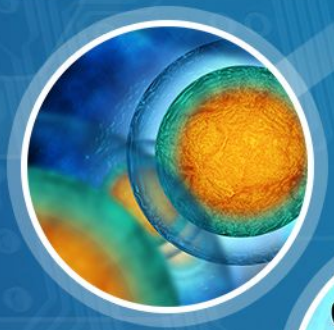

Companies - 170
Corporations - 50
R&D Centers - 35
Investors - 400

Quarter 2 / 2019

AI

FOR DRUG DISCOVERY, BIOMARKER DEVELOPMENT AND ADVANCED R&D LANDSCAPE OVERVIEW 2019 / Q2

DEEP KNOWLEDGE ANALYTICS
"PHARMA DIVISION"

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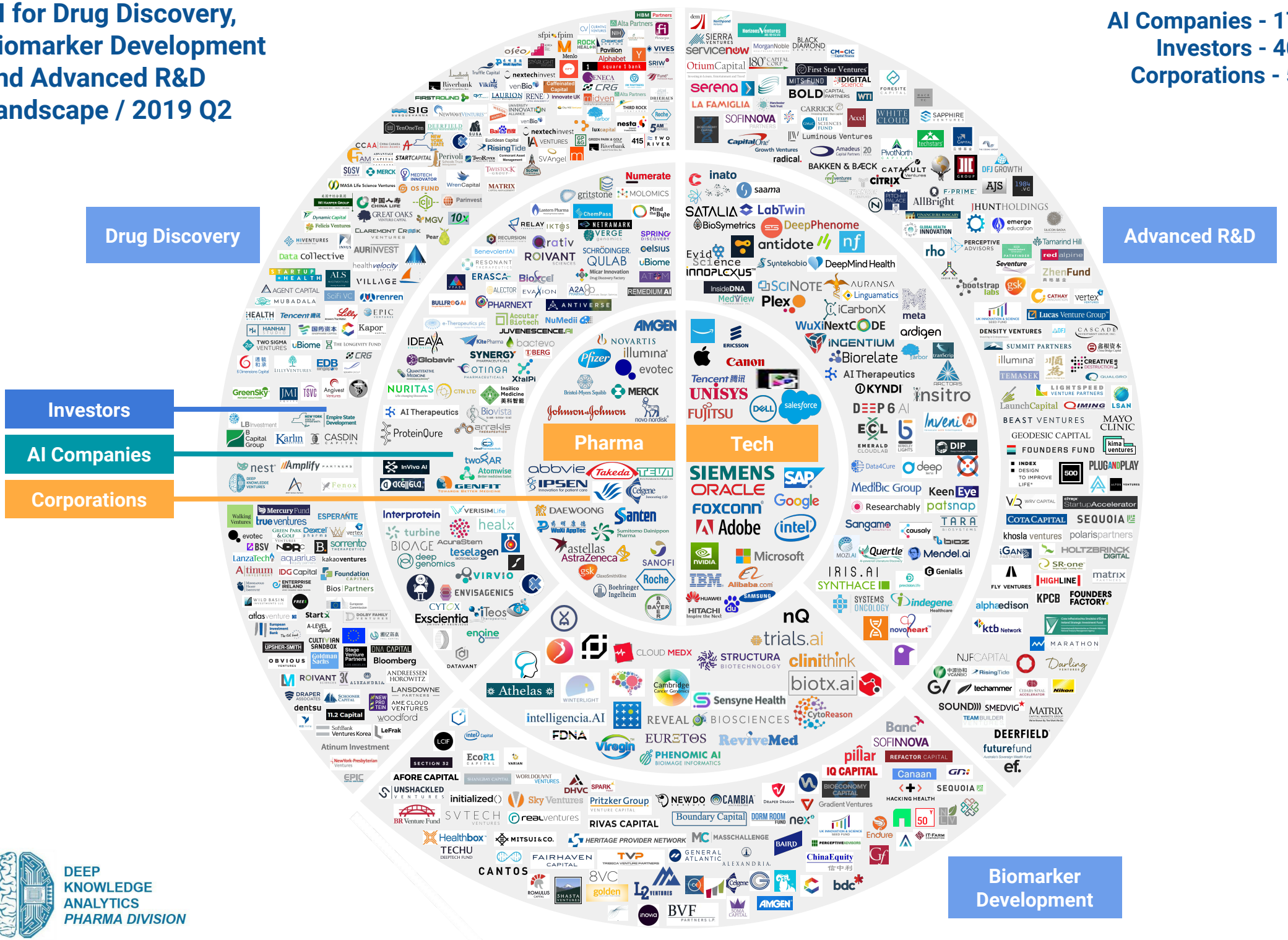

Diversification of AI for R&D and Drug Discovery Process 2019 Q2

AI Companies - 170
Investors - 400

Companies

Investors

Design Preclinical Experiments

EUROTOS

AFORE CAPITAL
golden
inovia
Healthbox
Boundary Capital
LCIF
IQ CAPITAL
Gradient Ventures

Preclinical Experiment Execution

novoheart
BERKELEY LIGHTS
EMERALD CLOUDLAB
ECL
SYNTHACE
SOFINNOVA PARTNERS
ktb
varian
BIOECONOMY CAPITAL
Nikon
UK INNOVATION & SCIENCE SEED FUND
ROCK HEALTH
BLACK DIAMOND
luxcapital
HOLTZBRINCK DIGITAL
Luminous Ventures
COTA CAPITAL

Data Aggregation & Analysis

InsideDNA
SATALIA
DeepPhenome
INGENTIUM
biotx.ai
intelligencia.AI
DIP
Genialis
meta
iCarbonX
Inveni AI
Data4Cure
MedView
MOZI.AI
WuXiNextCODE
Researchably
ardigen
insitro
BioSymetrics
SCINOTE
MediBic Group
Evid Science
bioz
Accutar Biotech
patsnap
Biorelate
INNOPLEXUS
causaly
nf
KYNDI
THOUGHTSPOT
IRIS.AI
Plex

500
ef.
techammer
MITS FUND
SAPPHIRE VENTURES
KPCB
鑫根资本
ECL
MATRIX
AllBright
WHITE CLOUD
StartupAccelerator
LIFE SCIENCES FUND
PITCH PALACE
matrix
servicenow
DFJ GROWTH
DIGITAL
FOUNDERS FUND
FORESITE CAPITAL
MAYO CLINIC
CATHAY
futurefund
TAVISTOCK
DIGITAL
Endure
NJF
OtiumCapital
rho
GEODESIC CAPITAL
BEAST VENTURES
PLUG and PLAY
khosla ventures
BAKKEN & BÆCK
polarispartners
PivotNorth CAPITAL
CREATIVE DESTRUCTION
iGAN PARTNERS
UpHonest Capital
LIGHTSPEED VENTURE PARTNERS
kima ventures
Banc
LaunchCapital
illumina
ZhenFund
CITRIX
CapitalOne
FOUNDERS FACTORY
JHUNTHOLDINGS
HIGHLINE
BOLD CAPITAL PARTNERS
Darling VENTURES
VENTURES
DENSITY VENTURES
INDEX DESIGN TO IMPROVE LIFE
vertex VENTURES
red alpine
CATAPULT Ventures
MorganNoble
TRANCOS
QIMING
180° CAPITAL CORP
TEMASEK
QUALGRO
SUMMIT PARTNERS
MARATHON
EMERGE EDUCATION
SR-one
SEQUOIA
First Star Ventures
CARRICK

Drug Design

Syntekabio
arrakis THERAPEUTICS
Micar Innovation
TransCrip
QULAB
ATOM
ANTIVERSE
RELAY
AI Therapeutics
gritstone
Insilico Medicine 英科智能
DATAVANT
CYTOX
SCHRÖDINGER
ProteinQure
NETRAMARK
BERG
Celsius
EVAXION
A2A PHARMA
Parbor
REMEDIUM AI
COTINGA PHARMACEUTICALS
GTN LTD
bactevo
IKTOS
JUVENESCENCE.AI
Globavir
PEPTICOM
Numerate
CloudPharmaceuticals
BIOAGE
VERGE genomics
engine
BenevolentAI
SPRING DISCOVERY
uBiome
NuMedii
ENVISAGENICS
RESONANT THERAPEUTICS
Mind the Byte
MOLOMICS
Atomwise
twoXAR
teselagen
VIRVIO
e-Therapeutics plc
Exscientia
XtalPi
QUANTITATIVE MEDICINE
NURITAS
deep genomics

NIH
Wuxi AppTec
SUSA
true ventures
ALS
SciFi VC
Empire State Development
Mercury Fund
FIRSTROUND
nesta
Tencent 腾讯
Pavilion
CASCADE INVESTMENT GROUP, INC.
DEEP KNOWLEDGE VENTURES
6 Dimensions Capital
DRAPER ASSOCIATES
Pear
MASA Life Science Ventures
Foundation Capital
HANHAI
Karlin
VILLAGE
WrenCapital
LBInvestment
ENTERPRISE IRELAND
LILLYVENTURES
sorrento
TWO SIGMA VENTURES
Data Collective
THIRD ROCK
Alden
DEERFIELD
evotec
LanzaTech
CLAREMONT CREEK VENTURES
B Capital Group
ESPERANTE
Dynamic Capital
Felicis Ventures
MERCK
THE LONGEVITY FUND
Baidu
SERAPH GROUP
risingtide
UPSHER-SMITH
SIG
11.2 Capital
nest
BSV
AME CLOUD VENTURES
DOLBY FAMILY VENTURES
Bloomberg
A-LEVEL Capital
Atinum Investment
atlas venture
LANSDOWNE PARTNERS
ANDREESSEN HOROWITZ
MGV
SoftBank Ventures Korea
CULTIVIAN SANDBOX
ROIVANT
FRAZIER HEALTHCARE PARTNERS
edbi
woodford
CLI
ENECA
BVF
50
GreenSky
renren
IDG Capital
RENAISSANCE
Y Combinator
DEERFIELD
Caffeinated Capital
Perivoli
Kapor
NDRC
MEDTECH INNOVATOR
Stage Venture Partners
SVAngel
MUBADALA
Goldman Sachs
Stanford University
STARTCAPITAL
GREAT OAKS
10x
dentsu
AGENT CAPITAL
MassDevelopment
ALTOS
LeFrak
CASDIN CAPITAL
Euclidean Capital
OS FUND
Walking Ventures
Alphabet
SECTION 32
MAVEN
aquarius
uBiome
Amplify
DNA CAPITAL
SRIW
sfpi spim
UCL
Tamarind Hill
Viking
QVT
Dexcel pharma
CV
TwoRiver
Roche
oseo
HBM Partners
Riverbank

Clinical Trial Design, Optimization, Recruitment

AURANSA
Sensyne Health
antidote
BULLFROG AI
ARCTORIS
indegene
DeepMind Health
nQ
WINTERLIGHT
Mendel.ai
REVEAL
clinithink
Athelas
DEEP 6 AI
trials.ai
inato
CLOUD MEDX

UNSHACKLED VENTURES
REFACTOR CAPITAL
realventures
BAIRD
Enzyme
CYTOX
dcm
Gi Global Health Fund LP
Amadeus Capital Partners
20
DORM ROOM FUND
nex
JIC
ChinaEquity
A2A PHARMA
bootstrap labs
NEWDO
TVP
SMEDVIG
HACKING HEALTH
L2 VENTURES
serena
FAIRHAVEN CAPITAL
SEQUOIA
initialized
AMGEN
DHVC
FLY VENTURES
Celgene VR
MITSUI & CO.
CMS
CAMBIA
Pritzker Group
ALEXANDRIA VENTURE INVESTMENTS
HERITAGE PROVIDER NETWORK
WTI
SVTECH VENTURES
KdT Ventures
bdc
pillar
FundersClub
CRG
CEDARS-SINAL ACCELERATOR
DHVC
techstars
Sky Ventures
BR Venture Fund
radical.
healthvelocity CAPITAL
Northpond
revventures
CM-CIC
SIERRA VENTURES

Repurposing Existing Drugs

Biovista
Lantern Pharma
Pioneering Precision medicine
healx
BioXcel
RECURSION pharmaceuticals
Qrativ
AcuraStem
PHARNEXT

NYP
1 square 1 bank
ROCK HEALTH
pillar
ReviveMed
Menlo
Truffle Capital
OBVIOUS VENTURES
TECHU HEALTH WILDCATTERS
AURINVEST
EPIC VENTURES
TSVC
luxcapital
ADVANTAGE CAPITAL PARTNERS
MUBADALA
SPARK
SENECA
SOMA CAPITAL
Atinum Investment
Bios Partners
WILD BASIN INVESTMENTS LLC
LBInvestment
kakaoventures
GREEN PARK & GOLF VENTURES
Parinvest.net
MATRIX CAPITAL MANAGEMENT

Researching Mechanisms of Disease`

SYSTEMS ONCOLOGY
PHENOMIC AI
ReviveMed
Virogin
CytoReason
FDNA
STRUCTURA BIOTECHNOLOGY
Sensyne Health

SOFINNOVA PARTNERS
MC
BIOECONOMY CAPITAL
Endure
UK INNOVATION & SCIENCE SEED FUND
SciFi VC
NEWDO
Seedcamp
RIVAS CAPITAL
ROMULUS
WORLDQUANT VENTURES
JMI
PARINVEST
TECHU
DEEPTECH FUND
MC
IT-FARM
RIVA Capital S.A.
Independent Alternative Investment Advisors

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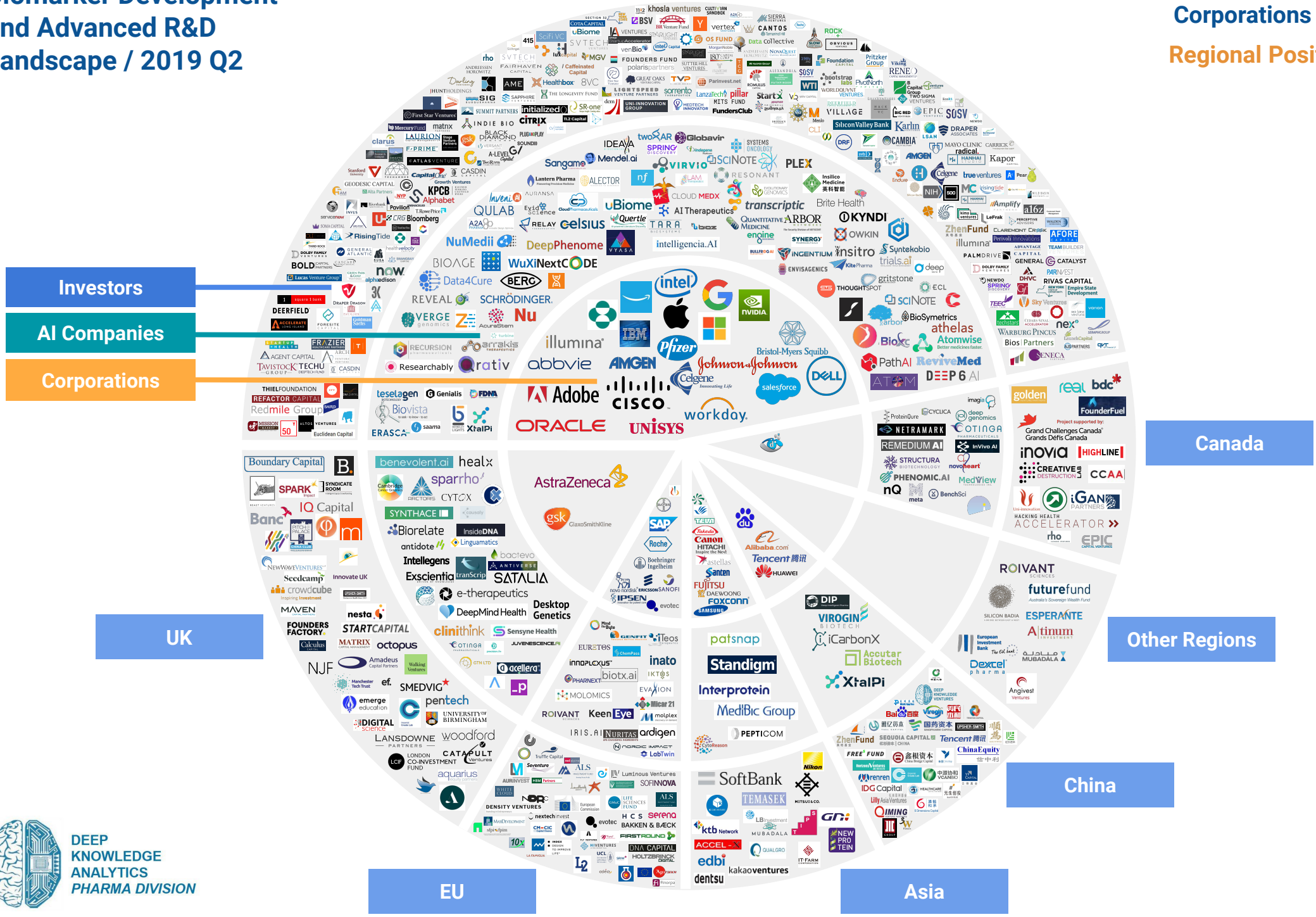
AI for Drug Discovery, Biomarker Development and Advanced R&D Landscape / 2019 Q2

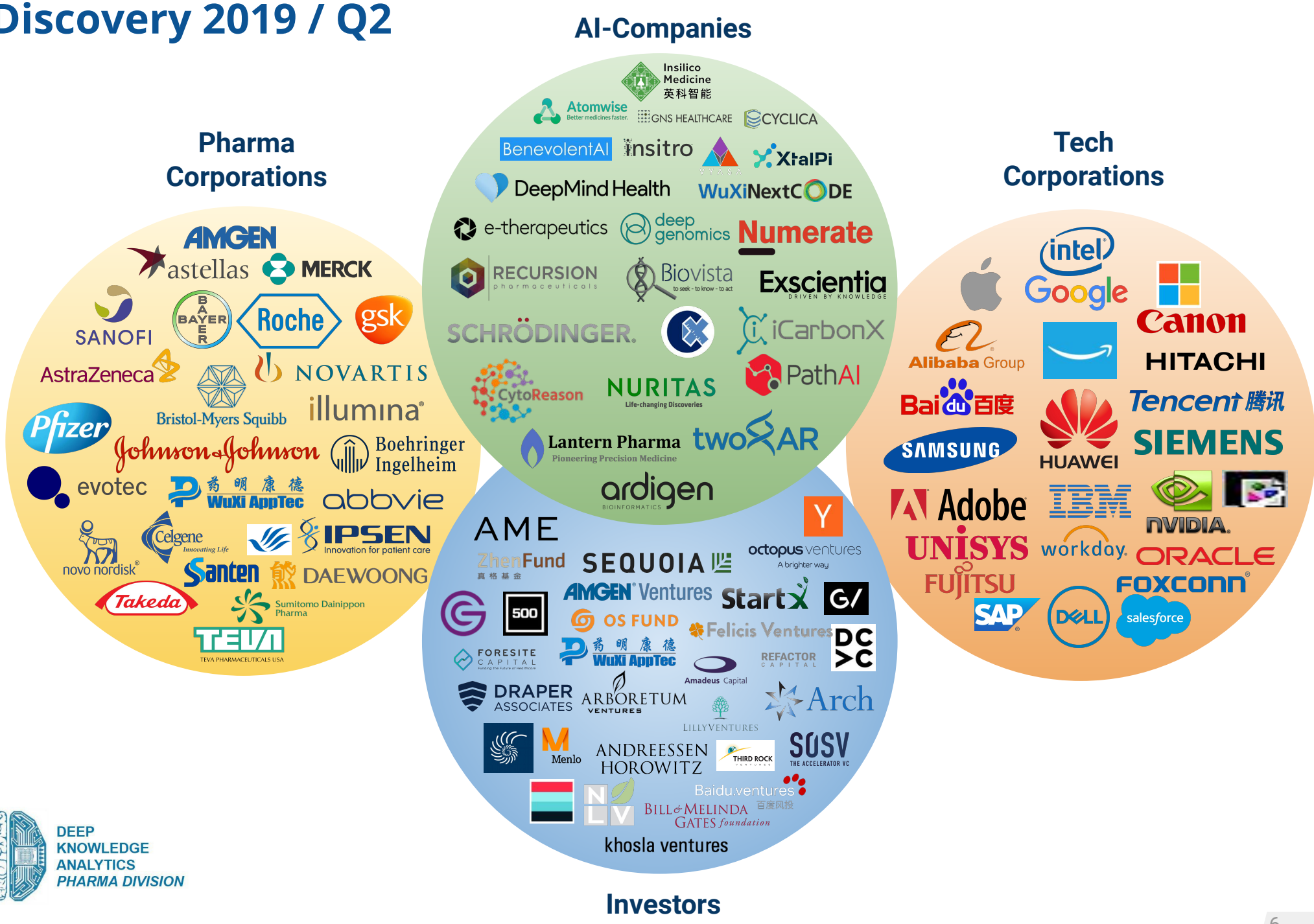
AI Companies - 170
Investors - 400
Corporations - 50

Regional Position



DEEP KNOWLEDGE ANALYTICS
PHARMA DIVISION

Leading Companies - Advanced AI in Healthcare and Drug Discovery 2019 / Q2



DEEP KNOWLEDGE ANALYTICS
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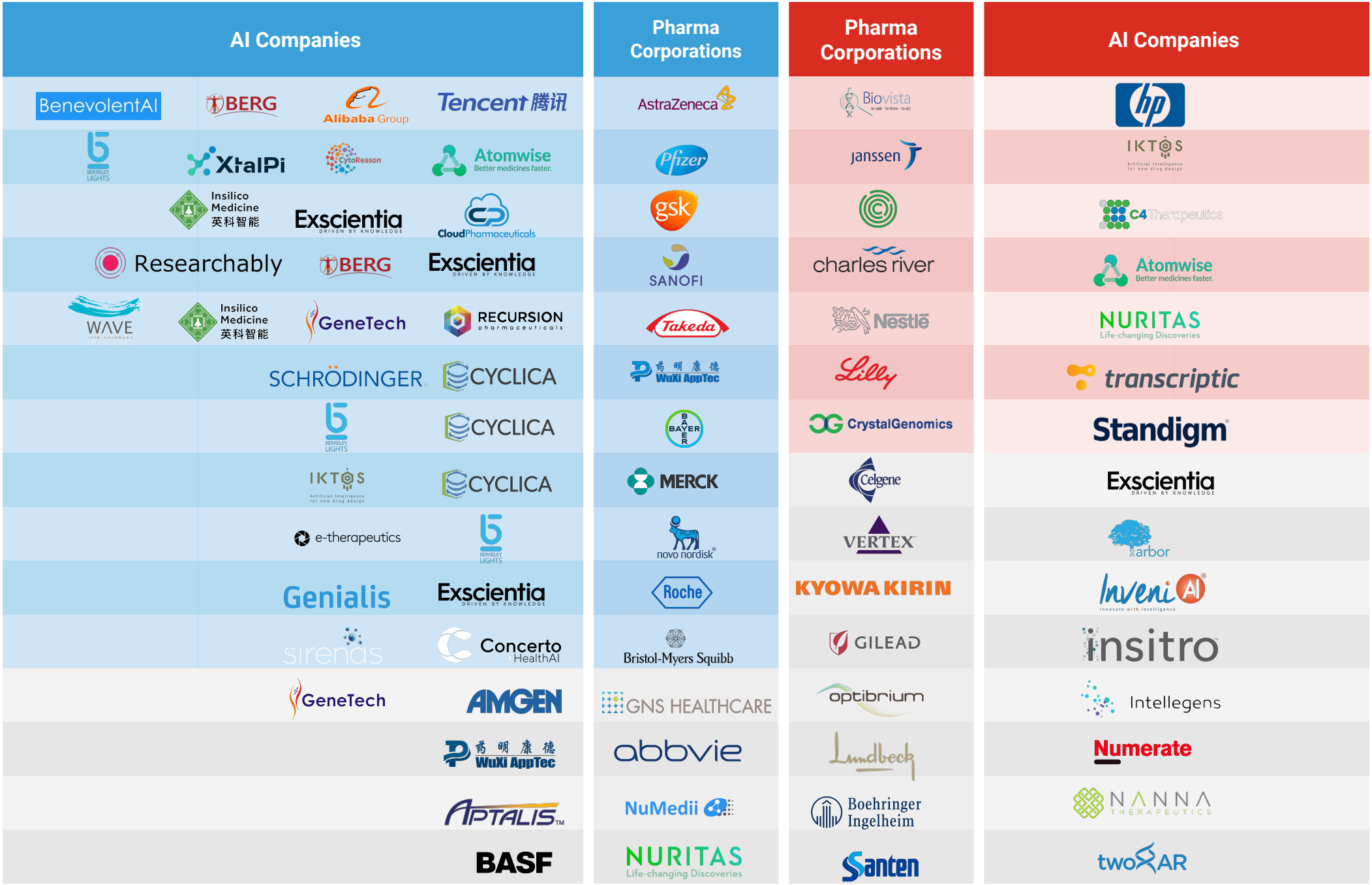
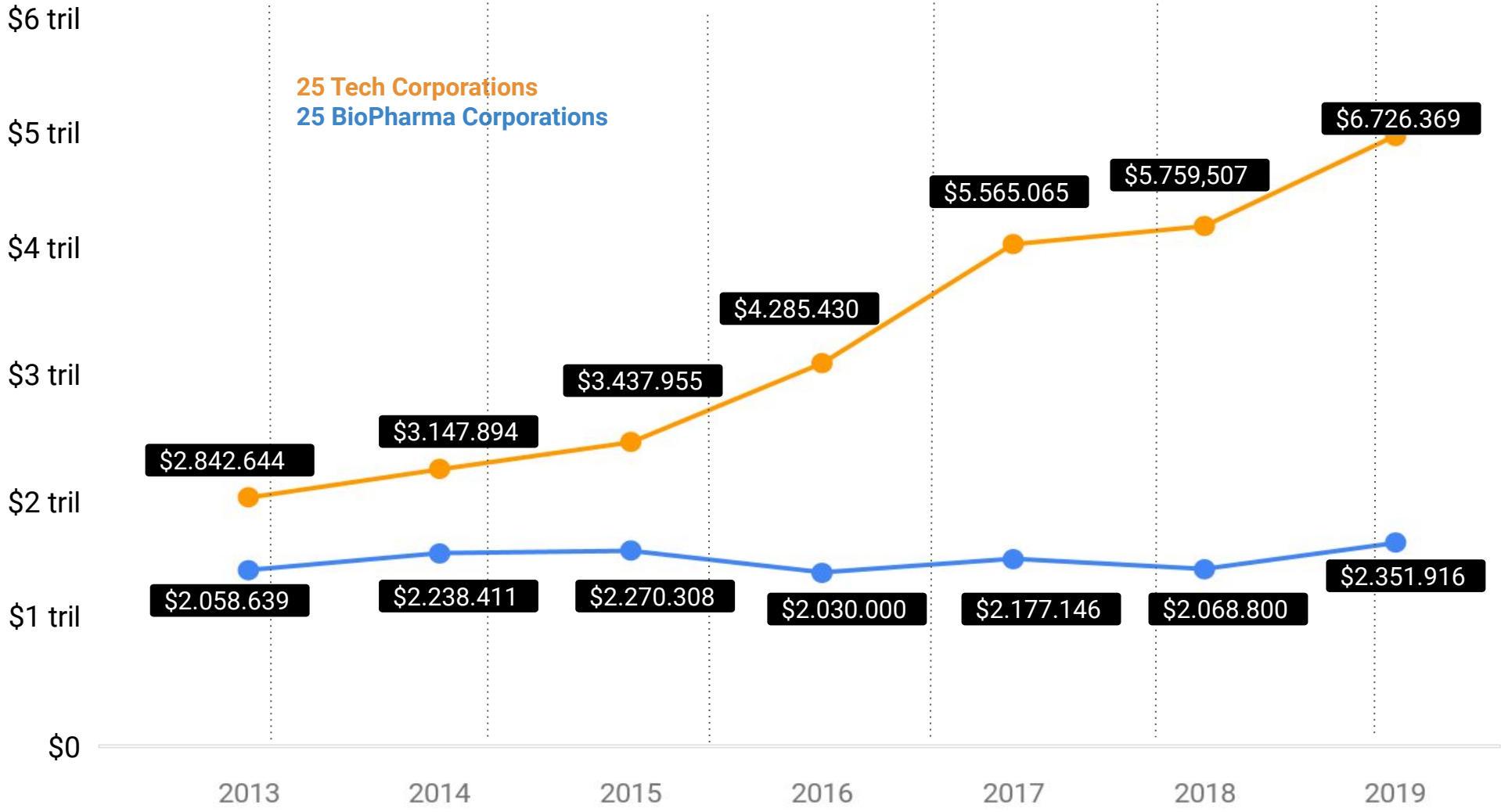
Pharma AI Deals Structure 2019 / Q2



Top-20 Investors in AI Companies

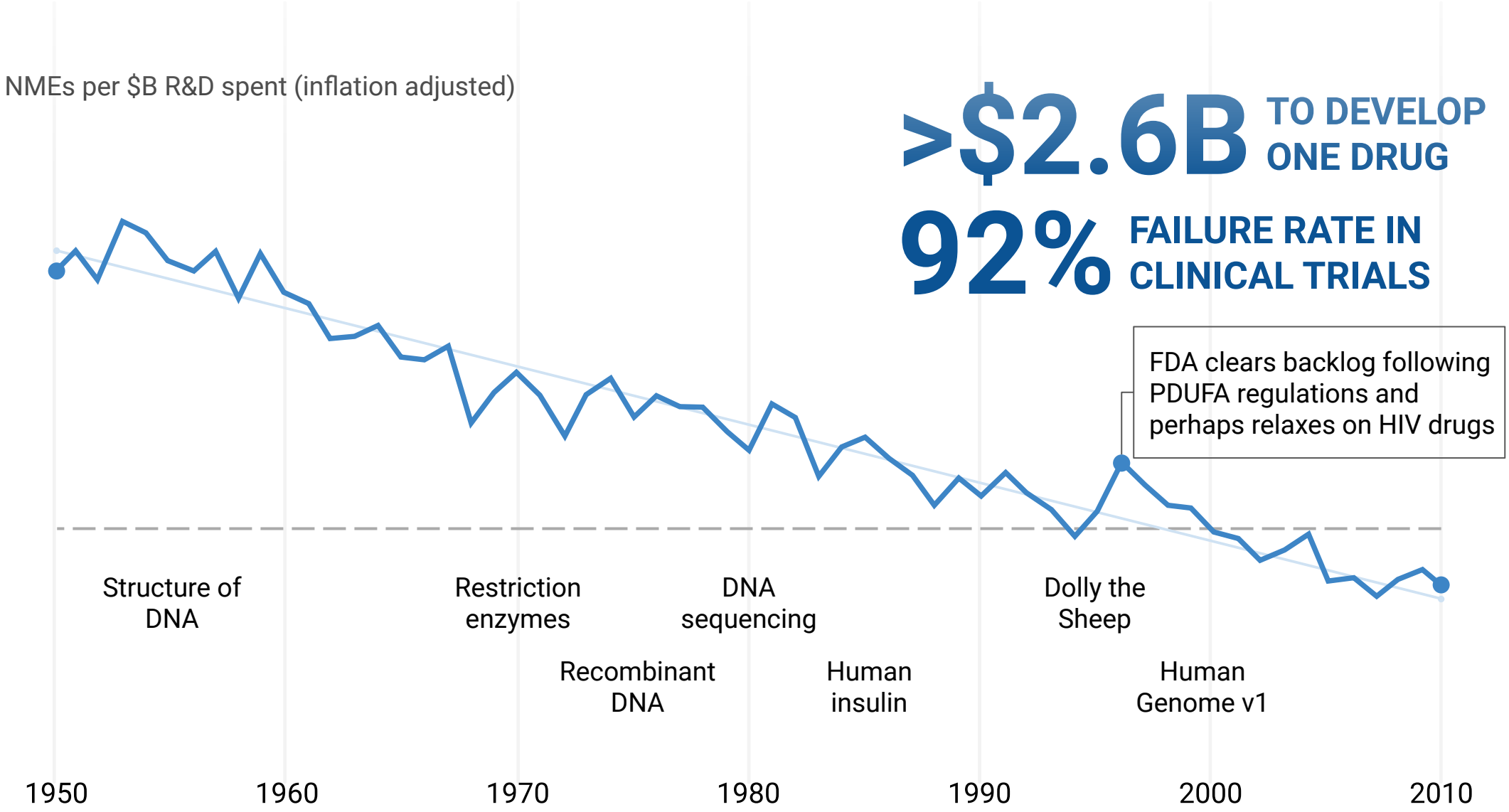
Top AI Companies		Investments overall	INVESTORS		Investments overall	Top AI Companies	
	Atomwise	9	Y combinator	Sequoia Capital	9	XtalPi	WuXiNextCODE
		8	SOSV	OS Fund	8	Atomwise	twoXAR
SCHRÖDINGER	insitro	8	GV	Data Collective DCVC	8	Atomwise	RECURSION
Atomwise	RECURSION	8	AME Cloud Ventures	ZhenFund	7	XtalPi	
Atomwise	deep genomics	6	Khosla Ventures	Andreessen Horowitz	6	insitro	twoXAR
		6	Amadeus Capital Partners	WuXi AppTec	5	Insilico Medicine 英科智能	
	PathAI	5	General catalyst	StartX	4	XtalPi	
	PathAI	4	Refactor Capital	Founders fund	4	RECURSION	
		4	Felicis ventures	Draper associates	4	Atomwise	
	WuXiNextCODE	3	Amgen ventures	500 startups	3		

Combined Capitalization of
25 Tech Corporations vs 25 BioPharma Corporations



As can be seen in the figure above, the combined capitalization of the 25 BioPharma corporations profiled in this report has remained on the same level for the past 5 years while the capitalization of the 25 IT & Tech corporations profiled in this report is growing significantly. For instance, the capitalization of Tech companies grew by 17% since the beginning of 2019, meaning that the industry continues to show the rapid growth.

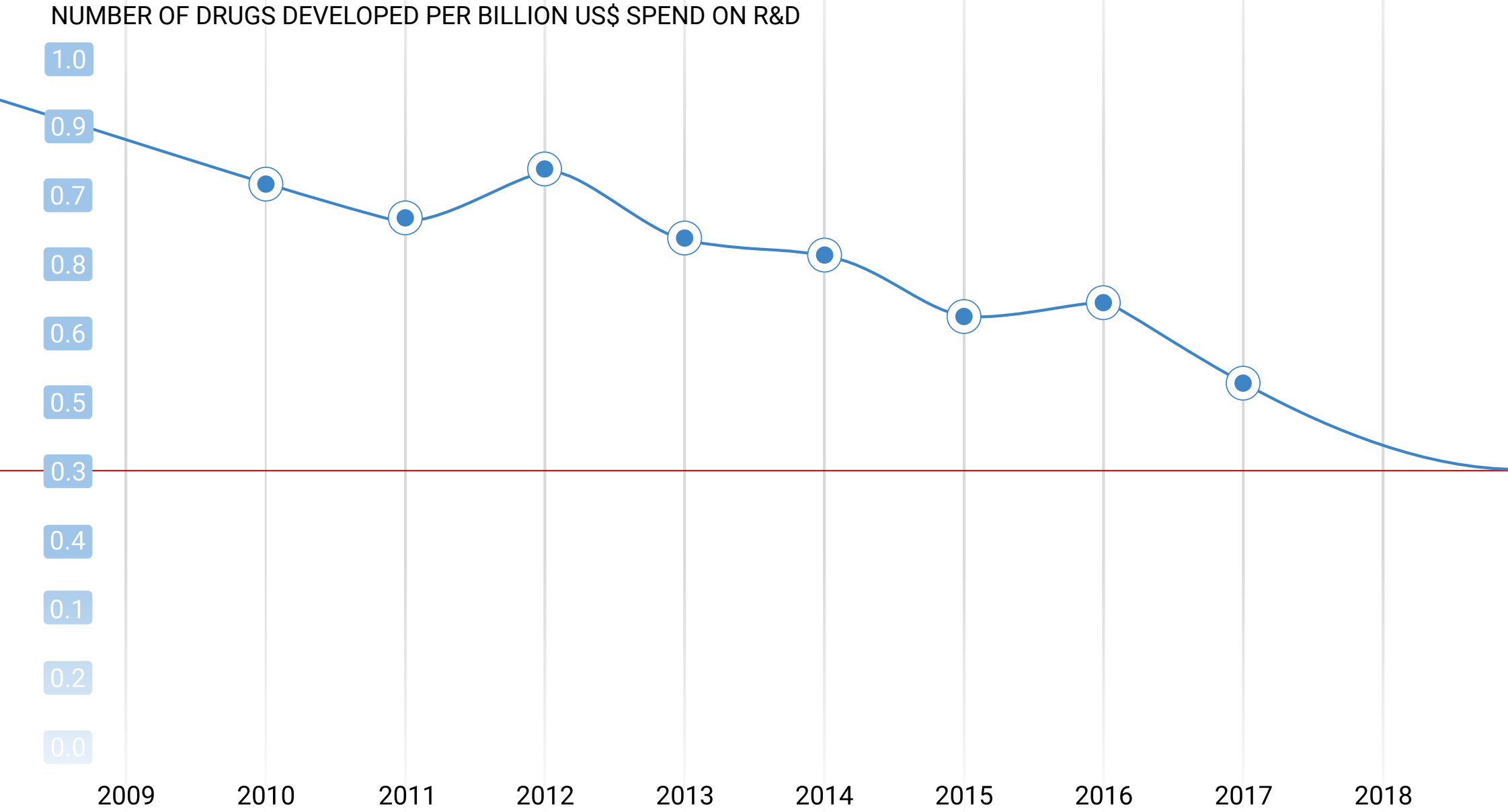
Pharma Efficiency is **Declining Steadily**



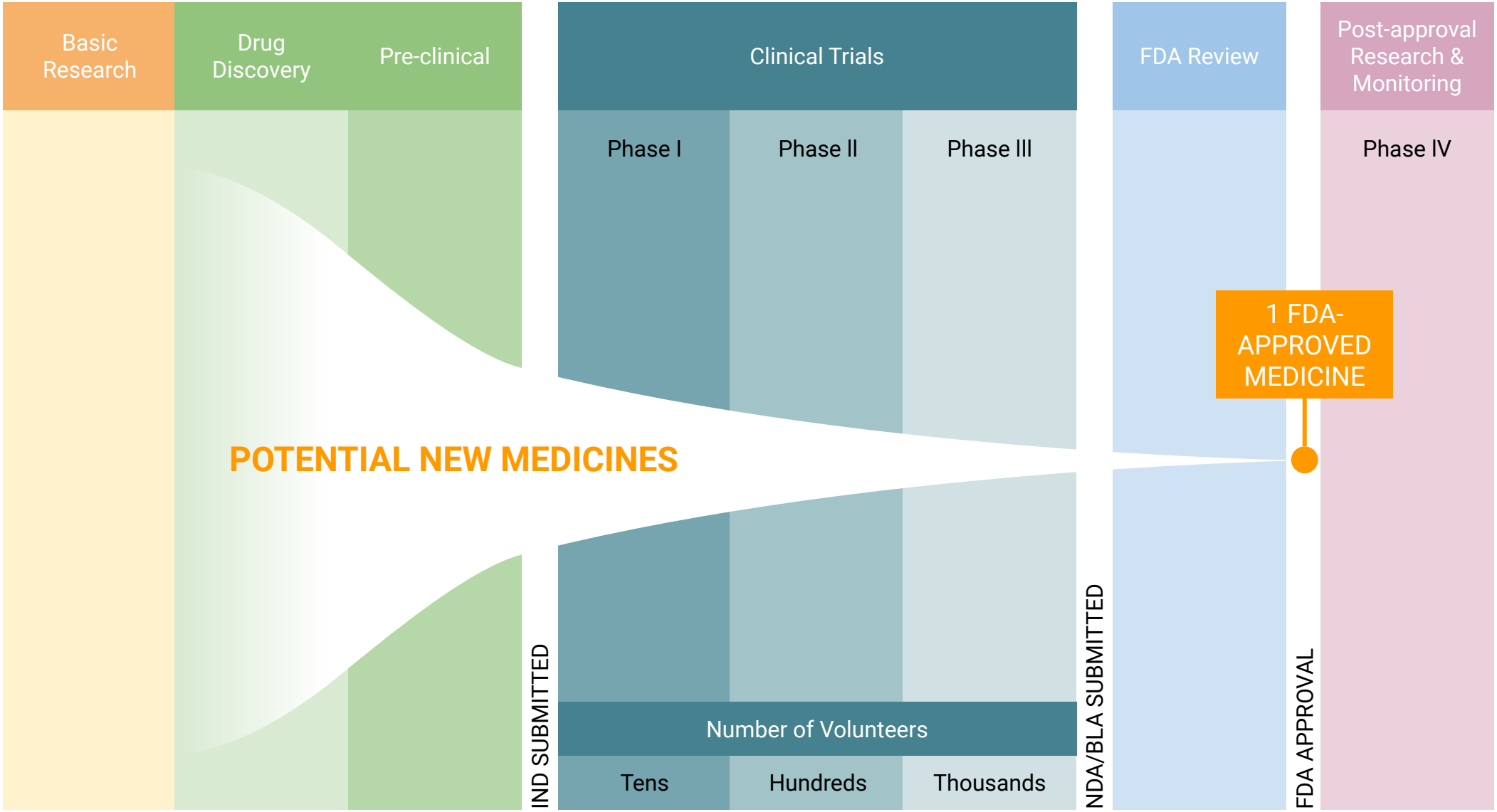
Source Bernstein Research: The Long View - R&D Productivity, 2010

59 NEW DRUGS launched in 2018

Pharma Efficiency is **Declining Steadily**



Biopharmaceutical R&D Process / **Low Efficiency**



Source | Biopharmaceutical Research & Development, PRMA | phrma-docs.phrma.org | pdf

Application of AI for Advanced R&D

Generate Novel Drug Candidates

- Analyze data sets, form hypotheses and generate novel insights
- Identify novel drug candidates
- Analyze data from patient samples in both healthy and diseased states to generate novel biomarkers and therapeutic targets
- Predict binding affinity and other pharmacological properties of molecules
- Allow filtering for drug-like properties of molecules
- Reduce complexity in protein design

Clinical Trials

- Optimize clinical trial study design
- Transform diverse streams of biomedical and healthcare data into computer models representative of individual patients
- Deliver personalized medicine at scale by revealing optimal health interventions for individual patients
- Analyze medical records to find patients for clinical trials
- Automate matching cancer patients to clinical trials through personal medical history and genetic analysis
- Improve pathology analysis
- Identify patients that would benefit from novel therapies

Design and Processing of Preclinical Experiments

- Reduce time, money, and uncertainty in planning experiments
- Decode open- and closed-access data on reagents and get actionable insights
- Automate selection, manipulation, and analysis of cells
- Expedite development of cell lines and automate manufacturing of cellular therapeutics
- Automate sample analysis with a robotic cloud laboratory

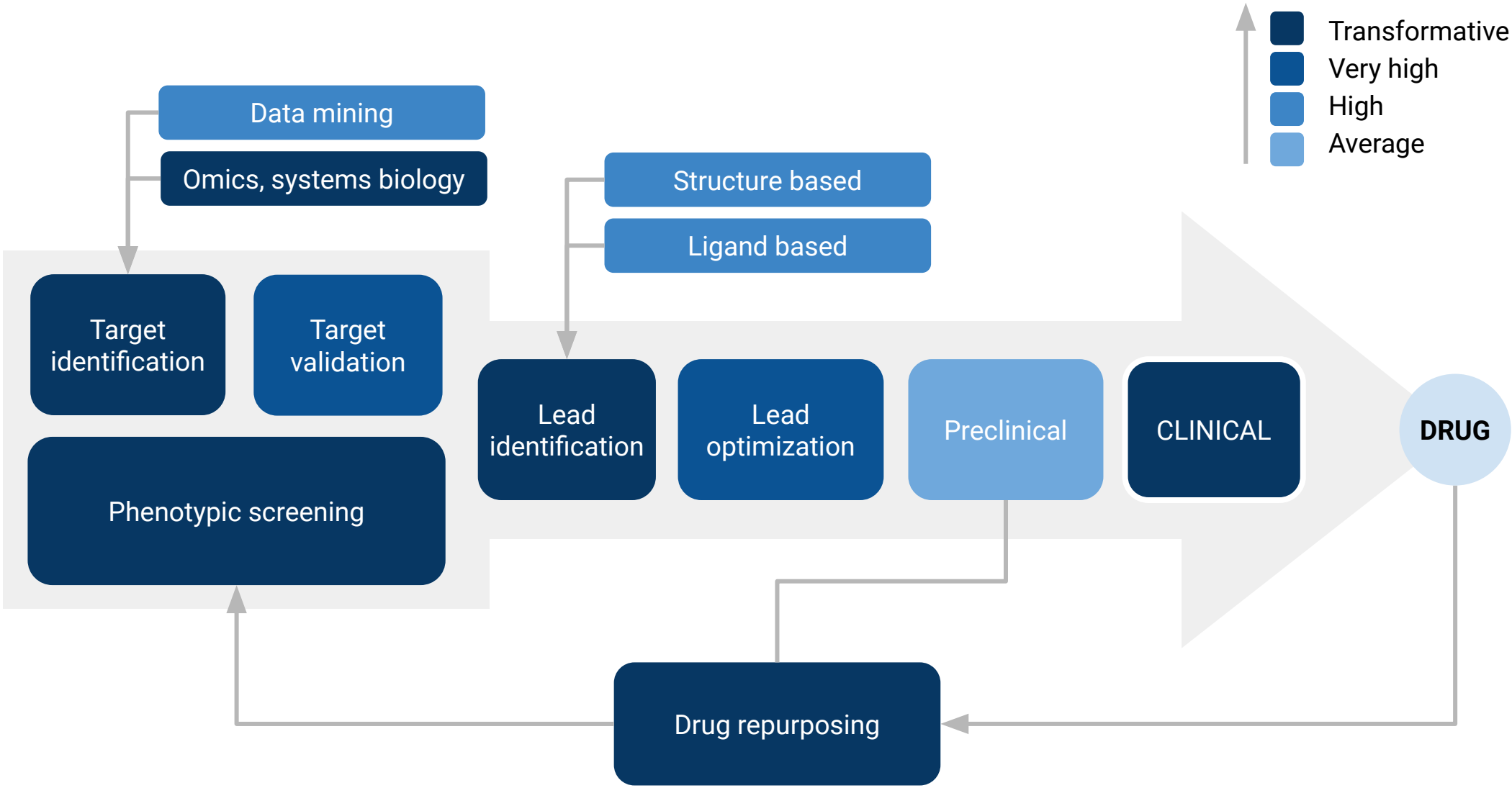
Repurposing of Existing Drugs

- Rapidly identify new indications for many known drugs
- Match existing drugs with rare diseases
- Conduct experimental biology at scale by testing 1000+ of compounds on 100+ of cellular disease models in parallel
- Generate novel biomarkers and therapeutic targets

Aggregation and Synthesis of Information

- Extract knowledge from literature
- Generate insights from thousands of unrelated data sources
- Improve decision-making
- Eliminate blind spots in research
- Identify competitive whitespace

The "Heat Map" of AI Potential Value for Various R&D Areas



Executive Summary

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KNOWLEDGE
ANALYTICS
PHARMA DIVISION

Executive Summary

This 105-page report marks the **seventh installment** in a series of reports on the topic of the Artificial Intelligence in Drug Discovery Industry that Deep Knowledge Analytics have been producing since 2017. These reports are released on quarterly basis, and are designed to provide the landscape of the industry, show trends and correlations, and benchmark the performance of key players. This is an overview analysis to help the reader understand what is happening in the industry.

The present edition consists of an updated overview of the state of the industry in Q2 of 2019, tuned to the latter half of 2019 and including extended coverage of major events in Q2 of 2019. It revisits the major insights, trends, data analytics, conclusions and forecasts of our previous report, analyzing which trends and conclusions are still on track, which ones have changed course, and which ones have been usurped by entirely new insights, trends and conclusions.

The report is structured into the following sections:

1. Infographic Summary - provides a set of mind maps and diagrams visualizing key trends and analytics.
2. Executive Summary - presents a bird's view of the report, key observations and conclusions.
3. AI for Drug Discovery Landscape Overview aggregates, lists and categorizes 170 AI-companies, 400 investors, 25 biopharma corporations, 25 IT & Tech corporations, 35 industry-specific conferences and 35 R&D centers covering the AI for Drug Discovery topic.
4. Industry Developments - Q2 2019 outlines an overview of major industry developments in Q2 of 2019, including some of the key initiatives, investment deals and M&A activity.
5. Declining R&D Efficiency of Biopharma Corporations
6. AI Friendly CEOs and Board Members of Pharma and Tech Corporations
7. Pharma AI Deals
8. Top-35 AI for Drug Discovery Conferences 2019-2020
9. Appendixes
   - Overview of Proprietary Analytics by Pharma Division of Deep Knowledge Analytics
   - Overview of the "Comparative Industry Analysis and Classification Framework" and "Comparison of 25 Leading AI Companies" reports.

Executive Summary: Key Trends

Expanding upon the key observations in our previous Reports with new knowledge and analytics of Q2 2019, we can now better distinguish several major industry trends that will be shaping the market of AI in Drug Discovery in 2019 and beyond:

The industry continues "heating up" after a long period of skepsis, which is reflected in a substantial increase in the volume of investments and the number of joint ventures in 2019 compared to 2018 and earlier years. The industry's growth dynamics is largely influenced by the more active participation of largest pharmaceutical corporations in the AI-related investment and research collaborations, as can be seen in the "BioPharma Corporations Onboarding AI for Drug Discovery" section of this report. Despite some Pharma corporations still being critical about AI applications,, the number of research collaborations between pharma companies and AI-expertise vendors is rapidly increasing (7 in 2016, 19 in 2017, 20 in 2018 and 30 in 2019).

IT and Tech corporations are becoming stronger competitors to Pharma Corporations in the AI race, leveraging their "natural" advantage in computational infrastructures, AI technology and already acquired AI/Data Science talent. As can be seen in "BioPharma Corporations Onboarding AI for Drug Discovery", the number of IT and Tech corporations active in this area is steadily growing. It is noteworthy that IT and Tech corporations started investing and acquiring AI-driven healthcare as early as 2016-2017, while pharma giants were still skeptical — a phenomenon, referred to in our first three Reports as the "Big Gap". While our most recent analysis indicated that the "Big Gap" was narrowing due to rapidly increasing attention and activity of pharmaceutical companies with regards to AI prospects, the year 2019 will mark a challenge in the ability to innovate, transform and adopt AI at scale faster. Given the exponential nature of the AI-driven progress and rather limited available market of top AI-talent, time will be a crucial parameter for the competitive differentiation between future front runners and those lagging behind.

It should be noted that IT and Tech corporations have in general more flexible approach to innovation and business models, compared to more conservative pharmaceutical companies — it will be an important advantage in the pharmaceutical AI race. Moreover, big tech corporations like Google and Tencent are willing to expand their super-platforms to the area of pharmaceutical research. Having much bigger expertise of building and integrating super-platforms, currently they are conducting significant M&As and gaining some expertise in the area of the drug discovery, which would enable in the nearest future their expansion in this area. At the same time, the number of the deals between Tech corporations and AI companies aiming at the application of AI in drug discovery decreased comparing with the same period in 2018, while Pharma companies were more active in this area in 2019. This means that Pharma corporations are trying to catch up in terms of AI collaborations, so the "winner" of this race is still unclear.

Executive Summary: Key Trends

Global shortage of AI talent will be a challenge for the pharma industry, as was noted in our reports. The majority of talented AI specialists, in general, have been acquired by traditional IT-corporations and have been applied for purposes other than AI in healthcare, creating a lack of enough specialists to support the activities of AI for Drug Discovery companies in particular. The shortage of pharmaceutical AI talent is a notorious issue, and not only large pharmaceutical companies will be increasingly competing for the scarce resource, but also specialized AI-driven drug discovery companies cannot fully fill gaps of AI talent, with only 15.6% of their stuff being AI-experts, on average. One of the central aims of this report is to derive actionable ideas of minimizing the negative effect of this talent gap.

Deep learning (DL) family of algorithms become a major technology differentiator in the pharmaceutical AI race. Deep Learning in general and Generative Adversarial Networks (GANs) in particular are being increasingly regarded as a "golden standard" of innovation in the pharmaceutical AI space.

Research in AI is facing challenges due to lack of available quality data. The significant bottleneck in the applications of Artificial Intelligence for drug discovery purposes is the need to have clean and properly linked data. Such types of data are quite scarce for the life sciences industry. A lot of research data in drug discovery is poorly validated. Often it is provided under a strict code of secrecy due to the high level of competition between drug makers. All these factors pose a challenge for the industry and complicate the process of drug discovery.

Valuation of the industry will be growing substantially, yet uncertainties might delay the process in time. Notably, this appears to be a result of the general growth in the number of active business players, rather than an increase in the value of innovation and new products as a result of a specific practical AI breakthrough. No AI-derived drug has been approved by the FDA or even validated in clinical trials yet, although we expect first milestones to be reached by the end of 2020. It is reasonable to predict that first practical results, stipulated directly by the AI adoption, will bring a significant expansion of the total sub-sector capitalization — on the order of 5-10x. On the other hand, the anticipated global financial crisis may somewhat hinder the industry's exponential growth dynamics, delay the AI adoption at scale, as well as the emergence of the first AI-derived blockbuster drugs.

Companies with AI-friendly CEOs and Board members will have a competitive advantage. According to a recently conducted research, the location of AI-friendly CEOs and Board Members is concentrated in US, Japan and Germany. Most of the work in tech (54%) and pharma (46%) companies, only 3% have experience and education in both AI and Pharma. Such companies are expected to outperform the market due to more efficient application of the AI.

Executive Summary: Geography

China is building up muscles in the Pharma AI race. Currently, geographic diversity is increasing in the Pharma AI industry, with more countries joining the pharmaceutical AI race. Historically the US has been dominating the space of pharmaceutical AI - both in terms of companies, investments and industry conferences. Now, however, we are seeing an increased level of activity from the UK and EU, particularly in the form of government initiatives. We are also seeing a dramatic increase in activity from the Asia-Pacific region generally, and from China in particular.

The entry of Chinese investors in the broader biotech and drug industry landscape mounted significantly in 2019, rising to $1.4 billion of investments into US-based biotech and drug firms compared to just $125.5 million during the same period the previous year. Furthermore, the Chinese government has recently shown significant interests in building up their AI industry, and in prioritizing AI in healthcare in particular. In an AI Strategic Plan released in July 2017, they outlined their intentions to catch up in the AI race by 2020, make major breakthroughs by 2025 and become the world leader in AI by 2030.

Chinese IT and Tech corporations, such as Alibaba, Baidu and Tencent, have made significant investments and acquisitions in the area of pharmaceutical and healthcare AI, while also the number of Chinese investors active in this area is steadily increasing. This trend was noted in our last report Q1 2019 and can be further confirmed throughout Q2 observations. Among notable examples, there is a leading Chinese IT-giant Tencent, which led a $155 million round for AI-driven healthcare company iCarbonX and also co-invested with Google and Sequoia China in a $15 million round for XtalPi, a startup applying AI, cloud computing and quantum physics to drug discovery. Chinese IT-corporation Alibaba has also entered the AI for healthcare space with the launch of the "ET Medical Brain", a platform leveraging company's massive computational resources to generate new medical applications of AI. In 2019, prominent Chinese pharma company Wuxi AppTec invested in AI for Drug Discovery company Insilico Medicine together with Pavilion Capital (a VC firm owned by the Singaporean government), as well as several Western VC firms including BOLD Capital Partners and Juvenescence Limited.

Among top drivers of China's march in the pharmaceutical AI race, there is, firstly, the ability to generate massive amounts of real-time medical data from more than 1 billion local population, stimulated by rather flexible privacy laws. Secondly, the market of Chinese AI and data science talent is rapidly growing — due to proactive government programs, and "reverse migration" of highly skilled and educated Chinese professionals from the US, UK and EU. However, China is lagging behind the Western world in terms of core pharmaceutical and biotech innovation, which will be limiting the speed of progress in the global pharmaceutical AI race. Another limiting factor is less stringent IP protection laws, compared to Western countries — newly generated innovation in pharmaceutical AI might be diffusing to competitors.

Executive Summary: Business Activity

Overall, the business activity has been steadily increasing in the pharmaceutical AI space over Q2 2019, judging by an increased number of transactions and partnership announcements in this period, compared to what was covered in our Q1 Report.

The most significant deals and collaborations having happened in Q2 of 2019 are the following:

- Insitro - Gilead strategic collaboration - aims to discover and develop therapies for patients with nonalcoholic steatohepatitis (NASH);
- Benevolent AI - Astrazeneca long-term collaboration - intends to use artificial intelligence (AI) and machine learning for the discovery and development of new treatments for chronic kidney disease and idiopathic pulmonary fibrosis;
- Iktos - Janssen collaboration - Iktos virtual drug design technology is expected to be implemented and applied to several Janssen small molecule drug discovery projects. Iktos will collaborate with Janssen to develop new applications, leveraging Iktos' proprietary know-how in deep generative models applied to chemistry and Janssen expertise in AI-enabled prediction of small molecule activities;
- Concerto HealthAI collaboration with Pfizer on Precision Oncology using Concerto's EurekaHealth platform, AI models and Real World Clinical electronic Medical Record (EMR) and healthcare claims;
- France-based pharma giant Sanofi collaboration with Google to use the tech giant's AI and cloud-computing tools in a new Innovation Lab, per Bio Space. The goal of the partnership is to speed up drug discovery, maximize operational flows, and improve the patient experience;
- Atomwise collaboration with Enamine Ltd - Atomwise has launched a 10 billion compound AI-powered virtual drug screening initiative, the 10-to-the-10 program. The initiative aims to dramatically increase the discovery of safer small molecule drugs to treat pediatric cancers.

Such deals and collaborations have a significant effect on industry development and are important for the competitive position of a company among the competitors. For big Pharma and Tech corporations, such deals also mean their commitment towards the application of AI in drug discovery. It became a recent trend that corporations use deals with promising startups not only for true collaboration purposes but also as a reputational play. At the same time, the most common type of deals is aiming at saving costs and operational efficiency. This is especially relevant for Pharma corporations, due to the need to increase productivity, as well as the efficiency of R&D costs.

Executive Summary: Conferences and Declining Efficiency of R&D in Pharma Corporations

“The chapter “Top-35 AI for Drug Discovery Conferences in 2019” is an updated addition to this report. Its purpose is to enable academics, investors, scientists, politicians, and technologists, as well as interested general public, to participate more readily in the emerging industry by identifying affordable events at venues near to them.

35 conferences have been included, based on the following criteria:

- Well attended, with a large number of speakers as well as participants.
- Include at least one panel on the application of AI in Pharma Industry.
- Include speakers from pharmaceutical corporations (e.g., Johnson & Johnson, Merck, etc.) and/or tech corporations (such as IBM or Microsoft). These corporations are the main driving force behind the development of AI in Pharma and are the primary end-users of technologies, developed by AI startups.

Thus, the report includes an updated and expanded list of the top AI in drug discovery and healthcare conferences, together with illustrative event analytics — a resource that would be useful both for planning activities, as well as making sense of the industry's top places to maintain constructive discussions on a broad range of AI topics.

The chapter “Declining R&D Efficiency of Biopharma Corporations” provides an overview of the major sources of declining productivity of Pharma corporations. The major conclusions of this chapter include:

- Costs of R&D per drug are currently growing exponentially, yet sales per asset are definitely not increasing. This is one of the major challenges for companies operating in this industry.
- In the nearest future, pharmaceutical corporations will have to embrace a more venture fund-like approach, given its naturally inherent risk of failure.
- One opportunity to pharma is to use solutions of young pharma AI startups by making acquisitions.
- To respond to the mentioned challenges, the business model of pharma has to be changed to favor more agile early stage drug discovery, a much larger number of initial pool of projects (with minimal investment, via outsourcing, partnering, or VC funds), and an efficient process of project prioritization

Executive Summary: Major Conclusions for Q2 2019

- The industry continues its rapid development after a major breakthrough in 2018 with another series of collaborations and investments announced in Q2 2019. More and more investors are getting interested in AI for Drug Discovery companies, as can be seen in an expanded list of investors of the report. 400 investors were identified in the first quarter of 2019, 50 more than in Q1 2019. A growing interest in the industry was reported from companies, corporations and R&D centers as well. The list of companies and corporations was expanded by 20 entities, and 5 new centers were recorded in the R&D sphere of the industry compared to the first quarter of 2019, which speaks to further growth of the market. Regional proportion remained almost the same, despite an increased number of entities and a growing interest from China.
- Declining R&D efficiency of Biopharma Companies remains a major concern among all parties in the industry with a continuous decline recorded during the last 8 years. Costs of R&D per drug are growing exponentially, yet sales per asset are definitely not increasing. Pharma companies need to consider new approaches in their R&D process, such as the development of artificial intelligence and implementation of experience of biotech startups. This brings us to an issue which is of profound concern to everyone - a growing race for AI talent.
- Over the last several years, the pharmaceutical and healthcare organizations have developed a strong interest in applying artificial intelligence (AI) in various areas. The demand for the ML/AI technologies, as well as for ML/AI talent, is growing in pharmaceutical and healthcare industries and driving the formation of a new interdisciplinary field — data-driven drug discovery/healthcare. The overall success of all the companies in the industry depends strongly on the presence of highly skilled interdisciplinary leaders, able to innovate, organize and guide in this direction. It will be crucial to hire top AI experts, especially for Big Pharma companies that are fighting to survive. The USA and Great Britain remain home for the largest number of top experts. However, it should be noted that China has the potential to substantially alter these statistics in the coming years due to reverse migration of top AI experts from the USA. It will also be a challenge to poach AI experts from academia, where most of them work and where they are clearly comfortable. Some might argue that the focus should perhaps be on the collaboration with academia to avoid a “brain-drain”, which is a harmful phenomenon, with far-reaching negative implications for both science and educational process.

Landscape
AI for Drug Discovery and Advanced R&D
Q2 2019

DEEP
KNOWLEDGE
ANALYTICS
PHARMA DIVISION

AI for Drug Discovery and Advanced R&D Landscape Q2 2019

The present section aims to deliver an overview of the AI for Drug Discovery landscape, including lists of Companies, Investors, R&D Centers, Conferences & Media in one fell swoop.

It features detailed lists of:

- 25 Leading Companies in AI for Drug Discovery Sector
- 30 Leading Investors in AI for Drug Discovery Sector
- 170 companies applying AI for Drug Discovery & Advanced R&D
- 400 investors in AI for Drug Discovery companies
- 35 leading AI for Drug Discovery R&D centers
- 25 IT and Tech corporations embracing AI for Drug Discovery and advanced AI in Healthcare
- 25 Biopharma corporations applying AI for Drug Discovery

Our aim is to list them and, where applicable, to classify them according to application, industry segmentation, and regional location. Companies, for instance, are categorized according to industry segmentation (i.e. focusing on Drug Discovery, Biomarker Development, or Advanced R&D, respectively), while investors are classified according to their regional location and the companies in which they invested. Mentioned categorization can be seen on mind maps and infographics.

These lists have been extended in comparison to our previous report (AI for Drug Discovery, Biomarker Development and Advanced R&D Q1 2019) in order to include those companies, investors and entities that rose into prominence in Q2 of 2019. Namely, there were added 20 new AI-companies specialising in AI for Drug Discovery, 5 R&D centers, as well as 50 investors. It is worth noting that the list of the leading companies and investors, as well as major Pharma and Tech corporations, stayed the same.

Besides, the AI in Drug Discovery industry now is constantly growing, as well as the number of deals the aim of which is to enable collaboration between corporations, AI-companies and startups for the purpose of the usage of AI in drug discovery. That is why in the next chapter the major deals on this topic are analyzed.

25 Leading Companies in AI for Drug Discovery Sector

1	Ardigen
2	Atomwise
3	Benevolent.AI
4	Biovista
5	C4X discovery
6	Cyclica
7	CytoReason
8	Deep Genomics
9	DeepMind Health
10	e-therapeutics
11	Exscientia
12	GNS Healthcare
13	iCarbon X
14	Insilico Medicine
15	Insitro
16	Lantern Pharma
17	Numerate
18	Nuritas
19	PathAI
20	Recursion Pharmaceuticals
21	Schrödinger
22	twoXAR
23	Vyasa Analytics
24	WuXi NextCODE
25	XtalPi

30 Leading Investors in AI for Drug Discovery Sector

1	500 Startups
2	Amadeus Capital Partners
3	AME CLoud Ventures
4	Amgen Ventures
5	Andreessen Horowitz
6	Arboretum Ventures
7	Atlas Venture
8	Baidu Ventures
9	Bill & Melinda Gates Foundation
10	Data Collective DCVC
11	Draper Associates
12	Felicis Ventures
13	Foresite Capital
14	Founders Fund
15	General Catalyst
16	GV
17	Khosla Ventures
18	Lilly Ventures
19	Menlo Ventures
20	New Leaf Venture Partners
21	OS Fund
22	Refactor Capital
23	Sequoia Capital
24	Sequoia Capital China
25	SOSV
26	StartX
27	Third Rock Ventures
28	WuXi AppTec
29	Y Combinator
30	ZhenFund

Top-30 AI for Drug Discovery Investors

Menlo Park

- Menlo Ventures — Menlo Park, California, US
- Sequoia Capital — Menlo Park, California, US
- Andreessen Horowitz — Menlo Park, California, US
- Felicis Ventures — Menlo Park, California, US
- Draper Associates — Menlo Park, California, US
- Khosla Ventures — Menlo Park, California, US

San Francisco

- Amgen Ventures — San Francisco, California, US
- Data Collective DCVC — San Francisco, California, US
- Founders Fund — San Francisco, California, US
- Foresite Capital — San Francisco, California, US
- Refactor Capital — Burlingame, California, US

Mountain View

- 500 Startups — Mountain View, California, US
- Y Combinator — Mountain View, California, US
- GV — Mountain View, California, US
- OS Fund — N/A, California, US

Palo Alto

- StartX — Palo Alto, California, US
- AME CLoud Ventures — Palo Alto, California, US

Massachusetts

- General Catalyst — Cambridge, Massachusetts, US
- Atlas Venture — Cambridge, Massachusetts, US
- Third Rock Ventures — Boston, Massachusetts, US

California

- Arboretum Ventures — Ann Arbor, Michigan, US
- SOSV — Princeton, New Jersey, US
- New Leaf Venture Partners — New York, New York, US

Other States

- Bill & Melinda Gates Foundation — Seattle, Washington,US
- Lili Ventures — Indianapolis, Indiana, US

- WuXi AppTec — Shanghai, China
- ZhenFund — Beijing, China
- Baidu Ventures — Beijing, China
- Sequoia Capital China — Beijing, China

- Amadeus Capital Partners — Cambridge, United Kingdom

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

1. A2A Pharmaceuticals
2. AccutarBio
3. Acellera
4. AcuraStem
5. AiCure
6. Alector
7. Antidote
8. Antiverse
9. Arbor Biotechnologies
10. Arctoris
11. Ardigen
12. Arrakis Therapeutics
13. Athelas
14. ATOM
15. Atomwise
16. Auransa
17. Bactevo
18. BenchSci
19. BenevolentAI
20. Berg LLC
21. Berkeley Lights
22. BioAge Labs
23. Biorelate
24. BioSymetrics
25. Biotx.ai
26. Biovista
27. BioXcel
28. Bioz
29. BriteHealth
30. BullFrog AI
31. C4X discovery
32. Cambridge Cancer Genomics
33. Causaly
34. Celsius Therapeutics
35. Chempass
36. Clinithink
37. Cloud Pharmaceuticals
38. CloudMedX
39. Collective Scientific
40. Concerto HealthAI
41. Cotinga Pharmaceuticals
42. Cyclica
43. CytoReason
44. Cytox
45. Data4Cure
46. Datavant
47. Deep 6 AI
48. Deep Genomics
49. Deep Intelligent Pharma
50. DeepLens
51. DeepMind Health
52. DeepPhenome
53. Desktop Genetics
54. Dristi.ai
55. E-therapeutics
56. Emerald Cloud Lab
57. Engine Biosciences
58. Envisagenics
59. Erasca
60. Euretos
61. Evaxion Biotech
62. EvidScience
63. Evolutionary Genomics
64. Exscientia
65. FDNA
66. GenFit
67. Genialis
68. Globavir
69. GNS Healthcare
70. Gritstone Oncology
71. GTN Limited
72. Healx
73. HelixAI
74. iCarbon X
75. Ideaya Biosciences
76. Iktos
77. Imagia
78. Inato
79. Indegene
80. Ingentium
81. Innoplexus
82. Inside DNA
83. Insilico Medicine
84. Insitro
85. Intellegens
86. Intelligencia.AI
87. Interprotein

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

88. InveniAI
89. InVivo AI
90. Iris.ai
91. iTeos Therapeutics
92. Juvenescence AI
93. Keen Eye
94. Kite Pharma
95. Kyndi
96. LabTwin
97. LAM Therapeutics
98. Lantern Pharma
99. Linguamatics
100. MediBIC Group
101. MedView Technologies
102. Mendel.ai
103. Meta
104. Micar21
105. Mind the Byte
106. Molomics Biotech SL
107. Moplex
108. Mozi
109. NetraMark
110. Nference
111. Novoheart
112. nQ Medical
113. NuMedii
114. Numerate
115. Nuritas
116. Owkin
117. PathAI
118. PatSnap
119. Pepticom
120. Peptone
121. Pharnext
122. Phenomic AI
123. Plex Research
124. Precisionlife
125. ProteinQure
126. Qrativ
127. Quantitative Medicine
128. Quertle
129. Qulab
130. Recursion Pharmaceuticals
131. Relay Therapeutics
132. Remedium AI
133. Researchably
134. Resonant Therapeutics
135. Reveal Biosciences
136. Reverie Labs
137. ReviveMed
138. Roivant Sciences
139. Saamo
140. Sangamo BioSciences
141. Satalia
142. Schrodinger
143. sciNote
144. Sensyne Health
145. Sparrho
146. Spring Discovery
147. Standigm
148. Structura Biotechnology
149. Synergy Pharma
150. Syntekabio
151. Synthace
152. Systems Oncology
153. TARA Biosystems
154. TeselaGen
155. ThoughtSpot
156. TranScrip
157. Transcriptic
158. Trials.ai
159. Turbine
160. TwoXAR
161. uBiome
162. Verge Genomics
163. VERISIM Life
164. Virogin
165. Virvio
166. Vyasa Analytics
167. WinterLight Labs
168. WuXi NextCODE
169. XtalPi
170. ZappRx

400 Investors - AI for Drug Discovery and Advanced R&D

1. 415
2. 10x Group
3. 11.2 Capital
4. 180 degree capital
5. 1984 Ventures
6. 3W Partners
7. 500 Startups
8. 5AM Ventures
9. 6 Dimensions Capital
10. 8VC
11. Accel X
12. Advantage Capital
13. Afore Capital
14. Agent Capital
15. AJS Investments
16. Alan Cohen
17. Alchemist Accelerator
18. A-Level Capital
19. Alexa Fund
20. Alexandria Real Estate Equities
21. Alexandria Venture Investments
22. AllBright
23. Alpha Edison
24. Alphabet
25. ALS Investment Fund
26. Alta Partners
27. Altos Ventures
28. Amadeus Capital Partners
29. AME Cloud Ventures
30. Amgen Ventures
31. Amplify Partners
32. Andreessen Horowitz
33. Angivest Ventures
34. Aquarius Equity Partners
35. Arab Angel Fund
36. Arboretum Ventures
37. ARCH Venture Partners
38. Arkitekt Ventures
39. Atinum Investment
40. Atlas Venture
41. Aurinvest
42. B Capital Group
43. Baidu Ventures
44. Baird Capital
45. Bakken & Baeck
46. Balderton Capital
47. Baron Capital Management
48. Basis Set Ventures (BSV)
49. BDC Venture Capital
50. Beast Ventures
51. Bill & Melinda Gates Foundation
52. Bill Tai
53. Bioeconomy Capital
54. Biomatics Capital Partners
55. Bios Partners
56. Biotechnology Value Fund
57. Black Diamond Ventures
58. Bloomberg Beta
59. Bold Capital Partners
60. Bootstrap Labs
61. Boundary Capital Partners LLP
62. BR Ventures
63. Caffeinated Capital
64. Cambia Health Solutions
65. Canaan Partners
66. Cantos
67. Capital One Growth Ventures
68. Carrick Capital Partners
69. Cascade Investment
70. Casdin Capital
71. Catapult Ventures
72. Cathay Innovation
73. Celgene
74. China Bridge Capital
75. China Canada Angel Alliance
76. China Equity
77. China Life Healthcare Fund
78. Citrix Startup Accelerator
79. Citrix Systems
80. City Hill Ventures
81. Civilization Ventures

400 Investors - AI for Drug Discovery and Advanced R&D

82. Claremont Creek Ventures
83. CLI Ventures
84. CM-CIC Capital Finance
85. Cormorant Asset Management
86. Cosine
87. Cota Capital
88. Creative Destruction Lab
89. CRG L.P.
90. CRV
91. Cultivian Sandbox Ventures
92. Curative ventures
93. Daniel Curran
94. Darling Ventures
95. Data Collective DCVC
96. DCM Ventures
97. Deep Knowledge Ventures
98. Deerfield
99. Deerfield Capital Management
100. Density Ventures
101. Dentsu
102. Dexcel Pharma
103. DFJ
104. DFJ Growth
105. DHVC (Digital Horizon Capital)
106. Digital Science
107. DNA Capital
108. Dolby Family Ventures
109. Dorm Room Fund
110. Draper Associates
111. Draper Dragon
112. Driehaus Capital Management
113. Dynamic Capital
114. EcoR1 Capital
115. EDBI
116. Emerge Education
117. Endure Capital
118. Enterprise Ireland
119. Entrepreneur First (ef.)
120. EPIC Capital
121. EPIC Ventures
122. Esperante Ventures
123. Euclidean Capital
124. European Investment Bank (EIB)
125. European Union
126. Evotec
127. Fairhaven Capital Partners
128. Farzad (Zod) Nazem
129. Felicis Ventures
130. Fenox Venture Capital
131. Fifty Years
132. Finance Wales
133. Financière Boscary
134. Finorpa
135. First Round
136. First Star Ventures
137. Fly Ventures
138. Fond Vives II
139. Foresite Capital
140. Foundation Capital
141. Founders Factory
142. Founders Fund
143. F-Prime Capital
144. FREES FUND
145. FUND+
146. Future Fund
147. General Atlantic
148. General Catalyst
149. Geodesic Capital
150. Gi Global Health Fund LP
151. GlaxoSmithKline
152. GM&C Life Sciences Fund
153. GNI Group
154. Golden Ventures
155. Goldman Sachs
156. Goodman Capital
157. GPG Ventures
158. Gradient Ventures
159. Great Oaks Venture Capital
160. Green Park & Golf Ventures
161. GreenSky Capital
162. GV

400 Investors - AI for Drug Discovery and Advanced R&D

163. Hack VC
164. Hacking Health Accelerator
165. Hanhai Studio
166. HBM Partners
167. Health Velocity Capital
168. Health Wildcatters
169. Healthbox
170. Heritage Provider Network
171. Hewlett Packard Pathfinder
172. HIGHLINEvc
173. Hiventures Investment Fund
174. Holtzbrinck Digital
175. Horizons Ventures
176. IA Ventures
177. IDG Capital
178. iGan Partners
179. Illumina Ventures
180. INDEX: Design to Improve Life
181. IndieBio
182. Initialized Capital
183. Innovate UK
184. iNovia Capital
185. Intel Capital
186. Invus
187. IQ Capital
188. Ireland Strategic Investment Fund
189. IT-Farm
190. J. Hunt Holdings
191. Jiantou Huawen Investment
192. JMI Equity
193. Juvenescence
194. Kakao Ventures
195. Kapor Capital
196. Karlin Ventures
197. KdT Ventures
198. Khosla Ventures
199. Kima Ventures
200. Kleiner Perkins (KPCB)
201. Konstantin von Unger
202. Korea Tech Incubator Program
203. KTB Network
204. La Famiglia
205. Lane Bess
206. Lansdowne Partners
207. Lanza Tech Ventures
208. LaunchCapital
209. Laurion Capital Management
210. LB Investment
211. LeFrak
212. Life Sciences Angel Network
213. Lightspeed Venture Partners
214. Lilly Asia Ventures
215. Lilly Ventures
216. Linden Mobile Ventures
217. Liquid 2 Ventures
218. London Co-Investment Fund (LCIF)
219. Lucas Venture Group
220. Luminous Ventures
221. Lundbeck
222. Lux Capital
223. Manchester Tech Trust Angels
224. Marathon Venture Capital
225. Masa Life Science Fund
226. MassChallenge
227. Matrix Capital Management
228. Mayo Clinic
229. MedTech Innovator
230. Menlo Ventures
231. Merck Global Health Innovation Fund
232. Mercury Fund
233. Midven
234. Minneapolis Heart Institute Ventures
235. Mission and Market
236. Mission Bay Capital
237. MIT delta v
238. MITS Fund
239. Mitsui & Co
240. Monsanto Growth Ventures (MGV)
241. Morgan Noble
242. MPM Capital
243. MRL Ventures Fund

400 Investors - AI for Drug Discovery and Advanced R&D

244. Mubadala Investment Company
245. National Institutes of Health
246. NDRC
247. Nest.Bio Ventures
248. Nesta Ventures
249. New Leaf Venture Partners (NLV)
250. New Wave Ventures
251. New York Presbyterian Ventures
252. New York State of Opportunity
253. NewDo Venture
254. Nex Cubed
255. Nextech Invest
256. Nikon
257. NJF Capital
258. Nordic Impact
259. Northpond Ventures
260. Novaquest Capital Management
261. NPIF Maven Equity Finance
262. Obvious Ventures
263. Orbimed
264. OS Fund
265. Oséo
266. Otium Capital
267. Parinvest
268. Pavilion Capital
269. Paxion Capital Partners
270. Pear Ventures
271. Perceptive Advisors
272. Perivoli Innovations
273. Pi Campus
274. Pillar Companies
275. Pitch@Palace
276. PivotNorth Capital
277. Plug and Play
278. Polaris Partners
279. PP Capital
280. Pritzker Group Venture Capital
281. Qiming Venture Partners
282. QTV Financial
283. Qualgro VC
284. Quentin Clark
285. Radical Ventures
286. Real Ventures
287. Redalpine Venture Partners
288. Refactor Capital
289. Reneo Capital Management
290. Renren Inc.
291. Rev1 Ventures
292. Rho Canada Ventures
293. Rising Tide
294. Riva Capital
295. Riverbank Capital Securities
296. Roche Venture Fund
297. Rock Health
298. Roivant Sciences
299. Romulus Capital
300. S.R.I.W
301. Sapphire Ventures
302. Schooner Capital
303. SciFi VC
304. Sea Lane Ventures
305. Section 32
306. Seedcamp
307. Seneca Partners
308. Sequoia Capital
309. Sequoia Capital China
310. Seraph Group
311. Serena Capital
312. ServiceNow
313. Seventure Partners
314. SFPI-FPIM
315. Shangbay Capital
316. Shasta Ventures
317. Shunwei Capital
318. Sierra Ventures
319. Silicon Badia
320. Silicon Valley Bank
321. Singularity University Ventures
322. Sinopharm Capital
323. Sky Ventures Group
324. Slow Ventures

400 Investors - AI for Drug Discovery and Advanced R&D

325. Smedvig Capital
326. Sofinnova Partners
327. SoftBank
328. Softbank Ventures Korea
329. Soma Capital
330. Sorrento Therapeutics
331. SOSV
332. Sound Ventures
333. SPARK Impact
334. Square 1 Bank
335. SR One
336. Stage Venture Partners
337. Stanford University Venture Fund
338. Starlight Ventures
339. Start Capital
340. StartUp Health
341. StartX (Stanford-StartX Fund)
342. Summit Partners
343. Susa Ventures
344. Susquehanna International Group (SIG)
345. SV Angel
346. SV Tech Ventures
347. T. Rowe Price
348. Tamarind Hill
349. Tavistock Group
350. Team Builder Ventures
351. Techammer
352. Techstars
353. TECHU
354. Temasek Holdings
355. Tencent Holdings
356. TenOneTen Ventures
357. The Cedars-Sinai Accelerator
358. The Longevity Fund
359. Third Kind Venture Capital
360. Third Rock Ventures
361. Trancos Ventures
362. Travis May
363. Tribeca Venture Partners
364. True Ventures
365. Truffle Capital
366. TSVC
367. Tuesday Capital
368. Two River
369. Two Sigma Ventures
370. uBiome
371. UK Innovation & Science Seed Fund
372. Uni-Innovate Group
373. University of Birmingham
374. Unshackled Ventures
375. UpHonest Capital
376. Upsher Smith Laboratories
377. Vanguard Atlantic
378. Varian
379. VenBio Partners
380. Vertex Ventures
381. Vertex Ventures Southeast Asia & India
382. Viking Global Investors
383. Village Global
384. VisVires New Protein
385. Walden Riverwood Ventures
386. Walking Ventures
387. Western Technology Investment
388. White Cloud Capital
389. WI Harper Group
390. Wild Basin Investments
391. Woodford Investment Management
392. WorldQuant Ventures LLC
393. Wren Capital
394. WuXi AppTec
395. Y Combinator
396. Yael Capital Management Limited
397. YF Capital (Yunfeng Capital)
398. Yitu Technology
399. ZhenFund
400. Zhongyuan Union Cell & Gene Eng

25 Pharma Corporations Applying AI for Drug Discovery

COMPANY NAME	BASED IN	WEBSITE
1. AbbVie	United States	abbvie.com
2. Amgen	United States	amgen.com
3. Astellas Pharma	Japan	astellas.com
4. Astrazeneca	United Kingdom	astrazeneca.com
5. Bayer	Germany	bayer.com
6. Boehringer Ingelheim	Germany	boehringer-ingelheim.com
7. Bristol-Myers Squibb	United States	bms.com
8. Celgene	United States	celgene.com
9. Daewoong Pharmaceutical	South Korea	daewoong.com
10. Evotec	Germany	evotec.com
11. GSK	United Kingdom	gsk.com
12. Ilumina	United States	illumina.com
13. Ipsen	France	ipsen.com
14. Johnson & Johnson	United States	jnj.com
15. Merck	United States	merck.com

25 Pharma Corporations Applying AI for Drug Discovery

COMPANY NAME	BASED IN	WEBSITE
16. Mitsubishi Tanabe Pharma	Japan	mt-pharma.co.jp
17. Novartis	Switzerland	novartis.com
18. Novo Nordisk	Denmark	novonordisk.com
19. Pfizer	United States	pfizer.com
20. Roche	Switzerland	roche.com
21. Sanofi	France	m-en.sanofi.com
22. Santen	Japan	santen.com
23. Sumitomo Dainippon Pharma	Japan	ds-pharma.com
24. Takeda	Japan	takeda.com
25. Teva Pharmaceutical	Israel	tevapharm.com

25 Tech Corporations Applying Advanced AI Applications in Healthcare

COMPANY NAME	BASED IN	WEBSITE
1. Adobe	United States	adobe.com
2. Alibaba	China	alibaba.com
3. Amazon	United States	amazon.com
4. Apple	United States	apple.com
5. Baidu	China	baidu.com
6. Canon	United States	usa.canon.com
7. Cisco	United States	cisco.com
8. Dell Technologies	United States	delltechnologies.com
9. Foxconn Technology	Taiwan	foxconn.com
10. Fujitsu	Japan	fujitsu.com
11. Google	United States	google.com
12. Hitachi	Japan	hitachi.com
13. Huawei	China	huawei.com
14. IBM	United States	ibm.com
15. Intel	United States	intel.com

25 Tech Corporations Applying Advanced AI Applications in Healthcare

COMPANY NAME	BASED IN	WEBSITE
16. Microsoft	United States	microsoft.com
17. Nvidia	United States	nvidia.com
18. Oracle	United States	oracle.com
19. Salesforce	United States	salesforce.com
20. SAP	Germany	sap.com
21. Samsung Electronics	South Korea	samsung.com
22. Siemens	Germany	siemens.com
23. Tencent	China	tencent.com
24. Unisys	United States	unisys.com
25. Workday	United States	workday.com

Tech Corporations Applying AI in Advanced Healthcare and Drug Discovery

More tech corporations are constantly coming to the healthcare industry. What differentiates them from other newcomers is that these companies are already using or are going to use in the immediate future AI-related solutions for Drug Discovery.

A number of Tech Corporations announced partnerships with AI companies and institutions in the field of Drug Discovery and Healthcare. The most notable of these deals are the following:

- Chinese technology powerhouse Alibaba has teamed up with British pharmaceutical giant AstraZeneca to deliver smart healthcare services through the use of artificial intelligence (AI) and the internet of things in China. For a start, the partnership with Alibaba will enable more than one million Chinese patients to learn more about disease prevention and healthcare services by scanning the AliHealth traceability code on drug packages this year.
- AstraZeneca joined Chinese tech giant Tencent in signing a Memorandum of Understanding (MoU) for strategic cooperation. According to the agreement, the two companies will harness the power of big data-driven internet technologies to more accurately and effectively crack down on the online sale of counterfeit drugs, and will work together to build a new model for online drug safety management as part of a larger "Smart Healthcare" push.
- Hewlett Packard Enterprise (HPE) will collaborate with Biovista to advance Biovista's Project Prodigy Big Data AI healthcare platform applied in the personalized medicine vertical. Advances from the HPE-Biovista collaboration will be used initially within the context of Biovista's existing collaboration with Sarah Bush Lincoln Health Center (SBL), a hospital and healthcare organization that is home to more than 300,000 provider office visits per year.

Others decided to dive into the industry by themselves, e.g. SAP launched Intelligent Enterprise for Healthcare that uses intelligent technologies, such as artificial intelligence (AI), machine learning (ML), and the Internet of Things capabilities (IoT), and real-time, in-memory analytics to achieve operational and clinical excellence in care delivery. Oracle is planning Healthcare's digital transformation, its Autonomous Database takes out much of the human effort required in data ingestion and matching, while also ensuring its platforms meet global requirements for security and privacy. Furthermore, a number of Oracle’s AI applications are ready to make the difference in the business. Cisco’s digital technologies, including the Internet of Things (IoT), help to accelerate life sciences R&D and manufacturing. Cisco also expressed interest in AI diagnosis-focused algorithms. Workday introduced AI Maturity Model that is poised to transform medicine and healthcare. Unisys unveiled Artificial Intelligence Center of Excellence to help its clients build Advanced Data Analytics Capabilities. They are also using AI solutions in regard to research field engineering services to improve potential new cures.

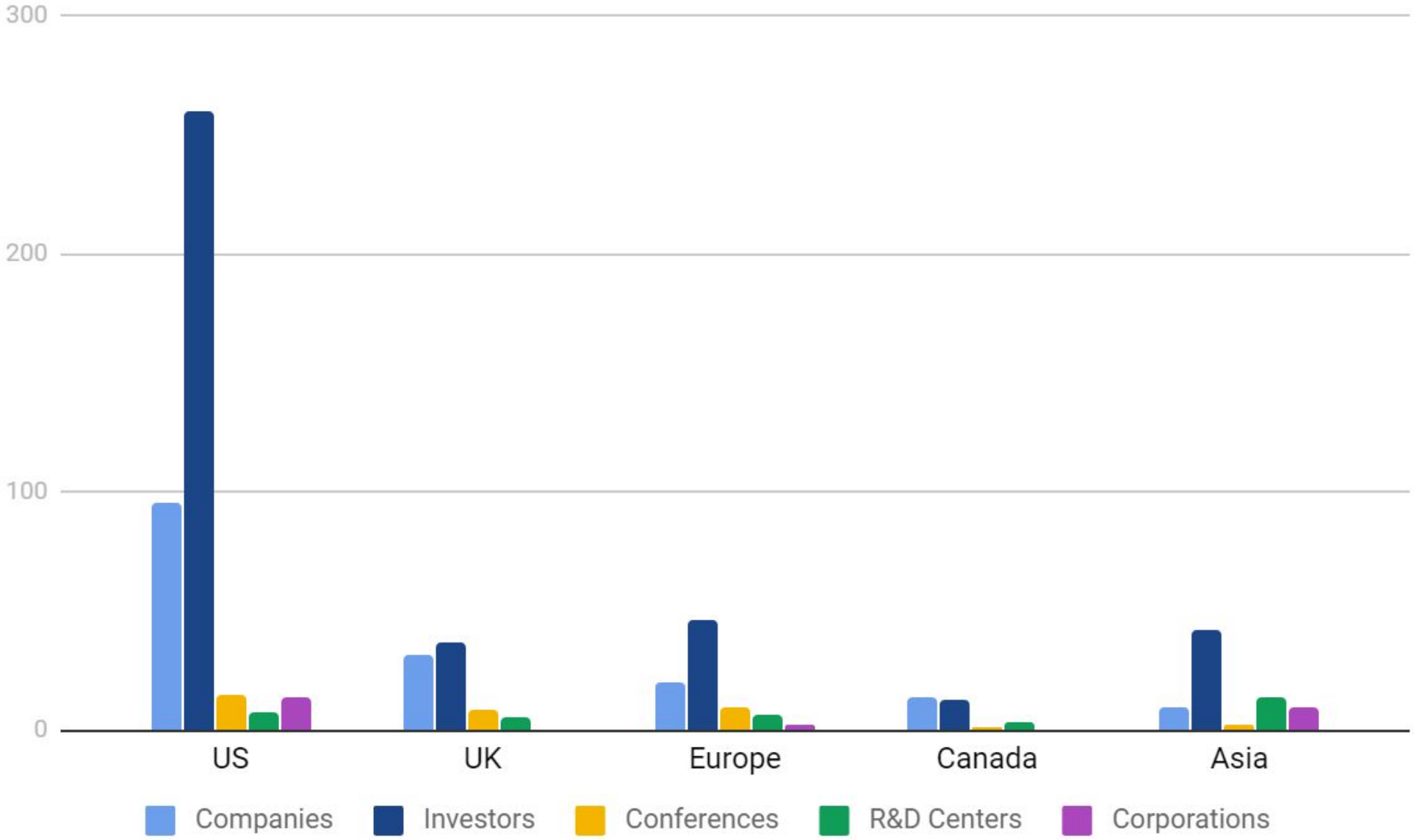
35 Leading AI R&D Centers in Drug Discovery and Advanced Healthcare

R&D CENTERS	LOCATION
Astellas Drug Discovery Research Centre	Japan
Babraham Research Campus	UK
BioMed Taiwan	Taiwan
BioVentureHub	Sweden
Cambridge Clinical Trials Unit (CCTU)	UK
Center for Computational Health - IBM Research	US
Center of Excellence for External Drug Discovery (CEEDD) - GSK	UK
Centre for Drug Design and Discovery (CD3)	Belgium
Centre for Drug Discovery Science (CDDS)	UK
Centre for Drug Research and Development	Canada
China R&D Center (CRDC) - Pfizer	China
Chinese Thoracic Oncology Group (CTONG)	China
Clinical Trials Centre, The University of Hong Kong	Hong Kong
Clinical Trials Unit Freiburg	Germany
Dabur Research Foundation	India
Drug Discovery Oxford	UK
Insilico Medicine R&D center	Taiwan
Janssen Pharmaceutical Companies of Johnson & Johnson	US

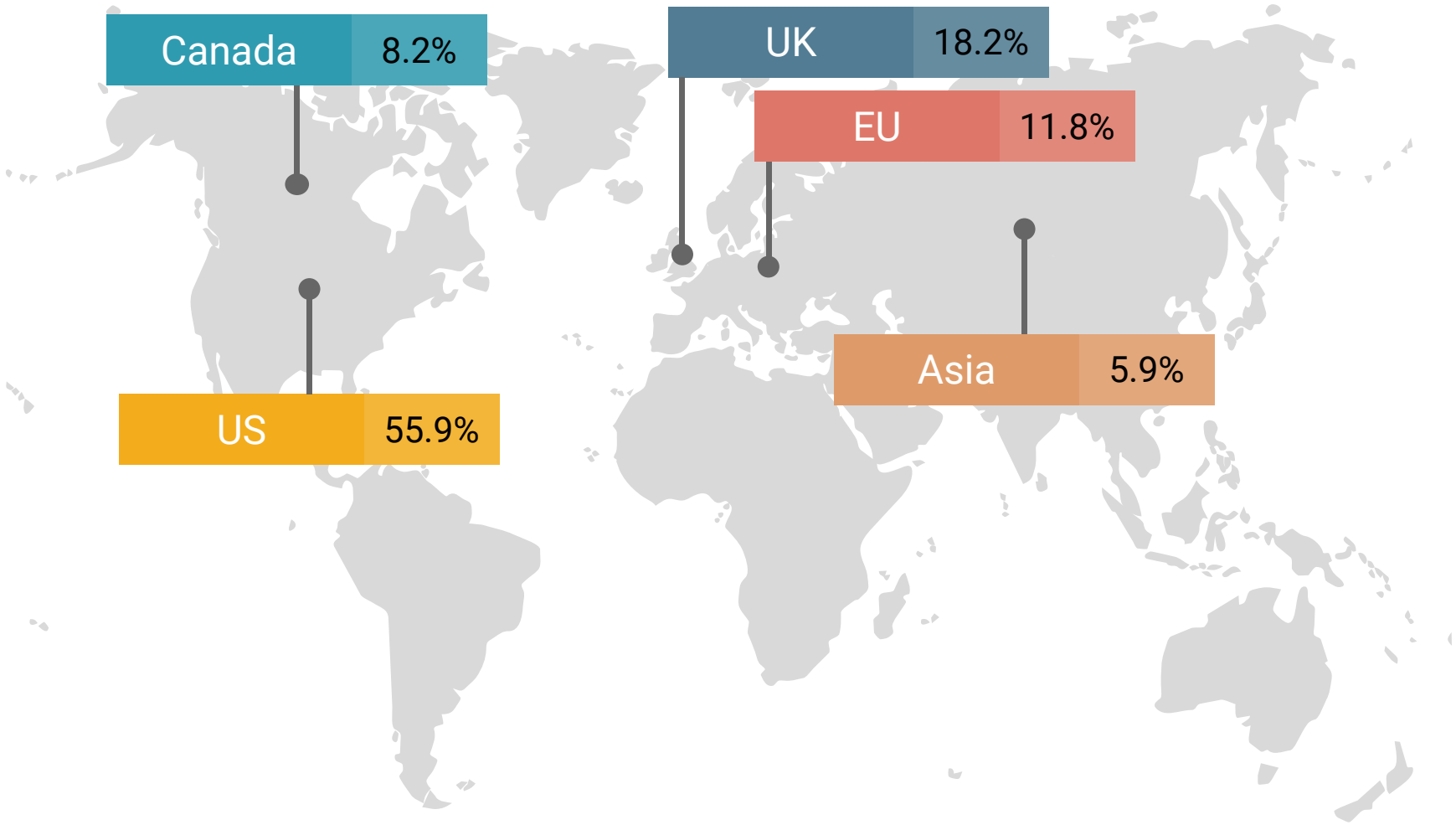
35 Leading AI R&D Centers in Drug Discovery and Advanced Healthcare

R&D CENTERS	LOCATION
Japan Agency for Medical Research and Development	Japan
Johnson & Johnson Pharmaceutical Research and Development	China
Korea Pharmaceutical and Bio-Pharma Manufacturers Association	South Korea
La Jolla Laboratories	US
Mayo Clinic's Center for Clinical and Translational Science (CCaTS)	US
Merck Exploratory Science Center (MESC)	US
Merck Serono Pharmaceutical R&D Co., Ltd	China
Montreal Clinical Research Institute (IRCM)	Canada
Pande Lab - Stanford University	US
Pharmaceutical and Molecular Biotechnology Research Centre (PMBRC)	Ireland
Ritsumeikan Research Center for Drug Discovery and Development Science	Japan
Roche Innovation Center Copenhagen	Danmark
Sanofi Pasteur R&D Centre	Canada
Shanghai Clinical Research Center (SCRC)	China
The Development Center for Biotechnology	Taiwan
The Swedish Center for Research and Innovation (SCRI)	Sweden
Warren Family Research Center for Drug Discovery and Development	US

Regional Comparison of AI for R&D and Drug Discovery Companies / Investors / R&D Centers 2019 / Q2

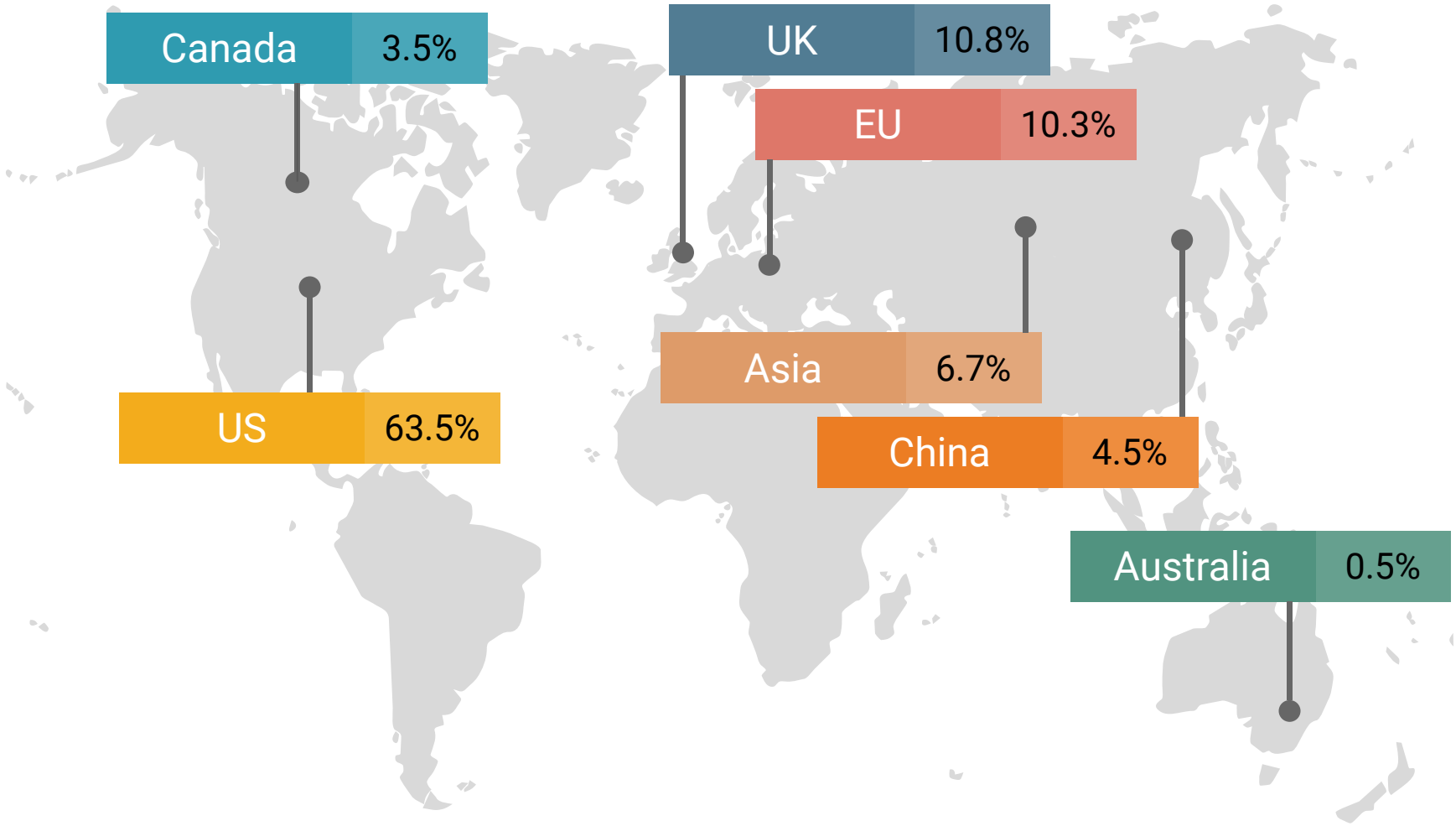


170 AI Companies: Regional Proportion



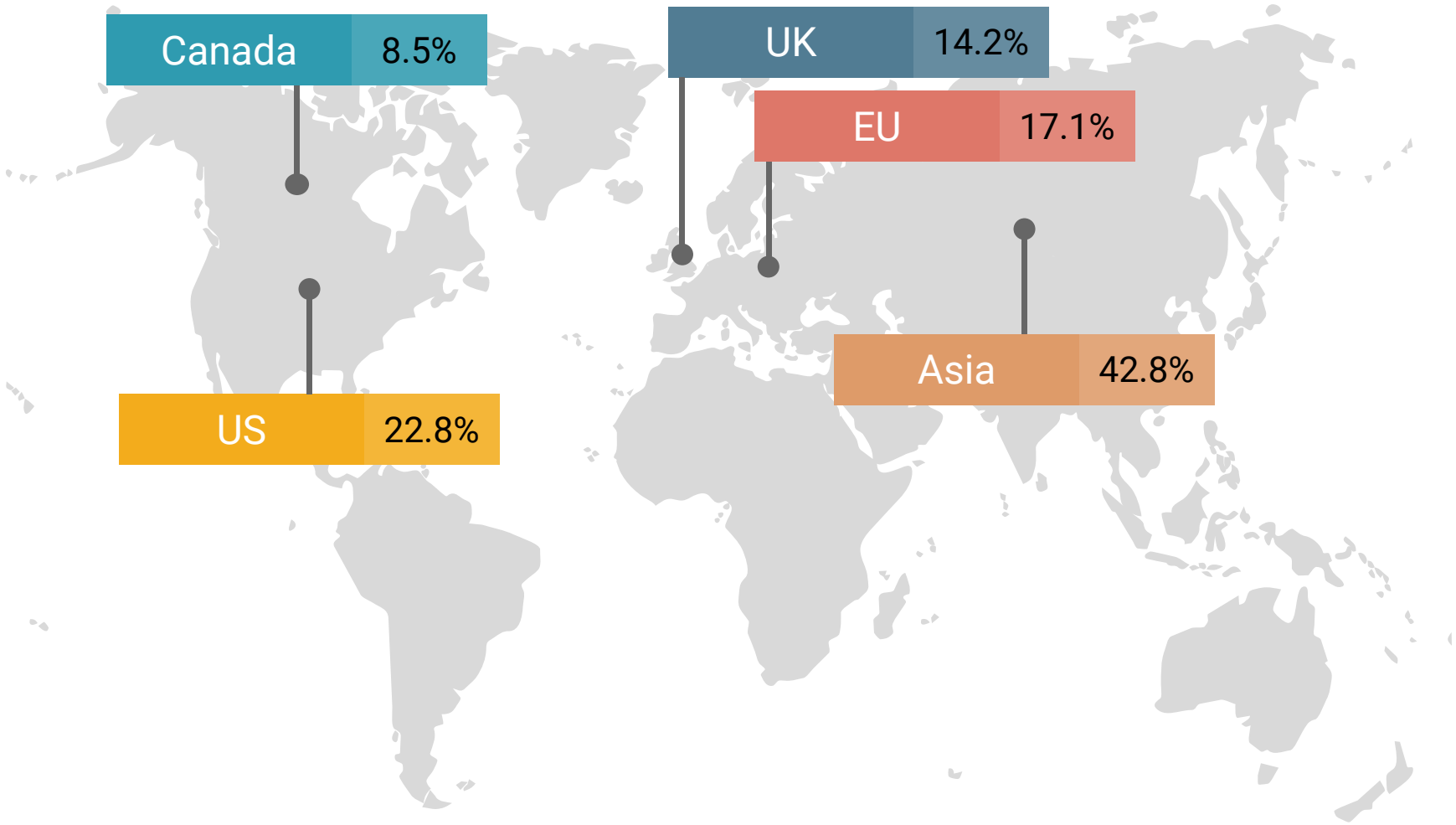
The US is still firmly in the lead in terms of its proportion of AI for Drug Discovery companies. Interestingly, Asia currently has the fifth-lowest proportion of AI for Drug Discovery companies. However, Asia-Pacific region has begun to aggressively increase its activity in the space in terms of investments into foreign companies (largely US-based companies), and we expect to see an increase in the number of AI for Drug Discovery Companies located in the Asia-Pacific region generally, and in China particularly. Comparing to the Q1 distribution, we can observe the significant increase in the number of the US companies.

400 Investors: Regional Proportion



The United States continues to lead the rest of the world in terms of artificial intelligence for investors in Drug Discovery. This is reasonable, given that they also have the largest share of AI for Drug Discovery companies. Comparing with Q1 2019, we can observe the biggest growth of the number of investors in the United States and EU. Thus, together with UK these regions are leaders by the number of investors in AI in Drug Discovery companies.

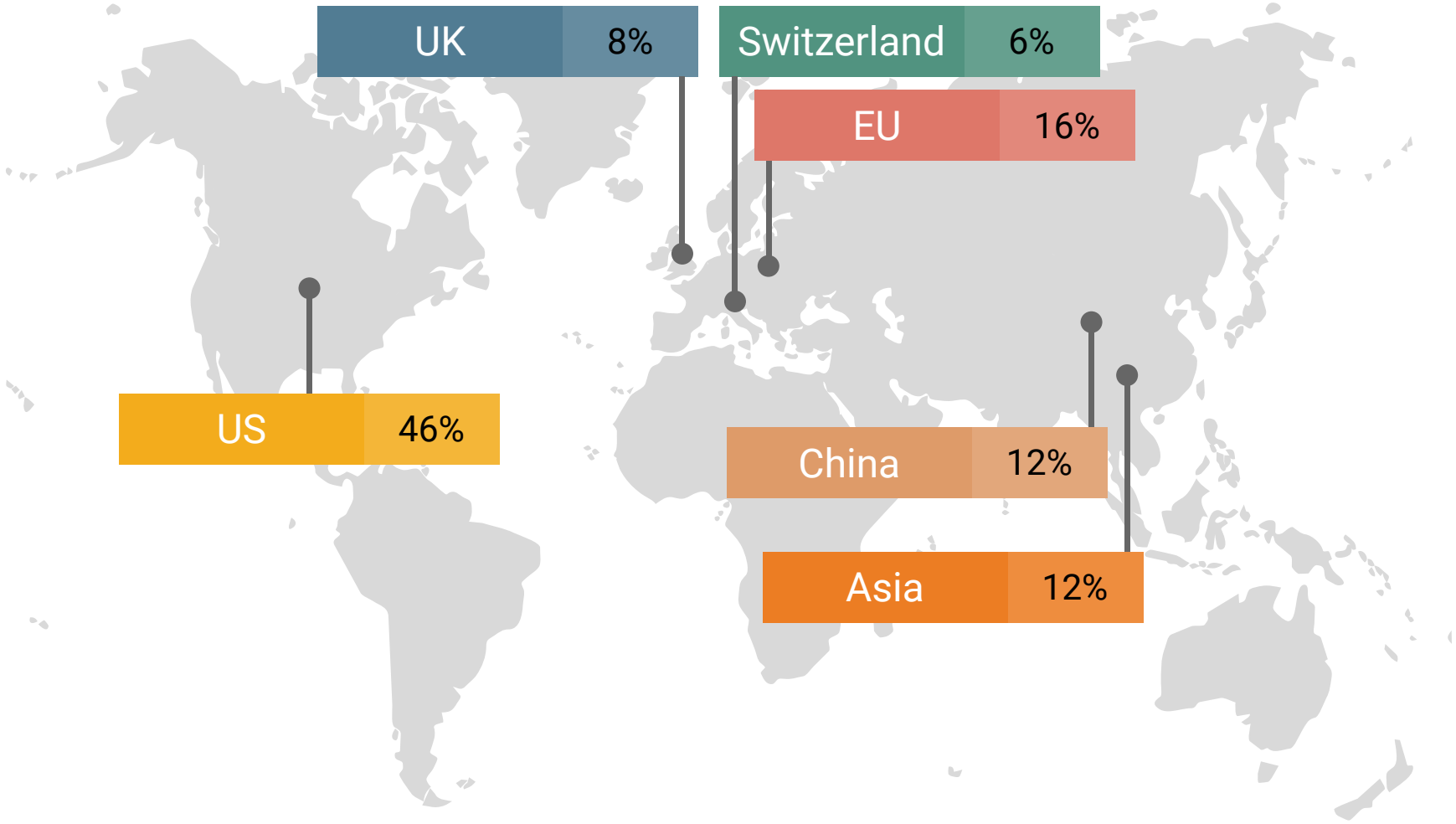
35 Leading R&D Centers: Regional Proportion



Whereas data in our previous reports indicated that the US leads the world in terms of the number of R&D Centers focused on AI for Drug Discovery, Asia has now surpassed them. This is sensible within the context of the recent increase in the number of Chinese investors entering the AI for Drug Discovery space, and the Chinese government's recent commitment to lead the world in AI by the year 2030. Comparing to Q1 the biggest fraction growth is attributed to the EU.

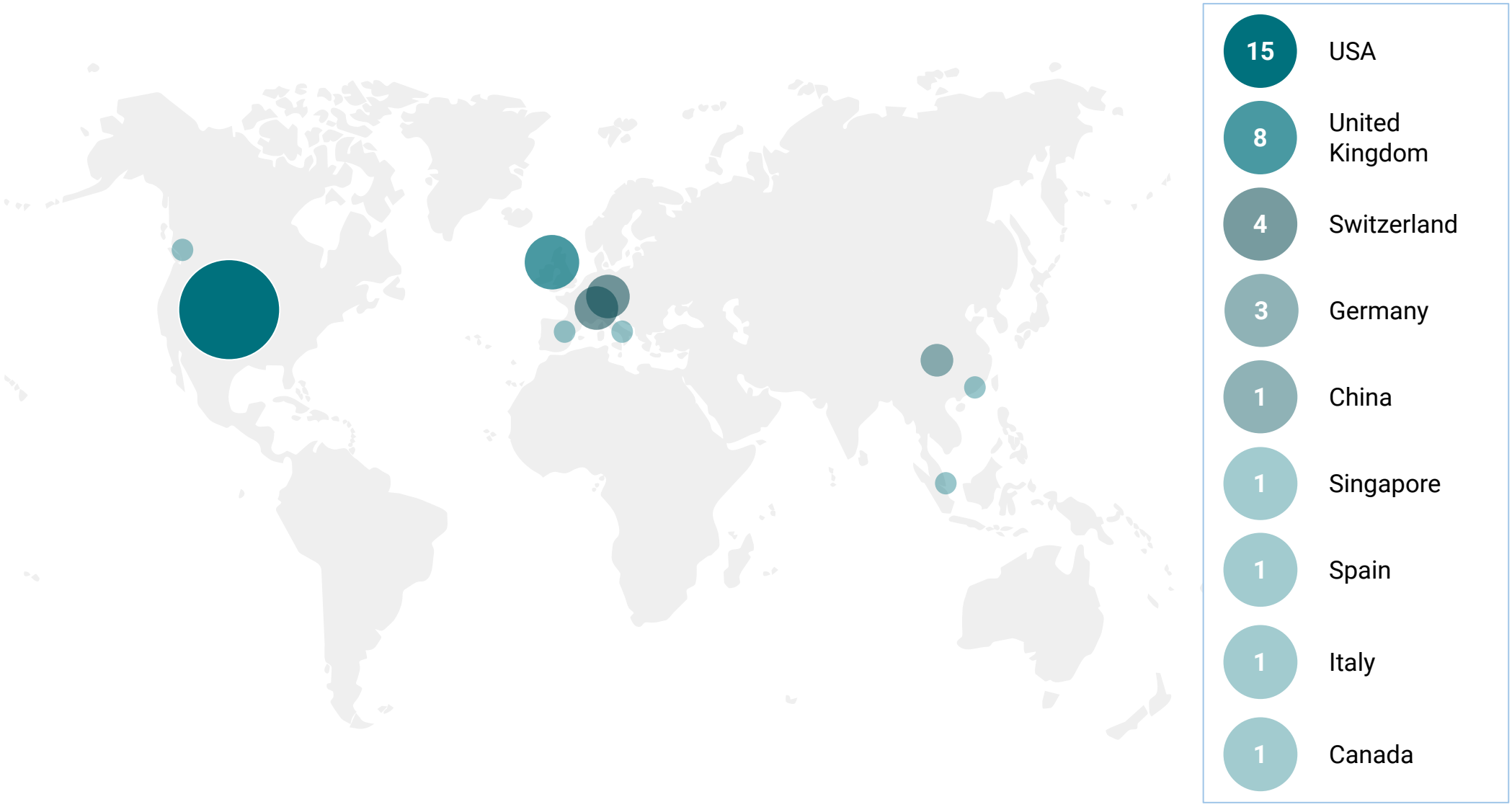
50 Corporations

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, in 2019 we are seeing an increased level of activity from the UK, Switzerland and China.

35 AI in Pharma Conferences: Distribution by Country



The vast majority of top AI in Pharma conferences are held in the US and UK because the most advanced and richest companies are headquartered there. Furthermore, these two countries are ones of the biggest world academic and business hubs that attract the top researchers and entrepreneurs.

AI for Drug Discovery and Advanced R&D Reports Produced by Deep Knowledge Analytics in Q2 2019

In this chapter, we described the dynamics of the industry landscape and analyzed its main players - investors, companies and R&D centres. To better understand the main trends of the industry, described in the executive summary, we include the most relevant information and main conclusions from the reports, made by Deep Knowledge Analytics in the second quarter of 2019. They include the information on the main trends and explain them using qualitative and quantitative matrices.

The featured reports include:

- Pharma AI Deals - describes the methodology and general classification comparison of the major partners in the field of usage of AI for Drug Discovery. The report itself includes the major 50 deals that were made during the last 3 years and their main goals. It shows how the major race between Pharma and Tech corporations for the segment of AI in Drug Discovery evolves;
- Declining R&D Efficiency of Biopharma Corporations - provides enhanced analysis of resource effectiveness and reveals the methods to overcome the burden of declining Eroom`s Law trend. This is a proprietary report explaining the problem of the declining efficiency from different angles and shows how the Pharma corporations are dealing with decreasing productivity;
- AI Friendly CEOs and Board Members of Pharma and Tech Corporations - identifies and provides a "bird`s view" on the global leadership scene in the area of adopting AI-driven methods in drug discovery and healthcare. It continues the discussion on the necessity of AI in Drug Discovery knowledge in Pharma and Tech corporations and shows, which companies are succeeding in this sense;
- Top-35 AI for Drug Discovery Conferences 2019-2020 - represents the top 35 conferences that accumulate people from the industry of Artificial Intelligence usage in drug discovery. It includes well attended events with presented academia and AI startup community. The conferences are featured in chronological order, so that interested parties can use the report as a guide on which conferences to attend.

Pharma AI Deals

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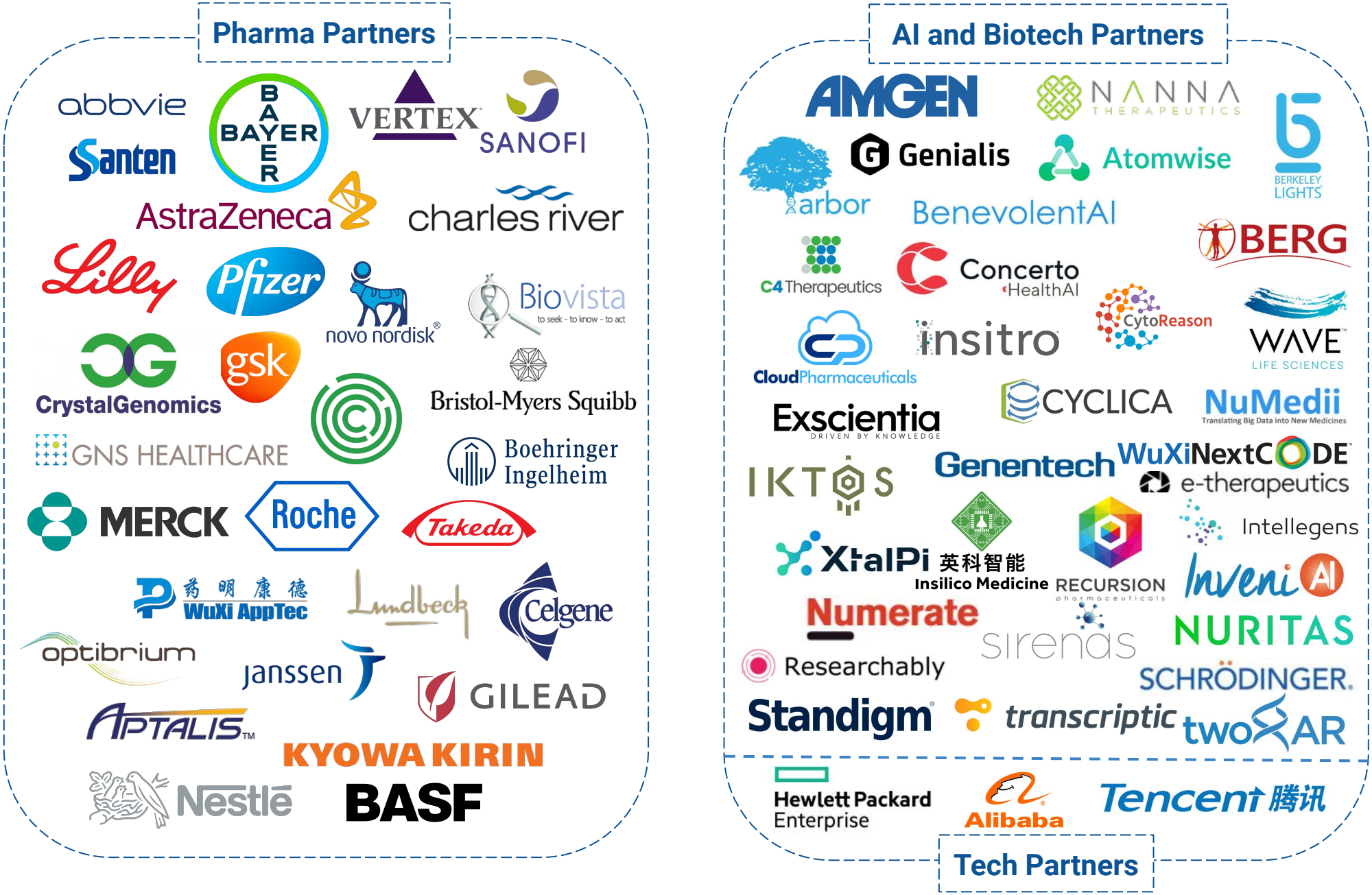
Corporation and AI-companies Participating in the Pharma AI Deals



Methodology

In order to identify major 50 Pharma AI deals, an initial pool of 100 deals companies was identified. The companies, as well as the respective deals of the companies satisfy the following criteria:

- **Parties criteria** - the companies participating in the deal represent Pharma, Biotech, Tech and related industries and actively participate in them; besides, the companies are involved in AI, Drug Discovery and related activities;
- **Object criteria** - the deals aim to develop a partnership, discover a new product or deliver a new technology related to the usage of AI in the Pharma or Biotech fields;
- **Time criteria** - the deals were conducted during the last 3 years, starting from 1 January 2017.

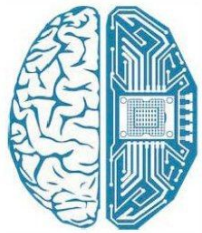
From the initial pool of the deals, the major ones in terms of the budget were identified and consequently divided into the categories for further analysis. The categories featured in this report include:

- **True partnership** - a partner to deliver tangible drug or product;
- **Kicking the tires** - general partnership, not including the cooperation at a specific project;
- **Saving costs and operational efficiency** - partnership to solve a specific problem a company faces;
- **Reputational partnership** - cooperation aiming at improving reputation of a company.

The deals were analyzed both inside of the categories and generally and visualized for convenience.

Deal Classification Framework: an Overview

Deal Metrics	**Region**	**Reports on results**	**Press Coverage (high, low)**	**Availability of Milestone Payments**
	Specific R&D service focus	**Deal Budget**	**Deal Length, years**	**Specific product development focus**
AI Startup parameters	**Business/marketing team**	**Company founding date**	**Number of previous similar collaborations**	
	Unique product/service offering	**Research team**	**History of research publications**	
Lead company parameters	**Main industry (Pharma/ Biotech/ High Tech)**	**Own programs in AI research**		
	Both Sexes Life Expectancy	**Number of previous deals with AI vendors**		



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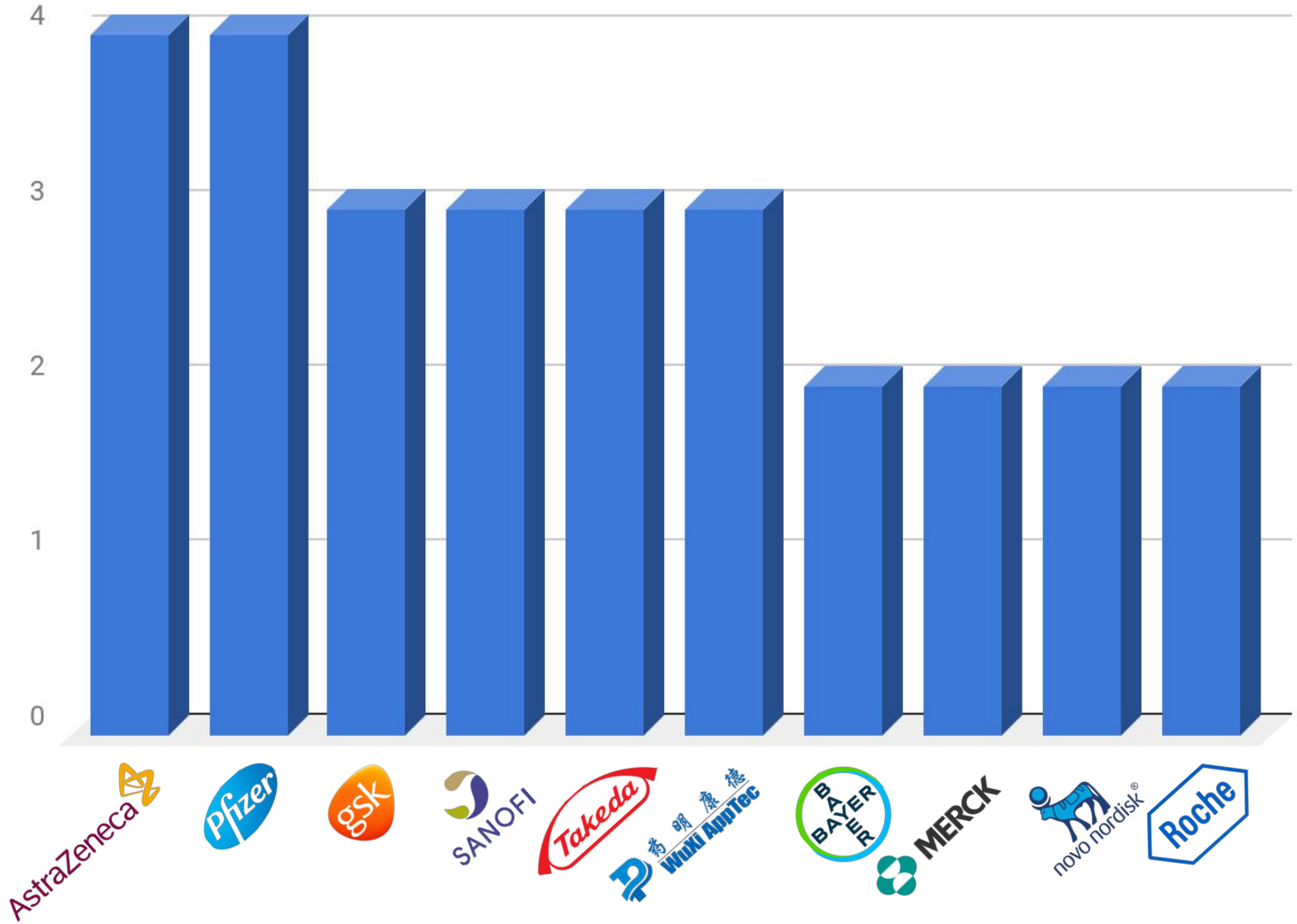
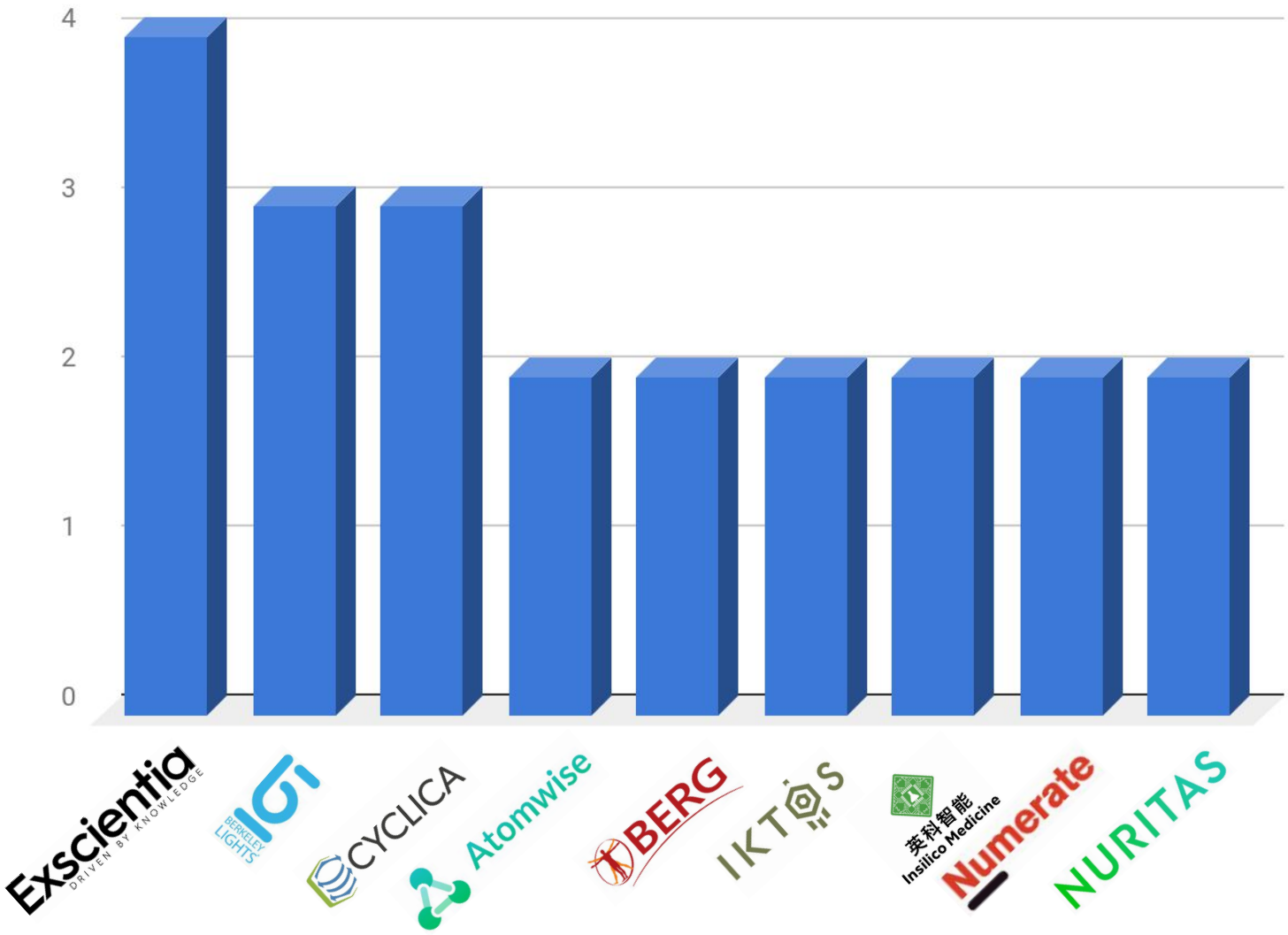
Each of the parties of the deals can be characterized by a number of metrics, which are different for lead companies and AI startups. For instance, while analyzing the startups, it is important to take into account the composition of the research team and their number of publications. This is an implicit indicator of the startup team's experience and knowledge of the topic. On the other hand, the lead companies should rather be analyzed on the level of the firm itself and its R&D activities.

Top 10 **Leading Corporations** by The Number of Pharma AI Deals



The biggest number of significant deals on the topic of AI in Drug Discovery for the studied period was concluded by AstraZeneca and Pfizer. These are both big Pharma corporations showing their commitment towards implementing innovations with the help of AI and invest significant funds in the deals on this matter. That is why for these companies the most common type of deals are true partnerships and saving the costs deals. As for the last one, it becomes more popular among pharma corporations facing the problem of declining R&D efficiency.

Top **AI and Tech Partners** by the Number of Pharma AI Deals



As we can see at the graph, the biggest number of AI in Drug Discovery deals was conducted by Exscientia. The company engages in small molecule drug discovery, selective single target molecules, bispecific small molecules, and phenotypic drug design. 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.

Declining R&D Efficiency of Biopharma Corporations

(Based on "Unlocking R&D productivity Measuring the return from pharmaceutical innovation 2018" Deloitte Report)

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Introduction to Declining Efficiency of Biopharma Corporations

Efficiency of R&D in drug discovery of biopharma declines for many decades and this trend (known as Eroom`s Law) does not stop. Costs of R&D per drug are growing exponentially, yet sales per asset are definitely not increasing. Actually, sales per asset even contribute to the trend, since an average asset brings less revenue. R&D spending continues to increase. Late-stage R&D continues to be inherently risky. The share of oncology assets in late-stage pipelines is growing and becoming the greatest.

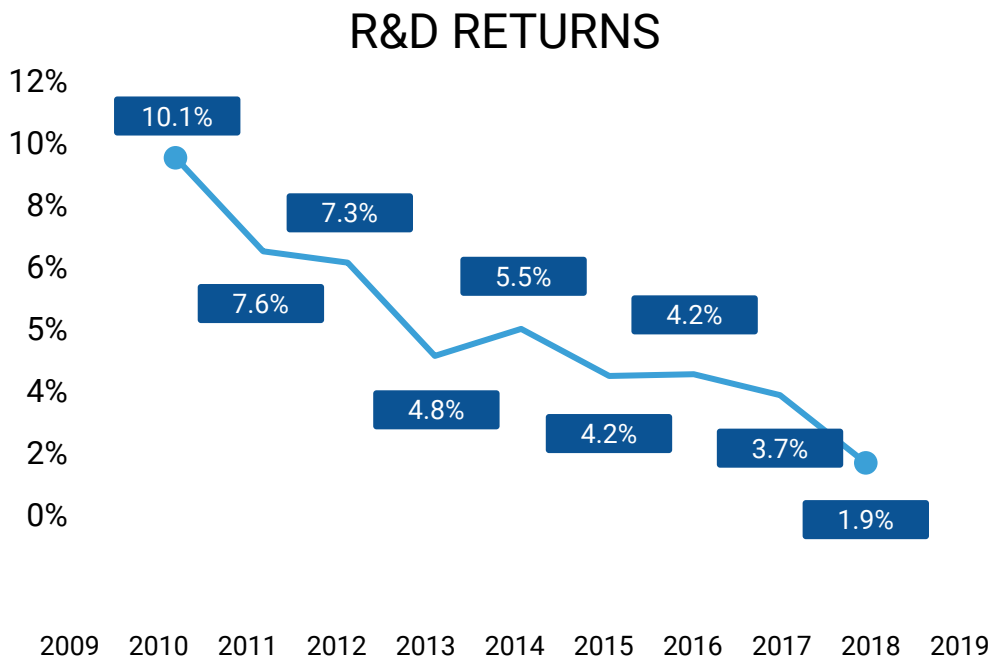
While big pharma has warmed to external sources of innovation from biotech, they continue to pursue a strategy that stresses large-scale, narrowly-focused research, rather than breadth of opportunity. The high-quality, low-volume, high-cost strategy makes corporations particularly vulnerable to the failure rate. As a result, limited output has left the industry dependent on monopolistic pricing and a target for potentially devastating political intervention. Under the current business model, pharma cannot reign-in drug prices without accelerating the decline that Stott has documented.

The solution to the problem is changing the business model of pharma to favor more agile early stage drug discovery, a much larger number of initial pool of projects (with minimal investment, via outsourcing, partnering, or VC funds), and an efficient process of project prioritization. In this sense, pharmaceutical corporations will have to embrace a more venture fund-like approach, given its naturally inherent risk of failure.

Development of AI for drug discovery may cause an additional boost in productivity and bring innovation for big pharma corporations. One opportunity to pharma is to use solutions of young pharma AI startups by making acquisitions. Some corporations that already apply AI for drug discovery have already shown positive changes in financial indicators.
However, it is very likely that negative trends can be overcome only by a combination of technological and managerial innovations in the industry.

Declining R&D Efficiency of Biopharma Corporations

	2010	2018
The cost to bring an asset to market	$1,188M	$2,168M
Forecast peak sales per asset	$816M	$407M



Efficiency of R&D in drug discovery of biopharma corporations continued to decline in the last 8 years.

Costs of R&D per drug are growing exponentially, yet sales per asset are definitely not increasing. Actually, sales per asset even contribute to the trend, since an average asset brings less revenue.

R&D spending continues to increase. Late-stage R&D continues to be inherently risky. The share of oncology assets in late-stage pipelines is growing and becoming the greatest.

Clinical cycle times have also continued to increase, which contributes to the negative trend.

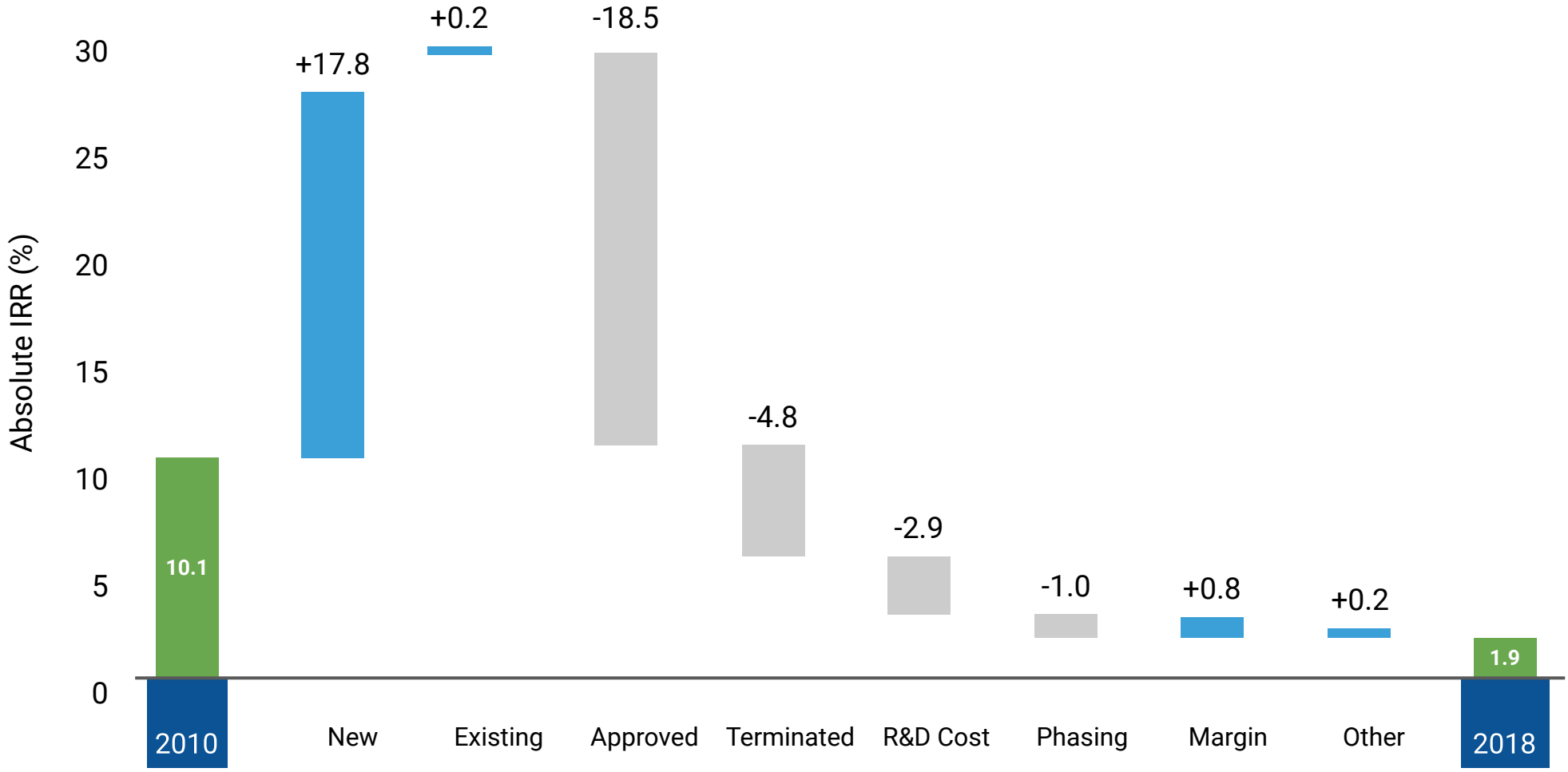
Smaller, more specialized corporations become more competitive since they have higher projected pipeline values.

Pharma corporations need to consider new approaches in their R&D process, such as the development of artificial intelligence and implementation of experience of biotech startups.

There is, however, some progress in de-risking and increasing returns from existing late-stage pipeline assets.

Source: Unlocking R&D productivity Measuring the return from pharmaceutical innovation 2018 by Deloitte

Declining R&D Efficiency of Biopharma Corporations: **Drivers of Change**

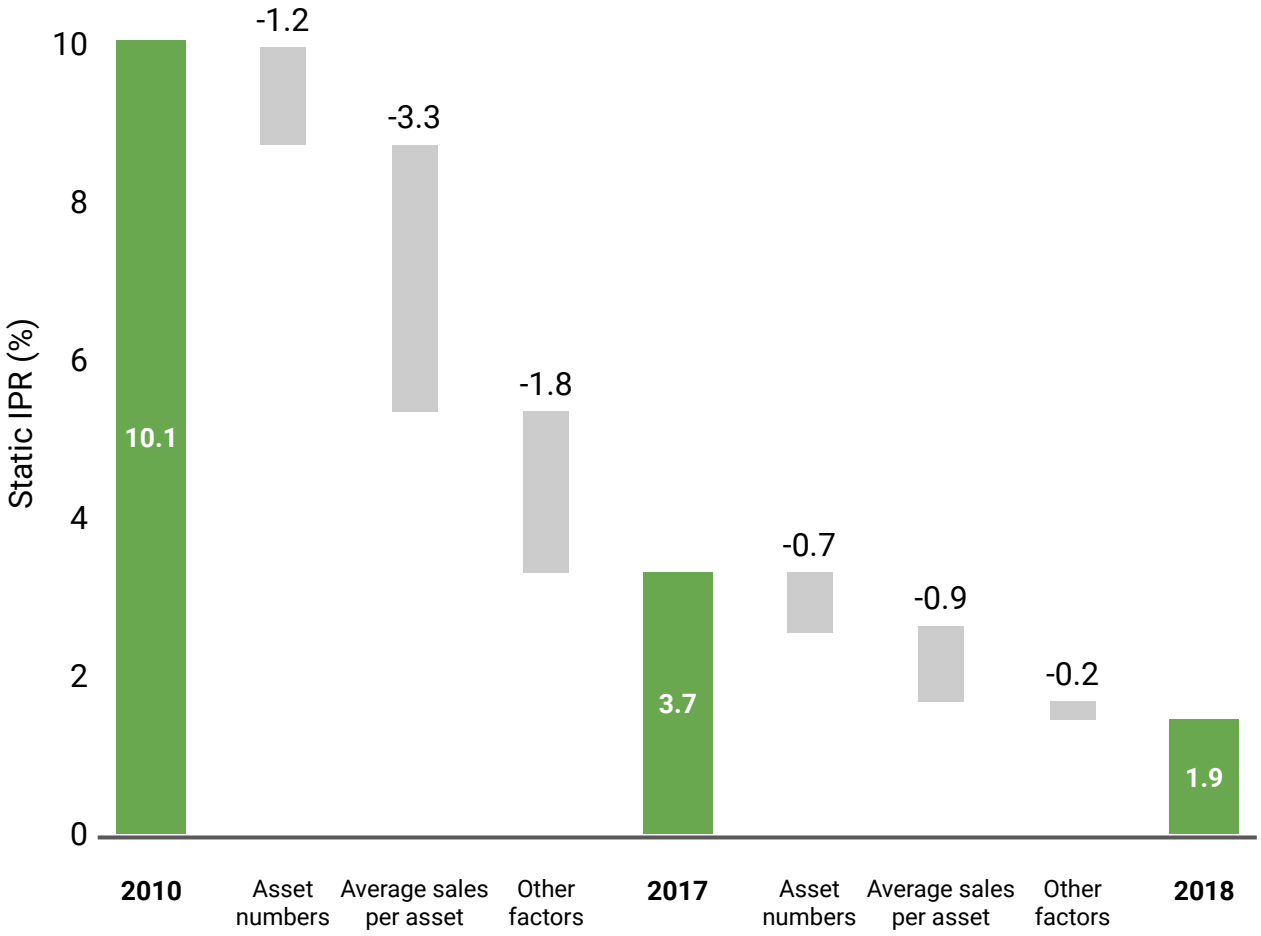


The figure above shows the key drivers of change between 2010 and 2018 years. We can see the drastic decrease in absolute IRR between those years, namely, starting with the indicator of 10.1% in 2010, it has fallen to the value of 1.9%. Also, the graph demonstrates, that R&D costs have led to a decline in projected returns of 2,9 percentage points. The figure shows also impact of different factors on the IRR. As we can see, the development of new drugs was the main driver of change.

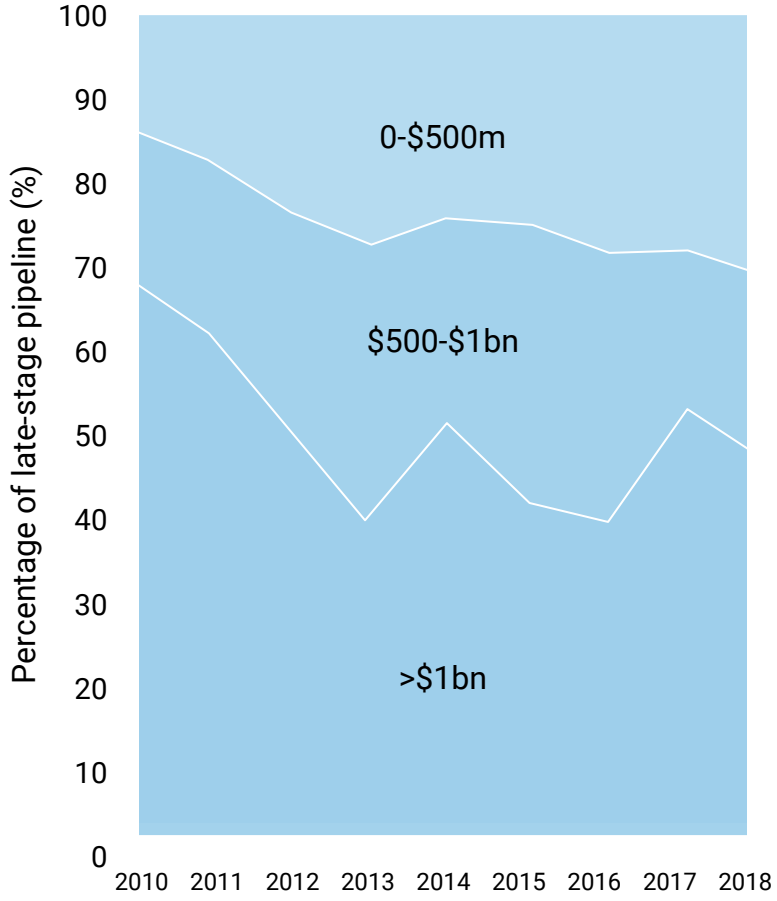
Source | Unlocking R&D productivity Measuring the return from pharmaceutical innovation 2018 by Deloitte

Declining R&D Efficiency of Biopharma Corporations

OVERALL IMPACT OF PIPELINE FACTORS ON CHANGE IN IRR



PROPORTION OF FORECAST PEAK SALES

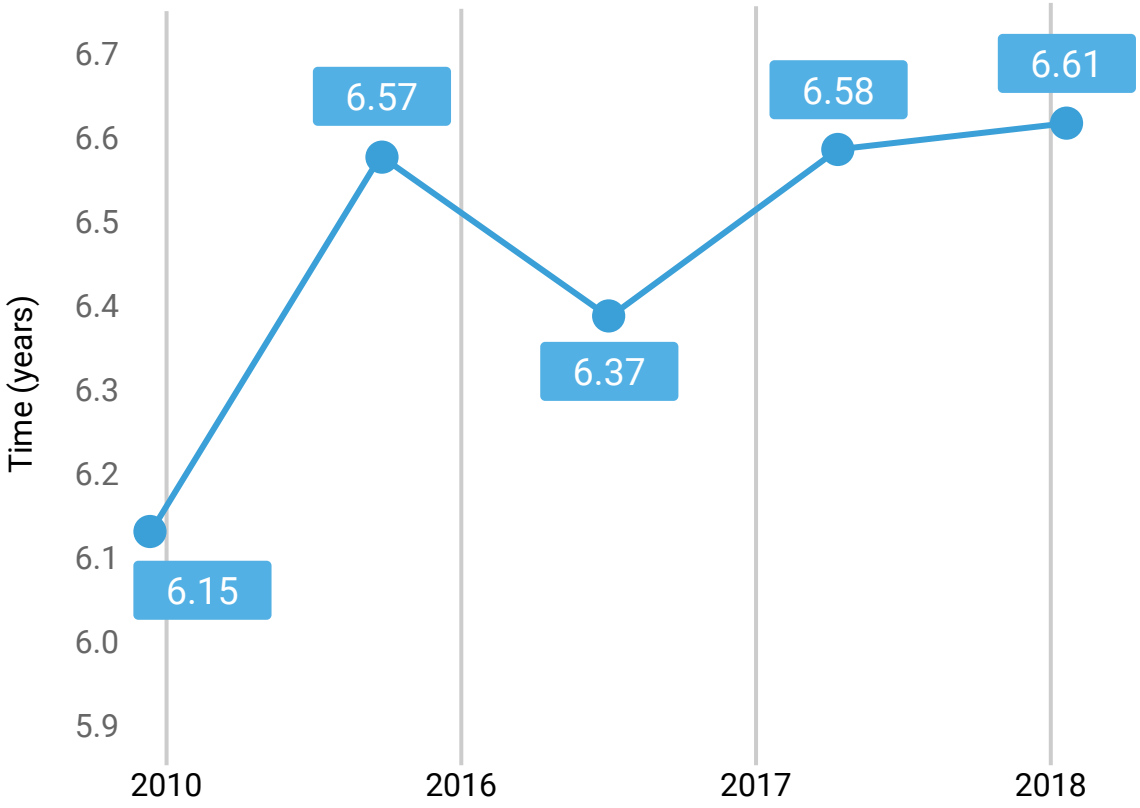


Source

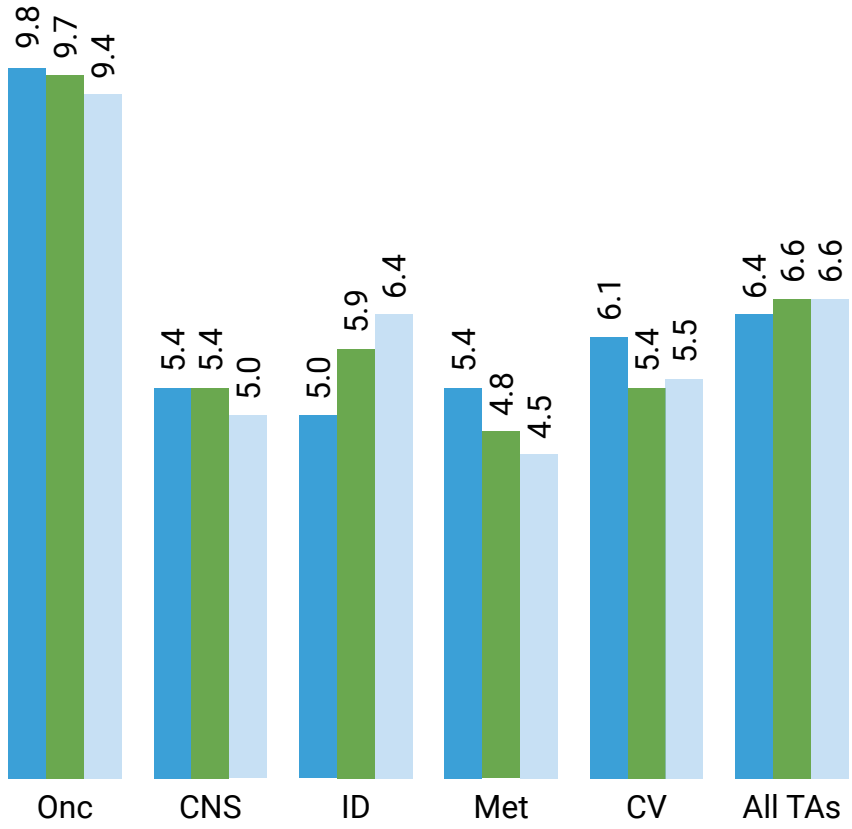
Unlocking R&D productivity Measuring the return from pharmaceutical innovation 2018 by Deloitte

Clinical Cycle Time

CLINICAL CYCLE TIME



CLINICAL CYCLE TIME BY THERAPY AREA



The average clinical cycle time saw a 7.48% increase over the last 8 years, or 5 and a half months. Clinical cycle time for drugs targeting infectious diseases saw the sharpest rise over the last 3 years.

Onc - oncology;
CNS - central nervous system;
ID - infectious disease;
Met - metabolic therapy;
CV - cardiovascular;
All TAs - all therapy areas.

Source: Unlocking R&D productivity Measuring the return from pharmaceutical innovation 2018 by Deloitte

Influence of AI Implementation

NET INCOME OF TOP-15 corporations USING AI ($B)

COMPANY	2013	2014	2015	2016	2017	2018	Chart	Tendency
Amgen	5.08	5.16	6.94	7.72	1.98	8.93		+
Astellas Pharma	0.88	0.88	1.24	1.61	1.95	1.55		+
AstraZeneca	2.56	1.23	2.83	3.50	3.00	2.05		-
Bayer	3.62	3.89	4.66	5.14	8.33			+
Boehringer Ingelheim	1.72	1.36	2.05	2.40	-0.30			-
Bristol-Myers Squibb	2.56	2.00	1.57	4.46	1.01	4.95		+
Evotec	-0.03	0.09	0.02	0.03	0.03	0.07		+
GSK	8.81	4.67	12.88	1.24	1.97	4.84		+
Eli Lilly	4.685	2.391	2.408	2.738	-0.204	3.232		+
Johnson & Johnson	13.83	16.32	15.41	16.54	1.30	15.30		+
Merck	4.40	11.92	4.44	3.92	2.39	6.22		+
Novartis	9.18	10.21	17.78	6.71	7.70	12.61		+
Pfizer	22.00	9.14	6.96	7.22	21.31	11.15		+
Roche	11.30	9.54	9.06	9.73	8.83	10.87		+
Sanofi	4.94	5.84	4.76	5.21	9.53	5.09		-

- The year the company started to use AI in drug development

The table on the left shows the net income of top-15 corporations, with an adjustment on using AI. It's easy to see, that almost every company faced a negative trend in net income. However, after starting to use AI in drug discovery, net income starts to show a considerable. So applying AI for DD positively influences net income of pharma corporations.

Some financial information has not been published yet (for Bayer and Boehringer Ingelheim in 2018).

The Reasons for Declining Efficiency of R&D

Rise in costs of R&D outpaces increase in sales

Increasingly exigent requirement to the efficacy, safety, and quality of new drugs

The shortening of the lifespan of drugs mainly because of antimicrobial resistance

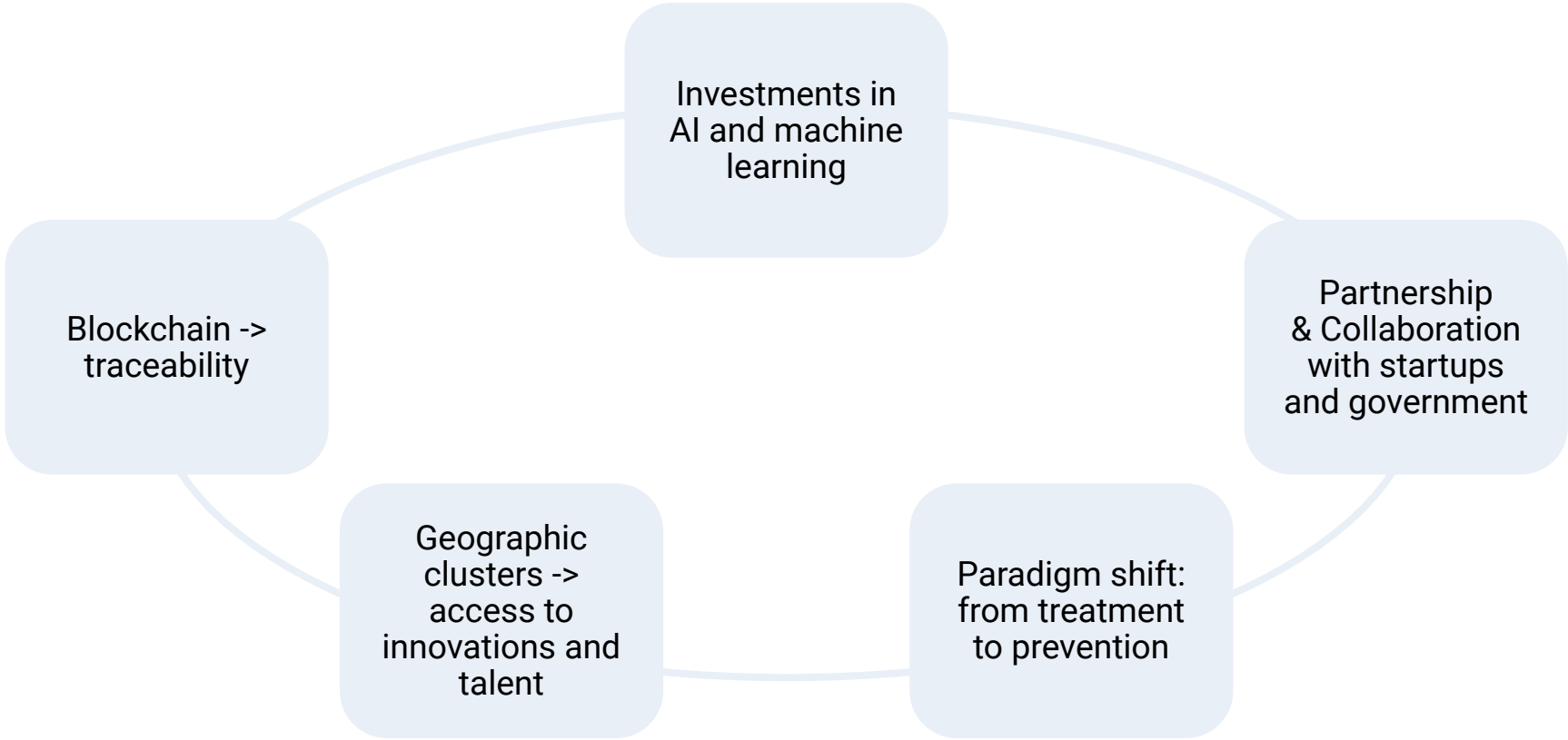
Small incremental benefit are not enough to convince payers to switch to new, more effective drugs.

95 % commercial failure rate

Growing level of scrutiny from political entities and public regarding drug prices

Pharma have failed produce “blockbusters” Pharma have been left with complex diseases who cores carry many ramifications

Way to “Fix” – Technology-Based Solutions



Main obstacle:

Pharma is conservative by nature. It will take time to develop the industry.

Proprietary Analytical Report “Declining Efficiency of R&D in Pharma Corporations” Summary

This chapter is a brief summary of a proprietary analytical report “Declining Efficiency of R&D in Pharma Corporations” by Deep Knowledge Analytics Pharma Division.

The goal of this report is to provide deep analysis of the prospects of pharma industry considering declining efficiency of R&D. Besides, it includes **practical guide** to the way for assembling the best possible solutions to deal with the declining efficiency of R&D. Analytical report comprises analysis of key market players in pharma industry for the specific understanding of how they should deal with the risk which arises while declining efficiency.

According to this purpose, the main reasons for declining trend in pharma industry were analyzed based on the tangible indicators. As a result, analytical report provides some recommendations for pharma corporations concerning the issue of finding the solutions to deal with this negative trend. It was also analyzed what strategic areas are appropriate for immediate AI adoption. Thus, quantitative analysis was enhanced by a qualitative one. The system of metrics and criteria can be applied for the forecasting and predictive analytics in order to understand which companies could be successful and which ones will not survive from the pressure of reducing efficiency. Thus, future prospects of pharma corporations regarding the evidence of R&D efficiency are described. Moreover, analytical report includes specific methods of how these prospects can be changed. These implications can be extremely useful for every institution operating in the field of AI for Drug Discovery. Except this, the possible impact of AI on the declining efficiency trend was investigated. These implications may be helpful regarding the usage of AI to deal with negative efficiency trends in biopharma industry.

The results of the report can be applied for:

- Complex and deep analysis of the pharma industry
- Optimizing the short and long-term strategies of biopharma corporations and other institutions related to the industry
- Determination of the most promising development directions for the pharma corporations’ in order to maximize profits
- Risk assessment of the sector
- Predicting future dynamics and prospects of pharma industry
- Investigating the reasons for declining efficiency of R&D and suggesting solutions to deal with it

The parties who gain early access to this report will have deep expertise on how their strategic agendas can be optimized and stabilized in order to surpass the challenges and to utilize the opportunities related to these novel AI for Drug Discovery investment trends.

“AI-Friendly” CEOs and Board Members of Pharma and Tech Corporations

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Introduction to “AI-Friendly” CEOs and Board Members of Pharma and Tech Corporations Report

Over the last few years, there was a tendency that has shown a decline in the pharmaceutical industry. This is connected to the numerous facts, starting from the R&D inefficiency and ending with the world markets landscape.

Therefore, pharmaceutical companies have a strong interest in improving their positions. For this purpose, they use AI in various areas of their activity, namely, medical image analysis and elaboration of electronic health records (EHRs), building disease ontologies, preclinical drug discovery, and clinical trials. In such conditions, the demand for the ML/AI talent, as well as for ML/AI technologies, is growing in pharmaceutical and healthcare industries and driving the formation of a new interdisciplinary field — data-driven drug discovery/healthcare. This is, undoubtedly, one of the key options for the further development of the pharmaceutical industry.

Progress accelerates at the same time as people with the background in the field of AI occupy leadership positions in top companies. Main market trends are driving the growth in the AI implementation in pharmaceutical and tech research, but the overall success depends strongly on the presence of highly skilled interdisciplinary leaders. They must be able to innovate, organize and guide in this direction.

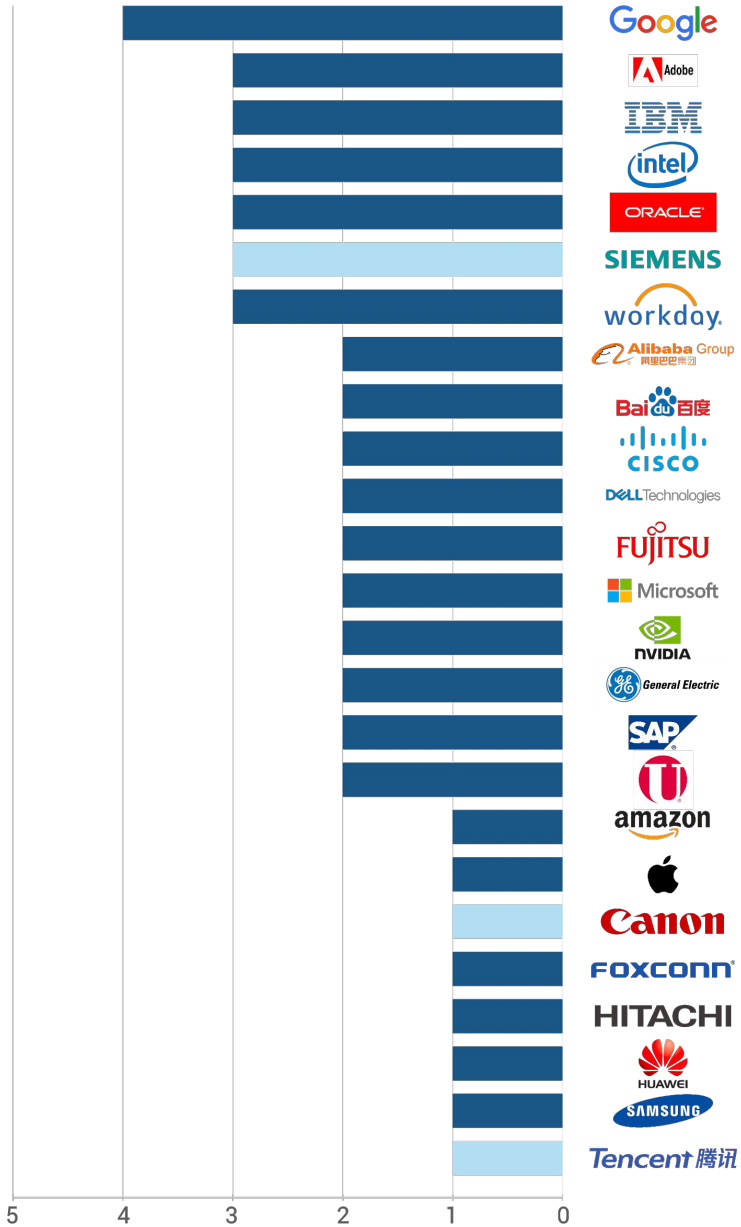
That is why, **the goal of this report** is to identify CEOs and board members, who are driving AI development in pharma and tech industries. This serves as an indicator for the companies, who are committed to using AI in their innovations processes and thus have a potential to improve their market position, comparing to their peers. To this extent, the presence of AI-friendly CEOs and Board members also indicates that the company is focused on increasing its R&D efficiency and thus is more likely to succeed in the drug discovery sector.

The general mechanism is as follows:

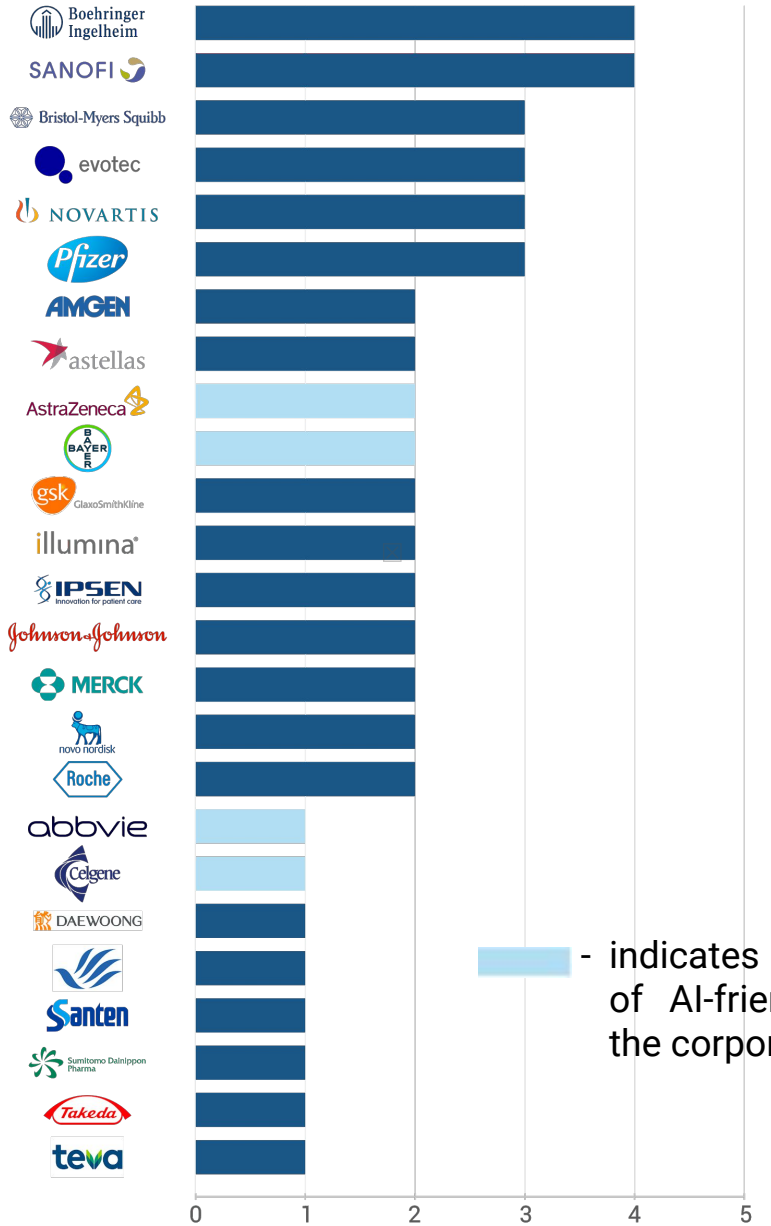
the decline of the pharmaceutical industry -> need to implement AI -> need for knowledge in the sphere of AI -> occupation of leading positions by people who have qualifications in AI -> accelerating applying of AI -> “restoration” of the pharmaceutical industry.

Thus, the relevance of this topic is explained by the need to advance the pharmaceutical industry, and in particular, the healthcare industry. The goal of the report is providing a “bird’s view” on the global leadership scene in the area of adopting AI-driven methods in drug discovery and healthcare to serve as a benchmark tool for indication of the most perspective pharma and tech corporations. Experience of tech corporations applying AI can be crucial in this framework.

AI-Friendly CEOs and Board Members Distribution by **Tech Corporations**



AI-Friendly CEOs and Board Members Distribution by **Pharma Corporations**



- indicates the presence of AI-friendly CEO in the corporation

Methodology for Ranking

The initial large pool of candidates (around 300) for the TOP AI-Friendly CEOs and Board Members list has been selected from multiple sources including:

- Top pharmaceutical and healthcare AI conference program lists
- Google Scholar
- Databases
- News
- Pharma and Tech corporations activities

Ranking is based on the analysis of the descriptive criteria (personal page descriptions, biographies, Linkedin and Bloomberg pages, public awards, article titles, news and PRs, and other text resources) and derived categorical metrics and formal numerical metrics (number of research citations in Google Scholar, RG score in ResearchGate, number of books/talks and articles, social media activity, number of educational diplomas in the field of AI etc).

Categorical variables are considered to be dimensions, descriptive attributes for univariate and bivariate analysis, and classification. Numerical variables are considered to be measures of the initial dataset.

To be nominated for the TOP 100 AI-Friendly CEOs and Board Members list, it was set to be a prerequisite for a candidate to have interdisciplinary technical skills and/or business/entrepreneurship/decision-making skills in both of the area of AI.

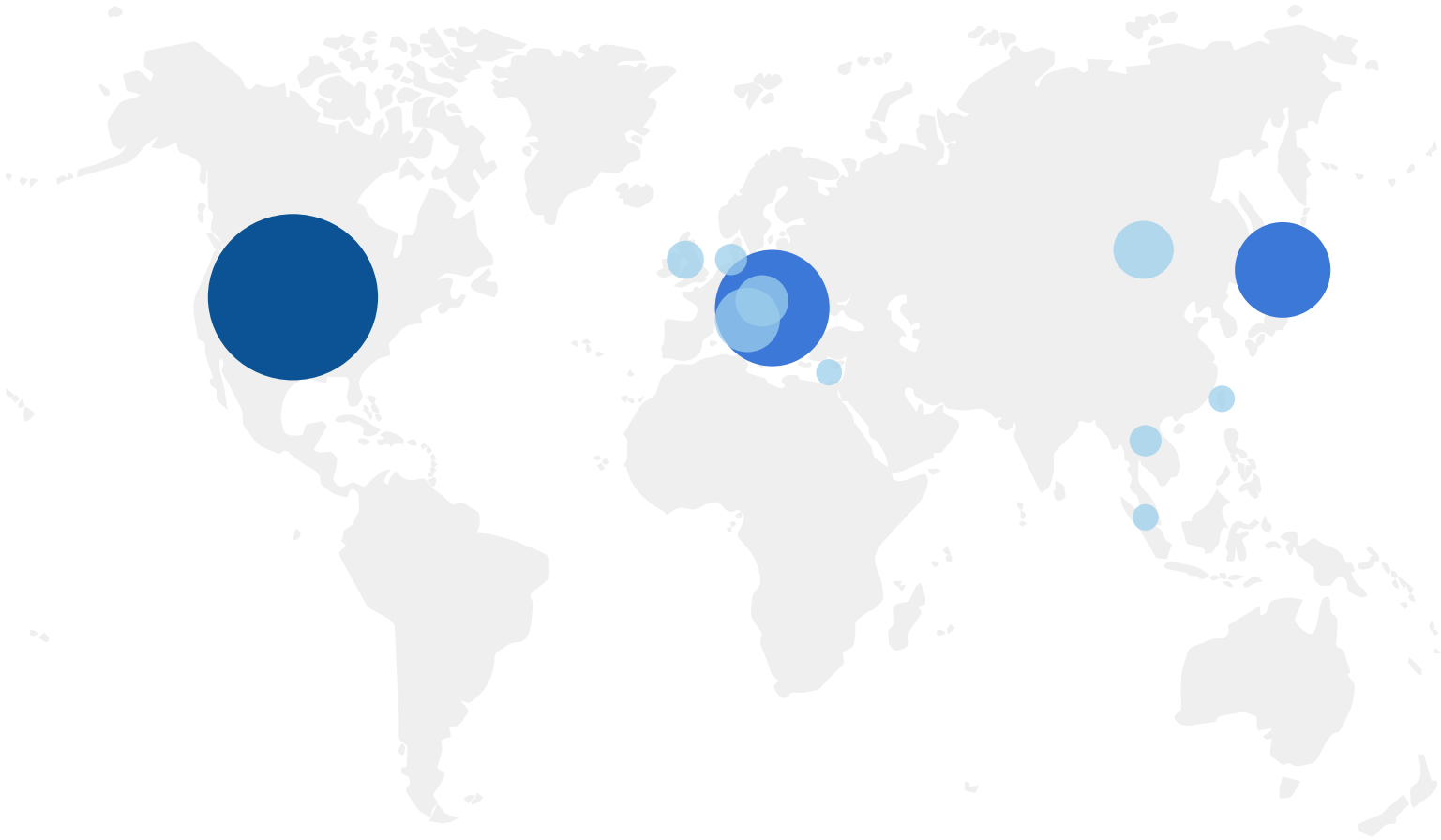
The initial pool of around 300 top candidates has been shortlisted down to the top 100 list following an iterative approach, starting with the obvious differentiating parameters (top tech or business achievements) and gradually specifying additional parameters for the final rating.

The ranking calculation model:

Is a first-order homogeneous polynomial that calculates a person's assessment variables and their relative impact weights (coefficients). Numeric variables were standardised. The weights of each variable have been logically designed to underline major contributions and impact (innovations, business achievements etc) and only augment them with less important, yet valuable, contributions (conference talks, social media activity etc).

The biggest emphasis was put on the activities of CEOs and board members in their corporations regarding AI applications and development.

100 AI-Friendly CEOs and Board Members Geographic Distribution

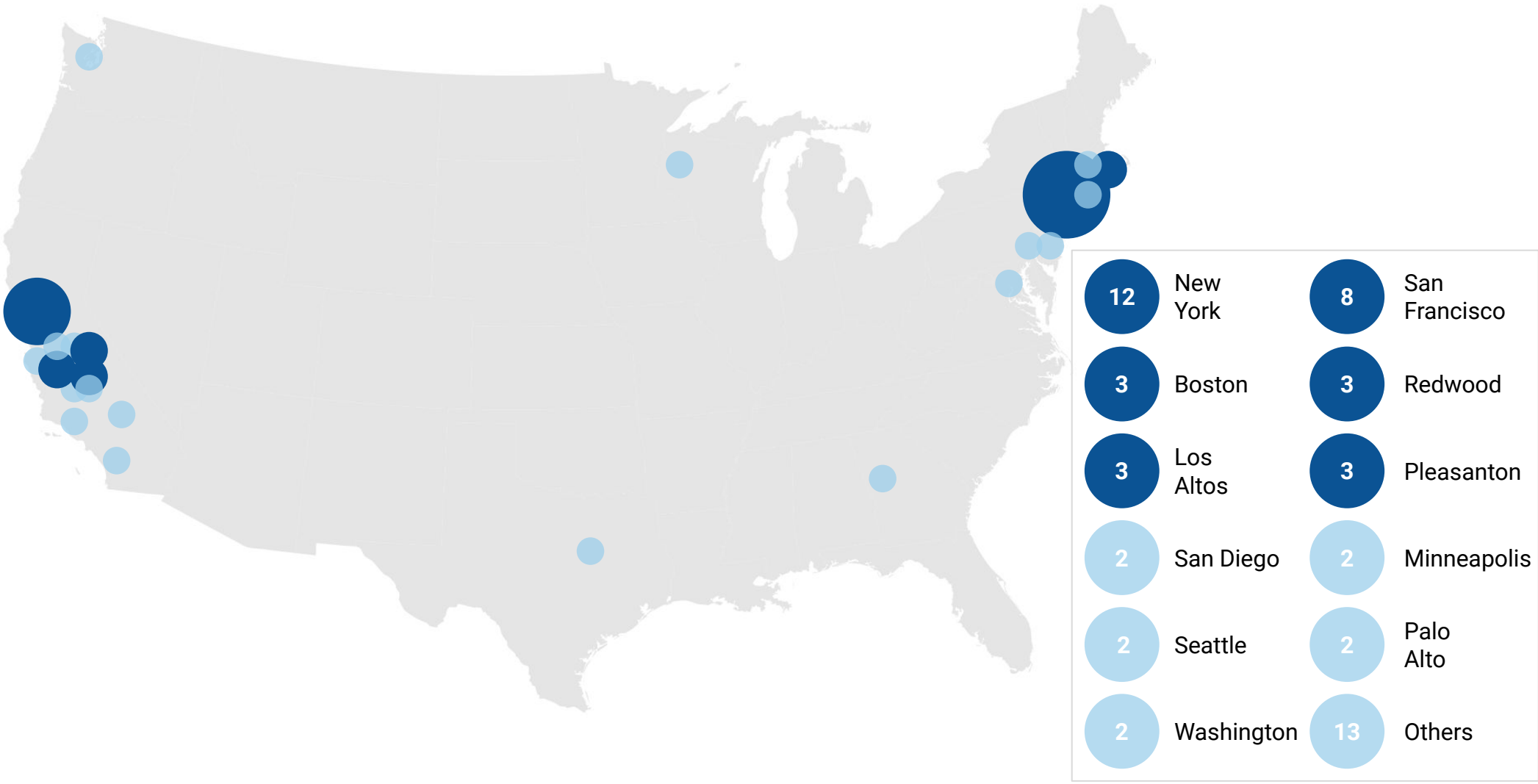


This map shows the geographic distribution of the AI-friendly CEOs and Board Members in Pharma and Tech Industries.

The majority - more than half - reside in the US. Germany and, Japan are also particularly attractive countries for these experts.

57 USA	10 Germany	9 Japan	6 France	4 China	4 Switzerland
3 United Kingdom	2 Denmark	2 South Korea	1 Israel	1 Taiwan	1 Singapore

US AI-Friendly CEOs and Board Members Dislocation in US



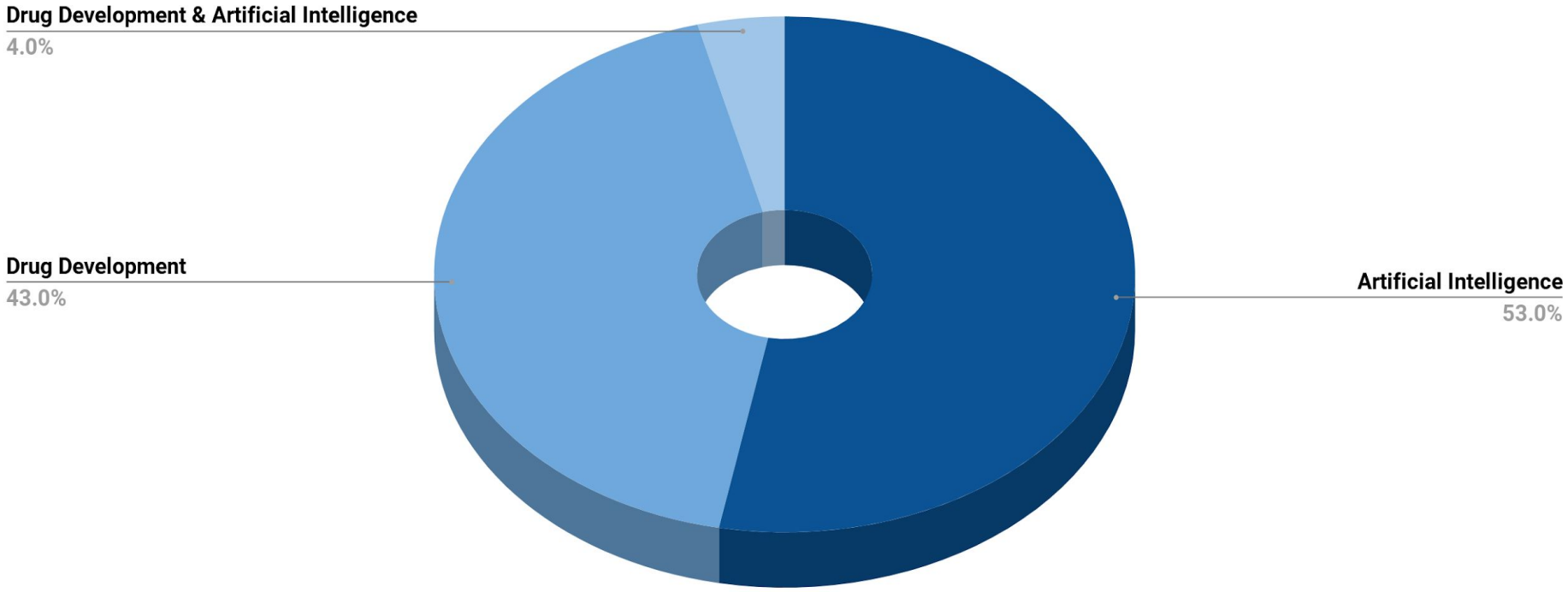
This map shows the geographic distribution of the AI-friendly CEOs and board members in pharma and healthcare within the United States. New York, San Francisco, Boston, Redwood, Los Altos and Pleasanton stand out as favored locations for these individuals.

100 AI-Friendly CEOs and Board Members outside America
Distribution by City

8	Tokyo	4	Basel
3	Ingelheim am Rhein	3	London
3	Munich	3	Paris
2	Bagsvaerd	2	Boulogne-Billancourt
2	Hamburg	2	Walldorf
1	Beijing	1	Hangzhou
1	Hong Kong	1	Osaka
1	Puteaux	1	Seoul
1	Shenzhen	1	Singapore
1	Suwon	1	Taipei
1	Tel Aviv		

This map shows that most of the top AI-Friendly leaders in pharma and tech reside in outside of America. With Tokyo being the most attractive city for this kind of experts.

Specialization of 100 AI-Friendly CEOs and Board Members of Pharma and Tech Corporations



The diagram above shows that AI-friendly CEOs and Board Members are predominantly specialized in either Drug Development or Artificial Intelligence, whereas CEOs and Board Members working at the intersection of the two disciplines represent a small fraction of the total. AI for Drug Discovery companies need much higher levels of expertise in traditional biopharmaceutical science (biochemistry, biology, biomedicine, etc.) and in core AI techniques. Therefore, CEOs and Board Members which belong to this group are well-qualified and have rich experience through practice and education in both fields.

Conclusions

- It is an axiom that CEOs and Board Members need to properly understand how applying of Artificial Intelligence in Pharma and Tech can be used to help them meet their goals. Moreover, level of implementation of AI will become a new dimension that will be used by the financial community to determine current and future market valuations of organisations.
- Simply explained, AI-friendly corporations able to demonstrate the use of AI in their domains, especially in Pharma or Healthcare, will be valued higher than their peer organisations who are not using any form of AI in their operations. We foresee that the use of AI by companies will become a standard component analyzed by fund managers to evaluate companies for investment.
- According to our research, top-100 AI-Friendly CEOs and Board Members occupy their positions in top-50 Pharma and Tech companies. 51% serve in Tech corporations and 49% of them operate in the Pharma industry. Only 4% of top-100 CEOs and Board Members have intense experience through practice and education both in Drug Development and Artificial Intelligence fields. This fact makes it possible to draw conclusions about kind of such people uniqueness.
- The geographic distribution of top-100 AI-Friendly CEOs and Board Members is characterized by their concentration in the US, Germany and Japan. Therefore, mentioned above countries are pretendents to be attractive research, innovation and business centres for AI in Pharma experts abroad, attracting and holding on to the best talents in AI, and to considerably expand their capacities in the field of AI. We predict, that this statistics may substantially change over the coming years in favor or China, firstly -- due to a strong government support for AI-driven healthcare and pharma initiatives, secondly -- due to relatively lower bureaucratic and regulatory barriers for “controversial” research, and thirdly -- due to an emerging trend for a “reverse migration” of Chinese top experts from Western countries back to China.
- Consequently, all the information provided in this report allows leaders in Pharma and Tech to garner facts they can confidently relay to their executive teams so they can make informed decisions when thinking about AI adoption.

Top-35 AI for Drug Discovery Conferences 2019-2020

DEEP
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Introduction to Top-35 AI for Drug Discovery Conferences 2019-2020 Report

The following report is the second edition of our global guide to conferences pertaining to Artificial Intelligence in Pharma for 2019 and 2020.

Its purpose is to enable academics, investors, scientists, politicians, and technologists, as well as interested general public, to participate more readily in the emerging industry by identifying affordable events at venues near to them.

Hereby we selected 35 conferences, which satisfy the following criteria:

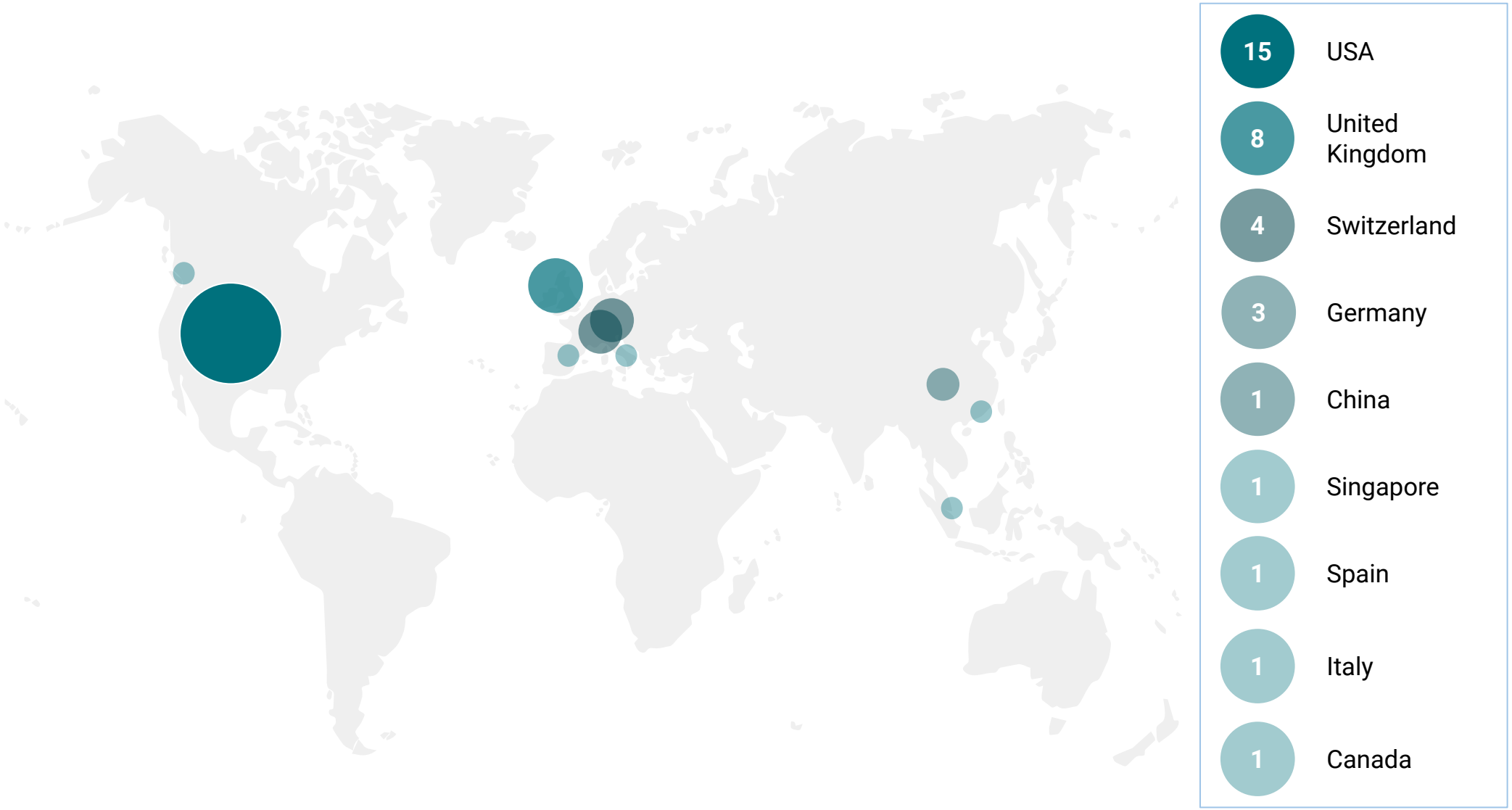
- Well attended, with a large number of speakers as well as participants.
- Include at least one panel on the application of AI in Pharma Industry.
- Include speakers from pharmaceutical corporations (e.g., Johnson & Johnson, Merck, etc.) and/or tech corporations (such as IBM or Microsoft). These corporations are the main driving force behind the development of AI in Pharma and are the primary end-users of technologies, developed by AI startups.

We also identified a few similarities between the selected conferences:

- They all include AI startups.
- They all have well-represented academia, with scholars collaborating with AI specialists to develop new efficient technologies.
- The vast majority of them take place in the US or UK, and only a few in Europe and Asia (mainly Singapore and China).

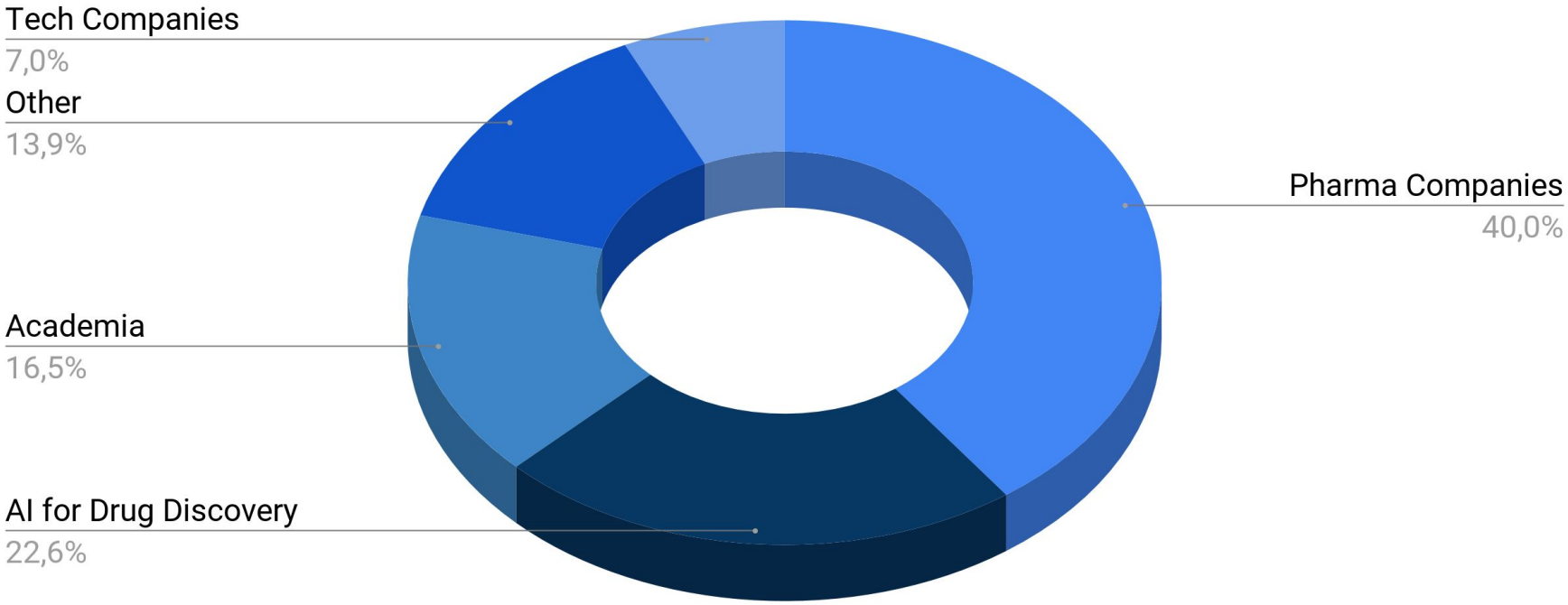
This is an experimental attempt to catalog these conferences. We expect to expand the size and scope of future editions.

Top-35 AI in Pharma Conferences 2019-2020: Distribution by Country



The vast majority of top AI in Pharma conferences are held in the US and UK because the most advanced and richest companies are headquartered there. Furthermore, these two countries are ones of the biggest world academic and business hubs that attract the top researchers and entrepreneurs.

Top-35 AI in Pharma Conferences 2019-2020: Distribution by Speakers Specialization



The chart shows the distribution of speakers by the companies they are working for and the industries they represent. Pharmaceutical companies account for almost half of the total number of speakers, which signifies the ever greater need to find ways to increase the efficiency of R&D activities. One way to achieve that is to look for promising partnerships with AI for Drug Discovery companies that, in turn, account for more than a quarter of the speakers. Academia speakers are represented well enough as well. They are the ones who could provide some useful information about the most recent scientific developments in Drug Discovery and Drug Development.

Top-35 AI in Pharma Conferences in 2019 - 2020

NAME	WEBSITE	DATE	REGION
Deep Learning in Healthcare Summit	re-work.co	May 23-24, 2019	US
Advanced Machine Learning And Artificial Intelligence For Drug Discovery And Development	drugdiscoverydevelopmentforum.com	May 28-29, 2019	UK
Precision Medicine Leaders' Summit East	Website	June 11-12, 2019	US
20th Annual Drug Discovery Summit	www.oxfordglobal.co.uk	June 11-12, 2019	Germany
AI Innovations For Life Science Summit West	aiinnovationsummit.com	June 13-14, 2019	US
2019 GNS Precision Medicine Industry Forum	gnshealthcare.com	June 14, 2019	US
Precision Medicine 2019: Can AI Accelerate Precision Medicine?	dbmi.hms.harvard.edu	June 18, 2019	US
Digital Biomarkers in Clinical Trials Summit	panagorapharma.com	June 19, 2019	Switzerland
Health Horizons Future Healthcare Forum	horizons.health	June 26-27, 2019	UK
SLAS Europe 2019 Conference and Exhibition	slaseurope2019.org	June 26-28, 2019	Spain
2nd Annual Pharma AI & IoT 2019	virtueinsight.com	July 10-11, 2019	UK
Ending Age-Related Diseases 2019	leafscience.org	July 11-12, 2019	US
Basel Life 2019	basellife.org	September 9-12, 2019	Switzerland
AI Applications for Drug Discovery and Development	lifesciences.knect365.com	September 10-11, 2019	US
Intelligent Health AI	intelligenthealth.ai	September 11-12, 2019	Switzerland
AI Med Europe	aimed.events	September 17-19, 2019	UK
8th International Conference on Biostatistics and Bioinformatics	Website	September 18-19, 2019	US

Top-35 AI in Pharma Conferences in 2019 - 2020

NAME	WEBSITE	DATE	REGION
PHARMA AI - BSG	globalbsg.com	September 19-20, 2019	UK
3rd Annual Artificial Intelligence in drug discovery Congress	oxfordglobal.co.uk	September 25-26, 2019	UK
BioData World West 2019	terrapinn.com	October 10-11, 2019	US
11th Euro Biosensors & Bioelectronics Congress	biosensors.conferenceseries.com	October 23-24, 2019	Italy
AI World Conference and Expo	aiworld.com	October 23-25, 2019	US
12th International Conference and Exhibition on Biosensors & Bioelectronics 2019	biosensors.conferenceseries.com	October 25-26, 2019	Canada
3rd Global Pharma R&D Informatics and AI Congress 2019	global-engage.com	October 28-29, 2019	UK
10th World Congress on Biosensors and Bioelectronics	Website	October 28-29, 2019	Switzerland
Drug Discovery 2019 – Looking Back To The Future	elrig.org	November 5-6, 2019	UK
Ai4 Healthcare	ai4.io	November 11-12, 2019	US
The AI Application Summit Biopharma	aiapplicationssummit.com	November 11-12, 2019	US
BIT's 17th Annual Congress of International Drug Discovery Science and Technology	iddst.com	November 15-17, 2019	China
ManuPharma 2019	manupharma.wbresearch.com	December 3-4, 2019	Germany
AIMed North America	aimed.events	December 11-14, 2019	US
Precision Medicine World Conference 2020	pmwcintl.com	January 21-24, 2020	US
ETIM 2020	etim.uk-essen.de/	February 28-29, 2020	Germany
Phar-East 2020	Website	March 18-19, 2020	Singapore
Healthcare & Medical Research Conference Sessions 2020	Website	March 23-24, 2020	US

Basel Life

9-12 September 2019

Basel, Switzerland

basellife.org/2019

BASEL LIFE is Europe's leading congress in the Life Sciences, showcasing cutting-edge science and technology. It brings together preeminent researchers in the field, and offers talented young scientists the possibility to present themselves. Basel is the heart of European's Life Sciences landscape.

Basel Life consists of:

- EMBO
- [BC]2 (BIG DATA IN MOLECULAR MEDICINE)
- The Innovation Forums
- MipTec Exhibition
- European Job Fair

Additionally, Basel Life includes **a forum on Aging, Drug Discovery and Artificial Intelligence.** During the forum, leaders in the aging, longevity, and drug discovery field will describe the latest progress in the molecular, cellular and organismal basis of aging and the search for interventions. Furthermore, the forum will include opinion leaders in AI to discuss the latest advances of this technology in the biopharmaceutical sector and how this can be applied to interventions.

The AI Application Summit Biopharma

11-12 November 2019

Boston, MA

aiapplicationssummit.com

The AI Applications in Biopharma Summit is the only event to convene key strategic biopharma stakeholders and data driven disruptors to discuss their experiences, obstacles, opportunities for partnerships, and strategies they have used to implement AI technologies in the discovery and drug development process.

Interest in AI driven technologies is growing fast among leaders in the biopharma industry. Over 40 industry peers discussed the practical steps for prioritizing and implementing AI technologies to achieve the greatest impact and ROI. The event enabled industry leaders to find partners to help keep the AI in Pharma movement growing and moving forward.

The Summit at a Glance:

- **AI in Research and Development:** Hear how to harness the power of AI to generate novel drug candidates, unlock ADME/Tox obstacles, and decrease the risk profile for regulatory decision-making.
- **AI in Clinical Trials:** Discover how AI can be used to influence the design and optimization of clinical trials and the recruitment and retention of patients and how getting the corporate culture right will improve business outcome conversations and results.
- **Moving from the 'Science of AI' to 'Using AI Tools in Pharma Science':** Understand from Chief Data Officers why data is the new key asset and explore real world evidence and AI and how we can take the next steps forward to start directly impacting care.

Industry Developments Q2 2019

DEEP
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Industry Developments Q2 2019

APR

- Accelerating Therapeutics for Opportunities in Medicine (ATOM) consortium started collaboration with NVIDIA to scale ATOM's AI-driven drug discovery platform. NVIDIA will provide additional resources that will enable ATOM's predictive model development pipeline to be run at increased scale and speed. The companies also aim to make ATOM's platform accessible to the research community.
- Exscientia has delivered a highly potent in vivo active lead molecule, targeting a novel pathway for the treatment of chronic obstructive pulmonary disease. By delivering the candidate, it has reached the first major milestone in its AI-drug discovery collaboration with GSK. The molecule was developed through the application of Exscientia's Centaur Chemist™ AI-driven automated drug discovery platform.
- Biopharmaceutical company Gilead Sciences started working with AI-startup Insitro to find medicines to treat a liver disease, nonalcoholic steatohepatitis (NASH), that is fast becoming a global epidemic fueled by poor diet and lack of exercise. Gilead will pay the South San Francisco-based startup $15 million to kick off a three-year research collaboration. The deal calls for Insitro to create disease models for NASH in hopes of finding targets for drugs meant to slow or reverse its progression.
- Concerto HealthAI will collaborate with Pfizer on Precision Oncology using Concerto's eurekaHealth platform, AI models and Real World Clinical electronic Medical Record (EMR) and healthcare claims.
- Atomwise, a biotech company using AI for drug discovery, and the Drugs for Neglected Diseases initiative (DNDi), a not-for-profit research and development organization working to deliver new treatments for neglected diseases, succeeded to discover promising drug-like compounds in a program to develop first-in-class treatments for Chagas disease.
- SK Biopharmaceuticals, a pharmaceutical company focused on disorders of central nervous system and cancer, and twoXAR, Inc., an AI-driven biopharmaceutical company, entered into an agreement to discover and develop first-in-class therapeutics for non-small cell lung cancer. Under the agreement, twoXAR will use its AI discovery technology to identify a set of initial candidates with the potential to treat lung cancer through novel biological mechanisms of action.

Industry Developments Q2 2019

APR

- Janssen Pharmaceutica has initiated a collaboration agreement to use Iktos' artificial intelligence (AI) technology to accelerate small molecule drug discovery. The companies will partner to develop applications using Iktos's knowledge in deep generative models and Janssen's expertise in AI-enabled prediction of small molecule activities.
- Y Combinator, the high-profile startup accelerator based in Mountain View, California, announced that it will prioritize applicants that are using Atomwise's artificial intelligence software for drug discovery. Researchers in academia can earn free access to Atomwise's service through the Artificial Intelligence Molecular Screen (AIMS) Awards program. Through YC's new initiative, AIMS participants will have an expedited route to applying for a spot in the accelerator, along with help from YC itself throughout the application process.
- After a three-month pilot program by Nvidia and American College of Radiology, Nvidia launches new software which will be used by more than 38,000 radiologists to improve diagnoses, and to aid in speeding up drug discovery.
- AstraZeneca and BenevolentAI began a long-term collaboration to use AI and machine learning for the discovery and development of new treatments for chronic kidney disease and idiopathic pulmonary fibrosis. Scientists from the two organisations will work side-by-side to combine AstraZeneca's genomics, chemistry and clinical data with BenevolentAI's target identification platform and biomedical knowledge graph.
- Chief.AI and Medicines Discovery Catapult has secured a grant from Innovate UK to make AI accessible to all drug discovery researchers. This partnership will address the need for more accessible AI and data in the B2B marketplace – prioritising drug discovery, diagnostics and clinical trials markets.

MAY

- MarkLogic Corporation, the next generation data platform provider for simplifying data integration, has launched Pharma Research Hub to accelerate drug research and results.
- NEC Corporation decided to expand the application of its cutting-edge AI technologies, "NEC the WISE", to cancer drug development that focuses on advanced immunotherapy as part of enhancing its healthcare business. As a start, clinical trials for individualized neoantigen vaccines will be initiated with Transgene SA, making NEC the first company in Japan to initiate such trials.

Industry Developments Q2 2019

JUNE

- Pharmaceutical industry leaders such as Janssen, AstraZeneca, GlaxoSmithKline, and Novartis, have launched the first collaboration to train their drug-discovery, machine-learning algorithms on each other's data. The Melloddy project (Machine Learning Ledger Orchestration for Drug Discovery) marks the first time pharmaceutical companies have shared data with each other, not just collaborated with AI startups individually. The Melloddy research consortium has €10m funding from each company and €8m from the EU Innovative Medicines Initiative, a public-private partnership. Some 17 partners including two European universities, four start-ups and Nvidia, the chipmaker, as well as the 10 pharmaceutical companies, form the consortium.
- Eli Lilly will support its drug discovery efforts through an up-to-$560 million partnership with Atomwise to develop up to ten drug targets selected by the pharma giant, using the San Francisco company's AI technology.
- Exscientia has begun a collaboration with China's GT Apeiron Therapeutics, focusing on oncology. Exscientia will use its Centaur Chemist AI fast drug discovery platform, taking advantage of China's investment in pharma and AI to improve the speed of discovery of new treatments for patients in the country, and globally.
- nference, a leader in knowledge synthesis software solutions for the life sciences industry has entered into a multi-year alliance with Janssen Research & Development, LLC that will leverage the nference AI platform to create a unified data science-powered connective fabric across the Janssen R&D organization.
- France-based pharma giant Sanofi will team up with Google to use the tech giant's AI and cloud-computing tools in a new Innovation Lab, per Bio Space. The goal of the partnership is to speed up drug discovery, maximize operational flows, and improve the patient experience.
- Atomwise has launched a 10 billion compound AI-powered virtual drug screening initiative, the 10-to-the-10 program, in collaboration with Enamine Ltd., the world's largest chemical supplier. The initiative aims to dramatically increase the discovery of safer small molecule drugs to treat pediatric cancers.

Industry Developments Q2 2019

JUNE

- Germany-based Evotec, Oxford University and AI expert Sensyne Health forged a partnership to form multiple spinout companies aimed at “accelerated data-driven drug discovery and development.” The three entities will fund a new BRIDGE (Biomedical Research, Innovation & Development Generation Efficiency) model known as LAB10x to drive research in the different fields of clinical artificial intelligence and digital health at Oxford.
- San Francisco-based AI-startup BlackThorn Therapeutics has raised $76 million in Series B funding round. This will allow the company to run human tests of two experimental treatments, one for mood or anxiety disorders and the other for autism.
- The Korean government announced it would spend 25.8 billion won ($21.7 million) on supporting the discovery and development of innovative medicines using AI in the next three years. The project focuses on building a customized AI platform for each phase of new drug development, including the discovery of candidate substances and clinical trials.

Industry Developments Q2 2019

Coming back to the major industry developments in Q1 2019, one of the most prominent events was the launch of Alliance for Artificial Intelligence in Healthcare (AAIH).

The newly formed Alliance for Artificial Intelligence in Healthcare was sponsoring a panel discussion open to the public, titled “The Future of AI-Powered Healthcare,” on January 7, in association with the Digital and Medtech Medicine Showcase at the Biotech Showcase in San Francisco.

AAIH is the global advocacy organization for the advancement and use of artificial intelligence in healthcare to improve patients’ lives and create more efficient, sustainable, and accessible healthcare systems. Through investment, invention, and innovation in AI, the AAIH and its member companies and organizations are creating novel interventions and product solutions that reduce failure rates and costs while improving quality across the entire healthcare spectrum.

AAIH Mandate and Goals:

- Develop appropriate regulations and industry guidance
- Seek engagement with appropriate stakeholders
- Interface with Government & NGO’s on growth of AI in healthcare industry
- Stimulate data sharing and open access to key findings
- Set a model and testing approach for quality control and use of standards
- Establish accreditation authority and/or affiliation with academic organizations
- Educate general populace, industry stakeholders, and government on value of AI and Machine Learning
- Prioritize and tailor forums for regulators, payors, providers, and other end-users as well as patients, the public, and media
- Produce informative and reliable industry reports

The AAIH is a coalition of technology developers, pharmaceutical companies, and research organizations who have expressed the common goal of realizing the potential for AI in healthcare to significantly improve quality of care, but who also recognize that these, and other, difficult questions must be considered.

Organization's website: https://www.theaaih.org

Trends of Investment and M&A Deals

DIVERSIFICATION

In 2015 and 2016, 26 and 22 investment rounds were conducted, and this number increased to 30 in 2017 and to 36 in 2018. In 2019 this number is expected to increase as well.

INCREASED AMOUNT OF INVESTMENTS

2017 and 2018 showed significant growth of investments. Comparing to 2015 and 2016, when AI R&D startups raised $231M and $230M accordingly, 2017 showed significant growth to $469M. The industry saw a total of $455M in Q2 of 2018, compared to $159M in Q1 2018. This is almost as much as was raised in all of 2017 combined ($468M). Thus, we expect this trend to continue.

CONSISTENCY

During 2013-2016 there was some growth in the amount of capital raised by the industry players, however, the trend was not steady. In 2017-2019 we observed stable growth of the investments in the industry, an increase in the number of IT and Tech corporations entering the field, and active participation from traditional BioPharma corporations, largely in the form of joint ventures. M&A deals will continue at a fast pace driven by a need to consolidate the business and simplify collaborations and outsourcing.

Trends of Investment and M&A Deals

2013-2015

During these years the first scalable AI approaches for Drug Discovery and Advanced R&D were developed and several industry players with forward-thinking executives started launching pilot collaborations and making small investments.

2016-2017

Because AI is still a young approach within the life sciences, many pilot projects failed, creating a lot of criticism towards the use of deep learning for Drug Discovery and Advanced R&D. Therefore, there were significant concerns regarding the scalability of such an approach, and whether they could deliver truly disruptive results, above and beyond traditional R&D departments in BioPharma. By the beginning of 2017, the first tangible results were achieved by a number of AI companies and new benchmark methods for the application of AI were established, and new collaborations between Pharma and AI startups yielded much better results. Since then the race for the acquisition of the best, AI startups began.

2018

Capitalization of the industry is continuously growing. If there will be major breakthroughs, the growth leading up to 2020 could approach 20x or more. Over the next several years, we can expect to see VC firms and subsidiary funds focused exclusively on the AI for Drug Discovery subsector, and funds that invest in a maximally-diverse number of AI for Drug Discovery companies so as to bet on the entire subsector, in such a way as to tie the performance of the fund to the performance of the entire sector rather than any individual company.

2019

It is going to be an important milestone in transitioning from the quantity of AI-related collaborations, investments, and M&As to qualitative gains — first practical validations of previously conducted research might be appearing during this year. We are expecting that in 2019 leading pharmaceutical companies will start adopting AI at scale, rather than follow a project-oriented path, as in previous years. The strategic importance of AI has become obvious to most organizations within the biopharma industry, and a majority of them will be looking for ways to rapidly progress in this direction.

Appendix

Overview of Proprietary Analytics by Pharma Division of Deep Knowledge Analytics

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Overview of Proprietary Analytics by Pharma Division of Deep Knowledge Analytics

The Pharma Division of Deep Knowledge Analytics encompasses deep intelligence of the pharma industry and the AI for Drug Discovery sector. AI has already become the key ingredient of success for Tech Corporations and is becoming crucially important for Big Pharma as well. It will be like oxygen for them in no time. This is why the knowledge and incorporation of AI and DL is of paramount importance for the pharma corporations if they plan to survive. Those pharma companies that are last have the potential to become first, and those of them that are downtrodden could rise up. All they need is AI and the knowledge of the market. The series of AI for Pharma reports from Deep Knowledge Analytics is there for the taking.

The key questions regarding AI for Drug Discovery and Biomarker Development sector include:

- **What are the major threats and opportunities facing biopharma corporations regarding AI development in the industry?**
- **What is the specifics of the stock indices aggregated based on pharma and tech corporations applying AI?**
- **What are the main reasons for declining efficiency of R&D of biopharma corporations and what are business consequences and solutions for the corporations and other participants of the industry?**
- **How can different institutions benefit from the aforementioned tendencies?**

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.

They will deliver:

- Concrete deep analysis of the prospects of AI for Drug Discovery and Biomarker Development industry regarding the development of the different trends;
- Tangible forecasts on the 3-5 years horizon, providing an overview of future scenarios of the development of AI in the pharma industry;
- Practical guide to the optimized way for assembling the best possible tools and solutions to deal with the industry trends;
- Analysis of key market players in the AI for Drug Discovery and Biomarker Development landscape.

The parties who gain early access to these reports will have deep expertise on how their strategic agendas can be optimized and stabilized in order to manage the usage of AI for Drug Discovery and Biomarker Development, to surpass the challenges and to utilize the opportunities related to these novel biopharma trends.

Deep Knowledge Analytics Pharma Division

Major Sectors of Expertise

AI | Deep Learning | Biomarker Development | Drug Discovery

Our Assets

- Next-generation infographics unifying big data analytics with advanced visualization
- Near-term forecasts using tangible, qualitative metrics
- Customised Pharma Industry analytics services for corporate and institutional clients

The **Pharma Division of Deep Knowledge Analytics** produced five case studies and analytical reports focused on AI for Drug Discovery sector in 2018, setting the gold standard for analytics on this topic. On multiple occasions, it was covered by top media such as Forbes and the Financial Times. Its opinions, insights and forecasts have been recognized and widely referenced by top executives at the level of senior Vice-Presidents of Big Pharma corporations, such as Johnson & Johnson, Merck, GSK. Recently, MIT named this division as a **top technology think-tank**, acknowledging the AI ranking framework it developed.

Plans for 2019

Deep Knowledge Analytics' Pharma Division is actively increasing both its number of open-access as well as proprietary reports, and the breadth and depth of its industry-landscape and competitive analytics.

Proprietary Analytics scheduled for Q2 2019

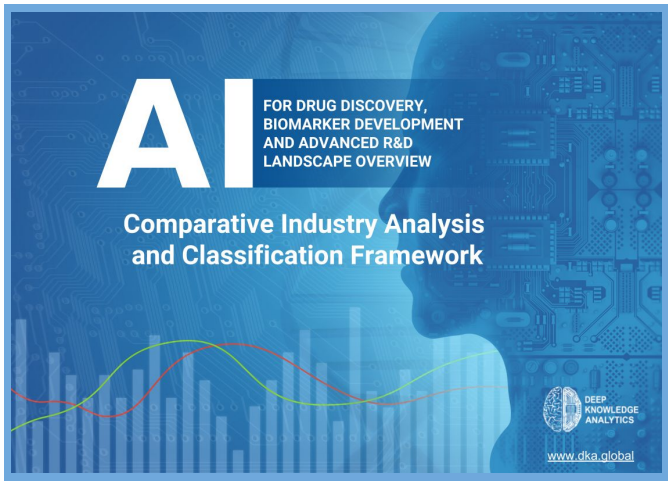
- New edition of Proprietary Analytical Report: Comparative Industry Analysis
- Ranking of Investment Funds
- Investment targets for AI-Pharma Fund (enhanced analysis of best AI startups)
- Declining Efficiency of R&D of Pharma Corporations
- Pharma AI Stock Index
- Pharma AI Risks
- Ranking of Pharma AI Analysts

The **Pharma Division of Deep Knowledge Analytics** aggregates the most advanced team of analysts and experts to produce customized case studies and deep industry analysis for the top executives of big pharma corporations. Its reports cover a number of converging sectors, including AI for Drug Discovery, the systemic declining efficiency of R&D of Big Pharma corporations and the rise of Tech-corporations entering healthcare and drug discovery space.

Deep Knowledge Analytics Pharma Division offers several services to its clients:

- Conduct customised case studies, research and analytics for internal (organizational) use, tailored to the precise needs of specific clients;
- Perform customised solutions using specialised software, industry and technology databases, interactive IT-platforms;
- Provide customized competitive analytics and development recommendations for specific companies and corporations interested in enhancing AI in Pharma assets and activities.

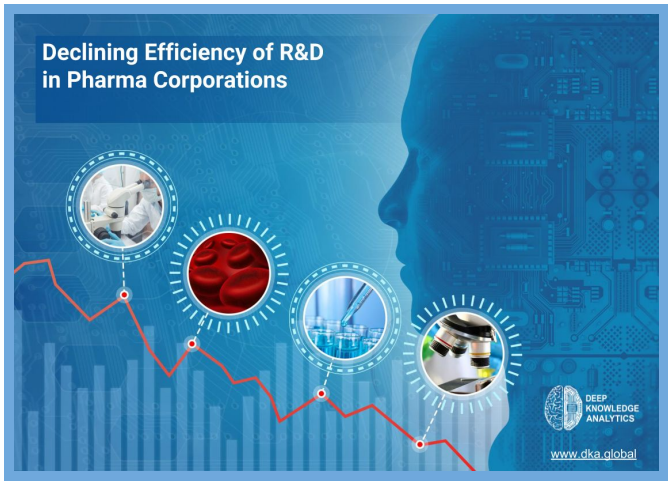
Deep Knowledge Analytics “Pharma Division”: Upcoming Proprietary Reports Q3 2019



Comparative Industry Analysis & Classification Framework

Pharma AI Stock Index

Top Analysts AI in Pharma



Declining Efficiency of R&D in Pharma Corporations

Top-20 AI in Drug Discovery Investors

Enhanced analysis of most promising AI-companies as the best investments targets for AI-Pharma Index Hedge Fund

Deliverables of “Comparative Industry Analysis & Classification Framework”

AI for Drug Discovery and Biomarker Development sector has large potential to impact the whole biopharma industry essentially. Knowledge of the landscape of the market is crucial for the survival and development of every company operating in the market.

The key questions regarding implementation of AI for drug discovery and biomarker development include:

- What are the major threats and opportunities facing biopharma corporations regarding AI development in the industry?
- What are the main players in AI for drug discovery field? How are they categorized and differentiated?
- How can different institutions benefit from the AI for drug discovery development?

This is a 100+ page report 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 new updated edition being released each month, incrementally increasing the precision, practicality and actionability of its industry analysis. Each new edition will provide a more sophisticated, comprehensive and precise understanding of the challenges and opportunities provided by the development AI in biopharma industry, as well as what businesses such as pharma corporations and private biotech companies need to do in order to benefit, rather than stagnate, from the oncoming boom of AI in the industry.

It will deliver:

- Deep analysis of the prospects of AI for Drug Discovery and Biomarker Development industry regarding the development different trends
- Analysis of the most promising pharma AI companies, their opportunities, strengths and weaknesses
- Comparison of key market players
- Assessment of the future prospects of these companies

The parties who gain early access to this report will have deep expertise on how their strategic agendas can be optimized and stabilized in order to manage the usage of AI for Drug Discovery, to surpass the challenges and to utilize the opportunities related to these novel biopharma trends.

Deliverables of “Pharma AI Stock Index”

Pharma and Tech corporations demonstrate an increasing interest in AI. Applying AI for Drug Discovery and cooperation with pharma AI companies can be a sign that a corporation has prospects for competitive advantage. Understanding financial dynamics of such corporations is crucial for the analysis and assessment of threats and opportunities of AI for Drug Discovery industry.

The key questions regarding financial dynamics of pharma and tech corporations applying AI include:

- What is the specifics of the stock indices aggregated based on these corporations?
- What is the relation of these indices to the most important, well-known and relevant stock indices and what are the reasons for that?
- How can different institutions benefit from the knowledge of dynamics of these indices?

This is a 60+ page report delivering practical answers to these specific questions in order to optimize the short and long-term strategies of investors, biopharma corporations and other institutions related to the industry, with a new updated edition being released each month, incrementally increasing the precision, practicality and actionability of its financial analysis. Each new edition will provide a more sophisticated, comprehensive and precise understanding of the reasons and consequences of financial dynamics of the aforementioned corporations, as well as what businesses such as pharma and tech corporations and private biotech companies need to do in order to benefit, rather than stagnate, from these tendencies. The report also suggests important insights for investors dealing in the related market. It is also planned to establish real-time information on the indices dynamics as well as on the statistical indicators of their relation to traditional and industrial-specific stock indices.

The findings of the report can be used for:

- Developing the optimal portfolio for investing in AI for Drug Discovery industry
- Predicting future financial dynamics in the industry
- Gaining understanding of current pharma and tech markets tendencies and crucial risks
- Risk assessment and formation of future market development scenarios
- Determining what has to be done in order to benefit from these tendencies

The parties who gain early access to this report will have deep expertise on how their strategic agendas can be optimized and stabilized in order to benefit from the impact of financial dynamics of the aforementioned corporations and how to utilize the opportunities related to these financial trends. Pharma and tech corporations themselves will be able to observe their place on financial landscape regarding the sector of AI for Drug Discovery.

Deliverables of "Declining Efficiency of R&D in Pharma Corporations"

The decline of the R&D efficiency of biopharma corporations is perhaps the most crucial trend in the whole industry now. Today it is even more exacerbated due to the ever-increasing impact of this decline on financial indicators of pharma corporations and financial stagnation of the industry despite large technological progress.

The key questions regarding declining efficiency of R&D of biopharma corporations include:

- What are the main reasons for this declining trend and what are business consequences for the corporations and other participants of the industry?
- How can pharma corporations find the solutions to deal with this negative trend?
- What are future prospects of pharma corporations regarding the evidence of R&D efficiency and how these prospects can be changed?

This is a 70+ page report 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. Each new edition will provide a more sophisticated, comprehensive and precise understanding of the challenges and opportunities provided by the decreasing efficiency of R&D in biopharma corporations, as well as what businesses need to do in order to revert this trend, rather than stagnate. It is analyzed and assessed also how are these solutions applicable and how is it likely to implement them.

The results of the report can be applied for:

- Complex and deep analysis of the pharma industry
- Optimizing the short and long-term strategies of biopharma corporations and other institutions related to the industry
- Determination of the most promising development directions for the pharma corporations' in order to maximize profits
- Risk assessment of the sector
- Predicting future dynamics and prospects of pharma industry
- Investigating the reasons for declining efficiency of R&D and suggesting solutions to deal with it

The parties who gain early access to this report will have deep expertise on how their strategic agendas can be optimized and stabilized in order to manage the problem of declining efficiency of R&D in pharma corporations, to surpass the challenges and to utilize the opportunities related to these biopharma trends.

Deliverables of "Top-20 AI in Drug Discovery Investors"

AI for Drug Discovery and Biomarker Development industry has a large potential to impact the whole biopharma industry essentially. Knowledge of the key investors in this industry is crucial for the survival and development of every company operating in the market.

The key questions regarding analysis and evaluation of AI for drug discovery investors include:

- What are the major threats and opportunities facing investors in AI for Drug Discovery industry?
- What are the main investors in AI for drug discovery field? What are their key features and similarities?
- What are their investment strategies and how can biopharma companies benefit from cooperation with them?

This is a 40+ page report delivering practical answers to these specific questions in order to optimize the short and long-term strategies of biopharma companies, investors and other institutions related to the industry, with a new updated edition being released each quarter, incrementally increasing the precision, practicality and actionability of capital market analysis. Each new edition will provide a more sophisticated, comprehensive and precise understanding of the challenges and opportunities for investors provided by the development AI in biopharma industry, as well as what businesses such as pharma corporations and private biotech companies need to do in order to benefit, rather than stagnate, from the strategies of these investors.

The results of the report can be applied for:

- Defining the best investment strategies for the investment in AI for Drug Discovery sector
- Defining the most prospective investment funds in the industry
- Predicting future dynamics and prospects of AI for Drug Discovery investors (in order to understand which funds to invest in)
- Complex analysis of the whole industry
- Identifying inefficient investment strategies

The parties who gain early access to this report will have deep expertise on how their strategic agendas can be optimized and stabilized in order to surpass the challenges and to utilize the opportunities related to these novel AI for Drug Discovery investment trends.

Deep Knowledge Group

DEEP KNOWLEDGE ANALYTICS

Deep Knowledge Analytics - the analytical arm of Deep Knowledge Ventures, specialising in forecasting on the convergence of technological megatrends, conducting special case studies and producing advanced industry analytical reports on the topics of Artificial Intelligence, DeepTech, GovTech, Blockchain, FinTech and Invest Tech.

DEEP KNOWLEDGE ANALYTICS *PHARMA DIVISION*

Deep Knowledge Analytics Pharma Division - the leading analytical entity specifically focused on deep intelligence of the pharma industry and the 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 Drug Discovery sector.

DEEP KNOWLEDGE VENTURES

Deep Knowledge Ventures - A data-science driven investment fund focused on the synergetic convergence of specific DeepTech verticals. Investment sectors include AI, Precision Medicine, Longevity, Blockchain and Invest Tech.

Enhanced Analysis of 25 Leading AI Companies

To get access to this specialized section of the analytical report please contact us by email pharma@dka.global

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Goal and Applications of the Analytical Report

This report aims to enhanced analysis of most promising AI-companies as the best investments targets for AI-Pharma Index Hedge Fund in order to enable investors, corporations and other industry participants to develop effective short and long-term strategies.

To understand development line of best companies applying AI in drug discovery, bioinformatics and biotechnology it is crucial to analyze their backgrounds, technical skill-sets, strengths, competencies and types of impact they have on the industry in general. Applying AI for Drug Discovery and cooperation with pharma AI companies may indicate the prospects for competitive advantage in the market and opportunities for further growth.
Particularly, analytical report estimates activities of 30 the most promising AI-companies as the best investments targets for AI-Pharma Hybrid Index Hedge Fund Also, the report is supplemented with a qualitative analysis and comparison of the best 25 companies.

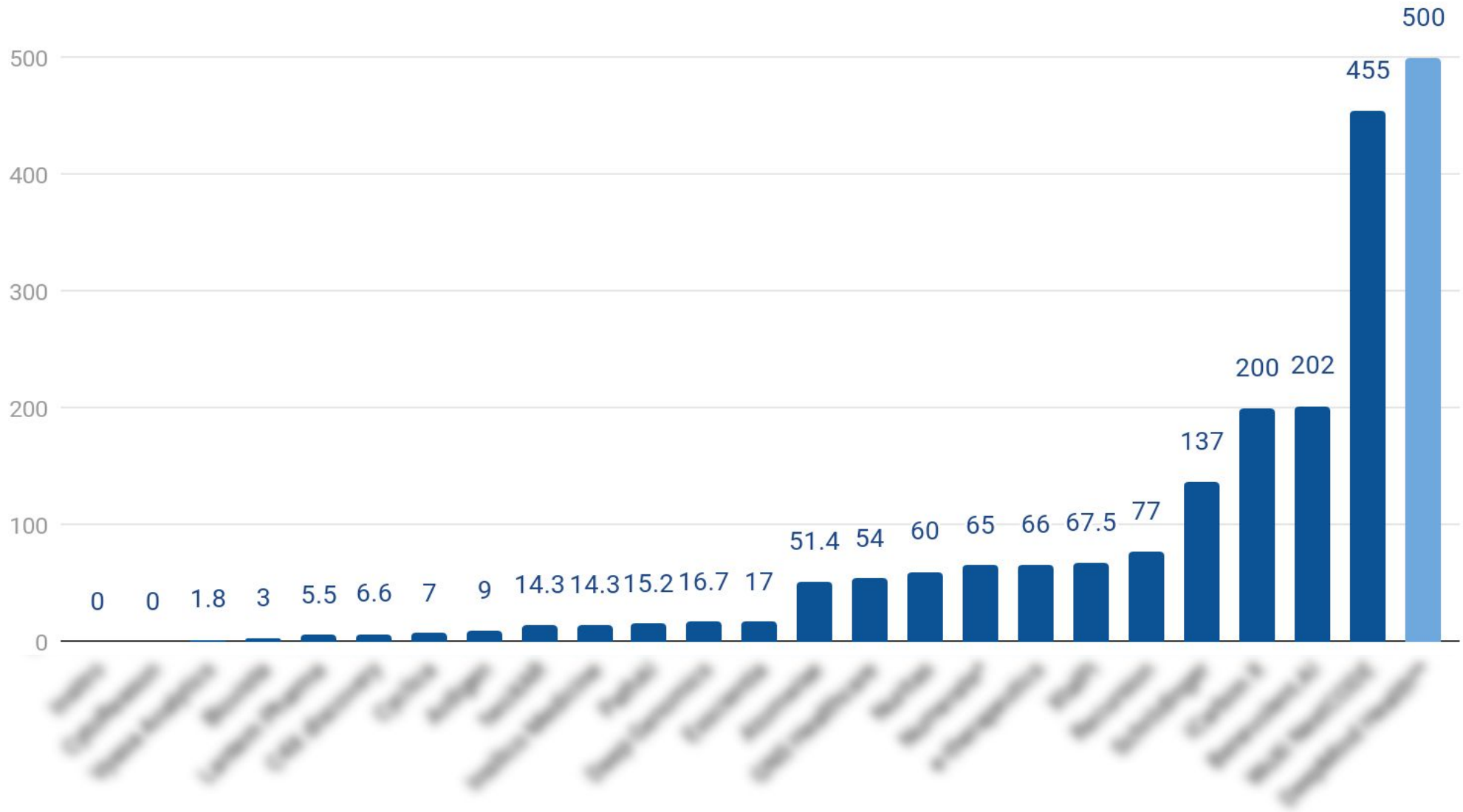
Key factors have combined to increase the capability of AI in particular: high number of AI-experts, cooperation with well-known companies,high level of funding, end-to-end clinical development, high publicity position, personalized medicine, use of unique technology.

The findings of the report can be used for:

- Developing the optimal portfolio for investing in AI for Drug Discovery, Bioinformatics and Biotechnology industry
- Gaining understanding of current pharma and tech markets opportunities and crucial threats
- Determining what has to be done in order to benefit from these tendencies and tackle particular issues.

The parties who gain early access to this report will have deep expertise on how their strategic agendas can be optimized and stabilized in order to benefit and choose the best attractive companies for investments in AI-Pharma industry.

Comparison of Top-25 AI for Drug Discovery Companies



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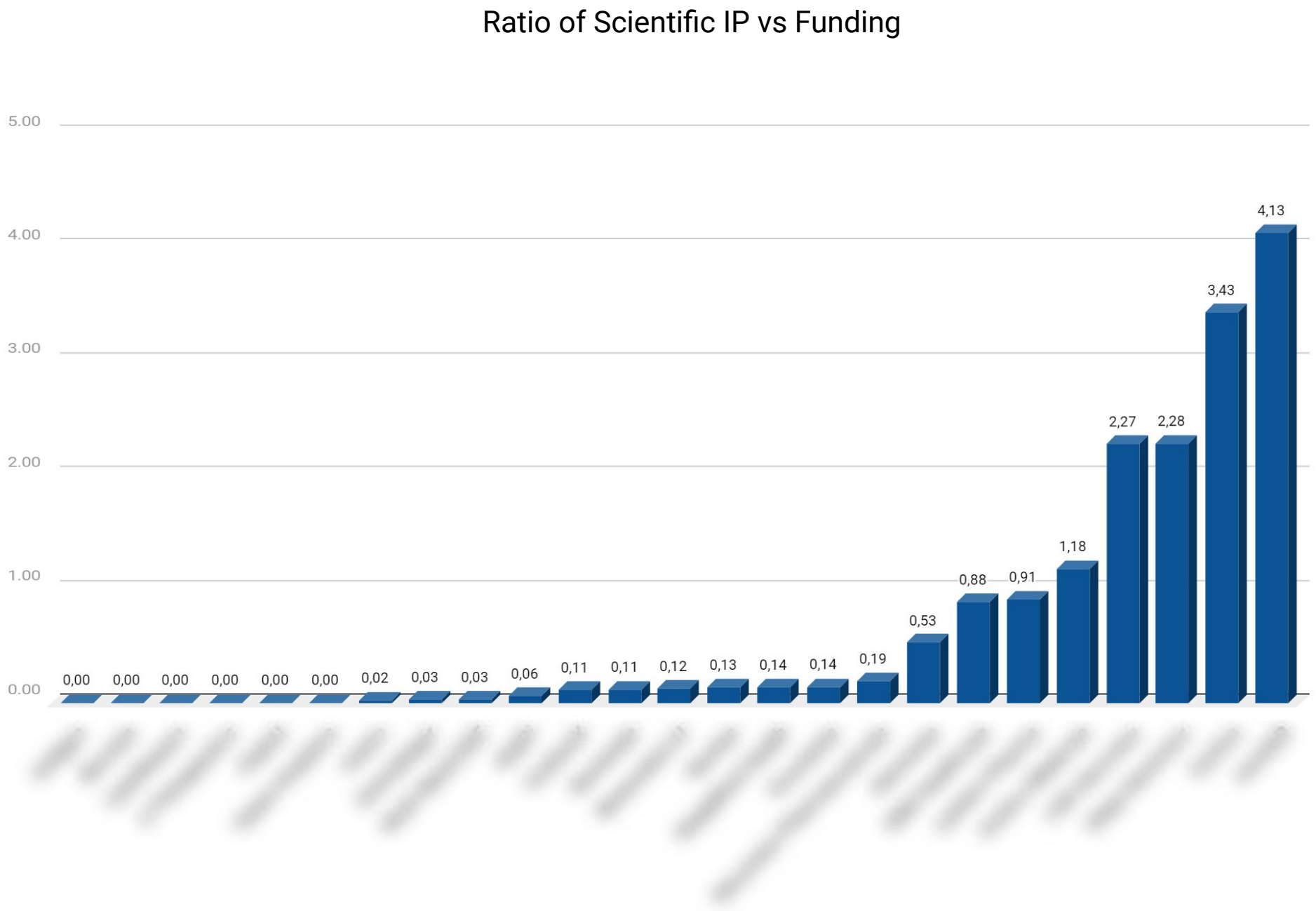

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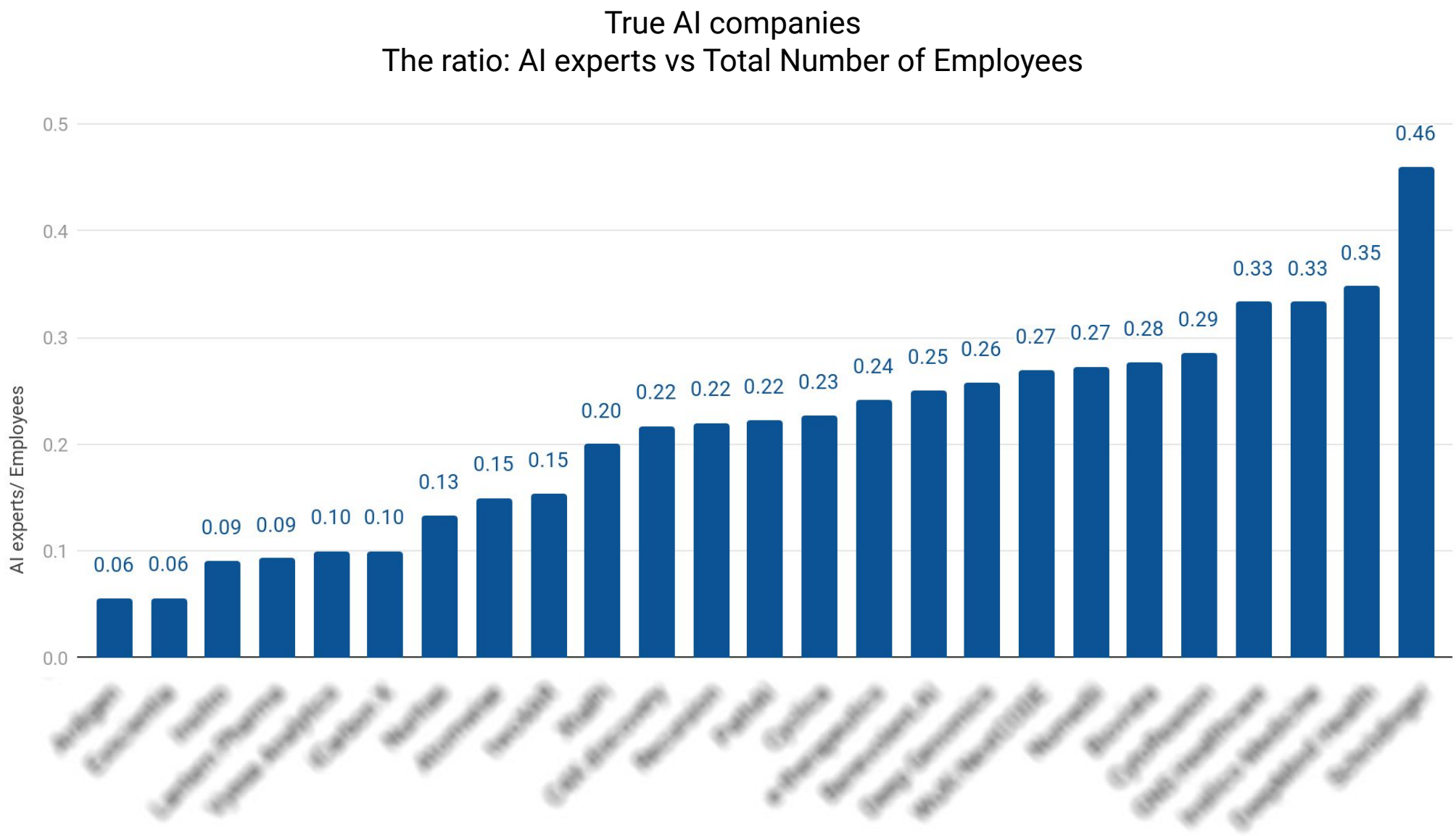

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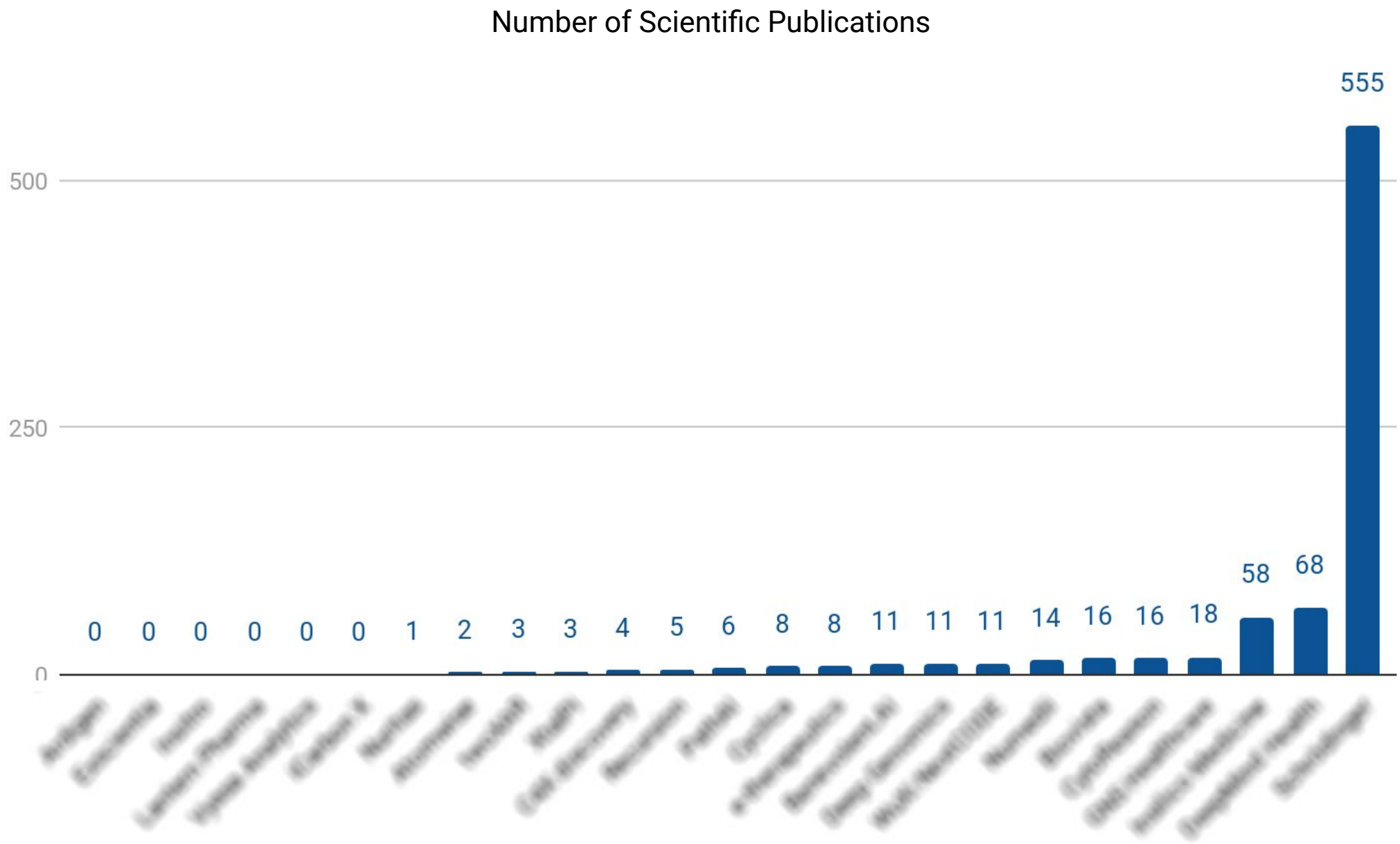

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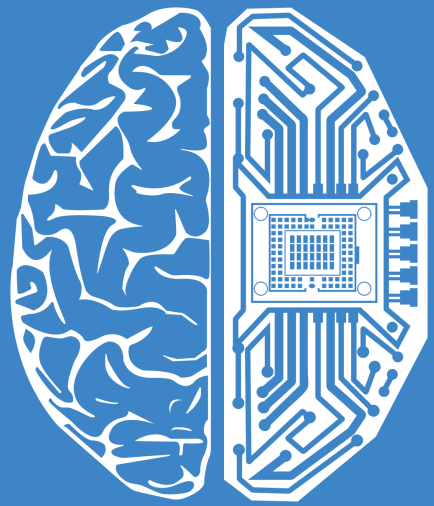

Link to the Report: https://www.ai-pharma.dka.global/quarter-2-2019

E-mail: pharma@dka.global | **Website: ai-pharma.dka.global**