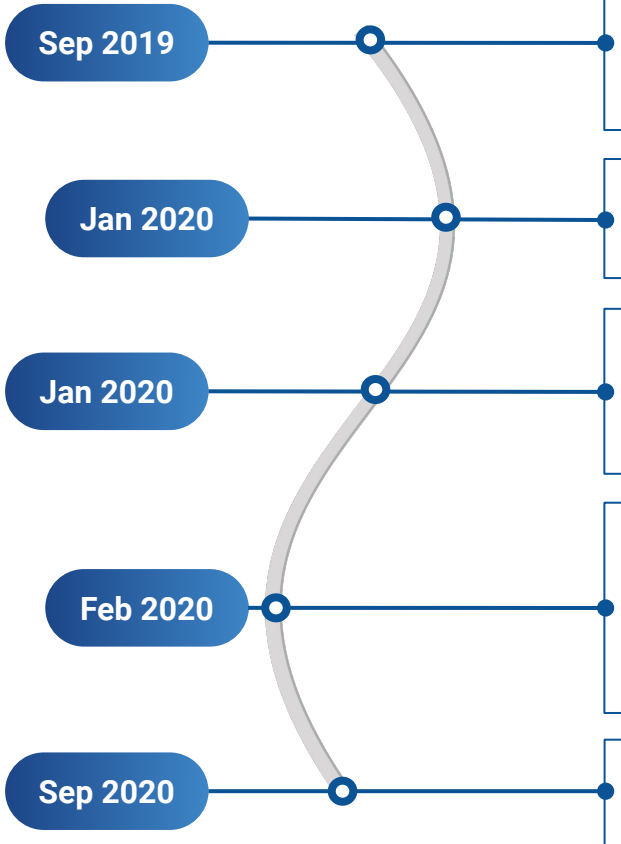
Notable AI Breakthroughs



Notable AI Breakthroughs



Sep 2019

Deep Genomics created a DG12P1 drug in 18 months using an **AI-augmented drug design**. It is an **antisense oligonucleotide therapy** to treat **rare Wilson disease**. Deed Genomics platform screened over 2,400 diseases and over 100,000 mutations to predict and confirm the precise disease-causing mechanism of the mutation Met645Arg.

Jan 2020

Mendel Recruit proprietary platform **increases patient enrollment for clinical trials by 24-50%**. It applies AI algorithms that combine the recognition of scanned documents with **natural language processing** of clinical records and automated clinical reasoning.

Jan 2020

A new drug candidate, DSP-1181, created using the **Exscientia Centaur Chemist Artificial Intelligence platform**, began clinical study. The drug was developed together with **Sumitomo Dainippon Pharma** for the treatment of an **obsessive-compulsive disorder**. It was advanced to Phase 1 clinical trials.

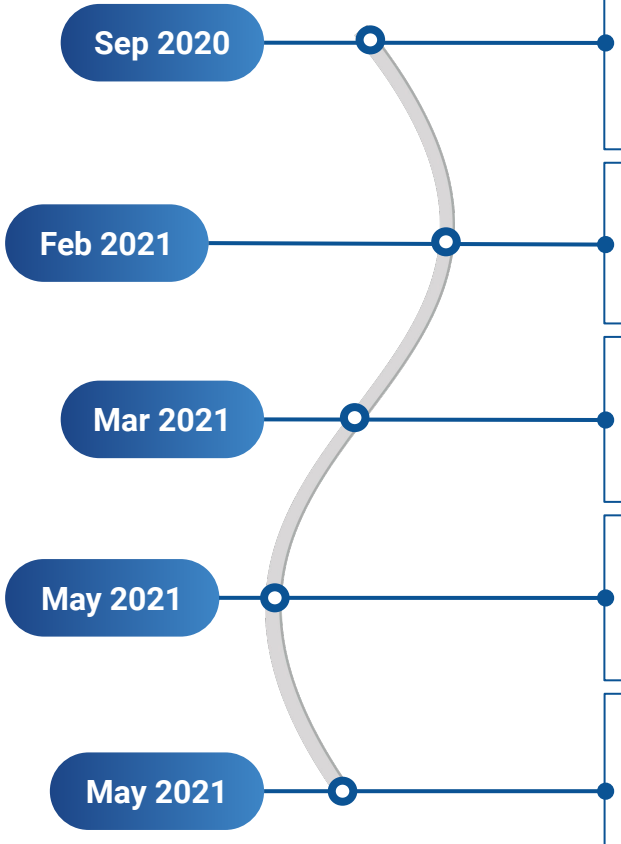
Feb 2020

Scientists from **MIT** discovered **halicin** — **a new super powerful antibiotic capable of killing 35 of the world's most problematic disease-causing bacteria**, including multiresistant strains. The model applied was able to screen more than a hundred million chemical compounds and pick out potential antibiotics that kill bacteria using different mechanisms than existing drugs.

Sep 2020

Aladdin has built a platform for the **early diagnostics of Alzheimer's disease and COVID-19**. Disease Diagnosis platform uses **AI** and **multimodal data**, including biomarkers, imaging, blood samples, medical records, etc.

Notable AI Breakthroughs



Sep 2020

MELLODDY — the '**Machine Learning Ledger Orchestration for Drug Discovery**' group — was created by ten pharma companies to **develop ML models** without sharing data. MELLODDY leverages the world's most extensive collection of small molecules with known biochemical or cellular activity to provide more accurate predictive models and **improve drug discovery efficiency**.

Feb 2021

Insilico Medicine achieved industry-first nominating Preclinical Candidate. The company performed all the required human patient cell, tissue, and animal validation experiments to claim a **first-in-class preclinical candidate for a novel pan-fibrotic target**. The company is preparing for clinical development.

Mar 2021

Cyclica launched an AI-based drug discovery platform that **achieved over 60% of actionable hits for its pharma clients**. Cyclica has partnered with over 100 global pharma and biotech companies and academia across many therapy areas. These partnerships have resulted in 64% of programmes resulting in actionable hits.

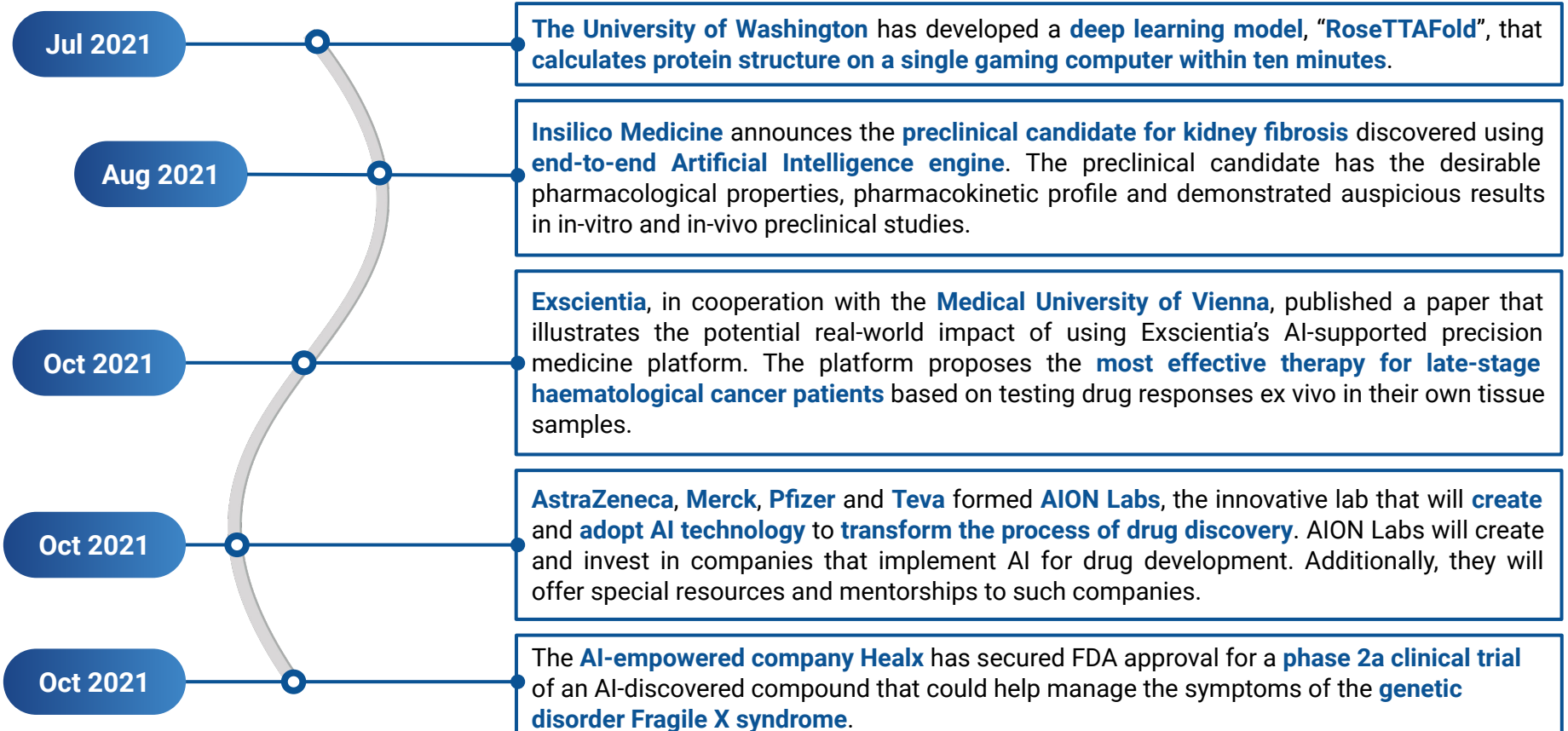
May 2021

BioXcel Therapeutics, Inc., a clinical-stage biopharmaceutical company **utilizing AI approaches**, announced that the FDA has accepted for filing the New Drug Application for BXCL501, for the **acute treatment of agitation associated with schizophrenia and bipolar disorders I and II**.

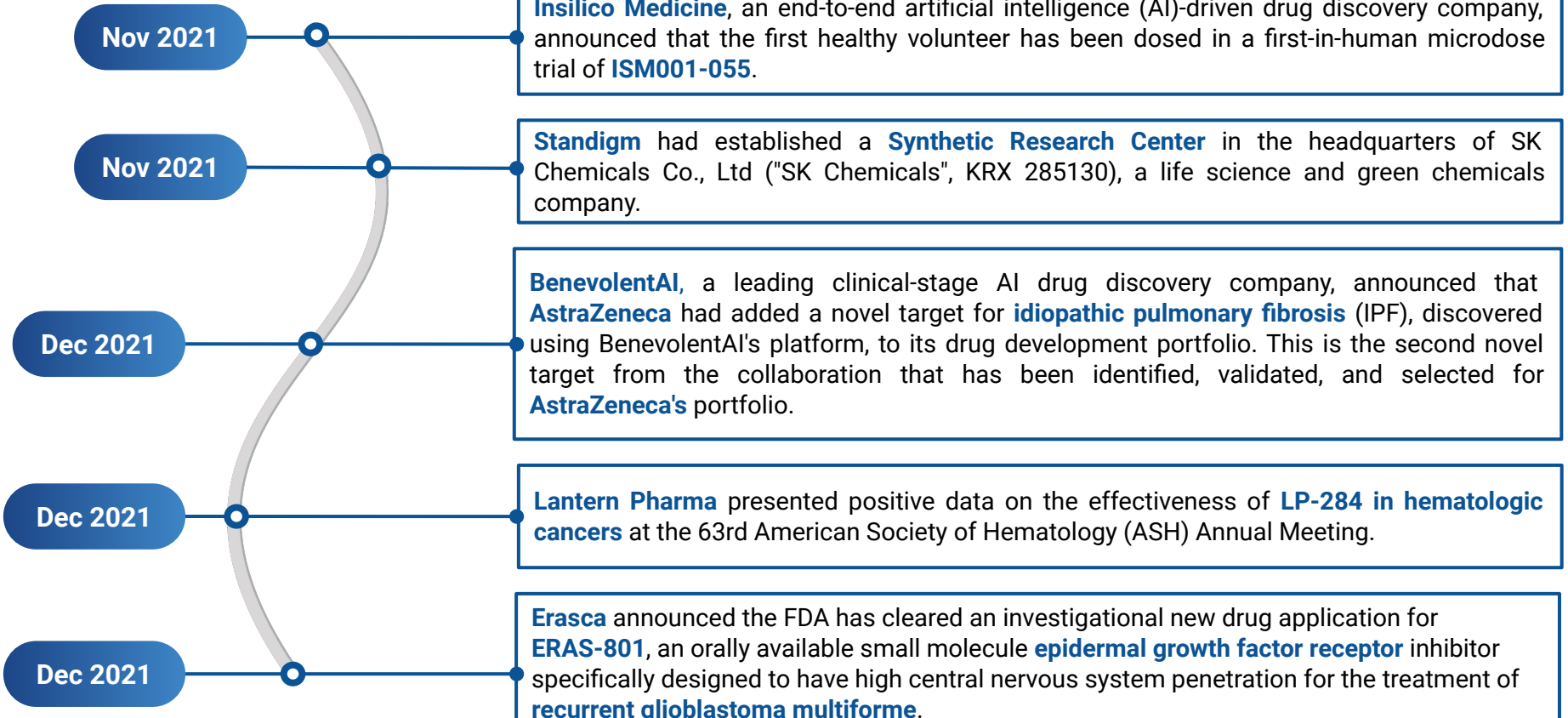
May 2021

Using its AI technology, **Exscientia** designed an **Alzheimer's disease drug candidate** who has **entered Phase I clinical testing**. The AI-designed drug candidate will be assessed for improved antipsychotic effects associated with Alzheimer's psychosis, in addition to improvements in behavioural and psychological symptoms of dementia

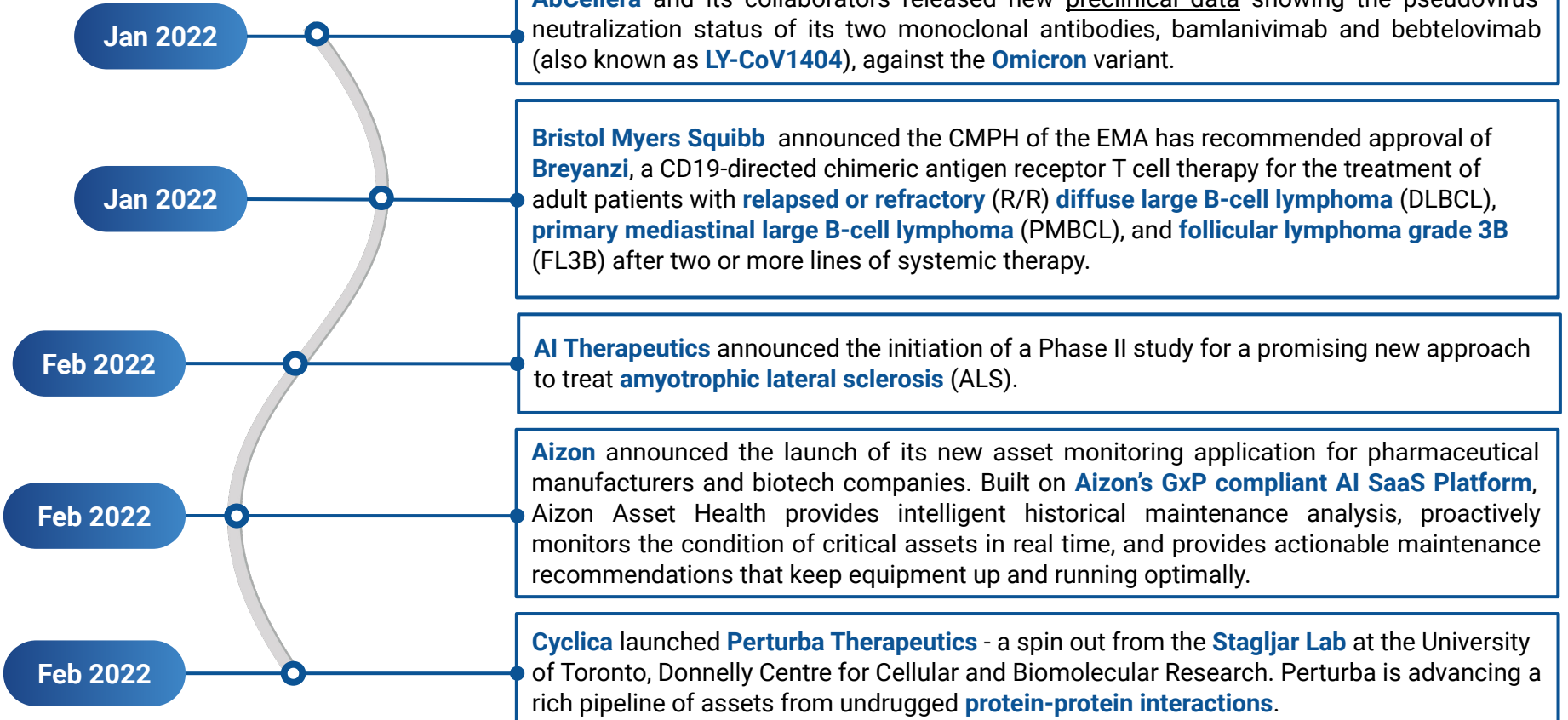
Notable AI Breakthroughs



Notable AI Breakthroughs



Notable AI Breakthroughs



Computational Methods Used by the Most Advanced AI Companies

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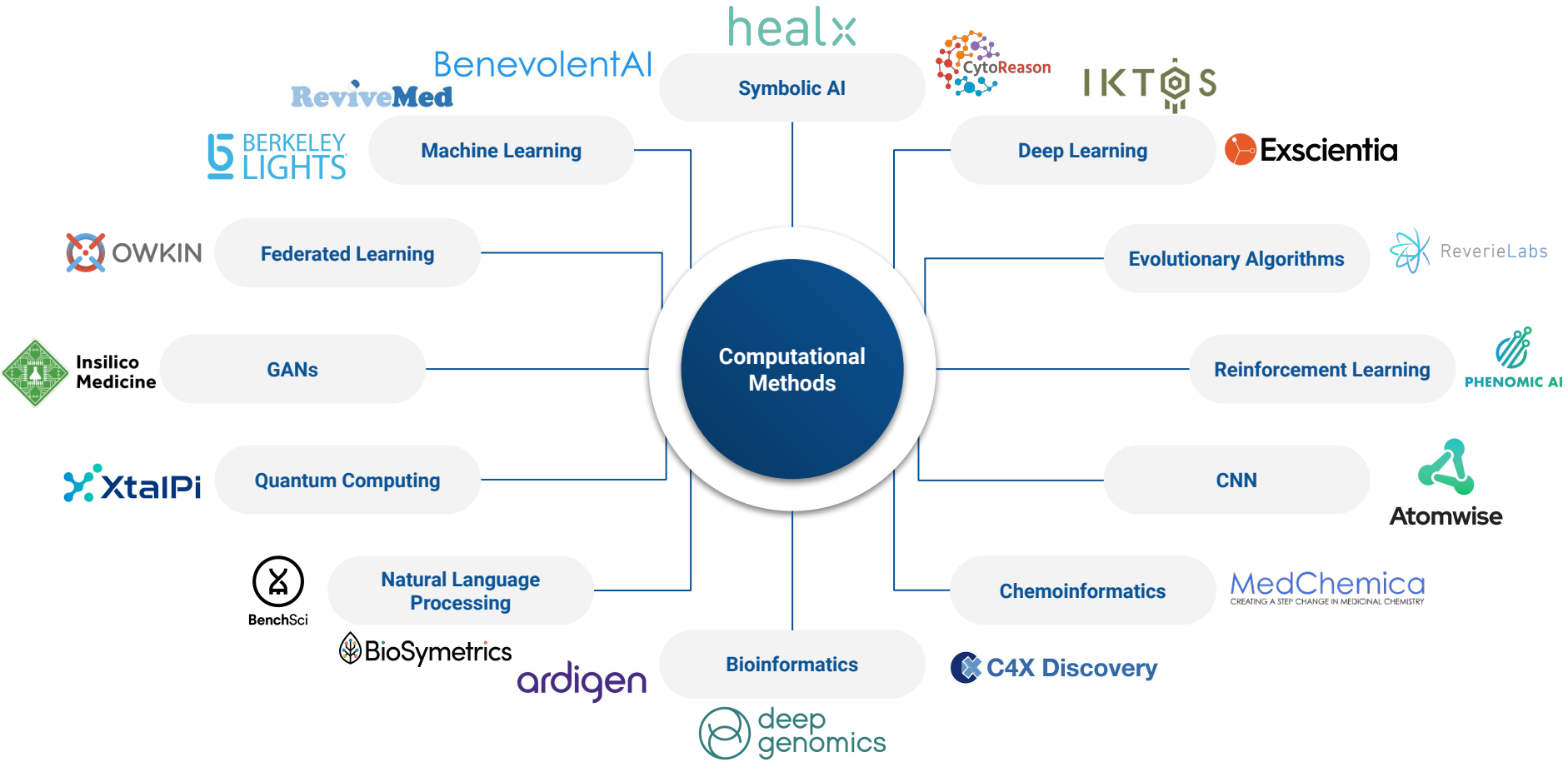
Computational Methods Used by the Most Advanced AI Companies



Computational Methods Used by the Most Advanced AI Companies

Company	Computational methods used	Technology Abstract
ardigen	**Bioinformatics, Deep Learning, NLP**	**Ardigen** is active in the field of **laboratory information management systems**, **biological and clinical data analysis**, **Big Data integration**, as well as **custom application development**.
Atomwise	**Machine Learning, Deep Learning (Convolutional neural networks), chemoinformatics**	**AtomNet** is the first drug discovery algorithm to use a **deep convolutional neural network**. It has already explored questions in cancer, neurological diseases, antivirals, antiparasitics, and antibiotics.
BenchSci	**NLP, Deep Learning, Machine Learning**	**Decodes open- and closed-access data on reagents** such as antibodies and **present published figures** with actionable insights.
BenevolentAI	**Machine Learning, Deep Learning, symbolic AI, chemoinformatics**	Evolved from text mining and semantic linking into **knowledge graphs** to tackle complex multifactorial diseases, identify novel targets, small molecule drug discovery and patient stratification.
BERG	**Machine Learning, Deep Learning, bioinformatics**	**Analyze data from patient samples** in both healthy and diseased states to generate novel biomarkers and therapeutic targets.
BERKELEY LIGHTS	**Machine Learning, bioinformatics**	**Automate selection, manipulation, and analysis of cells**. Allows researchers to: Expedite development of cell lines and automate manufacturing of cellular therapeutics.

Computational Methods Used by the Most Advanced AI Companies

Company	Computational methods used	Technology Abstract
BioSymetrics	NLP, Deep Learning, Machine Learning	**Process raw phenotypic, imaging, drug, and genomic data sets**. Allows researchers to integrate rapid analytics and machine learning capabilities into existing business processes.
bioz	NLP, Deep Learning, Machine Learning	**Bioz** has developed a **search engine for Life Sciences community** using natural language processing and machine learning technology to scan hundreds of millions of pages of complex and unstructured scientific papers on the web.
bioxcel therapeutics	Machine Learning, Deep Learning, chemoinformatics	**Bioxcel Corporation** is a biopharmaceutical company pioneering the **application of artificial intelligence and big data analytics** integrated with drug development expertise.
C4X Discovery	Machine Learning, Deep Learning, chemoinformatics, bioinformatics	**C4X** innovative **DNA-based target identification platform (Taxonomy3(R))** utilises human genetic datasets to identify novel patient-specific targets.
CelerisTx	Deep Learning, Bioinformatics	It is a **deep learning company** that uses innovative, computer-based methods to degrade undruggable targets and validate lead drug candidates in automated lab
CytoReason	Machine Learning, Deep Learning, symbolic AI, chemoinformatics, bioinformatics	**CytoReason's** access to unmatched proprietary and public data, combined with cutting-edge machine learning technologies, **creates their unique biological models of disease, tissue and drug.**

Computational Methods Used by the Most Advanced AI Companies

Company	Computational methods used	Technology Abstract
Data4Cure	**Machine Learning, Deep Learning, NLP**	**The Data4Cure** platform's modular architecture allows independent system components to **handle integration and advanced analysis of heterogeneous data types** spanning molecular, phenotypic and clinical data, both structured and unstructured.
deep genomics	**Machine Learning, Deep Learning, bioinformatics**	**Deep Genomics** is using **artificial intelligence** to build a new universe of life-saving genetic therapies.
DESKTOP GENETICS	**Bioinformatics, Machine Learning**	**Desktop Genetics** is team of **genome editing experts, bioinformaticians and data scientists,** driven by the real-world impact of CRISPR technology. Their core technology, DESKGEN AI, was trained on the largest database of genome editing data in the world.
ENVISAGENICS	**Machine Learning, Deep Learning, high-performance computing**	**Envisagenics'** SpliceCore platform integrates proprietary **machine learning algorithms, high performance computing, and RNA-splicing analytics** to identify disease-specific alternatively spliced RNA that will function as therapeutic targets.
EURETOS	**Machine Learning, Deep Learning, bioinformatics**	**Euretos** provides direct access to the cloud based discovery platform via user friendly application and also allows **integration of company proprietary data and public data in a secure environment.**
Exscientia	**Machine Learning, Deep Learning, bioinformatics, chemoinformatics**	The company uses ML for **predicting ADME, novelty, synthetic accessibility, pharmacology of molecules.**

Computational Methods Used by the Most Advanced AI Companies

Company	Computational methods used	Technology Abstract
Genialis	Machine Learning, Deep Learning	**Blending computational biology and AI-based methods**, Genialis merges and models data at the intersection of clinical and translational medicine.
GNS HEALTHCARE	Machine Learning, Deep Learning	**GNS Healthcare** AI technology **integrates and transforms a wide variety of patient data types into in silico patients** which reveal the complex system of interactions underlying disease progression and drug response.
healx	Machine Learning, NLP, symbolic AI, chemoinformatics, bioinformatics	**Healx** AI platform uses **natural language processing** to extract disease knowledge from published sources and to complement biomedical databases and proprietary, curated data.
IKTOS	Machine Learning, Deep Learning, cheminformatics	**Iktos** has invented and is developing a technology based on **DL for ligand-based de novo drug design**, focusing on multi parametric optimization (MPO)
Insilico Medicine	Deep Learning, GANs, GANs + Reinforcement Learning, symbolic AI, Machine Learning, chemoinformatics, bioinformatics	**Comprehensive DL pipeline**. Biology: **Signaling pathways, DNNs for target ID and HTS analysis.** Chemistry: **GANs-RL for novel molecule generation.**
KYNDI	NLP, Deep Learning, Machine Learning	**Kyndi** provides **leading artificial intelligence software** that can analyze long-form text and find actionable insights in a smarter, faster, and more explainable way.

Computational Methods Used by the Most Advanced AI Companies

Company	Computational methods used	Technology Abstract
MedChemica CREATING A STEP CHANGE IN MEDICINAL CHEMISTRY	**Machine Learning, chemoinformatics**	With a huge experience in **Lead Generation, Lead Optimisation and method development** the goal of the company is to accelerate the progress of our clients programmes.
nference®	**NLP, Deep Learning**	**nferX** uses state-of-the-art **Neural Networks for real-time, automated extraction of knowledge** from the commercial, scientific, and regulatory body of literature.
NuMedii	**Big data analytics; Deep Learning, Machine Learning**	**Discover connections between drugs and diseases at a systems level** by analyzing of millions of raw human, biological, pharmacological, and clinical data points.
NURITAS	**Deep Learning, Bioinformatics**	**Predict the therapeutic potential of food-derived bioactive peptides**. Allows researchers to: cost-effectively develop highly targeted treatments for specific diseases from natural food sources.
OWKIN	**Machine Learning, Federated Learning**	**Owkin** combines the **expertise in biology** and **machine learning** to fuel precision medicine. Owkin facilitates access to real-world data by therapeutic area through its data connect service.
Peptone	**Deep Learning (TensorFlow + Keras base)**	World's first **protein database** specifically for Deep Learning and AI applications **with full Keras™ and Tensorflow™ integration.**

Computational Methods Used by the Most Advanced AI Companies

Company	Computational methods used	Technology Abstract
PHENOMIC AI	Deep Learning, Reinforcement Learning	**Phenomic predicts which cells will survive chemotherapy** and **identifies compounds that selectively target** these resistant cells. It will then develop the compounds and bring them to market.
ProteinQure	Quantum Computing, Reinforcement Learning, Chemoinformatics	**ProteinQure** is combining quantum computing, reinforcement learning, and atomistic simulations to **design protein drugs.** They can design p**eptide-based therapeutics** and explore **protein structures** without crystal structures.
ReverieLabs	Evolutionary algorithms, Machine Learning	**ML-based structure based predictive models f**or potency and ADMET/PK properties of small molecules.
ReviveMed	Machine Learning, Deep Learning	**ReviveMed's** platform enables the **rapid, high-throughput, and cost-effective application of metabolic data** to discover new disease mechanisms for drug discovery and, simultaneously metabolomic biomarkers to identify which patients stand to benefit by targeting the disease mechanism.
STRUCTURA BIOTECHNOLOGY	Machine Learning (stochastic gradient descent and branch-and-bound maximum likelihood optimization)	**The cryoSPARC System™** enables high-throughput structure discovery of **proteins and molecular complexes** from cryo-EM data with help of machine learning.
XtalPi	Quantum physics; Machine Learning	**XtalPi's ID4** platform provides accurate predictions on the **physiochemical and pharmaceutical properties of small-molecule candidates for drug design, solid-form selection,** and other critical aspects of drug development.

15 Notable R&D Use Cases of AI Application in Biopharma

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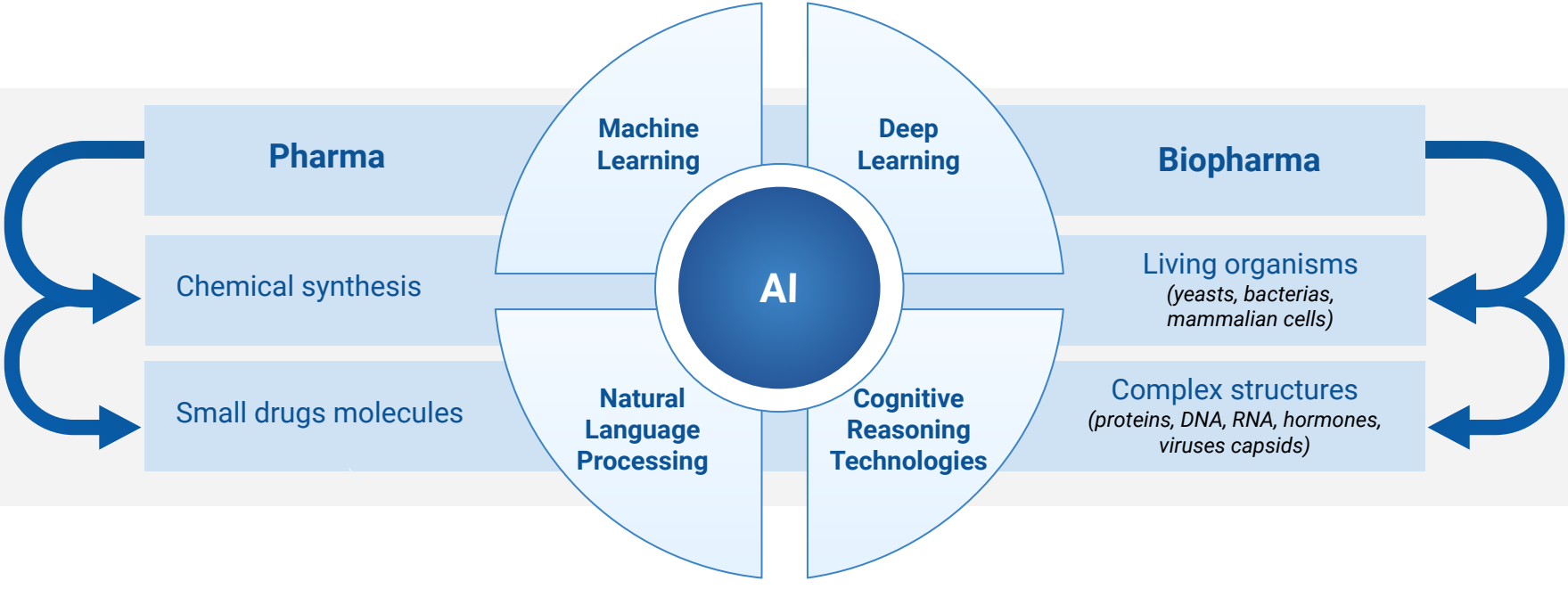
Introduction to Most Innovative R&D Approaches of AI in Biopharma

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

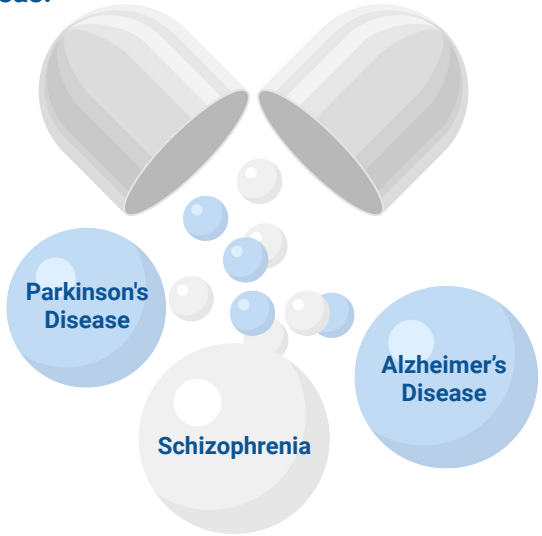


Most Innovative R&D Approaches of AI in Biopharma. Abbvie

AbbVie is a global, research-based biopharmaceutical company founded in 2013 following separation from Abbott. The company's mission is to use its expertise, dedicated people and innovative approaches to develop and market advanced therapies that address some of the complex and serious diseases.

AbbVie does have a confidential project listed with Atomwise. Also, in September 2016, together with its partner AiCure, AbbVie announced how its AI-based patient monitoring platform improved adherence in an AbbVie phase 2 schizophrenia trial.

Main focus areas:



The way AI is used:

- to visually confirm medication ingestion
- to increase medication adherence in patients
- to use data to assess effectiveness of treatment

Cooperation:

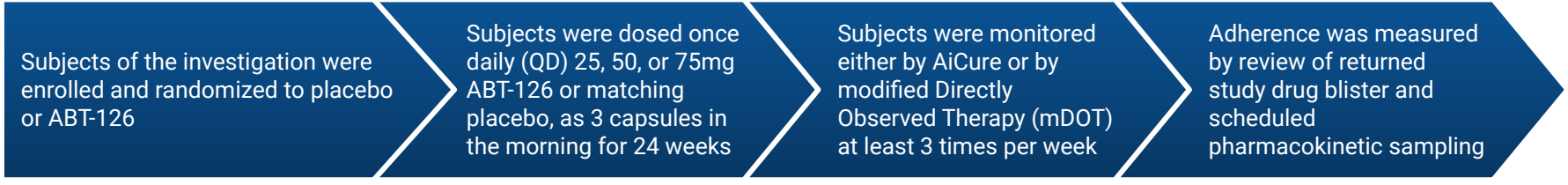
- Mission Therapeutics, AiCure, Atomwise, Calico Labs, BenchSci

Source: Crunchbase

How Abbvie Uses AI in R&D?

Abbvie and Mission Therapeutics collaboration is aimed at developing DUB inhibitors that promise to treat two currently incurable conditions, Parkinson's and Alzheimer's diseases. With over 50 million Americans struggling Alzheimer's and dementia, this AI partnership bringing treatment closer and hope for many.

1. **Abbvie** in cooperation with another AI-specialized company AiCure (clinically-validated artificial intelligence company that visually confirms medication ingestion on smartphones), announced that their study confirms that use of the AiCure Platform significantly increases medication adherence in patients with schizophrenia, as measured by drug concentration levels. The data was presented during the International Society for CNS Clinical Trials and Methodology (ISCTM) Scientific Sessions.



2. The sub-study was part of a larger Phase 2, multicenter, randomized, double-blind, placebo-controlled, dose-ranging, parallel-group, study in nonsmoking subjects with schizophrenia who were clinically stable. The AiCure platform was introduced in 10 of 31 US sites; subjects were monitored either by AiCure or by modified Directly Observed Therapy (mDOT) at least 3 times per week. In addition, adherence was measured by review of returned study drug blister and scheduled pharmacokinetic sampling.
3. Results: cumulative adherence, measured by study drug concentrations above the LLOQ (minimum required therapeutic level), were higher through 24 weeks for subjects monitored using the AiCure platform (89.7%) compared with subjects monitored using mDOT (71.9%). This research adds to the growing body of scientific evidence showing the advantages of using AI to increase statistical power and reduce sample size in clinical trials, thereby decreasing costs and accelerating drug development.

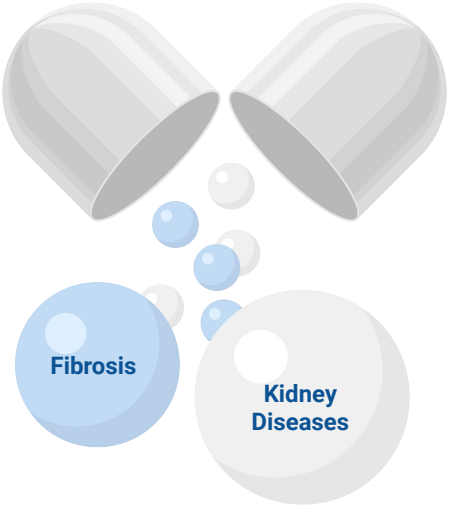
Source: AiCure, Blog.Benchsci, Healthcare Weekly

Most Innovative R&D Approaches of AI in Biopharma. AstraZeneca

AstraZeneca is a global, science-led biopharmaceutical company, whose medicines are used by millions of patients worldwide. Jim Weatherall, Vice President in AstraZeneca, said that data science and AI has the potential to transform the way they develop new medicines – turning yesterday's science fiction into today's reality with the aim of enabling the translation of innovative science into life-changing medicines.

AstraZeneca uses AI to combine information from multiple sources in order to draw more accurate conclusions than if science literature was analysed by human alone. AI also has the potential to find patterns in these graphs revealing previously unexplored hypotheses. Company claims that its Centre for Genomics Research is going to analyse up to two million genomes by 2026.

Main focus areas:



The way AI is used:

- to build disease understanding through knowledge graphs to integrate genomic, disease, drug and safety information
- to identify new targets for novel medicines
- for fast, accurate image analysis

Cooperation:

- Schrödinger, Mila, Melloddy, MLPDS Consortium, BenevolentAI, Roivant Sciences, Tencent

Source: AstraZeneca

How AstraZeneca Uses AI in R&D?

AstraZeneca focuses on the discovery, development and commercialisation of prescription medicines, primarily for the treatment of diseases in three therapy areas - Oncology, Cardiovascular, Renal & Metabolism and Respiratory. The company has turned to AI to cut development costs by improving the efficiency of repetitive tasks and engendering better-informed decision.

1. In AstraZeneca they using knowledge graphs - network of contextualised scientific data on genes, proteins, diseases and compounds and their relationship. AI also helps with this having the potential to find patterns in these graphs revealing previously unexplored hypotheses.The company's knowledge graphs integrate data of.

2. Discovering a potential drug molecule requires several years of detailed scientific research. AI is enabling us to rapidly generate novel ideas for potential treatment molecules using predictions based on large data sets. Having identified promising molecules, the next step is to synthesise the them in the laboratory. AI is starting to help here too – the science of synthesis prediction is rapidly evolving and scientist will soon be able to use AI to help deduce the best way to make drug molecules in the shortest time.

3. AI systems are trained to assist pathologists in analysing samples accurately and more effortlessly. This has the potential to cut analysis time by over 30%. For one of their AI systems, they implemented an approach inspired from how some self-driving cars understand their environment. They trained the AI system to score tumour cells and immune cells for a biomarker, called PD-L1, which has potential to help inform immunotherapy-based treatment decisions for bladder cancer.

Source: AstraZeneca, TechCrunch

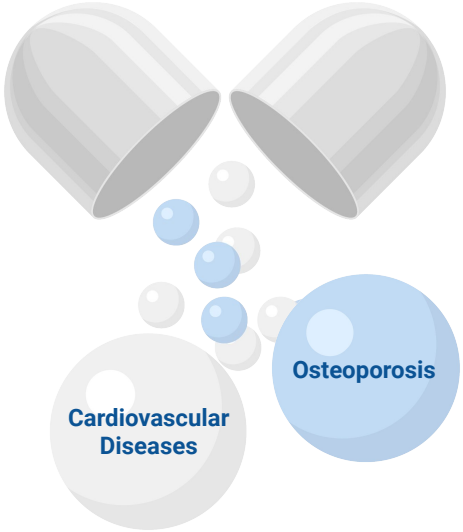
Most Innovative R&D Approaches of AI in Biopharma. Amgen

Amgen is one of the world's leading biotechnology companies committed to unlocking the potential of biology for patients suffering from serious illnesses by discovering, developing and manufacturing innovative human therapeutics.

AI is one of a series of emerging digital capabilities that are applied by Amgen.

Other technologies that company is leveraging include digital automation, natural language processing. Taken together, they do a whole host of activities across the company — from drug discovery and patient identification to optimized interactions with physicians.

Main focus areas:



The way AI is used:

- to boost the accuracy of risk predictions
- to provide personalized approach to patient care
- to support compliance via real-time answers with accuracy and consistency
- to use data to determine the most effective treatment

Cooperation:

- Owkin

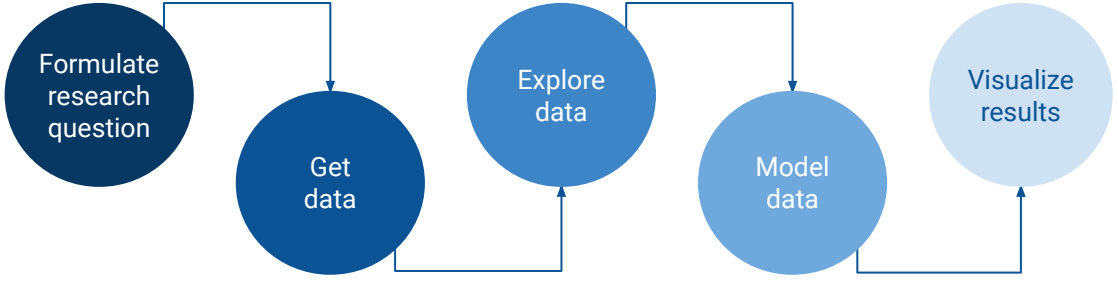
OWKIN

Source: Wired

How Amgen Uses AI in R&D?

Amgen is piloting a process using AI that has the potential to greatly enhance its ability to find patterns in manufacturing deviations and to prevent their recurrence. The AI tool will replace a manual, labor-intensive process with one that can look across large data sets and find correlations between obscure signals and events which the previous system could have missed.

1. While large company manufactures, purifies, and packages biotech drugs, a huge amount of diverse data is generated, not all of which is digitized. The focus of Amgen is the application of data science specifically in quality operations, using a data science process:



Quality data sciences creates solutions that unlock and leverage data. These solutions will efficiently provide insights and intelligence for the Quality Operation. This involves:

1) Ensuring data access; 2) Application of appropriate analysis methods to unlock information; 3) Meaningful visualisation.

2. Amgen have created a project team to look for a system algorithm that could replicate and perhaps improve upon the manual process. The goal was to build a product that could be deployed across the manufacturing network. Using an **agile development approach** and **natural language processing (NLP)** tools, the team developed a consistent algorithm that is able to reasonably replicate the manual process.

NLP is described as an AI technology that turns text into numbers, which can be read by a computer and used to identify similar records. Each record has a series of numbers associated with it that can be analyzed to create similarity scores. The records can then be clustered together. Those clusters can then be given to an subject matter expert, who can decide if there is trending and if action should be taken. Feedback can then be given to the algorithm, which can be adjusted.

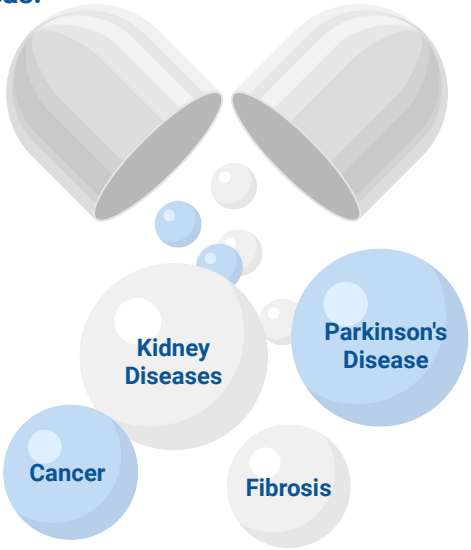
Source: Wired, Pharmaceutical Online

Most Innovative R&D Approaches of AI in Biopharma. BenevolentAI

BenevolentAI is the global leader in the application of AI for scientific innovation. The company's aim is to accelerate the journey from inventive ideas to medicines for patients. BenevolentAI integrates AI technologies at every step of the drug discovery process: from early discovery to late stage clinical development.

The company has developed the Benevolent Platform™ — a leading computational and experimental discovery platform that allows scientists to find new ways to treat disease and personalise medicines for patients. The Benevolent Platform™ focuses on three key areas: Target Identification, Molecular Design and Precision Medicine.

Main focus areas:



The way AI is used:

- to collect more diverse data
- to identificate specific drug target
- in molecular design
- in patient stratification

Cooperation:

- Neuropore Therapies, Novartis, AstraZeneca

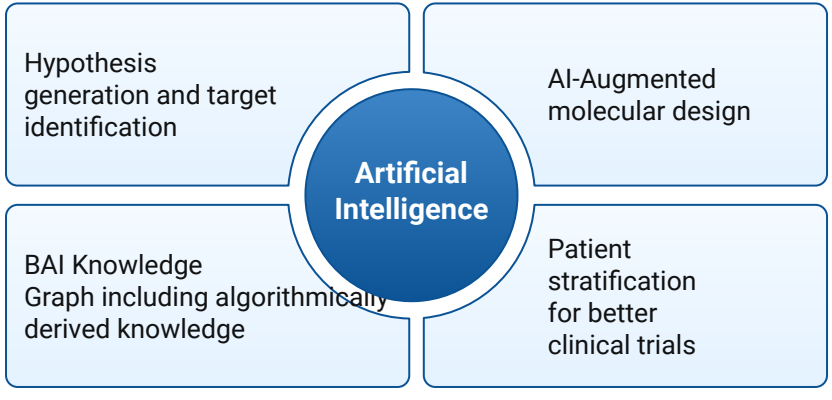
Source: Wired, Benevolent.ai

How BenevolentAI Uses AI in R&D?

BAI

The **Benevolent Platform™** of computational and experimental technologies and processes draws on vast quantities of mined and inferred biomedical data and is built by their world-class scientists, researchers, and technologists, working side-by-side, to improve and accelerate every steps of the drug discovery process.

1. BenevolentAI uses AI to mine and analyse biomedical information, from clinical trials data to academic papers. The company's approach:



2. BenevolentAI has spent the last five years developing a knowledge pipeline that pulls data from various biomedical data sources and **curates and standardizes this knowledge via a data fabric**. This is fed into their proprietary **knowledge graph** which extracts and contextualises the relevant information. The knowledge graph is made up of a vast number of contextualised, machine curated relationships between diseases, genes, drugs and with over 20 types of biomedical entities.
3. Relation inference AI models help to predict **potential non-obvious disease targets** that may be overlooked. Their specific expression based models help to identify proteins, genes that express differently in a disease and healthy cell.
4. By leveraging advanced AI, the **EvoChem** product designs de novo compounds based on multiparametric optimisations with a scoring function that factors in all the properties the company is seeking to optimise for that molecule.
5. Company applies ML models to identify patient groups by the molecular signature of their disease and design, allowing to run faster clinical trials.

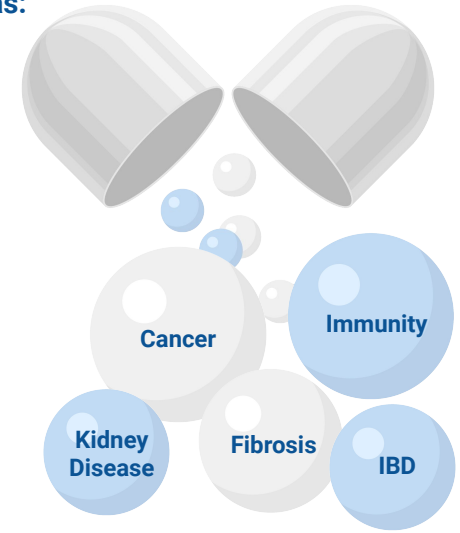
Source: Wired, Benevolent.ai

Most Innovative R&D Approaches of AI in Biopharma. Insilico Medicine

Insilico Medicine, Inc. is a bioinformatics company located at the Emerging Technology Centers at the Johns Hopkins University Eastern campus in Baltimore. It utilizes advances in genomics, big data analysis and deep learning for in silico drug discovery and drug repurposing for age-related diseases. The company pursues internal drug discovery programs and geroprotector discovery and provides services to pharmaceutical companies.

Combining genomics, big data analysis, and deep learning, the company has been using artificial intelligence algorithms to potentially discover the next world-changing drug.

Main focus areas:



The way AI is used:

- to find cheaper and faster ways to discover drug molecules
- to find new biological targets for existing drugs
- to validate the targets, using novel chemistry
- to predict clinical trial outcomes

Cooperation:

- BioTime, Juvenescence AI Limited , Bitfury, Fosun Pharma

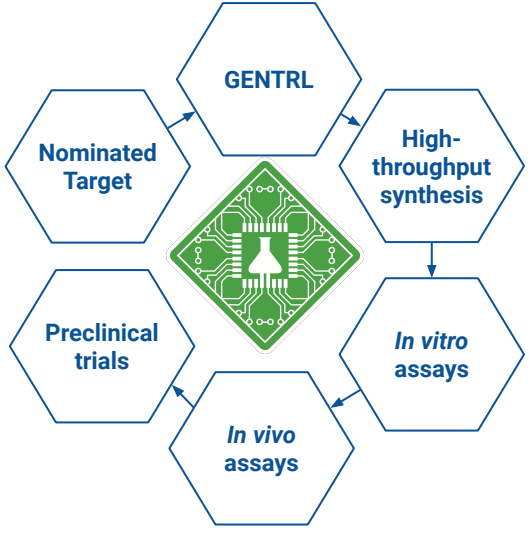
BIOTIME JUVENESCENCE.AI Bitfury FOSUNPHARMA 复星医药

Source: Eurekalert, Insilico

How Insilico Medicine Uses AI in R&D?

Next-generation AI developed by Insilico Medicine can be used to validate, assess and improve the quality of biological experiments as well as learn using large volumes of heterogeneous data without human intervention. Multiple new methodologies including the feature importance, deep feature selection and deep pathway analysis among the others can provide the biologically-relevant interpretation by AI systems.

1. Since 2016, Insilico Medicine researchers have been working to get GANs (Generative Adversarial Networks consisting of two distinct neural networks) to "invent" new molecules with drug-like properties. In 2017, they combined it with another type of groundbreaking AI in the form of Reinforcement Learning. Reinforcement Learning is built around game-like situation where AI trained by trials and errors. It helps to train algorithms to serve for autonomous tasks.



2. Insilico Medicine has developed GENTRL (Generative Tensorial Reinforcement Learning), a new artificial intelligence system for drug discovery that dramatically accelerates the process from years to days (from 3 years to 21 days before first synthesis and trials). In the industry's first successful experimental validation of such AI technology for drug discovery in cells and animals, Insilico successfully tested the technology by creating a series of entirely new molecules capable of combating disorders like fibrosis.

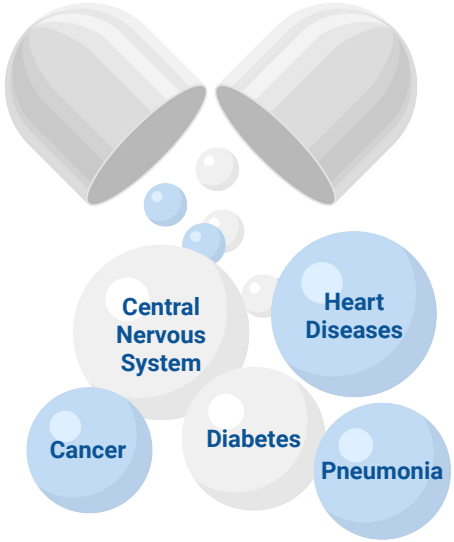
3. The system bucks the standard brute-force approach for AI drug development, which involves screening millions of potential molecular structures looking for a viable fit, in favor of a creative AI algorithm that can imagine potential protein structures based on existing research and certain preprogrammed design criteria. Insilico's system initially produced 30,000 possible designs, which the research team whittled down to six that were synthesized in the lab, with one design eventually tested on mice and exhibited promising results.

Source: Biospace, Digital Trends, Business Insider

Most Innovative R&D Approaches of AI in Biopharma. Sanofi

Sanofi is a healthcare company engaged in the research, development, manufacturing, and marketing of innovative therapeutic solutions. It covers areas such as diabetes, vaccines, small molecule drugs, consumer healthcare, etc. Its products includes prescriptions and over-the-counter drugs for thrombosis, cardiovascular disease, diabetes, central nervous system disorders, oncology and internal medicine, vaccines.

Main focus areas:



The way AI is used:

- to provide remote (ehealth) connection between patients and doctors
- to diagnose diseases at early stage
- to decentralize clinical trials
- to improve marketing strategies

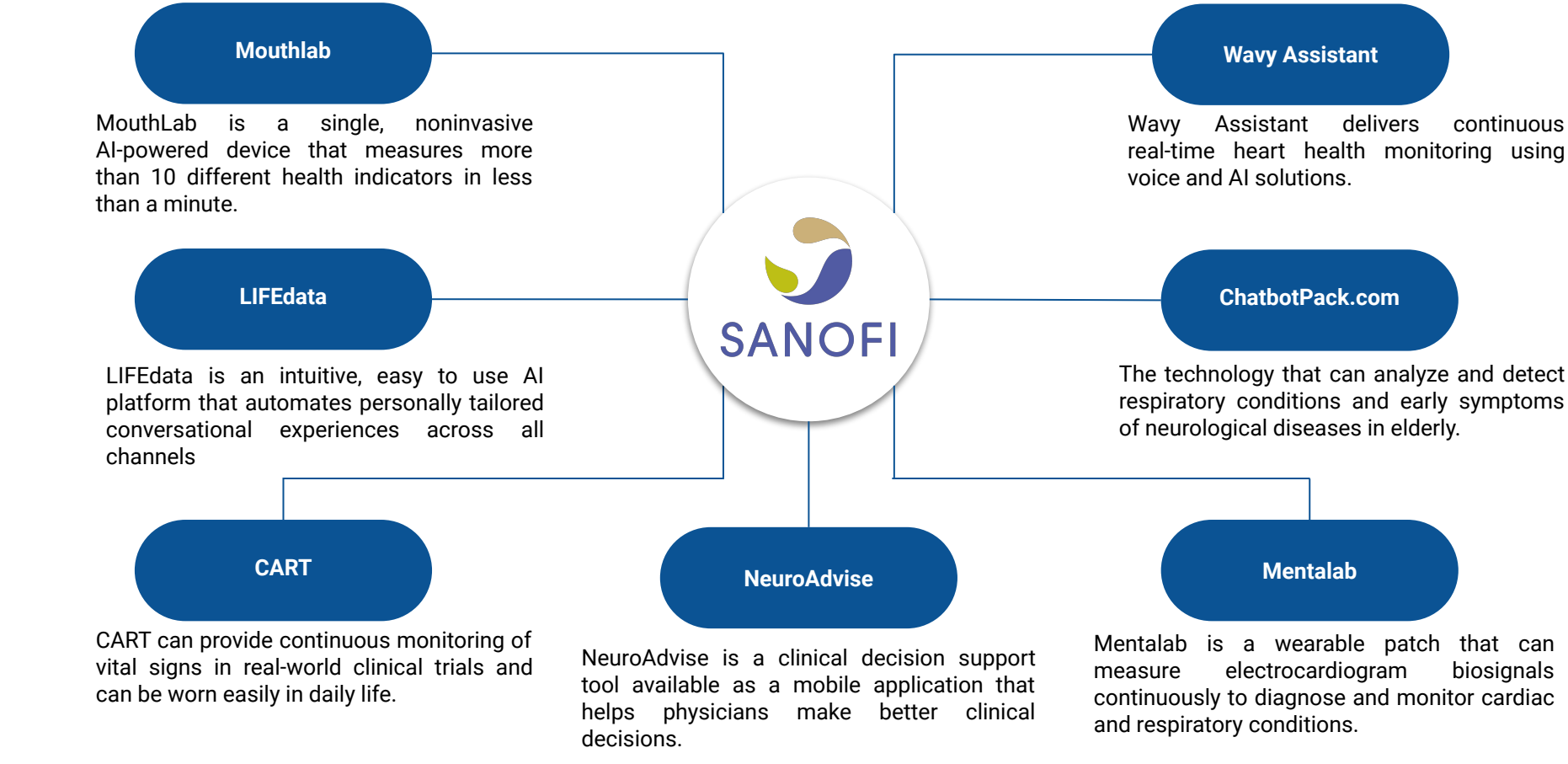
Cooperation:

- GSK, DNDi

Drugs for Neglected Diseases *initiative*

Source: Crunchbase

How Sanofi Uses AI in R&D?



Source: Sanofi

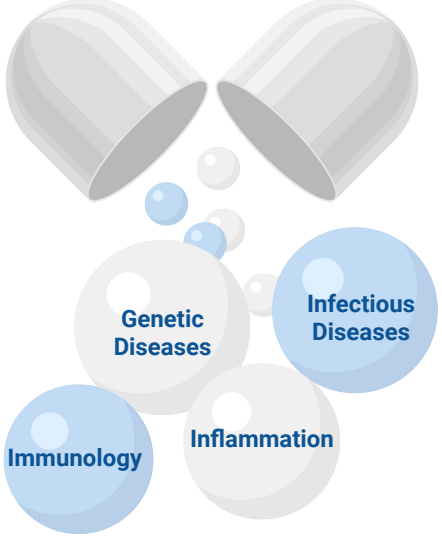
Most Innovative R&D Approaches of AI in Biopharma. Recursion Pharmaceuticals

Recursion Pharmaceuticals is a digital biology company, which applies AI for the development of its drug discovery platform and pipeline.

The Recursion Pharmaceuticals' integrates technological innovations across biology, chemistry, automation, data science and engineering to industrialize drug discovery.

The company currently has 4 clinical stage programs and 6 preclinical candidates in its pipeline.

Main focus areas:



Recursion Operating System ('OS') consists of:

- **Infrastructure Layer** is a highly synchronized network created to design, execute, aggregate, and store biological and chemical data
- **Recursion Data Universe** is a high-dimensional biological and chemical dataset spanning multiple different data modalities
- **Recursion Map** is a software application designed to process and translate data from the Recursion Data Universe

Cooperation:

- Bayer, Roche

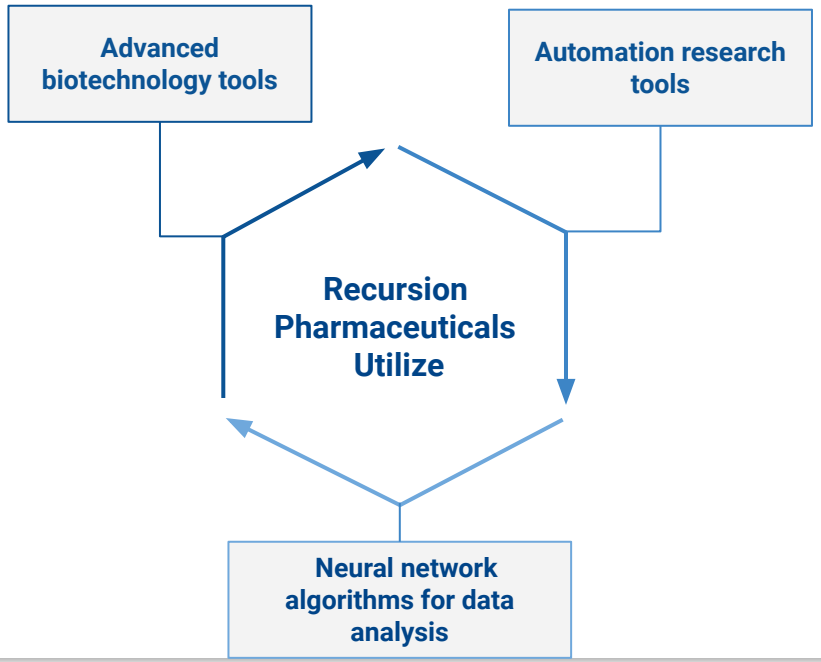
Roche

BAYER

How Recursion Pharmaceuticals Uses AI in R&D?

The **Recursion Pharmaceuticals** platform is a continuous, iterative loop of "biology and bits" which combines wet lab biology experiments that are executed automatically with machine learning algorithms computing the results in a cloud.

The company creates drugs for two categories of diseases: where the cause of the disease is well-defined and where are no approved therapies, or there are significant shortcomings with existing treatment paradigms.



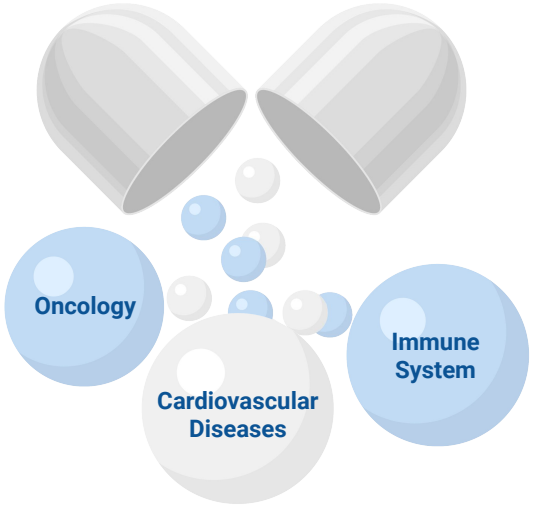
To generate its datasets Recursion Pharmaceuticals is primarily focused on:

- **Advanced biotechnology tools** such as CRISPR genome editing and synthetic biology
- **Reliable automation** of complex laboratory research at unprecedented scale using advanced robotics
- **Iterative analysis** of, and inference from, large, complex in-house datasets using neural network architectures
- **Increasing elasticity** of high performance computation using cloud solutions

Most Innovative R&D Approaches of AI in Biopharma. OWKIN

Owkin is a predictive analytics company that was founded based on the belief that medical research must be collaborative, inclusive and protect privacy. Today, Owkin is building a global research network leveraging federated learning that brings data scientists, physicians, researchers and pharmaceutical companies representatives together on a research platform that ensures data security and privacy. Owkin is developing AI tools for medical researches to give patients access to safer and more effective therapies.

Main focus areas:



The way AI is used:

- to investigate the mechanisms which cause a different drug efficacy from patient to patient
- to enhance the drug development process
- to identify the best personalized drug candidates for the patient to improve treatment outcomes

Cooperation

- Roche

Roche

How Owkin Uses AI in R&D?

Owkin has created a unique research platform, and a portfolio of AI models and solutions.

The **Owkin Loop** is the heart of the **Owkin Research Platform**: it connects medical researchers with high-quality datasets from leading academic research centers around the globe. **Owkin Loop** is powered by the two main components of **Owkin's Software Stack**: **Owkin Studio**, their machine learning platform, and **Owkin Connect**, their federated learning framework.

Owkin AI models

Owkin created a catalog of 30 live diseases models and has 40 additional models in the pipeline.These models differ from traditional black box models because they are built using interpreted AI, which allows the company to move further in research and identify biomarkers responsible for predictions. The discovery of new multimodal biomarkers is essential to identify new biological targets, optimize the design of clinical trials using patients subgroups, and identify patients eligible for a particular treatments.

Data Enrichment Models

Designed for translational researchers and pathologists, these models link histology to molecular markers.

Outcome Prediction Models

Designed for translational researchers, development executives, and commercial staff, these models can be implemented throughout the clinical drug development process to improve clinical trial design and evaluation, and to optimize product strategy.

Patient Identification Models

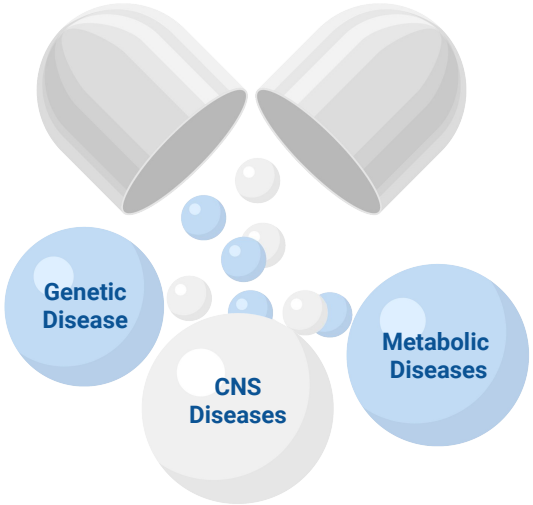
Designed for commercial and precision medicine leaders, these models help to identify patients who will benefit from a particular treatment.

Most Innovative R&D Approaches of AI in Biopharma. Deep Genomics

Deep Genomics uses artificial intelligence to build a new genetic therapy. They create steric blocking oligonucleotides. It is a short stretch of special DNA or RNA that attaches to a specific place in the RNA. By doing so, they modify the translation process. They do not integrate into the genome and do not make any permanent changes to the DNA.

The Workbench of Deep Genomics mines RNA biology data, processes it, identifies novel targets, and evaluates thousands of possibilities to identify the best therapeutic candidates.

Main focus areas:



The way AI is used:

- target discovery: they examine all the possibilities and identify disease-causing mutations and ways of fixing the genetic problem
- therapy design: the AI assesses hundreds of thousands to millions of different potential targeted therapies to find the ones that are most likely the best. These are then verified in the wet-lab
- to produce On-target and genome-wide off-target effect data, cell viability data and animal toxicity data

How Deep Genomics Uses AI in R&D?

Deep Genomics use its AI Workbench to discover and develop genetic therapies with an increasing success rate.

Genetic Medicines. Deep Genomics' AI Workbench enables them to efficiently find drugs with desired properties. The company is focussing on the development and marketing of antisense oligonucleotide therapy that target the disrupted genes. Deep Genomics is predicting altered molecular phenotypes, such as changes in gene expression, impaired splicing, and protein truncation that may caused genetic diseases.

The **Deep Genomics platform** is able to produce On-target and genome-wide off-target effect data, cell viability data and animal toxicity data for every compound. They also collect data related to biomarkers. All data is processed using feedback loops.

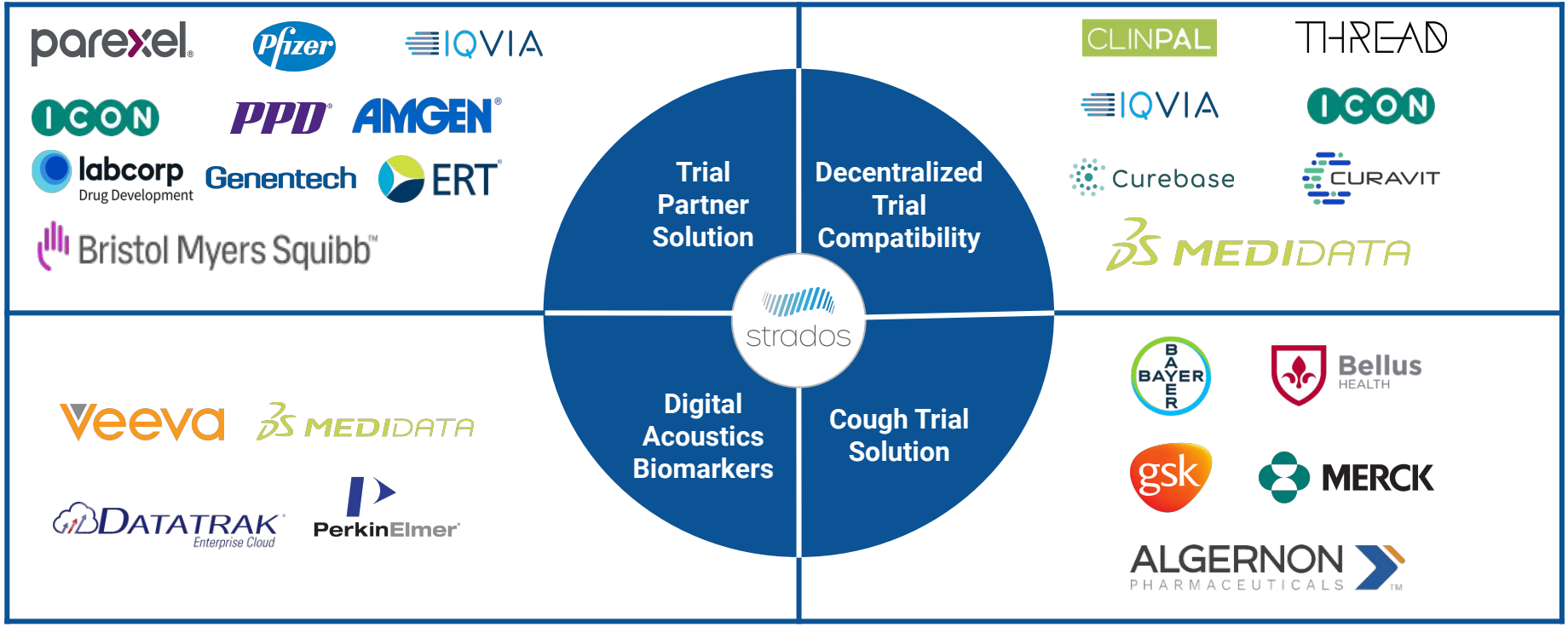
The **Deep Genomics' research works** have appeared in Science, Nature, Nature Genetics, Nature Medicine, Nature Methods, Proceedings of the IEEE, NIPS, Bioinformatics, RECOMB and ISMB.

Project Saturn has proved the utility of Deep Genomics' AI platform

In Project Saturn, the Deep Genomics team used their platform to evaluate over 69 billion oligonucleotide molecules against 1 million targets *in silico*, to generate a library of 1000 compounds that were experimentally verified to manipulate cell biology.

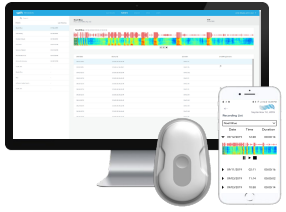
Most Innovative R&D Approaches of AI in Biopharma. Strados Labs

Strados Labs enters the Pharma and Life Science market with a **Respiratory Management Solution** that includes the only FDA-cleared, RESP biosensor which acquires lung sound acoustics wireless and hands-free, making it a perfect fit for clinical research to measure patient response to new drugs by objectively collecting coughs and other lung sounds discreetly, comfortably, and securely in a streamlined way, while having access to data for post-processing and analysis.



*Listed companies are industry leaders and prospects for Stradoslabs

How Strados Labs Uses AI in R&D?



Strados Labs — a respiratory management solution, which brings innovation at the intersection of lung biomarkers, patient centricity, and machine learning. The industry of life sciences can largely benefit from the enhancement of pulmonary care monitoring capabilities provided by Strados Labs to gain insight into patient drug response by analysis of longitudinal lung acoustics.

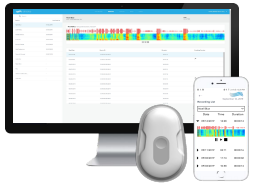
Data Collection Capacity	Patient Privacy & Security	Real-Time Data Analysis	Patient Centricity	Longitudinal Lung Data
220 hours of continuous data collection without patient intervention of objective lung sounds and respiratory dynamics while having access to data for post-processing and analysis.	Noise cancellation is applied to enhance the signal to noise ratio and eliminate speech discernibility while being HIPAA compliant with an end to end encryption.	Data collected via RESP is uploaded automatically to the Strados Cloud to allow assessment of recordings timely with identification of adventitious breath sounds including respiratory dynamics with ML algorithms.	Wireless, non invasive biosensor that monitors, records and stores every lung sound. That translates into longer wear times and an astounding 99.59% patient compliance.	Identification of wheeze, cough, and CABS detection gives the objective measurement of these changes over time on a patient and population basis with an ability to differentiate cough types in addition to frequency.

How Strados Labs Uses AI in R&D?

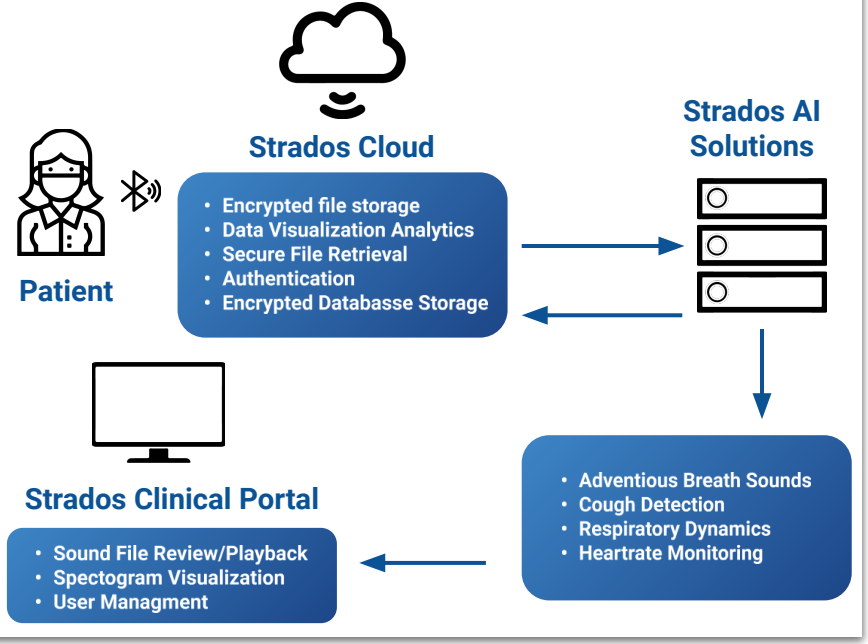
The **Strados Respiratory Management Solution** is the world's first FDA-cleared lung sound platform with a proprietary wireless biosensor, **RESP**, that is passive, patient-friendly, and clinically validated to acquire lung sounds in the real world.

Today **Strados Labs** has a unique opportunity to stand as a leader in Respiratory Health: their clinically validated bioacoustic library of sounds and AI engine is the world's largest entirely hands-free, clinical-grade dataset enabling **Strados Labs** to be the standard bearer of acoustic digital biomarkers for clinical research and respiratory care globally.

For instance, **Strados Labs RESP** fits perfectly into decentralized trials allowing remote patient access by unlocking lung sound data and putting it into the hands of the entire research team via the cloud. Making decentralized respiratory trials scalable and able to develop entirely new insights about respiratory status without episodic patient interaction.



Strados Cloud: company's passive and longitudinal bioacoustics insights allow them to build a more complete picture of the subject's respiratory status leading to better trial outcomes.



How Standigm Accelerates Drug Discovery using AI

Standigm's AI solution **Standigm ASK™** provides **novel targets** perfectly fit to a customer's research context within two weeks.

- **Novel target Identification**
- Query: **Disease**
- **Stangdim ASK™**
- Output: **Novel Target**

Standigm's optimized workflow **AI system** can generate **multiple First-in-Class** compounds within seven months.

- **Integrated workflow AI**
  - **Novel target Identification (Stangdim ASK™)**
  - **Novel compound design (Stangdim BEST™)**

Novel Targets Identification

First-in-Class Lead Generation

Standigm
The workflow AI drug discovery company

Cataloged Assets

Tailored Partnership Models

Standigm has an exceptional reservoir of ready-made in-house **therapeutic assets**, which are as attractive as to meet customer's pipeline needs.

Therapeutic areas of assets:

Cancer

Parkinson's Disease

NASH

Mitochondrial Disease

Standigm has **tailored partnership models** perfectly fit to a customer's needs, from licensing of AI platform and assets to AI solution providing.

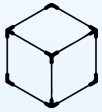
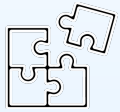
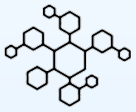
Standigm's partnership models:

1. Licensing of Standigm's AI Platform (Standigm ASK™, Standigm BEST™)
2. Licensing of First-in-class assets driven by Standigm's AI platform
3. Providing Standigm's AI solution

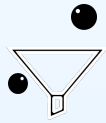
How Standigm Accelerates Drug Discovery using AI

Standigm is a workflow AI-driven drug discovery company headquartered in Seoul, South Korea and subsidiarized in Cambridge, UK. Standigm has proprietary AI platforms encompassing novel **target identification to compound design**, to generate commercially valuable drug pipelines. The company has established an early-stage drug discovery workflow AI to generate First-in-Class lead compounds within seven months. o date, Standigm is running 42 in-house or collaborative pipelines for drug discovery using the workflow AI technology. One of the company's pipelines is expected to enter a pre-clinical stage in 4Q 2021.

Standigm BEST™ is a novel **compound generation platform**, which can investigate lead compounds whenever target or ligand information is lacking or enough.

Database	Hit ID	Hit to Lead	Lead Optimization
			
Deep learning chemical space	**Securing activity**	**Securing novelty**	**Druggability optimization**
150-dimensional vector space which learned various compound properties	Accurate prediction of binding	New scaffold with various structures	Mainly-based substructural variation 3D-based druggability prediction

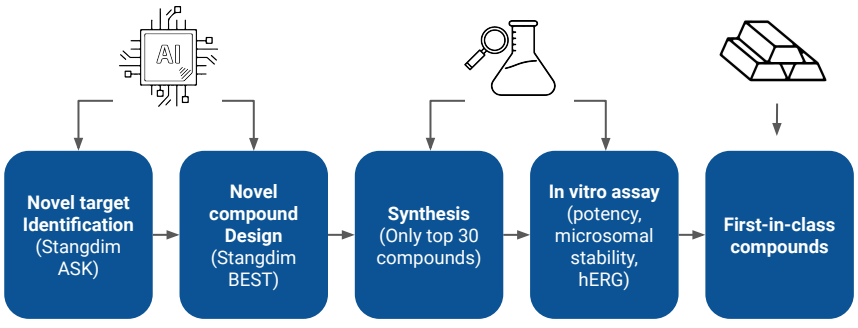
Standigm ASK™ is a customizable, AI-aided **drug target identification platform**, prioritizing disease-target relationships and providing evidence-based results through an interactive user interface.

Graph DB	Prioritization Algorithm	Multi Filters	Novel Target Selection
			
Biomap (Knowledge + Omics)	**Target prioritization based on disease-target-association scores**	**Screening attractive target's with multi filters**	**Novel Target Selection**

How Standigm Accelerates Drug Discovery using AI

Standigm Releases First-in-Class Compounds within 7 Months

Standardized workflow



7 months (rather than years/ Standigm)

30 months (Traditional Approach)

Featured Partners

아주대학교병원 Ajou University Hospital · Hanmi · Institut Pasteur Korea · KIST Korea Institute of Science and Technology · MILNER THERAPEUTICS INSTITUTE · inno.N · SK chemicals · SAMJIN · Fibrosis Control Center

Standigm made the hit-to-lead stage with a cancer Target A within 7 Months

Standgim BEST™ → **In Vivo & Tox** / **Preclinical Candidate** → **Lead Optimization**

1M	1M	1M	1M
Data Collection, Analysis* and Model Validation**	1st Round Commercial Compounds (Library of x million)	2nd Round Commercial Compounds & Hit-Based Design	SAR-Based Novel Design

Collaborator (Pharma Company): 3M (Hit Compounds)

Target Proposal (Patent Analysis)	Purchasing Compound, Assays, Hit Screen	Chemical Synthesis, Assays, Hit Selection	Chemical Synthesis, Assays, (In Vitro & In Vivo), Lead Selection

*Data Analysis – Binding site analysis using protein structure
**Model Validation – Validation of activity prediction models: ChemMap-based, 2D structure QSAR-based, Simulation-based and Ensemble-based methods

Most Innovative R&D Approaches of AI in Biopharma. Antiverse

Antiverse is a new type of antibody discovery company accelerating drug development. The Antiverse platform exists at the intersection of structural biology, machine learning and medicine to enable breakthroughs to happen more quickly and cost-effectively.

Antiverse **prevents diversity loss** during amplification to uncover more diverse and rare antibodies.

Traditional in vitro screening:

10^{10} antibodies

↓

3 amplification rounds

↓

10 antibodies

Antiverse discovery:

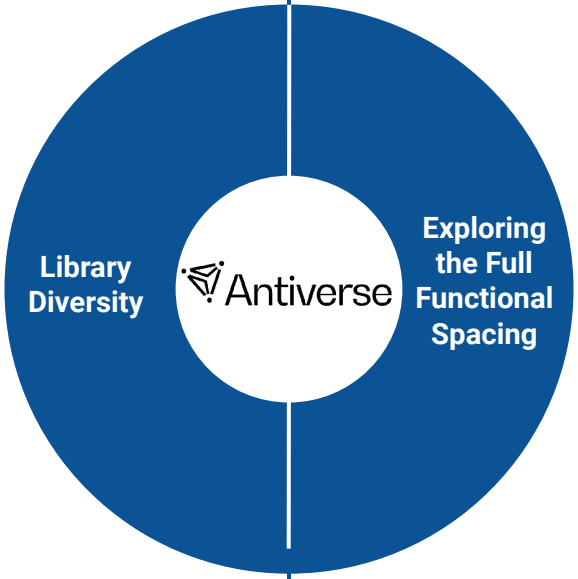
Antigen-antibody database

↓

AI-augmented screening

↓

96 antibodies



Antiverse **provides more candidates** by analysing NGS data, clustering on multi-dimensional space, and selecting based on sequential and structural grouping. The generative module **offers new sequences** and gives you options that haven't even been considered.

Antiverse AI-Augmented Discovery:

Antigen-antibody database

↓

Recovery Module | Generative Module

↓

96 antibodies

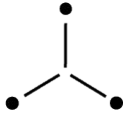
How Antiverse Engineers the Future of Drug Discovery

Antiverse

Antiverse is recognized as one of the top biotech startups in the UK with our antibody discovery service already in use by big pharma. The main feature of the company is **10x Diversity with AI-Augmented Drug Discovery**.

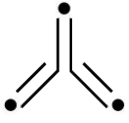
Existing antibody discovery methods are well-developed and often effective at discovering binders. But when there is a need to find the best possible candidate, or when finding a suitable candidate is hard with current methods, the options are **limited** and often **costly**.

Antiverse uses **next-generation sequencing (NGS)** to extract more data from existing workloads. The **AI-Augmented Drug Discovery platform** and trained models analyse the statistics gained from thousands of experiments. These outputs are compared against known data in order to select best candidates.



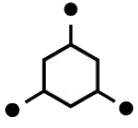
Target Selection

Antiverse provides targeted options in order to focus on testing safely once there are too many antibody-antigen binding options.



Binder Recovery

Antiverse can help to find sufficient potential binders that can be missed by conventional methods.



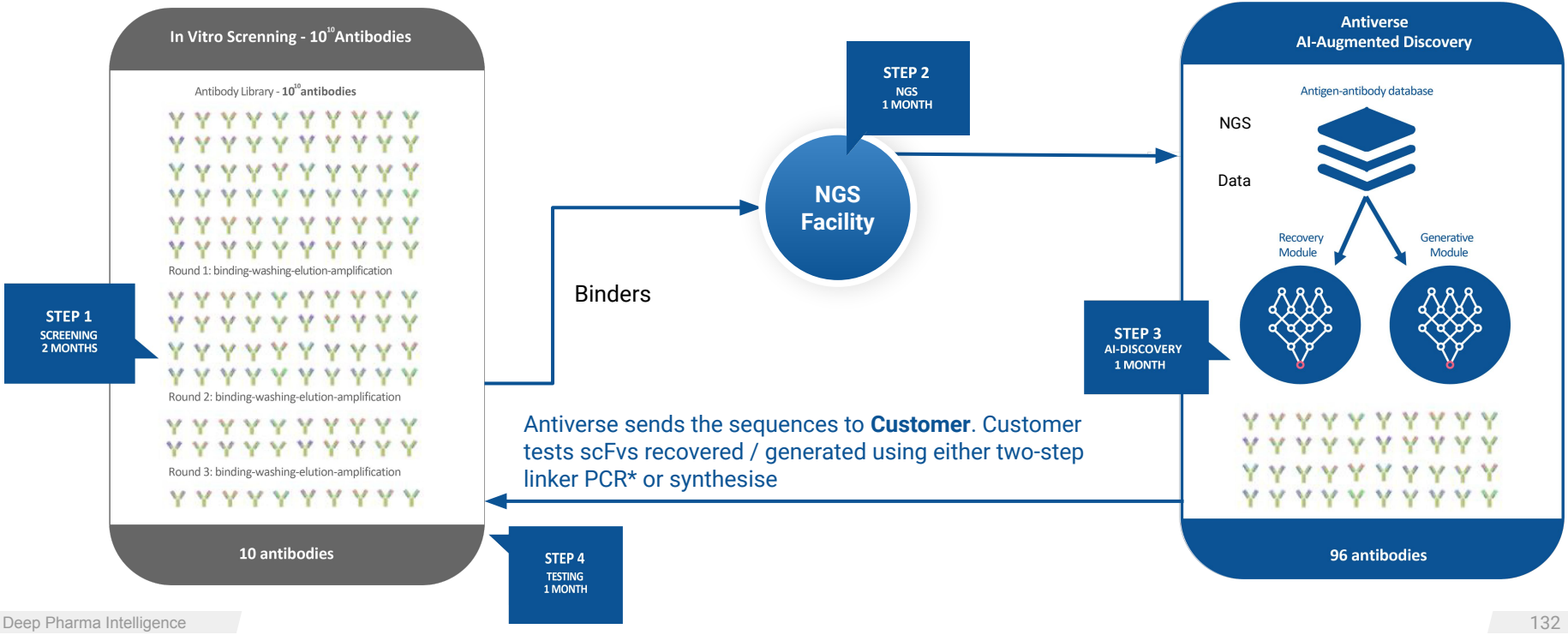
Binder Customisation

Antiverse can generate new binder variants that will be sufficient for clients purposes.

How Antiverse Uses AI in R&D

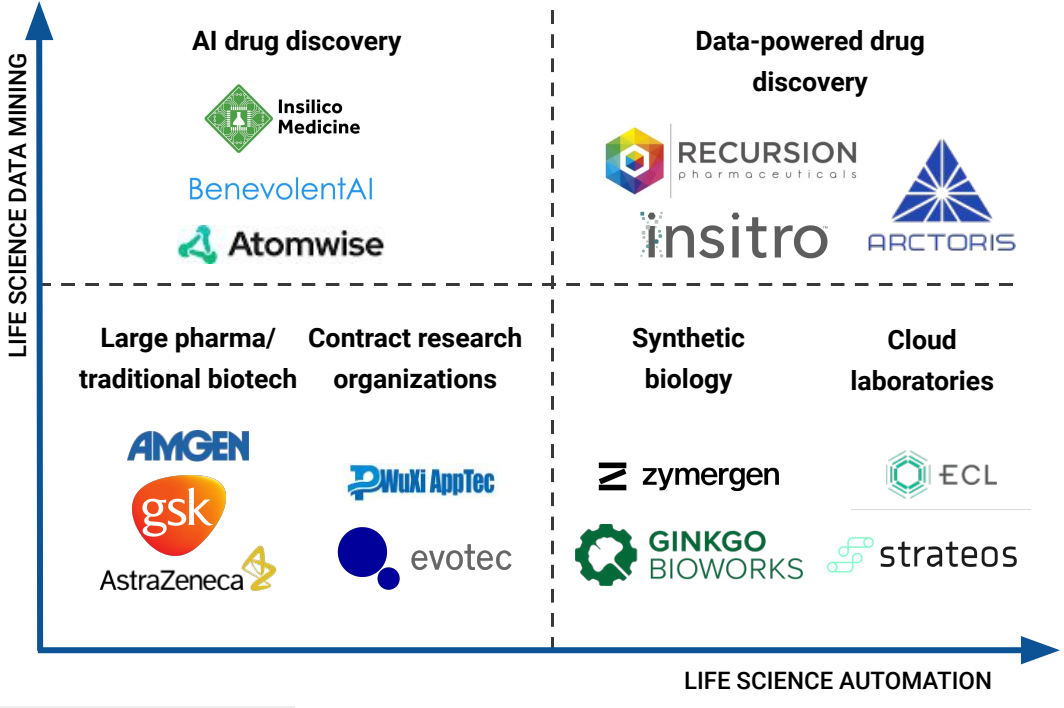
Antiverse

The **Antiverse AI-ADD** system found each and every cluster identified by other methods, plus more. These additional clusters contained rare and unique sequences.



The Drug Discovery Ecosystem is Evolving Rapidly - And Data is at the Core.

Drug discovery is undergoing massive and rapid change - the rise of Artificial Intelligence and Machine Learning for Drug Discovery and the evolution of robotics-centric companies in the biomedical research space has enabled a new generation of companies to emerge: **data-powered drug discovery companies** that combine automation and data science.



Arctoris is one of them: a biotech platform company with operations in Oxford, Boston, and Singapore, leveraging its **fully automated platform** for drug discovery.

The company was founded by an oncologist and a medicinal/ synthetic chemist, with the goal to accelerate the discovery and development of new therapies by harnessing the power of technology and combining it with deep industry expertise.

The **core thesis** of the company is that better data leads to better decisions, and that in order for drug discovery programs to develop and meet the next milestone faster and with higher chance of success, the underlying data must be rich, reliable, and reproducible. According to Arctoris, **the status quo is no longer enough**: in order to develop the best drugs, industry leaders have to rethink how they can improve their decision-making, powered by better data.

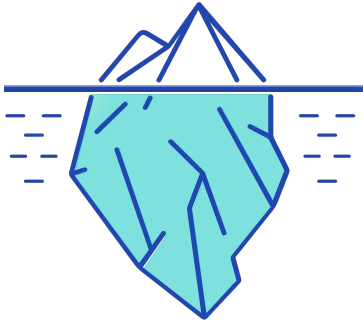
Having developed a suite of proprietary technologies across robotics and data science/ AI/ ML, Arctoris is a leader in this **new and rapidly evolving field**.

How Do Robotics and AI/ ML Synergize in Drug Discovery?

The greatest challenge in AI-driven and ML-powered drug discovery is access to well structured, fully annotated, reproducible and robust data. **Arctoris** leverages the power of robotics to generate vast amounts of **ML-ready data that enable better decisions** - thereby significantly accelerating timelines from target to hit, lead, and candidate.

INDUSTRY-STANDARD DATA GENERATION & PROCESSING

- Widespread lack of reproducibility
- Unclear reagent and cell line provenance
- Inconsistent use of methods & protocols
- Human error & variability
- Only collection of high-level results data
- Highly fragmented file & storage systems



ARCTORIS-ENABLED DATA GENERATION & PROCESSING

- Strict adherence to automated protocols
- Fully verified reagents and cell lines with complete audit trails
- Reproducible results data in standardized structure
- Additional collection of rich research meta-data
- Secure & convenient data storage & access
- Advanced assay performance monitoring

Both quality and speed are achieved by combining precision robotics with a unique data science platform and world-class drug discovery expertise from biotech and pharma veterans.

Arctoris tracks all experimental outputs in full depth, including the capture and analysis of extensive metadata – temperature, humidity, CO_2, reagent provenance and batch ID among many others. At the same time, the platform enables automated QA/ QC processing, applying statistical tools to ensure full reliability and validity of all results.

Thereby, **Arctoris** ensures **superior data to be generated in accelerated timeframes**, leading to better decisions taken earlier - in human-powered but especially in AI/ ML-driven programs, thanks to training of AI models with the best possible data.

Taken together, **Arctoris** has developed a **unique technology platform** based on robotics and data science that powers drug discovery programs both in the company's internal pipeline and in partnerships with biotech and pharma companies worldwide.

The Arctoris Platform: Leveraging Robotics & Data Science from Target to Candidate.

- Analysis of target expression and target half-live by quantifying protein turnover and route to degradation
- Investigation of target function (changes in phenotype, pathways, gene expression, etc.) via cell-based and molecular biology readouts
- Advanced insights into effects of target modulation by employing complex model systems such as organoids, primary cells, etc.

- Machine-learning guided screening set selection and hit evolution
- *In silico* and *in vitro* screening and profiling
- Biophysical screening/ profiling and FBDD
- Rapid synthetic hit expansion and diversification incl. use of CADD
- Kinetic and mechanistic biochemistry/ enzymology and biophysical quantitation of target engagement energetics & kinetics
- Protein science and (co)crystallography for SBDD

- Pharmacokinetics and pharmaco-dynamics (PK/ PD) & safety pharma-cology
- In-depth pharmacokinetics, including ADME, drug-drug interactions, metabolite profiling, concentration time profiles
- Comprehensive acute toxicology assess-ment, incl. single dose and repeated dose to determine MTD and NOAEL
- Additional toxicology studies (e.g. repro-ductive and developmental toxicity, etc.)

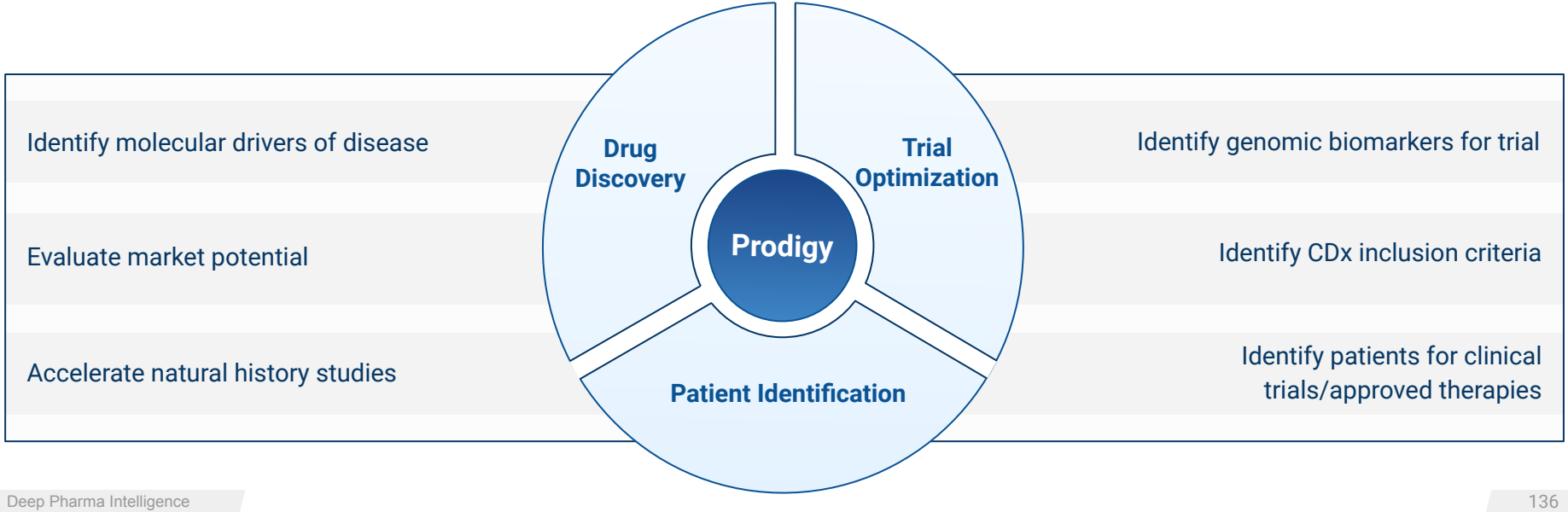
- Rapid biochemical profiling, kinetics, selectivity, mechanism of action
- Isolated and in-cell target engagement
- Cellular mode of action, elucidation of pathway modulation, confirmation of on-target/ off-target effect
- Medicinal and synthetic chemistry (optimizing SAR, SPR, STR)
- Integration of synthetic and computational chemistry as well as *in vivo* ADMET for late-stage lead optimization

Most Innovative R&D Approaches of AI in Biopharma. Genomenon

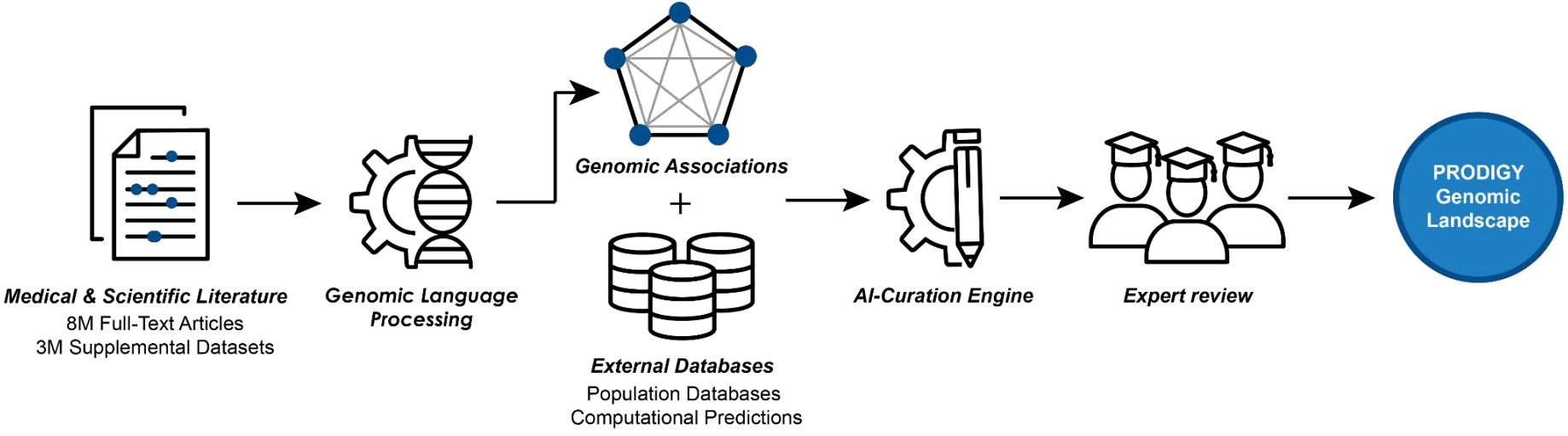
Genomenon is an AI-driven genomics company that organizes the world's genomic knowledge to accelerate the diagnosis and development of treatments for genetic disease.

Genomenon's **Prodigy™** Genomic Landscapes deliver a profound understanding of the genetic drivers and clinical attributes of any genetic disease and support the entire drug development process, from discovery to commercialization.

Genomenon's main focus therapeutic areas are **rare diseases**, **genetic diseases**, and **hereditary** and **somatic cancers.**



How Genomenon Uses AI in R&D



Genomenon's **Prodigy™ Genomic Landscapes** use a unique combination of proprietary **Genomic Language Processing (GLP)** and **expert, scientific review** to provide an evidence-based foundation for all stages of the drug development process. These landscapes can be completed at the disease, gene, variant, or patient level, and are maximally comprehensive as a result of GLP. Genomic Landscapes are also rapidly produced using an **AI-assisted curation engine** that expedites manual review of the data indexed by GLP.

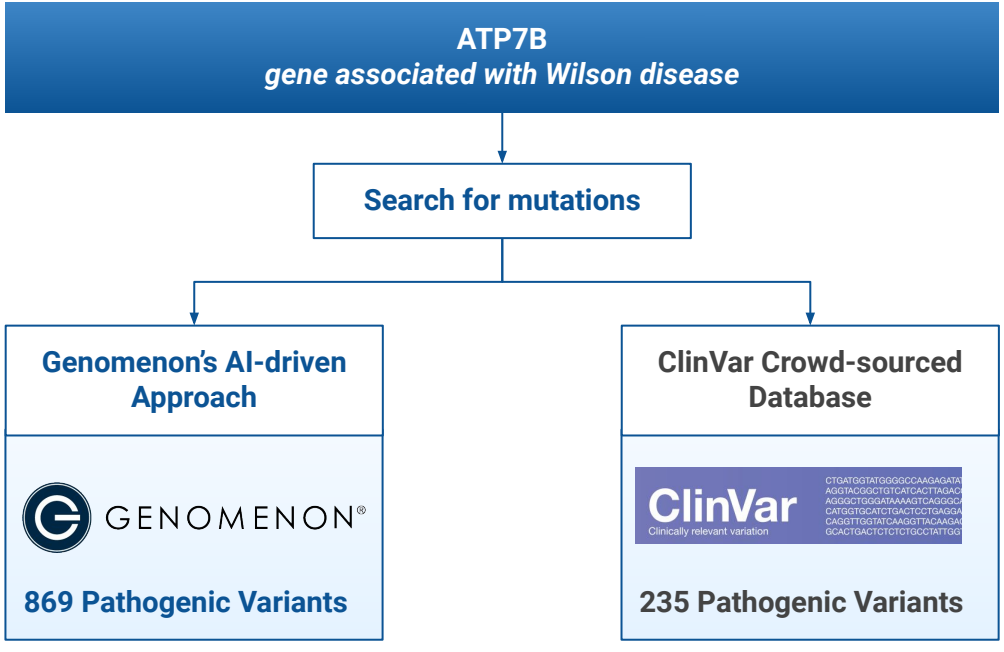
Genomic Language Processing (GLP) is a novel technology that systematically extracts and standardizes **genomic and clinical information** from the medical and scientific literature. Designed specifically to recognize this complex genomic information, GLP provides superior sensitivity compared to traditional methods, finding more variants and subsequently, more patients. **Genomenon's database**, built using GLP, currently contains over **14.8 million variants, 8.8 million full-text articles, and 3 million supplemental datasets**.

How Genomenon Uses AI in R&D

In collaboration with **Alexion**, AstraZeneca's Rare Disease group, **Genomenon applied its AI technology to help accelerate the genetic diagnosis for rare disease patients**. Genomenon's novel combination of AI-powered Genomic Language Processing and expert review **identified significantly more pathogenic variants associated with Wilson disease**.

Genomenon's AI-driven approach **identified 3.7x more evidence-supported, pathogenic/likely pathogenic variants for ATP7B** – a gene associated with Wilson disease – **compared to the crowd-sourced database, ClinVar**. This significantly expands the resources available to healthcare providers to make more informed diagnostic decisions.

With greater adoption of Mastermind, we predict that the substantial increase in the number of known, disease-causing variants **will improve the diagnosis of people living with Wilson disease by improving the ability to interpret genetic testing results**.



Genomenon's AI-driven approach identified **3.7x more** evidence-supported, pathogenic/likely pathogenic variants for ATP7B than ClinVar.

We predict that this **will improve the diagnosis of people living with Wilson disease** by improving the ability to interpret genetic testing results.

Most Innovative R&D Approaches of AI in Biopharma. GATC Health

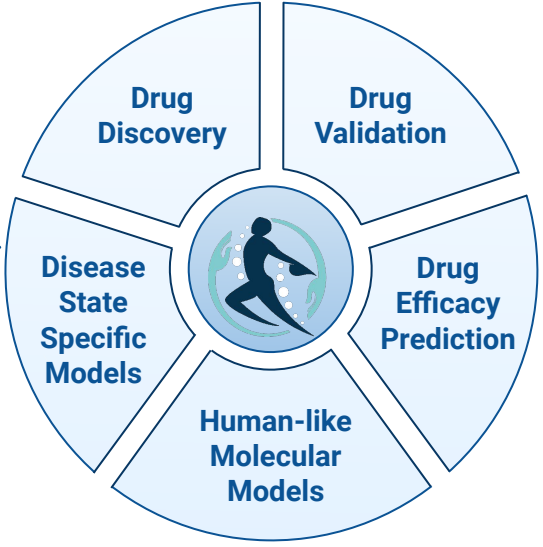
GATC Health

GATC Health is an AI company that accelerates the drug discovery and development process. The company proposes highly efficient services for pharma companies reducing the risk in the drug discovery process. GATC Health develops **an end-to-end drug development cutting-edge AI-based platform**. The platform assists in earlier disease detection, identify the disease biology, create new drug and therapeutic solutions, simulate in-silico clinical trials and feedback loop for in-vitro and in-vivo testing.

GATC's Platform combines massive volumes of disease-specific data and proprietary AI solutions to replicate human biology in discovering and validating novel drugs. The company develops a revolutionary approach to drug discovery, drastically improving efficiency and time for clinical development.

Target Diseases

- Oncology
- Neurology
- Cardiology
- Immunology
- Rheumatology
- Other diseases



Outcome

- 1-3 Molecules Optimized for Specific Disease State/ Molecule Recommendation

How GATC Health Uses AI in R&D

Diagnostic Biomarker Discovery

- Identifies the causal relationship between the biomarkers and the disease to illuminate insights into the disease.
- AI-assisted compound discovery is used to produce a set of novel treatment compounds.
- The targets and compounds are prioritized and documented for pre-clinical testing.

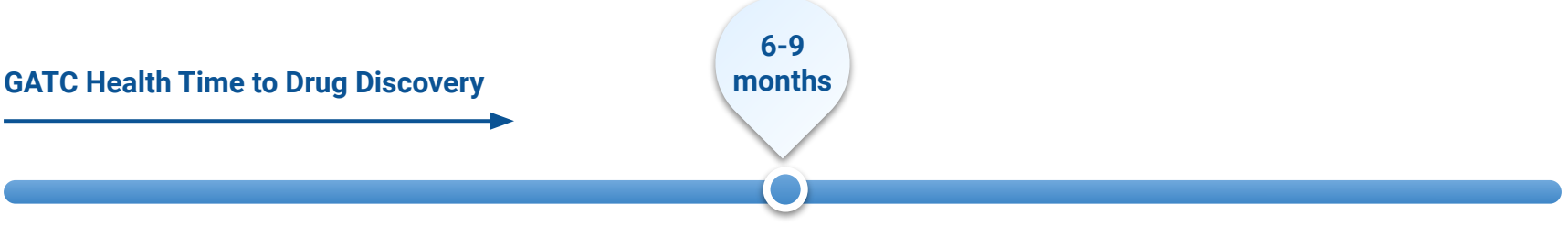
Drug Compound Discovery

- Diagnostic biomarkers are discovered on a dataset.
- Biomarkers mathematically assessed for causal and effect impacts.
- Validated causal biomarkers and pathways are simulated and evaluated by AI-assisted database models and human expertise.
- A final set of treatment targets emerges.

Pre-Clinical De-Risking of Drug

- Pre-clinical de-risking of the drugs through through the development of new therapeutics in-silico and in-vivo clinical studies with more comprehensive analysis.
- Ensuring higher levels of success as the drug progresses through FDA Trials.
- Eliminate the majority of the risk and cost associated with resolving disease.

GATC Health Time to Drug Discovery



Industry Developments 2020- Q1 2022

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Biggest Deals Q1 2021 - Q1 2022

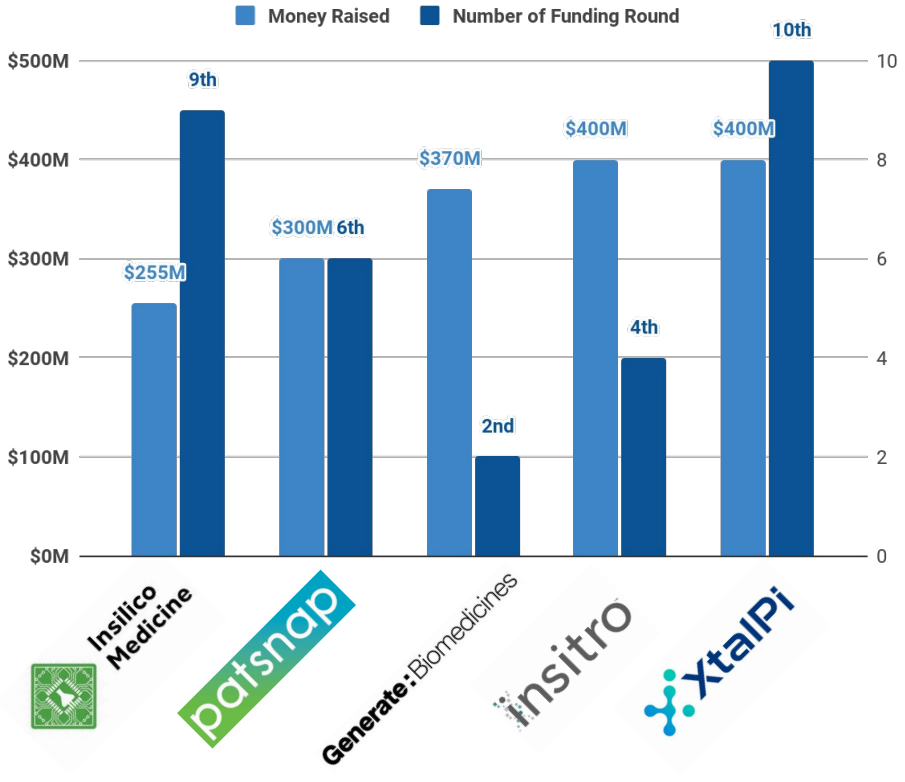
The total amount of VC funding in AI-biotech startups increased during Q1 of 2022 approaching a total of $12B.

There is an increasing number of late-stage mega-rounds including hundreds of millions. The apparent trend is sector consolidation, where a number of AI-startups have achieved substantial leadership and grown in resources and technology. An important driver of growth for the sector is a substantial shift in Big Pharma's interest in AI technology, making AI an important integral part in the research and implementation areas.

Top 5 highest fundings received the following companies:

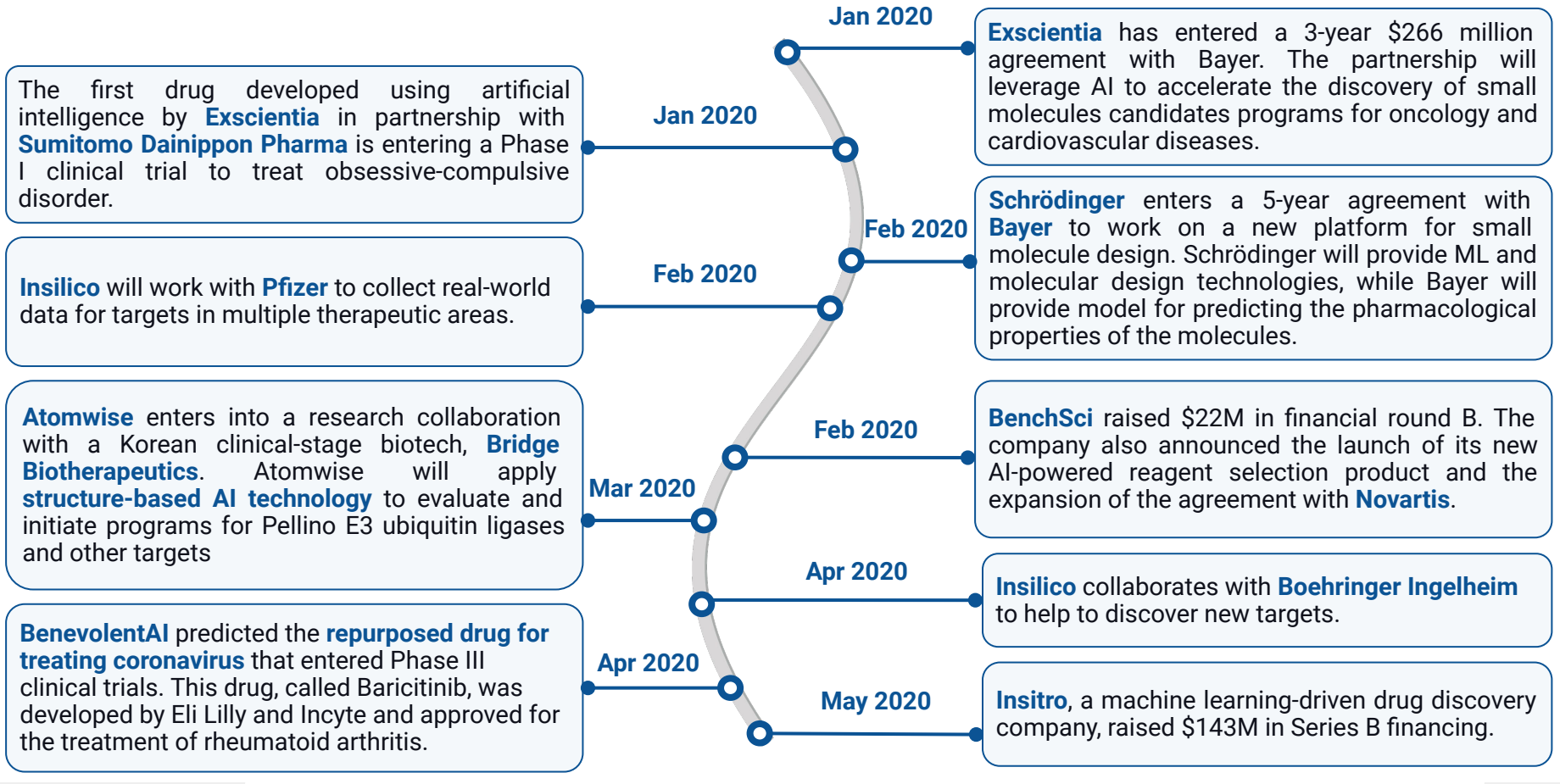
1. **Insitro** with $400 million (Series C)
2. **XtalPi** with $400 million (Series D)
3. **Generate Biomedicines** $370 million (Series B)
4. **PatSnap** with $300 million (Series E)
5. **Insilico Medicine** with $255 million (Series C)

Biggest Funding in Q1 2021 - Q1 2022



Sources: *Investment Digest AI in Pharma*

Selected Pharma AI Industry Developments Q1 2020 — Q1 2022



Selected Pharma AI Industry Developments Q1 2020 — Q1 2022

Jun 2020

Cyclica secured $17M in financing round B. This start-up developed two platforms — Ligand Design and Ligand Express that predict molecular properties using deep learning technology.

Jul 2020

Lantern Pharma prepares for the start of **Phase II** and **Phase I clinical trials** of its two anti-cancer drug candidates. Both drug candidates were created using the RADR® **AI platform**.

Jul 2020

Global Open Science project **COVID Moonshot** was launched by the international consortium of industrial and academic partners, including AI-driven startup **PostEra**.

Aug 2020

IBM introduced a new cloud platform — **RoboRXN**, a free AI-enabled chemical service for the prediction of molecule interactions and the discovery of new drugs. The platform will be primarily used to **discover compounds against coronavirus proteins**.

Aug 2020

Atomwise raised $123M in a round B led by **B Capital Group** and **Sanabil Investments**.

Sep 2020

Insilico Medicine is launching a new target and drug discovery platform **Pandomics.**

Sep 2020

Exscientia teams up with **Huadong Medicine** for the **small molecules oncology program**. The project focuses on DNA damage repair and investigates the transcription control of DNA damage response genes, which disruption leads to mutation accumulations.

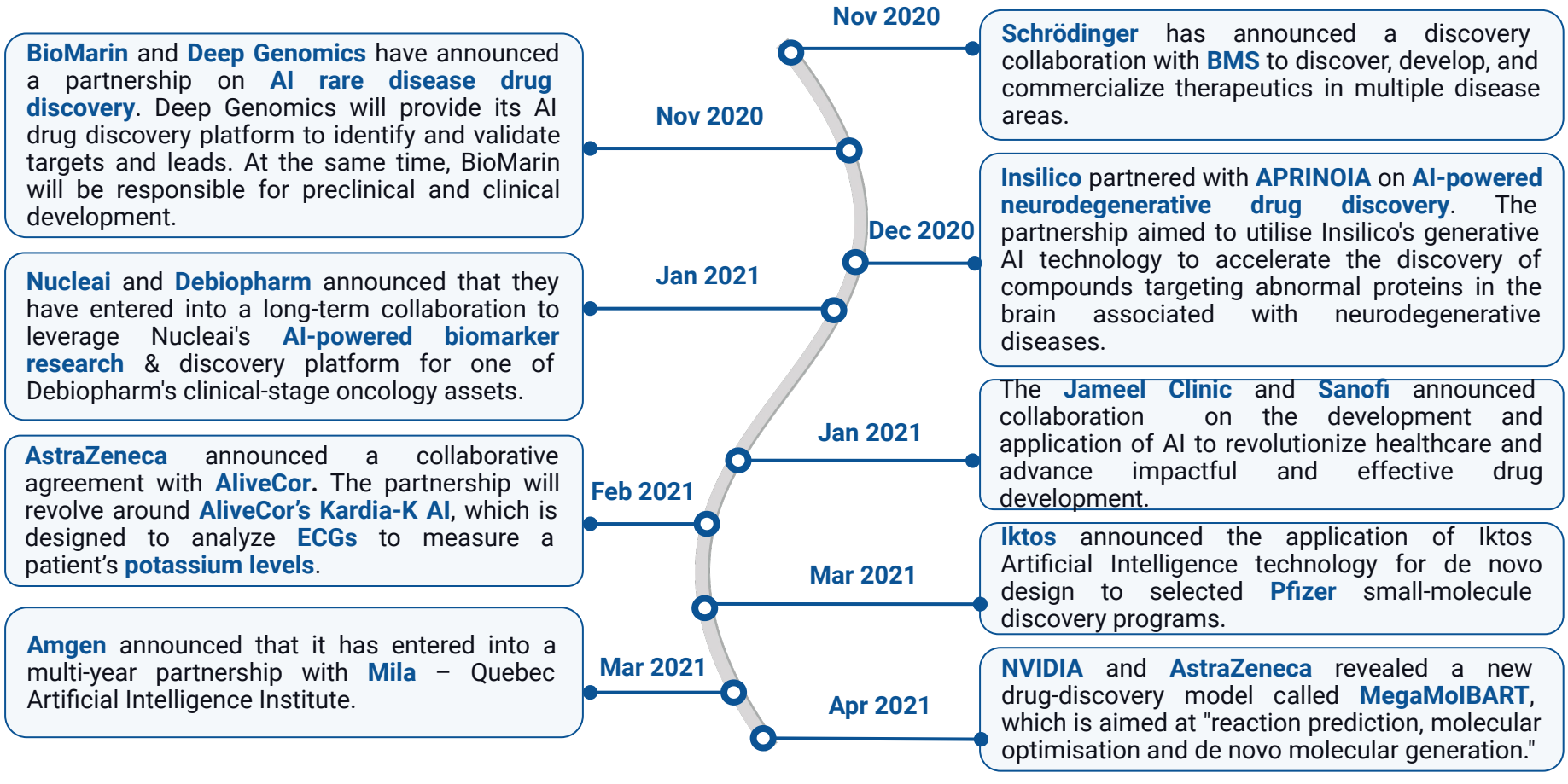
Oct 2020

Nvidia has entered into a partnership with **GlaxoSmithKline (GSK)** and its AI group to discover drugs and vaccines.

Oct 2020

Taisho Pharmaceutical and **Insilico** have entered into a research collaboration to identify **novel therapeutics against aging**.

Selected Pharma AI Industry Developments Q1 2020 — Q1 2022



Selected Pharma AI Industry Developments Q1 2020 — Q1 2022

Apr 2021

NVIDIA announced a strategic partnership with **Schrödinger** to **expand speed and accuracy of Schrödinger's computational drug discovery platform** and enable rapid, accurate evaluation of billions of molecules for the potential development of therapeutics.

May 2021

Lantern Pharma collaborates with **Actuate Therapeutics**. The partnership will focus on leveraging Lantern Pharma's ML technology, large-scale oncology datasets, and the AI platform to accelerate critical aspects of **Actuate's 9-ING-41 drug candidate**.

Jun 2021

CytoReason announced the initiation of a project with **Sanofi**. This project aims to gain clarity on the heterogeneity of **asthma** patients.

Jun 2021

Nucleai and **Merck** have entered into a long-term collaboration to leverage Nucleai's **image analysis and biomarker discovery platform** for several Merck clinical-stage oncology assets.

Jul 2021

Eli Lilly has entered a three-year partnership with biotech company **Verge Genomics** to research and create new drugs to treat **amyotrophic lateral sclerosis (ALS)**

Aug 2021

Insilico Medicine in collaboration with **4B Technologies** aims to find a cure for **amyotrophic lateral sclerosis** (**ALS**).

Aug 2021

BMS has exercised an option on an **immune-modulating drug** candidate developed by **Exscientia**, paying $20 million for the buy-in as part of their $1.2 billion alliance.

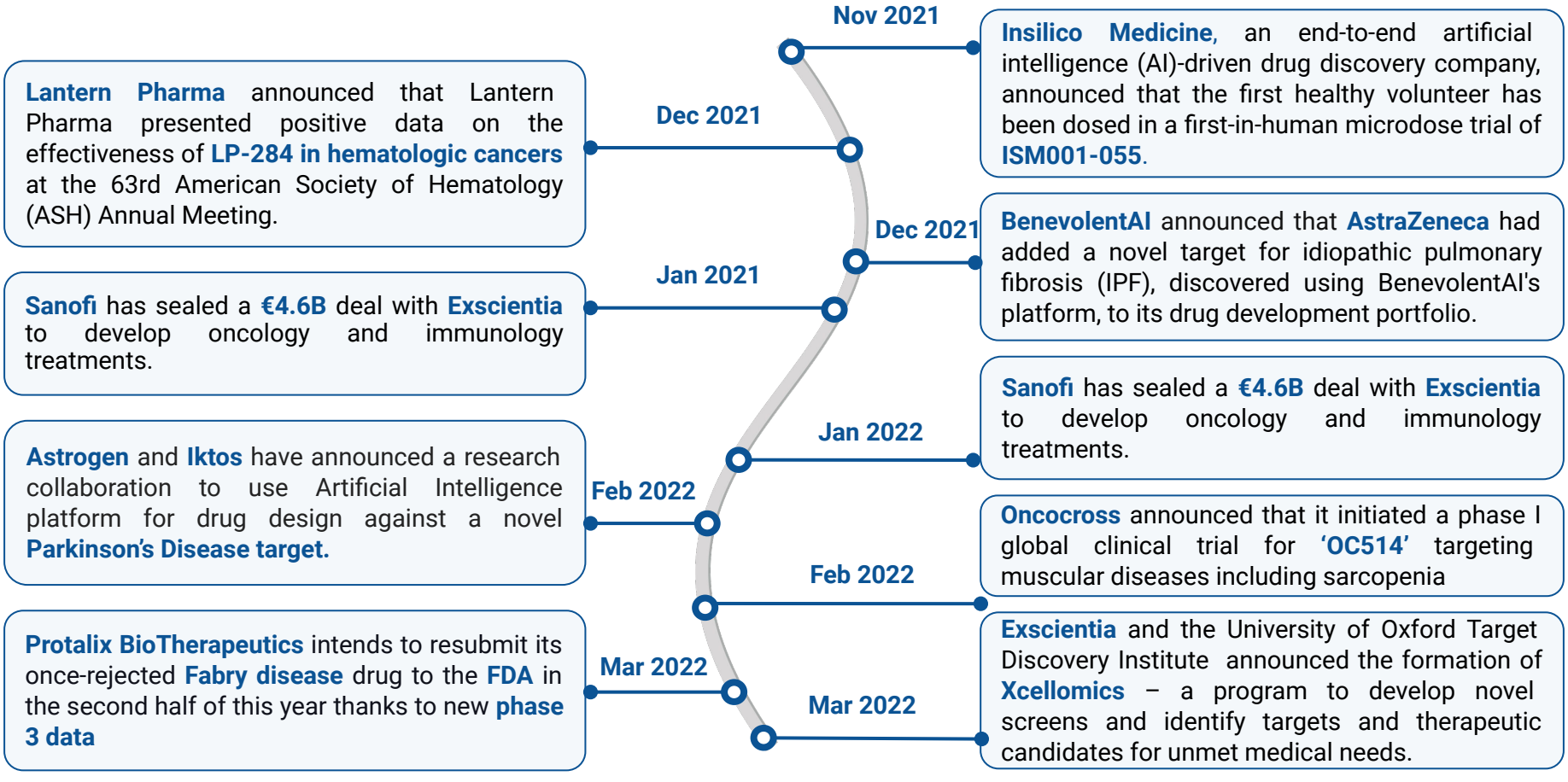
Sep 2021

The **Institute of Cancer Research** (ICR) in London used **AI** to identify the **most promising drug combinations** for children with incurable brain cancer.

Oct 2021

AstraZeneca, Merck, Pfizer and **Teva** formed **AION Labs**, the innovative lab that will create and adopt **AI technology** to **transform the process of drug discovery**

Selected Pharma AI Industry Developments Q1 2020 — Q1 2022



Key Takeaways

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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 $4,7B to $12,73B. 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.

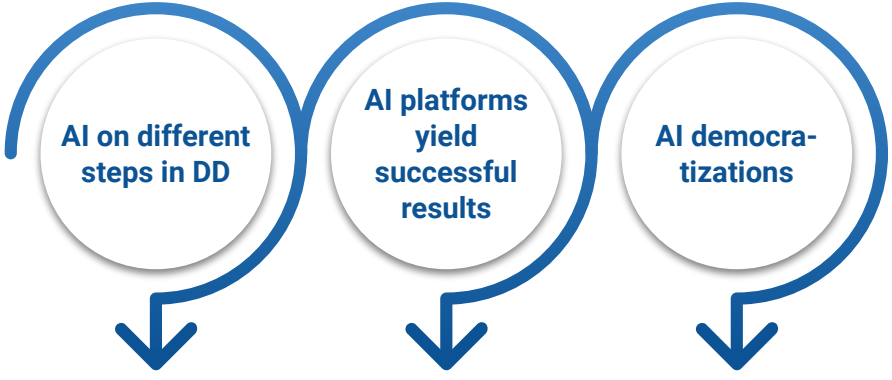
In 2021, **10 companies that use AI for DD reached IPO status**. New York-based Roivant Science closed its IPO in October and raised $611M. Exscientia, a pharmatech company that uses an end-to-end AI platform to design and discover new drugs launched IPO the same day as Roivant Science and raised $350M. 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**.

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.



Ai is used not only for drug design, but also target identification.

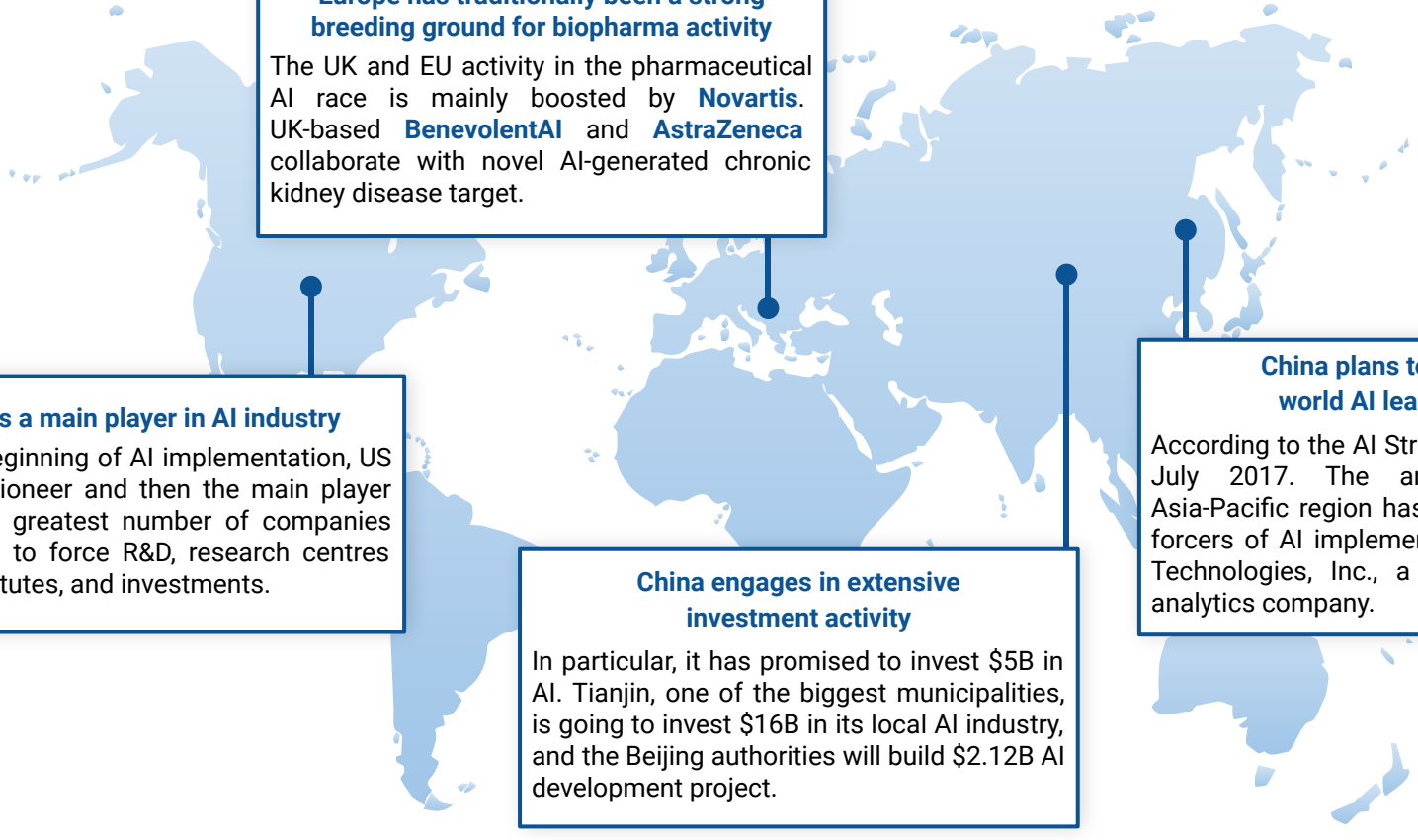
Many AI-designed drugs showed successful results in research studies and even clinical trials.

Ready-to-use AI platforms for DD became available and can be used by non-AI experts.

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 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.

Appendix:
List of Entities

DEEP
PHARMA
INTELLIGENCE

495 Companies Applying AI for Drug Discovery and Advanced R&D

1	1st Biotherapeutics	22	AiCure	43	Antiverse
2	3Analytics	23	Aiforia	44	Apeiron Biologics
3	3BIGS	24	Aigenpulse	45	ApexQubit
4	4G Clinical	25	AILON	46	Aqemia
5	A2A Pharmaceuticals	26	Aimble	47	Arbor Biotechnologies
6	AbCellera Biologics	27	Aizon	48	Arctoris
7	Absci	28	Alaife	49	Ardigen
8	AccutarBio	29	Alector	50	Ares Genetics
9	Acellera	30	Alembic Pharmaceuticals	51	Aria Pharmaceuticals
10	Acelot	31	AlgoDx	52	Ariadne.ai
11	Actimus Biosciences	32	Alife	53	Ariana Pharma
12	AcuraStem	33	AliveX Biotech	54	Arontier
13	Adagene	34	Allelica	55	Arpeggio Bio
14	ADMdx	35	Almirall	56	Arrakis Therapeutics
15	Aegicare	36	Alphanosos S.A.S.	57	Arzeda
16	Aetion	37	Altis Labs	58	Asimov
17	Agamon	38	Alto Neuroscience	59	Astellas Pharma
18	Agastiya Biotech	39	Amplion	60	Astex
19	AHEAD Medicine	40	Ancora.ai	61	Asymchem Laboratories
20	Ai Biopharma	41	Anima Biotech	62	Athelas
21	AI Therapeutics	42	Antidote.me	63	Athos Therapeutics

495 Companies Applying AI for Drug Discovery and Advanced R&D

64	Atomwise	85	bioSyntagma	106	Celsius Therapeutics
65	Auransa	86	Biotx.ai	107	Centaura
66	Banjo Health	87	Biovista	108	Champions Oncology
67	Beacon Biosignals	88	BioXcel Therapeutics	109	ChemAlive
68	BenchSci	89	Bioz	110	ChemPass
69	BenevolentAI	90	Black Diamond Therapeutics	111	Cipla
70	Berg LLC	91	Boehringer Ingelheim	112	Clario
71	Berkeley Lights	92	Brainomix	113	Clinion
72	BigHat Biosciences	93	Brickell Biotech	114	Clinithink
73	BioAge Labs	94	Bristol Myers Squibb	115	Cloud Pharmaceuticals
74	BioBetter	95	Brite Health	116	CloudMedx
75	BioCentury	96	BullFrog AI	117	Clover Therapeutics
76	Biodesix	97	C4X Discovery	118	Collaborations Pharma
77	BioDuro	98	Calico	119	Collective Scientific
78	Biofourmis	99	Capsida	120	ConcertAI
79	Biolojic Design	100	CaroCure	121	ConcertoCare
80	Biomatter Designs	101	Causaly	122	Coral Genomics
81	Biomea Fusion	102	Celeris Therapeutics	123	Cotinga Pharmaceuticals
82	Biorelate	103	Cellarity	124	Cunesoft GmbH
83	Biosortia Microbiomics	104	CellPly	125	CureMetrix
84	BioSymetrics	105	Cellter	126	Curi Bio

495 Companies Applying AI for Drug Discovery and Advanced R&D

127	Cyclica	148	Delta 4	169	eTherapeutics
128	Cytel Corporation	149	Denovicon Therapeutics	170	Eularis
129	CytoReason	150	Desktop Genetics	171	Euretos
130	Cytox	151	Dexstr	172	Evaxion Biotech
131	Dainippon Sumitomo Pharma	152	DNAnexus	173	Everest Medicines
132	Data2Discovery	153	Easemedcontrol	174	Evestra Onkologia
133	Data4Cure	154	Edifice Health	175	Evogene
134	DataClue.io	155	Eigengene	176	Evolutionary Genomics
135	Datavant	156	Elucidata	177	Evotec
136	Dayton Therapeutics	157	Emedgene	178	EVQLV
137	Deargen	158	Emerald Cloud Lab	179	Exogene
138	Deep 6 AI	159	Empiric Logic	180	Exscientia
139	Deep Genomics	160	Empirico	181	Fabric Genomics
140	Deep Intelligent Pharma	161	Engine Biosciences	182	FAR Biotech
141	Deep Lens	162	Enlitic	183	FDNA
142	DeepCure	163	EntheogeniX Biosciences	184	Fibronostics
143	DeepLife	164	Entropica Labs	185	Flagship Biosciences
144	DeepMatter Group	165	Envisagenics	186	Flatiron Health
145	DeepMind	166	ePharmaSolutions	187	Foundation Medicine
146	DeepThink Health	167	Epistemic AI	188	Fountain Therapeutics
147	DeepTrait	168	Erasca	189	Freenome

495 Companies Applying AI for Drug Discovery and Advanced R&D

190	Frontage Holdings	211	GNS Healthcare	232	iCarbonX
191	Frontier Medicines	212	Gordian Biotechnology	233	Ichor Biologics
192	Fulmz AI	213	Gritstone Oncology	234	iClinical Inc
193	G3 therapeutics	214	GT Apeiron Therapeutics	235	icometrix
194	Gain Therapeutics	215	Guided Clarity	236	Icosavax
195	Galixir	216	GV20 Oncotherapy	237	IDEAYA Biosciences
196	GATC Health	217	Hafnium Labs	238	Iktos
197	Gatehouse Bio	218	Healint	239	iLabService
198	Genentech	219	Health Technology Innovations	240	Imagia
199	Generate Biomedicines	220	HealthMatch	241	Imaginostics
200	Genesis Therapeutics	221	Healx	242	Immunai
201	GENFIT	222	HelixAI	243	ImmunoMind
202	Genialis	223	Herophilus	244	Inato
203	Genome Biologics	224	HiFiBiO	245	Indegene
204	Genomenon	225	Hinge Therapeutics	246	Infinite Intelligent Pharma
205	Genuity Science	226	Histoindex	247	Ingentium
206	Gero	227	HistoWiz	248	Innophore
207	GigaCeuticals	228	HK inno.N Corp	249	Innoplexus
208	Globavir	229	Huma.ai	250	Insilico Medicine
209	GlucoGear	230	Human API	251	Insitro
210	Glympse Bio	231	IBIS Therapeutics	252	Intellegens

495 Companies Applying AI for Drug Discovery and Advanced R&D

253	Intelligencia	274	Lantern Pharma	295	mettleAI
254	Intelligent OMICS	275	Lassogen	296	Micar Innovation (Micar21)
255	Interprotein	276	Leucadia Therapeutics Inc	297	Micrographia Bio
256	Intomics	277	LEXEO Therapeutics	298	Mitsui E&S Systems Research
257	InveniAI	278	Linguamatics	299	MNM Bioscience Inc.
258	Ionis Pharmaceuticals	279	Longenesis	300	Model Medicines
259	Ipsen	280	Lundbeck	301	Modulus Therapeutics
260	IQVIA	281	Lunit	302	Molecular Fingerprint
261	Iridia	282	MAbSilico	303	Molecule.one
262	Iris.ai	283	Massive Bio	304	Molomics Biotech SL
263	ITeos Therapeutics	284	Medable	305	MultiCASE
264	JADBio	285	MedAware Systems	306	Nashville Biosciences
265	Juvena Therapeutics	286	MedChemica	307	NBD | Nostrum Biodiscovery
266	Kebotix	287	MediBIC Group	308	NetraMark
267	Keen Eye Technologies	288	MediRita	309	Neumora Therapeutics
268	KOTAI Biotechnologies	289	MedView Technologies	310	Neuron23
269	Kuano	290	Mendel.ai	311	NeuScience
270	KYAN Therapeutics	291	Menten AI	312	nference
271	Kyndi	292	Meta	313	Nimbus Therapeutics
272	LabGenius	293	Metaoptima	314	NIRAMAI Health Analytix
273	LabTwin	294	METiS Therapeutics	315	Notable

495 Companies Applying AI for Drug Discovery and Advanced R&D

316	Notable Labs	337	Onegevity Health	358	Pera Labs
317	Novaccess Global	338	OneThree Biotech	359	Percayai
318	Novadiscovery	339	Open Orphan	360	Perceiv AI
319	Novo Nordisk	340	OpGen	361	Pharmacelera
320	Novoheart Holdings	341	Optellum	362	pharmAI
321	nQ Medical	342	Optibrium	363	Pharmaledger
322	Nucleai	343	OrganoTherapeutics	364	PharmCADD
323	Nucleus Health	344	Outcomes4Me	365	PharmEnable
324	NuMedii	345	Ovation	366	Pharnext
325	Nurenyx Inc.	346	Owkin	367	Pharos iBT
326	Nuritas	347	Paige	368	Phenomic AI
327	Nuventra	348	Paradigm4	369	Phenomics Health
328	OBVIOHEALTH	349	PatchAi	370	Pixyl
329	OccamzRazor	350	PathAI	371	Plex Research
330	Ochre Bio	351	Patiro	372	Polaris Quantum Biotech
331	OKRA Technologies	352	PatSnap	373	Portage Biotech
332	Olaris	353	PEACCEL	374	PostEra
333	Omnia Biosystems	354	Pending.AI	375	PreciseDx
334	Oncocross	355	Pepticom Ltd.	376	Precisionlife
335	Oncora Medical	356	Peptone	377	Predictive Oncology
336	OncoRadiomics	357	Peptris	378	Presagen

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379	Prognica Labs	400	Repurpose.AI	421	Sensyne Health
380	Promatix	401	Researchably	422	ShouTi
381	Proscia	402	Resonant Therapeutics	423	Sigma Technologies, Ltd.
382	Protai	403	Retinai	424	Silexon
383	Protea Biosciences	404	Reveal Biosciences	425	Simply Speak
384	ProteinQure	405	Reverie Labs	426	Simulations Plus
385	PsychoGenics	406	ReviveMed	427	Sirenas Marine Discovery
386	Pucho Life Sciences	407	Ro5	428	SkinVision
387	Purposeful	408	Roivant Sciences	429	SOCIUM Inc
388	QuantaCell	409	Saama	430	Soley Therapeutics
389	Quartz Bio	410	Sage Bionetworks	431	SOM Biotech
390	Quertle	411	Sage-N Research	432	SomaLogic
391	Quibim	412	Sangamo Therapeutics	433	SOPHiA GENETICS
392	Qulab	413	Satalia	434	Sopris Health
393	Quris	414	Scailyte	435	Sparrho
394	Qview Medical	415	Schrödinger	436	Spectral MD
395	Qynapse	416	sciNote	437	Spring Discovery
396	RECEPTOR.AI	417	Scipher Medicine	438	Standigm
397	Recursion Pharmaceuticals	418	Segmed	439	Steel Therapeutics
398	Relay Therapeutics	419	Sema4	440	Stelvio Therapeutics
399	Renalytix AI	420	SEngine Precision Medicine	441	StoneWise

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442	Strados Labs
443	Strata Oncology
444	Strateos
445	Structura Biotechnology
446	StuffThatWorks.health
447	Synergy Pharmaceuticals
448	Synsight
449	Syntekabio, Inc.
450	Synthace
451	Systems Oncology
452	TARA Biosystems
453	Tempus
454	TeselaGen
455	TheraPanacea
456	ThoughtSphere
457	ThoughtSpot
458	Totus Medicines
459	Tracked.bio
460	Transcenta
461	Transilico
462	Treeline Biosciences
463	TrialJectory
464	Trials.ai
465	Turbine
466	Ultromics
467	Unlearn.AI
468	Unnatural Products
469	Valence Discovery
470	Valo Health
471	VantAI
472	Variational AI
473	Veradigm
474	Veralox Therapeutics
475	Verge Genomics
476	VeriSIM Life
477	Vingyani
478	Virogin Biotech
479	Virvio
480	Visiopharm
481	VitalHub
482	Viva Biotech
483	VolitionRx
484	Volta Medical
485	Vyasa Analytics
486	Wave Life Sciences
487	Wild Biotech Ltd
488	Winterlight Labs
489	Wisecube
490	WuXi AppTec
491	X-37
492	X-Chem
493	Xbiome
494	xCures
495	XtalPi

1120 Investors AI for Drug Discovery and Advanced R&D

1	77	21	AbbVie	41	AGORANOV
2	10X Capital	22	Abstract Ventures	42	Air Street Capital
3	11.2 Capital	23	Abu Dhabi Investment Authority	43	AirTree Ventures
4	3B Future Health Fund	24	Acadia Woods Partners	44	Aisling Capital
5	3Lines	25	Accel	45	Ajax Health
6	3W Fund Management	26	Accelerate@Babraham	46	AJI Capital
7	3W Partners	27	Accelmed	47	AJS Investments
8	4Catalyzer	28	Access Biotechnology	48	Alaska Permanent Fund
9	4FO Ventures	29	Access Industries	49	Alcazar Capital
10	500 Startups	30	Access Venture Partners	50	Alchemist Accelerator
11	515 Ventures	31	ACE & Company	51	Alexandria Real Estate Equities
12	5AM Ventures	32	Acequia Capital	52	Alexandria Venture
13	5Y Capital	33	ACF Investors	53	Alexandria Venture Investments
14	6 Dimensions Capital	34	ACME Investments	54	Alium Capital
15	7 Gate Ventures	35	Acorn Bioventures	55	AllBright
16	70Ventures	36	Adage Capital Management	56	Allen & Company
17	7BC Venture Capital	37	Adara Ventures	57	Allen Institute for AI
18	8VC	38	Advantage Capital	58	Alliance of Angels
19	A-Level Capital	39	Advent Life Sciences	59	AFFPC
20	A&E Investments	40	Agilent Technologies	60	AllianceBernstein

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61	Asymchem Laboratories	81	Amplo	101	Ascend Capital Partners
62	Ally Bridge Group	82	Analytics Ventures	102	Asset Management Ventures
63	Alpha Capital Anstalt	83	Andreessen Horowitz	103	Astia Angels
64	Alpha Intelligence Capital	84	Angels Capital	104	AT Capital Group
65	ALS Investment Fund	85	Angels in MedCity	105	ATAI Life Sciences
66	Altira Group	86	Anges Quebec	106	Atain
67	Altitude Life Science Ventures	87	Ankur Capital	107	ATEM Capital Fund LP
68	Altos Ventures	88	Apeiron Investment Group	108	Atinum Investment
69	Alumni Ventures	89	Aperture Venture Partners	109	Atlantic Bridge
70	Amadeus Capital Partners	90	APEX Ventures	110	Atlantic Labs
71	Amazon Alexa Fund	91	Apollo Health Ventures	111	Atlas Venture
72	AME Cloud Ventures	92	Aquarius Equity Partners	112	Atmos Ventures
73	Amgen Ventures	93	Arboretum Ventures	113	Atomico
74	Amidi Group	94	ARCH Venture Partners	114	Aurinvest
75	aMoon Fund	95	ArcTern Ventures	115	AV8 Ventures
76	AMOREPACIFIC Ventures	96	ARK Investment Management	116	AVIC Trust
77	Amplify Capital	97	ARPA-E	117	Avidity Partners
78	Amplify Partners	98	ArrowMark Partners	118	Aviva Ventures
79	Amplify.LA	99	Artis Ventures	119	Axel Investments
80	Amplitude Venture Capital	100	Asahi Kasei	120	Axilor Ventures

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121	Ayala Corporation	141	Beacon Securities	161	Black Diamond Ventures
122	B Capital Group	142	Beast Ventures	162	Black Pearls VC
123	BACKED VC	143	BEENEXT	163	Black Point Group
124	Baidu Ventures	144	Beida Biomedical Industry Fund	164	BlackRock
125	Baillie Gifford	145	Ben Franklin Technology Partners	165	Blackstone Accelerates Growth
126	Bain Capital	146	Beresford Ventures	166	Block.one
127	Bain Capital Life Sciences	147	Berkeley SkyDeck Fund	167	Blu Venture Investors
128	Baird Capital	148	Better Food Ventures	168	Blue Bear Ventures
129	Bakken & Baeck	149	Better Ventures	169	Blue Ivy Ventures
130	Balderton	150	BIG BOOSTER	170	BlueCross BlueShield
131	Banco Santander	151	Big Pi Ventures	171	BlueRun Ventures
132	Bangarang Group	152	Bill & Melinda Gates Foundation	172	Blumberg Capital
133	BankInvest	153	Binder & Partners Ventures	173	Boehringer Ingelheim Venture Fund
134	Bantam Group	154	Bioeconomy Capital	174	Bold Capital Partners
135	Battery Ventures	155	Biomatics Capital Partners	175	Boomtown Accelerators
136	Bay City Capital	156	BARDA	176	BootstrapLabs
137	Bayer G4A	157	Biospring Partners	177	Borealis Ventures
138	Bayern Kapital	158	Biotechnology Value Fund	178	Borun Capital
139	BDC Healthcare Venture	159	BioVenture	179	Boston Angel Club
140	BDC Venture Capital	160	Bioverge	180	Boston Millennia Partners

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181	Boston Seed Capital	201	Cambridge Enterprise	221	CBC
182	Boxer Capital	202	Camford Capital	222	CDC Group
183	Bpifrance	203	Canaan Partners	223	CDH Investments
184	Breyer Capital	204	Canaccord Genuity Group	224	Cedars-Sinai Accelerator
185	Brighton Park Capital	205	CPPIB	225	Celgene
186	Brightspark Ventures	206	Cantos	226	CDTI
187	Bristol Myers Squibb	207	Capikris Foundation	227	Challenjers Capital
188	Broad Street Angels	208	Capital One Ventures	228	Cherubic Ventures
189	BroadOak Capital Partners	209	Capitol Health Ltd	229	Chiesi Pharmaceuticals
190	Btov Partners	210	Capricorn Partners	230	Chimera Partners
191	Buchanan Investments	211	CARB-X	231	China Bridge Capital
192	Bulba Ventures	212	Carlyle Global Partners	232	China Equity
193	Business Finland	213	Carrick Capital Partners	233	China Life Healthcare Fund
194	BVF Partners	214	Cascade Seed Fund	234	China Life Insurance
195	C.L. Davids Fond	215	Casdin Capital	235	China Merchants Capital
196	Caffeinated Capital	216	Castor Ventures	236	Cigna Ventures
197	Calculus Capital	217	Catalio Capital Management	237	CITIC Industrial Investment Group
198	CIRM	218	Catapult Ventures	238	CITRIS Foundry
199	CAM Capital	219	Cathay Innovation	239	Citrix Startup Accelerator
200	Cambridge Angels group	220	Cavendish Impact Capital	240	Citrix Systems

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241	City Hill Ventures	261	Commodore Capital	281	Cue Ball
242	Civilization Ventures	262	CDMRP	282	cultivate(MD)
243	CJ Corporation	263	Connecticut Innovations	283	Cultivian Sandbox Ventures
244	CKA Capital Ltd	264	Contour Venture Partners	284	curative ventures
245	Claremont Creek Ventures	265	Conversion Ventures LLC	285	D. E. Shaw Research
246	Clermont Group	266	Cormark Securities Inc.	286	D1 Capital Partners
247	Cleveland Avenue	267	Cormorant Asset Management	287	Dainippon Sumitomo Pharma
248	CLI Ventures	268	Corvex	288	Darling Ventures
249	ClimAccelerator	269	Cota Capital	289	DCM Ventures
250	CM-CIC Capital Finance	270	Counterpoint Global	290	DCVC
251	CMBI Zhaoxin Wuji Fund	271	Cowen Healthcare Investments	291	DCVC Bio
252	CMG-SDIC Capital Management	272	CPP Investment Board Europe	292	Debiopharm Group
253	CNO Financial Group	273	CPP Investments	293	Debiopharm Innovation Fund
254	Coatue	274	Creative Destruction Lab (CDL)	294	Decheng Capital
255	Cobre Capital	275	Credit Suisse	295	Declaration Partners
256	Cold Start Ventures	276	CRG	296	Dedalus Group
257	Colorcon	277	Crista Galli Ventures	297	Deep Track Capital
258	Colorcon Ventures	278	Crosslink Capital	298	Deerfield Capital Management
259	Colt Ventures	279	CRV	299	Deerfield Management
260	Commerce Health Capital	280	CTI Life Sciences Fund	300	DEFTA Partners

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301	Delin Ventures	321	Dynamk Capital	341	Endure Capital
302	Desjardins-Innovatech	322	E Squared Capital Management	342	Enterprise Ireland
303	Development Bank of Wales	323	EASME - EU EA for SMEs	343	Entrepreneur First
304	Dexcel Pharma	324	Eastern Bell Capital	344	EOS VC Fund
305	DHVC	325	EBRD (Investment Firm)	345	EPIC Capital
306	DigiTx Partners	326	Echelon Wealth Partners	346	EPIC Ventures
307	DNS Capital	327	Echo Health Ventures	347	Epiphron Capital
308	Dolby Family Ventures	328	EcoR1 Capital	348	Epsilon Health Investors
309	Draper Associates	329	EDBI	349	Era Funding Administration
310	Draper Dragon	330	Eight Roads Ventures	350	Esperante Ventures
311	Dream Incubator	331	Eisai	351	Euclidean Capital
312	Dreamit Healthtech	332	Elaia	352	Eurazeo
313	Dreamit Ventures	333	Elev8.VC	353	EB Reconstruction and Development
314	Driehaus Capital Management	334	Eli Lilly	354	European Innovation Council
315	Drive Capital	335	Eli Lilly & Company Foundation	355	European Investment Bank
316	Droia Ventures	336	Embark Ventures	356	Eurostars
317	dRx Capital	337	Emerald Development Managers	357	Eventide Asset Management
318	DS Asset Management	338	Emerge Education	358	EvoNexus
319	DSC Investment	339	Endeavour Vision	359	Excelerate Health Ventures
320	Duquesne Family Office	340	Endpoint Ventures	360	Expa

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361	F-Prime Capital	381	Folklore Ventures	401	Gaorong Capital
362	Famillie C (Clarins Family)	382	Foresite Capital	402	Garage Capital
363	Farallon Capital Management	383	Forestay Capital	403	Geekdom Fund
364	Felicis Ventures	384	Formic Ventures	404	GEIF Ventures
365	Fidelity Canada	385	Fortune Venture Capital	405	General Atlantic
366	FMRC	386	Fosun Pharma	406	General Catalyst
367	Fifty Years	387	Founders Factory	407	Generation Investment Management
368	Financière Boscary	388	Founders Fund	408	Genesys Capital
369	FinLab	389	FoundersX Ventures	409	BMBF
370	Finorpa	390	Franklin Templeton	410	Gi Global Health Fund LP
371	Firlej Kastory	391	Franklin Templeton Investments	411	GIC
372	First In Ventures	392	Frazier Healthcare Partners	412	Gilde Healthcare
373	First Round Capital	393	FREES FUND	413	Gilead Sciences
374	First Star Ventures	394	Fresco Capital	414	GL Ventures
375	Flagship Pioneering	395	Front Row Fund	415	GlenRock Israel
376	Flare Capital Partners	396	FundersClub	416	Global Brain Corporation
377	Flex Capital	397	Fushia Investments	417	Global Founders Capital
378	Fly Ventures	398	Fusion Fund	418	GM&C Life Sciences Fund
379	Flybridge	399	Future Planet Capital	419	Golden Seeds
380	Flying Fish Partners	400	Future Shape	420	Golden Ventures

1120 Investors AI for Drug Discovery and Advanced R&D

421	Goldman Sachs	441	Greenspring Associates	461	HCS Beteiligungsgesellschaft
422	Goldman Sachs Asset Management	442	Grey Sky Venture Partners	462	Health Wildcatters
423	GSMBD	443	Greycroft	463	Healthcare Venture Partners
424	Good Growth Capital	444	Greylock	464	HealthInc
425	Goodman Capital	445	Grosvenor Food & AgTech	465	HealthQuest Capital
426	Google	446	Groupe Pasteur Mutualité	466	HealthTech Capital
427	Google Launchpad Accelerator	447	Grove Ventures	467	Healthware Ventures
428	Gopher Asset Management	448	GSR Ventures	468	Helicase Venture
429	Gore Range Capital	449	GT Healthcare Capital Partners	469	Hemex
430	Government of Canada	450	Guardant Health	470	Hemi Ventures
431	Government Of Quebec	451	Guardian Life	471	Hengxu Capital
432	GPG Ventures	452	GLIC - Dental Service Organization	472	Heritage Provider Network
433	Gradient Ventures	453	GV	473	Hermes-Epitek
434	Grand Mount Capital	454	H2020	474	High-Tech Grunderfonds
435	Granpool Innovative Investments	455	Hacking Health Accelerator	475	Highland Capital Partners
436	Gray's Creek Capital Partners	456	Hanhai Studio	476	Highline Capital Management
437	GBA Homeland Development Fund	457	Harmonix	477	Hike Capital
438	GreatPoint Ventures	458	Hatteras Venture Partners	478	Hike Ventures
439	Green Park & Golf Ventures	459	HBM Healthcare Investments AG	479	Hikma Ventures
440	GreenSky Capital	460	HBM Partners	480	Hillhouse Capital Group

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481	Hitachi Ventures	501	ICONIQ Growth	521	Innovation Partnership Programme
482	Hiventures	502	ICONYC labs	522	Inovia Capital
483	HOF Capital	503	IDG Capital	523	Insight Partners
484	Holnest	504	Illumina	524	Intel Capital
485	Honeywell Venture Capital	505	Illumina Ventures	525	Intermountain Ventures
486	HKSTP	506	Imagen Capital Partners	526	International Private Bank (IPB)
487	Hongyou Investment	507	IMM Investment	527	InterVest Co.
488	HOPU IMC	508	Indaco Venture Partners	528	Intus Capital
489	Horizon 2020	509	Index Ventures	529	Inventures SA
490	Horizons Ventures	510	IndieBio	530	Invest Detroit
491	Hoxton Ventures	511	Industrial Alliance Securities Inc	531	Invest Detroit Ventures
492	Human Capital	512	Industry Ventures	532	Investlink Holdings
493	HLPI Venture Fund	513	INGENIUM Emilia Romagna	533	InvestMichigan
494	Hyperplane Venture Capital	514	InHealth Ventures	534	Invus
495	I2BF Global Ventures	515	Initialized Capital	535	Ionis Pharmaceuticals
496	IA Ventures	516	Innospark Ventures	536	IQ Capital
497	iAngels	517	InnoSuisse	537	IQVIA
498	IBM	518	Innovate UK	538	IRA Capital
499	IBM Ventures	519	Innovation Endeavors	539	Ireland Strategic Investment Fund
500	ICF Capital	520	Innovation Fund Denmark	540	IrishAngels

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541	Iron Yard Ventures	561	Kaiser Permanente	581	KTB Network
542	Irving Investors	562	Kakao Ventures	582	La Famiglia
543	Italian Angels for Growth	563	Kaufman Financial Group	583	LabCorp
544	IvyCap Ventures	564	KB Securities	584	Lake Bleu Capital
545	JAL Ventures	565	KDB Bank	585	Lansdowne Partners
546	Janchor Partners	566	KDB Capital	586	Lauder Partners
547	January Capital	567	KdT Ventures	587	LaunchCapital
548	Janus Henderson Investors	568	Keiretsu Forum	588	Laurion Capital Management
549	Jazz Venture Partners	569	Kepha Partners	589	LBO France
550	JDRF T1D Fund	570	KF Ventures	590	LDV Partners
551	Jennison Associates	571	Khosla Ventures	591	Leaps by Bayer
552	JFDI.Asia	572	Kima Ventures	592	Legend Capital
553	Jianke	573	Kindred Capital	593	Legend Star
554	Jiantou Huawen Investment	574	King Star Capital	594	LEO Innovation Lab
555	Jiashan SDIC	575	KKR Real Estate Finance Trust	595	Life Science Angels
556	JMCR Partners	576	Kleiner Perkins	596	Lifeforce Capital
557	Johnson & Johnson Innovation	577	Knoll Capital Management	597	LifeSci Venture Partners
558	JSR Corp	578	Koch Disruptive Technologies	598	LIFTT
559	Jungle Capital	579	Korea Investment Partners	599	Lightspeed China Partners
560	Kaiser Foundation Hospitals	580	Korify Capital AG	600	Lightspeed Venture Partners

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601	Lilly Asia Ventures	621	MACSF	641	Mayo Clinic Ventures
602	Lim Teck Lee	622	Madrona Venture Group	642	Menlo Ventures
603	Linear Capital	623	Magnetic Ventures	643	Merck
604	Linear Venture	624	Maison Capital	644	Merck Global Health Innovation Fund
605	Liquid 2 Ventures	625	Malta Enterprise	645	Meridian Street Capital
606	Lishen Capital	626	Manchester Tech Trust Angels	646	Mérieux Equity Partners
607	Litmore Capital	627	Marathon Venture Capital	647	Merstal Ltd.
608	Logos Capital	628	March Capital	648	Metaplanet Holdings
609	London Co-Investment Fund	629	Marketplace Funds	649	Metavallon VC
610	Long Hill Capital	630	MaRS Discovery District	650	Metaventures
611	Longevity Vision Fund	631	Marshall Wace	651	Michael J. Fox Foundation
612	Longevitytech.fund	632	Marubeni	652	Michigan Angel Fund
613	Longley Capital	633	Maryland Momentum Fund	653	Michigan Rise
614	LS Polaris Innovation Fund	634	MassChallenge	654	Midven
615	Luminous Ventures	635	MassDevelopment	655	Mighty Capital
616	Lundbeck	636	MMV SEA	656	Millennium Technology Value Partn.
617	Lux Capital	637	Matrix Capital Management	657	Mindset Ventures
618	Luxor Capital Group	638	Matrix Partners	658	Ming Bioventures
619	M12 - Microsoft's Venture Fund	639	Maverick Ventures	659	Mirae Asset Capital
620	Mack-Cali Realty Corporation	640	Mayfield Fund	660	Mirae Asset Global Investments

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661	Mirae Asset Venture Investment
662	Mission Bay Capital
663	Mission BioCapital
664	MIT delta v
665	MMC Ventures
666	Monashee Investment Management
667	Moneta VC
668	Monsanto
669	Morgan Noble
670	Morgan Stanley
671	Morningside Ventures
672	Morpheus Ventures
673	Mount Sinai Health System
674	MPM Capital
675	MS&AD Ventures
676	MSA Capital
677	MTIP AG
678	Mubadala
679	Mubadala Capital Ventures
680	Nan Fung Life Sciences
681	NanoDimension
682	Nascent Invest
683	National Cancer Institute
684	NHGRI
685	NIDA
686	National Institutes of Health
687	National Research Foundation
688	National Science Foundation
689	NEO
690	Neoteny
691	Neotribe Ventures
692	Nest.Bio Ventures
693	Nesta Ventures
694	Neue Fund
695	New Enterprise Associates
696	New Leaf Venture Partners
697	New Mountain Capital
698	New World TMT Ltd
699	New York Ventures
700	Newable Ventures
701	Newchip
702	NewDo Venture
703	Newpath Management
704	NewSpring
705	Nex Cubed
706	Nex Cubed Digital Health
707	Nextech Invest
708	Nikon
709	Nimble Ventures
710	Nina Capital
711	Nissay Capital
712	NJF Capital
713	Nordic Impact
714	North Sound Ventures
715	Northcap
716	Northleaf Capital Partners
717	Northpond Ventures
718	Novaquest Capital Management
719	Novatio Ventures
720	Novotech

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721	NPIF Maven Equity Finance	741	Origin Capital	761	Parkwalk Advisors
722	NTT Venture Capital	742	OS Fund	762	Partech
723	Nvidia Inception	743	Osaka University Venture Capital	763	ParticleX
724	O2h Ventures	744	Oséo	764	Partner Fund Management
725	Oak HC/FT	745	OTV	765	Partnership Fund for New York City
726	Oasis Capital	746	OUP (Osage University Partners)	766	Patient Square Capital
727	Obvious Ventures	747	OurCrowd	767	Pavilion Capital
728	OCA Ventures	748	Outsized Ventures	768	Paxion Capital Partners
729	OCCIDENT	749	Overkill Ventures	769	Pear VC
730	Octagon Capital Partners	750	Oxford Sciences Innovation	770	Peking University Mingde Fund
731	Octopus Ventures	751	Oxford University Innovation	771	Pennington Partners & Co
732	Olive Tree Capital	752	Pacific Health Ventures	772	Pentech Ventures
733	Omega Funds	753	Palantir Technologies	773	Perceptive Advisors
734	OMX Ventures	754	Palisade Capital Management	774	Perivoli Innovations
735	One Way Ventures	755	Palisades Growth Capital	775	Pfizer
736	Ontario Centres of Excellence	756	Pan-Lin Capital	776	Pfizer Venture Investments
737	Open Field Capital	757	Panache Ventures	777	PharmStars
738	Open Philanthropy Project	758	Panda Capital	778	Phase 1 Ventures
739	Optum Ventures	759	Paradigm Capital	779	PHC Holdings
740	OrbiMed	760	Parinvest	780	Phoenix Venture Partners

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781	PHS Capital	801	Portfolia	821	Qiming Venture Partners
782	Pi Campus	802	Portland Seed Fund	822	Qualgro VC
783	Pi Ventures	803	Possible Ventures	823	R42 Group
784	PICC CIM	804	PP Capital	824	RA Capital Management
785	Picc Group	805	PPD	825	Radical Ventures
786	Pictet Private Equity Investors S.A.	806	Practica Capital	826	Raglan Capital
787	Piedmont Capital Investments	807	Prefix Capital	827	Ramen Ventures
788	Pillar VC	808	Presight Capital	828	Razor's Edge Ventures
789	Ping An	809	Primary Venture Partners	829	Real Ventures
790	Ping An Ventures	810	Primavera Capital Group	830	Rearden Capital Management LLC
791	Pioneer Fund	811	Prime Movers Lab	831	Red Cedar Ventures
792	Pitango Venture Capital	812	Princeton Alumni Angels	832	Red Cell Partners
793	Pitch@Palace	813	Pritzker Group Venture Capital	833	Redalpine
794	Pivotal bioVenture Partners	814	Pritzker/Vlock Family Office	834	Redmile Group
795	PivotNorth Capital	815	Propagator Ventures	835	Redpoint
796	Playground Global	816	Propel(X)	836	Refactor Capital
797	Plug and Play Tech Center	817	Prosperico Ventures	837	Regal Funds Management
798	Point Field Partners	818	PP Investments	838	Regeneron
799	Point Sur Investors	819	Pura Vida Investments	839	Renaissance Venture Capital
800	Point72 Ventures	820	Purity Star	840	Rev1 Ventures

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841	Revo Capital	861	S.R.I.W.	881	Seneca Creek Ventures
842	Revolution's Rise	862	Sabby Capital	882	Seneca Partners
843	Rho Ventures	863	Sabby Management	883	Senshu Ikeda Capital
844	Ridgeback Capital	864	Safar Partners	884	Sequoia Capital
845	Right Side Capital Management	865	Samsara BioCapital	885	Sequoia Capital China
846	Rising Tide	866	Samsung Ventures	886	Seraph Group
847	Risk and Return	867	Sanabil	887	Serena
848	Rivas Capital	868	Sanofi	888	Serra Ventures
849	Robin Hood Ventures	869	Sanofi Ventures	889	Service Provider Capital
850	Roca X	870	Sapir Venture Partners	890	Seven Peaks Ventures
851	Roche	871	Sapphire	891	Seventure Partners
852	Roche Venture Fund	872	Scale Venture Partners	892	SFEM Italia
853	Rock Springs Capital	873	Schooner Capital	893	SGInnovate
854	Rockies Venture Club	874	Schusterman Foundation	894	Shangbay Capital
855	Roivant Sciences	875	SciFi VC	895	Shengding Equity Investment Fund
856	RT Ventures	876	SCOR Life & Health Ventures	896	Shenzhen Xiaoxi Holdings
857	RTAventures VC	877	Section 32	897	Sherpa Venture Capital
858	RTW Investments LLC	878	Seed Capital	898	Shin Ryoku Trust
859	Rubio Impact Ventures	879	Seedcamp	899	Shinhan Investment Corporation
860	Ruvento	880	Selvedge Venture	900	Shunwei Capital

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901	Sierra Ventures	921	Social Impact Capital	941	StageDotO
902	SIG China	922	Sofinnova Partners	942	Stanford Angels and Entrepreneurs
903	Sigma Prime Ventures	923	SoftBank	943	Stanford University
904	SignalFire	924	Softbank Ventures Asia	944	Start Capital
905	Signant Health	925	SoftBank Vision Fund	945	Startup Capital Ventures
906	Silicon Valley Bank	926	SoGal Ventures	946	Startupbootcamp
907	Singtel Innov8	927	Soma Capital	947	StartX
908	Singularity University Ventures	928	Sorrento Therapeutics	948	SteelSky Ventures
909	Sino Biopharmaceutical	929	SOSV	949	Sto-Rahoitus
910	Sinovation Ventures	930	Sound Ventures	950	Streamlined Ventures
911	SIT Capital	931	Source Code Capital	951	StreShi
912	Sixty Degree Capital	932	South Park Commons	952	Stripes
913	SK Global Chemical	933	Spark Growth Ventures	953	Sunfish Partners
914	Skip Capital	934	Sphera Global Healthcare Fund	954	Surveyor Capital
915	SKS PE	935	SPRIM	955	Susa Ventures
916	Sky Ventures Group	936	Springbank Collective	956	Sustainable Conversion Ventures
917	Sky9 Capital	937	SpringRock Ventures	957	Suvretta Capital Management
918	Small Business Innovation Research	938	Square Peg Capital	958	SV Angel
919	Smedvig Capital	939	St. John's College	959	SV Health Investors
920	Snowflake Ventures	940	Stage Venture Partners	960	SV Tech Ventures

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961	Sway Ventures
962	Swisscom Ventures
963	SymphonyAI
964	SyndicateRoom
965	Synetro Group
966	T. Rowe Price
967	Tachyon Ventures
968	Takeda Ventures
969	Talos VC
970	Tamarind Hill
971	Tao Capital Partners
972	TAU Ventures
973	Tavistock Group
974	TCG Crossover
975	TCV
976	TD Veen
977	Teal Ventures
978	Team Builder Ventures
979	Tech Coast Angels
980	Tech Transfer UPV
981	Techammer
982	Techstars
983	TechU Ventures
984	TEDCO
985	Tekla Capital Management
986	Temasek Holdings
987	Tencent
988	Teng Yue Partners
989	Tensor Ventures
990	Terra Magnum Capital Partners
991	Teva Pharmaceutical Industries
992	TF Capital
993	The Baupost Group
994	The Chartered Group
995	The E14 Fund
996	The Family
997	The Index Project
998	The Jagen Group
999	The Longevity Fund
1000	Third Kind Venture Capital
1001	Third Rock Ventures
1002	Thorney Investment
1003	Three Leaf Ventures
1004	Threshold
1005	TIA Ventures
1006	Tiantu Capital
1007	Tiger Global Management
1008	Tikehau Capital
1009	TIS Japan
1010	TiVenture
1011	TLV Partners
1012	Touchdown Ventures
1013	TPG
1014	TPG Biotech
1015	Trancos Ventures
1016	Transformation Capital
1017	Trend Investment Group
1018	Tribeca Venture Partners
1019	True Ventures
1020	Truffle Capital

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1021	Tsingyuan Ventures
1022	TSVC
1023	TT Capital Partners
1024	Two Sigma Ventures
1025	Tybourne Capital Management
1026	U.S. Food and Drug Administration
1027	UBC Seed Fund
1028	UCB
1029	UCLB
1030	UK Innovation & Science Seed Fund
1031	Ukrainian Startup Fund
1032	UL Ventures
1033	Ulu Ventures
1034	Uncork Capital
1035	Uni-Innovate Group
1036	Universal Materials Incubator
1037	University of Cambridge Enterprise
1038	University of Minnesota
1039	Unshackled Ventures
1040	UPMC
1041	Upsher Smith Laboratories
1042	UTC Investment
1043	UTEC - UTECP
1044	UTEST
1045	UV-Cap
1046	v1.vc
1047	Vaekstfonden
1048	Validus Growth Investors
1049	Valor Ventures
1050	Vanedge Capital
1051	Vanguard Atlantic
1052	Varian
1053	Vast Ventures
1054	Vectr
1055	venBio Partners
1056	Venrock
1057	Venture Kick
1058	Verition Fund Management
1059	Veronorte
1060	Versant Ventures
1061	Vertex Pharmaceuticals
1062	Vertex Venture Holdings
1063	Vertex Ventures
1064	Vertex Ventures Israel
1065	Verve Ventures
1066	Vienna Business Agency
1067	Vienna Insurance Group
1068	Viking Global Investors
1069	Village Global
1070	Vinno Capital
1071	VTC Innovation Fund
1072	VisVires New Protein
1073	VitalizeVC
1074	VitaTech S.A
1075	Viva BioInnovator
1076	Viva Biotech
1077	Viva Ventures Biotech Fund
1078	Vives Louvain Technology Fund
1079	Vivo Capital
1080	Vizille Capital Innovation

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1081	Voxel Ventures
1082	Vulcan Capital
1083	W Fund
1084	Walden Riverwood Ventures
1085	Walking Ventures
1086	Warburg Pincus
1087	Washington Research Foundation
1088	Watson Capital Partners
1089	Watson Investment
1090	Wavemaker 360
1091	Wavemaker Partners
1092	Waycross Ventures
1093	Wellington Management
1094	Wells Fargo Strategic Capital
1095	Welltech Ventures
1096	West Virginia Jobs Investment Trust
1097	Western Digital Capital
1098	Western Technology Investment
1099	Westlake Village BioPartners
1100	Westwood Ventures
1101	What If Ventures
1102	WI Harper Group
1103	Windham Venture Partners
1104	Wisemont Capital
1105	Women Who Tech
1106	WONIK Investment Partners
1107	Woodford Investment Management
1108	Woodline Partners
1109	WorldQuant Ventures LLC
1121	Yingqi Investment
1122	Yipu Capital
1123	Yitu Technology
1124	ZhenFund
1125	Zhongyuan Union Cell & Gene Eng
1100	WPSS.bio
1111	Wren Capital
1112	WuXi AppTec
1113	WuXi Healthcare Ventures
1114	Wuxi Venture Capital Group
1115	Wuyuan Capital
1116	Xiamen Changrong Invest. Manag.
1117	XLerateHealth
1118	XTX Ventures
1119	Y Combinator
1120	YF Capital

36 Pharma Corporations Applying AI for Drug Discovery

1	AbbVie
2	Agios Pharmaceuticals
3	Amgen
4	Astellas Pharma
5	AstraZeneca
6	Bayer
7	Daewoong Pharmaceutical
8	Dexa Medica Group
9	Eddingpharm (Cayman)
10	Eli Lilly
11	Galapagos NV
12	Genentech
13	Gilead Sciences Inc.
14	GSK
15	Hanmi Pharmaceutical
16	Illumina
17	Jamjoom Pharma
18	Janssen Pharmaceuticals
19	Johnson & Johnson
20	La jolla Pharmaceutical
21	Maruishi Pharmaceutical Co. Ltd.
22	Merck
23	Mitsubishi Tanabe Pharma
24	Nektar Therapeutics
25	Novartis
26	Novo Nordisk
27	Otsuka Pharmaceutical
28	Pfizer
29	Roche
30	Sanofi
31	Santen
32	Shionogi
33	Sumitomo Dainippon Pharma
34	Takeda
35	Teva Pharmaceutical
36	Viva BioInnovator

31 Tech Corporations Applying Advanced AI in Healthcare

1	Adobe
2	Alibaba
3	Alphabet
4	Amazon
5	Apple
6	Baidu
7	Canon
8	Cisco
9	Dell Technologies
10	Foxconn Technology
11	Fujitsu
12	General Electric (GE)
13	Google
14	Hitachi
15	HP
16	Huawei
17	IBM
18	Intel
19	LG Electronics
20	Microsoft
21	NVIDIA
22	Oracle
23	Pulse Infoframe
24	RAIR Health
25	Salesforce
26	Samsung Electronics
27	SAP
28	Siemens
29	Tencent
30	Unisys
31	Workday

20 CROs AI in Healthcare & 15 Chemical Corporations Applying AI in Healthcare

1	Actimus Biosciences
2	Aptuit
3	BioClinica
4	Charles River Laboratories
5	CMIC
6	Covance
7	Evotec
8	Frontage Holdings
9	ICON
10	IonsGate
11	IQVIA
12	Iris Pharma
13	J-STAR Research, Inc. / Porton
14	Open Orphan plc
15	PAREXEL
16	Phastar
17	Phlexglobal
18	PRA International
19	Samsung Biologics
20	SGS

1	Asahi Kasei
2	BASF
3	COVESTRO
4	DIC
5	The Dow Chemical Company
6	DSM
7	DUPONT
8	ECOLAB
9	EVONIK INDUSTRIES
10	Henkel
11	Lonza
12	MITSUI CHEMICALS
13	Solvay
14	SUMITOMO CHEMICAL
15	SYNGENTA

Overview of Proprietary Analytics by Deep Pharma Intelligence

DEEP
PHARMA
INTELLIGENCE

About Deep Pharma Intelligence

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:

DEEP KNOWLEDGE ANALYTICS

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

Deep Pharma Intelligence (DPI) is a strategic partner to the leading Life Science organizations, investment institutions (VC funds, investment banks), and governments across the globe — in matters related to investments, strategic positioning, and policy development in the areas of pharmaceutical and biotech research, and healthcare tech.

While Deep Pharma Intelligence is regularly producing open industry reports covering high-growth sectors in the Life Sciences, including artificial intelligence (AI), digital health, and new therapies, some of the more in-depth research is only available to our clients and strategic partners under the "Proprietary Analytics" category.

Our range of proprietary services includes custom consulting projects, based on the specific customer needs, as well as a collection of pre-produced "ready-to-use" proprietary reports, produced by our research team, covering general trends and specific action ideas and strategy insights related to the most promising investment prospects (e.g. new technologies, biotech startups), M&A prospects (e.g. pipeline development targets), and strategic growth ideas (trends profiling, industry overviews etc).

Services:

- Investment landscape profiling, identifying investment ideas in the biotech/healthcare tech space
- Preliminary due-diligence (business, science and technology, intellectual property (IP) profiling, freedom of operation assessment, legal assessment etc)
- Comprehensive due-diligence (deep business, science and technology assessment, IP and legal assessment, growth potential assessment etc)
- Infringement analysis of technology (i.g. If you plan to partner or invest in a data-analytics biotechs, or AI-development vendors, it is essential to understand their technological assets, both in terms of innovation potential and in terms of legal protection and non-infringement risk management)
- SWOT analysis of companies and technological sectors, competitive profiling
- Industry profiling and growth strategy development for top-tier companies and governments.

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.

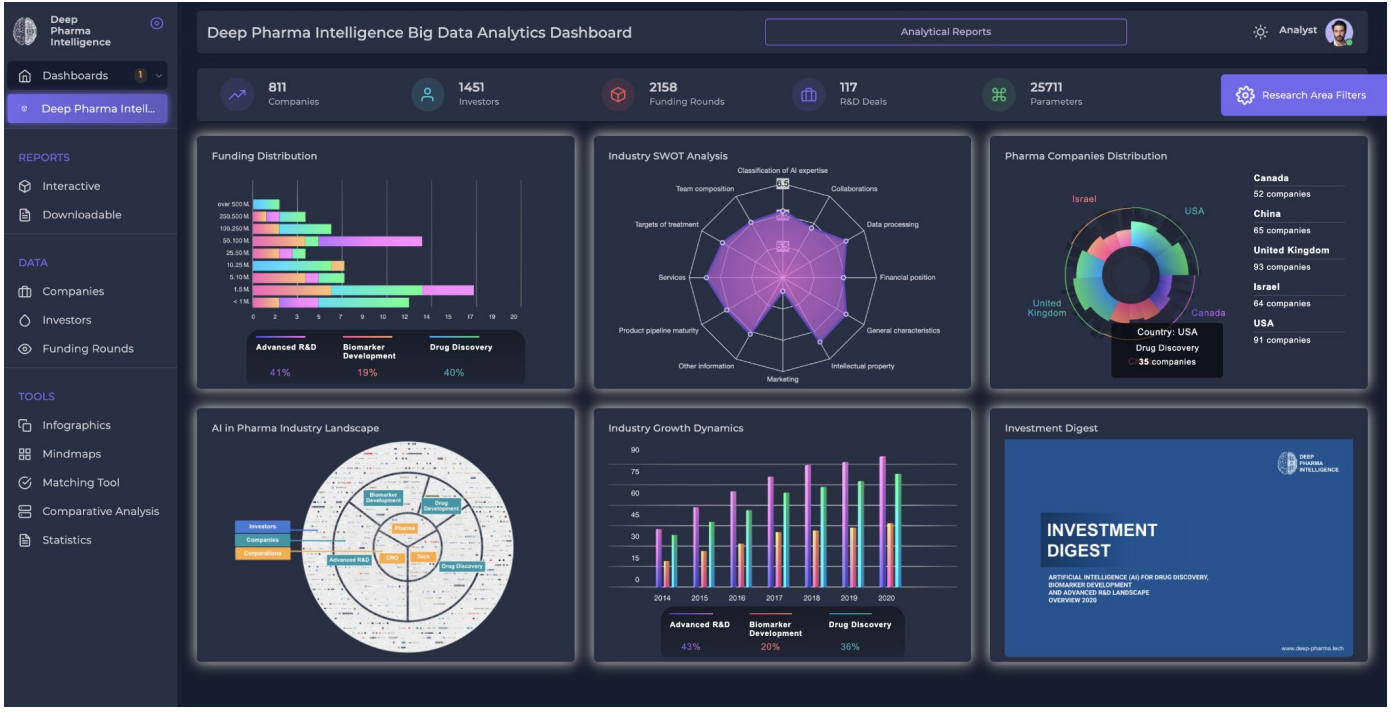
Our reports are supported by our rapidly developing data mining engine, data visualization platform and analytics dashboards.

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**

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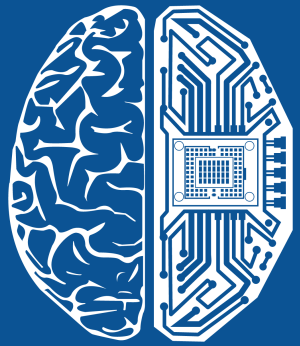

Link to the Report: deep-pharma.tech/ai-for-drug-discovery-q1-2022	
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