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Cell Therapies in Healthcare Landscape Overview Q2 2021 (Stem Cells and CAR-Ts)

May 2021

DEEP PHARMA INTELLIGENCE

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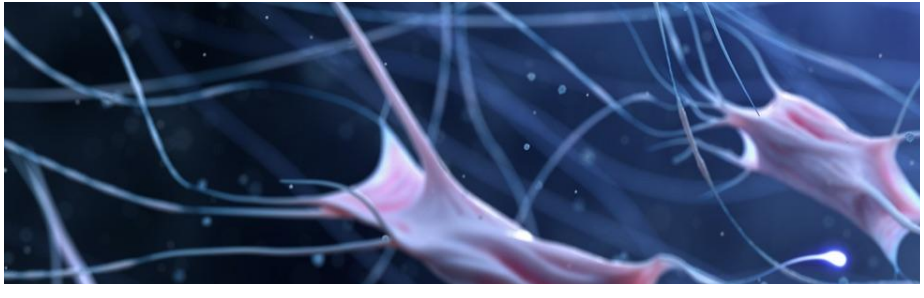

This 115-page report "**A Landscape of Cell Therapy Technologies in Healthcare 2021**" is the first systematic study of the cell therapy industry by Deep Pharma Intelligence, which serves as a landscape overview and a beginning of a series of reports and analytics studies related to the domain of cell therapies and regenerative medicine. This reports specifically focuses on Stem Cells and CAR-T therapies.

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

The reports is based on the online cloud-based analytics system (Dashboard), which incorporated the database of all entities featured in the report, and tens of thousands of data points about market trends, key developments, funding, deals, and more. While this report serves as an introduction into the industry, the underlying analytics system is updated on daily basis and can be a powerful tool for monitoring the fast-paced industry of stem cells, cell therapies, and regenerative medicine.
Alongside investment and business trends, the report also provides technical insights into some of the latest achievements in the stem cell research and practical medical and R&D applications.

Classification of Cell Therapy Companies by Industry Focus

Biotechnology - 370
Health care - 180
Medical - 140
Pharma - 90
Manufacturing, Device - 50
Biopharma - 30

Manufacturing, Device 12,3 %

Pharma 21,5%

Health care 46%

Biotechnology 92,8%

Medical 35,5%

Biopharma 8%

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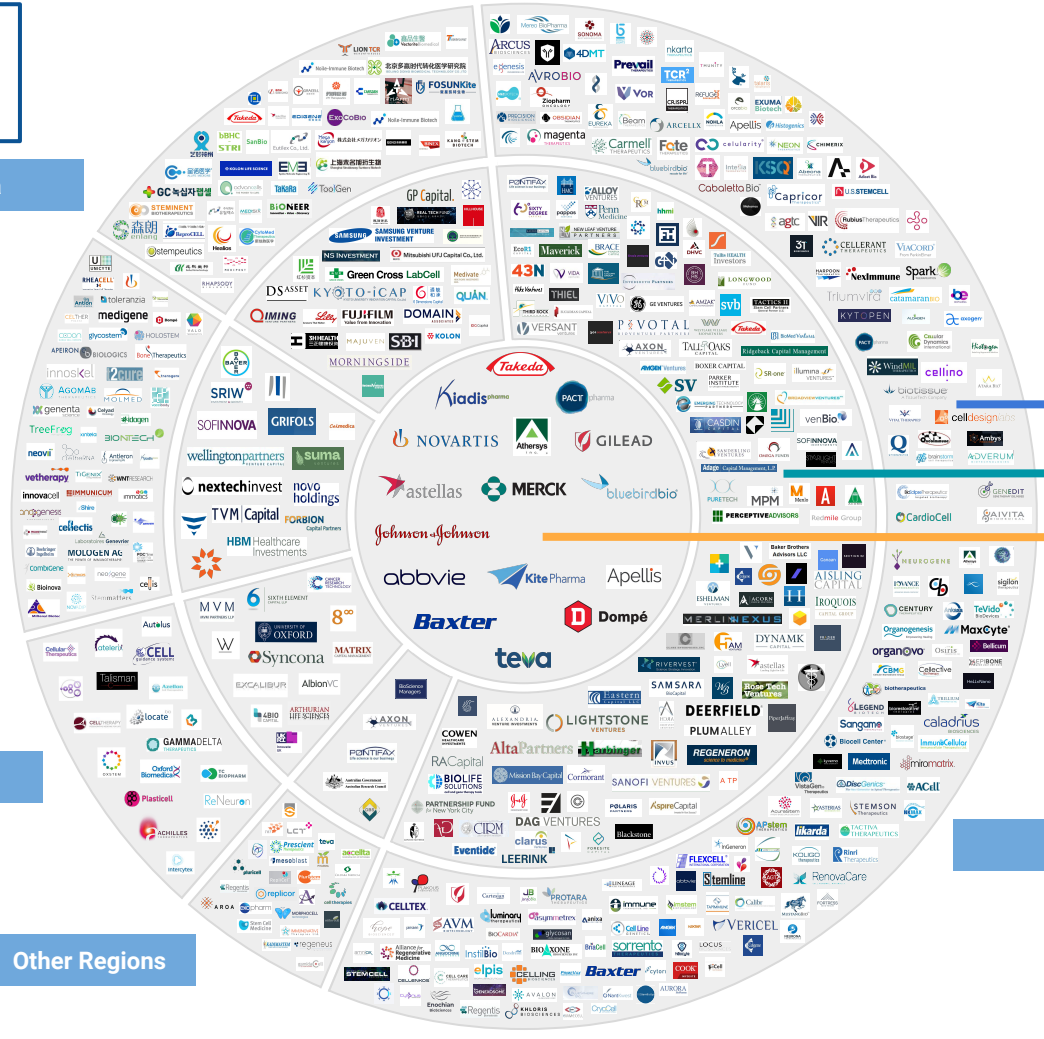
Cell Therapies In Healthcare Landscape Overview Q2 2021 (Stem Cells and CAR-T)

Companies - 400
Investors - 200
Corporations - 15



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Application of Cell Therapies in Pharma R&D and Medicine (Stem Cells and CAR-Ts)

Companies - 400

Cell Therapies

Gene Therapies

Stem Cell Products

Companies

Corporations

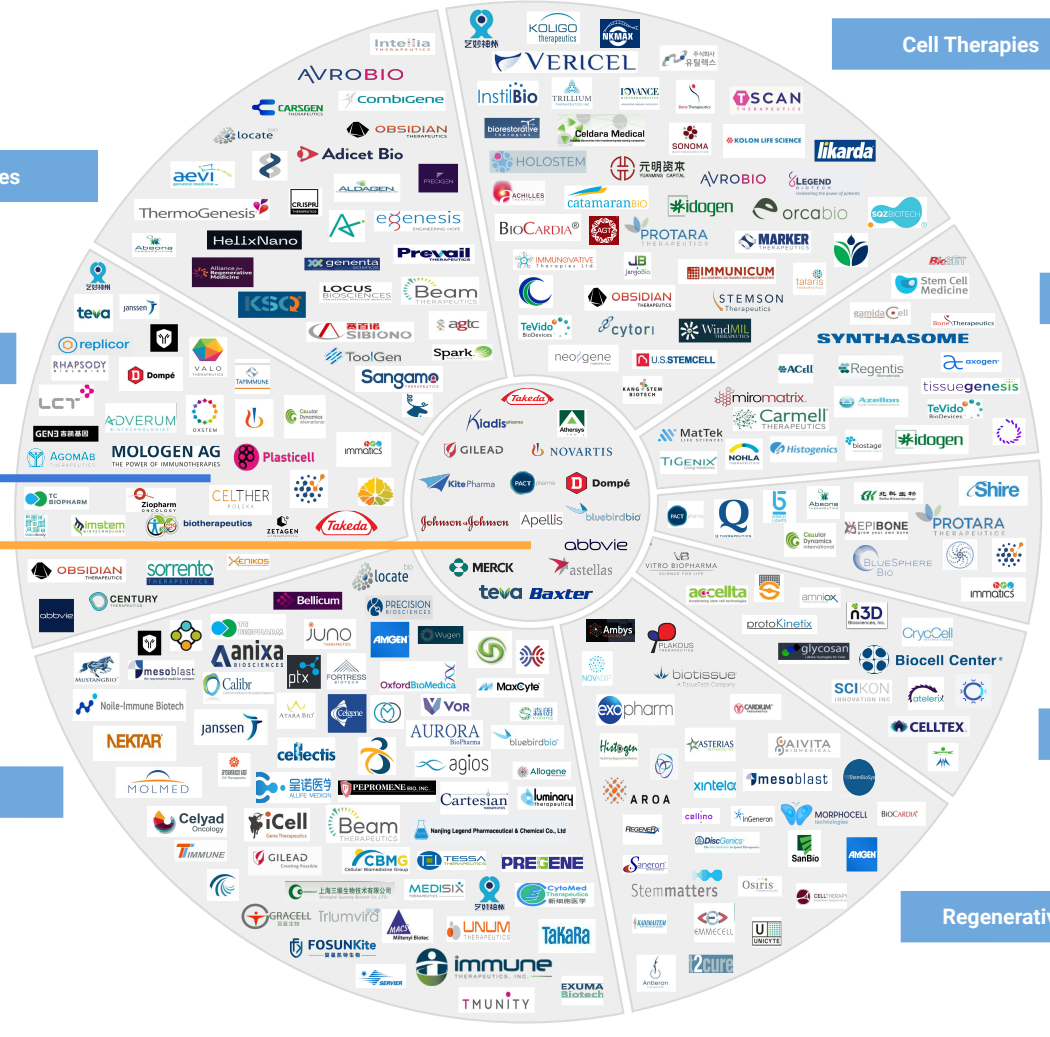
CAR-T Therapy

Tissue Reconstruction

Personalised Medicine

Storage/Cultivation

Regenerative Medicine



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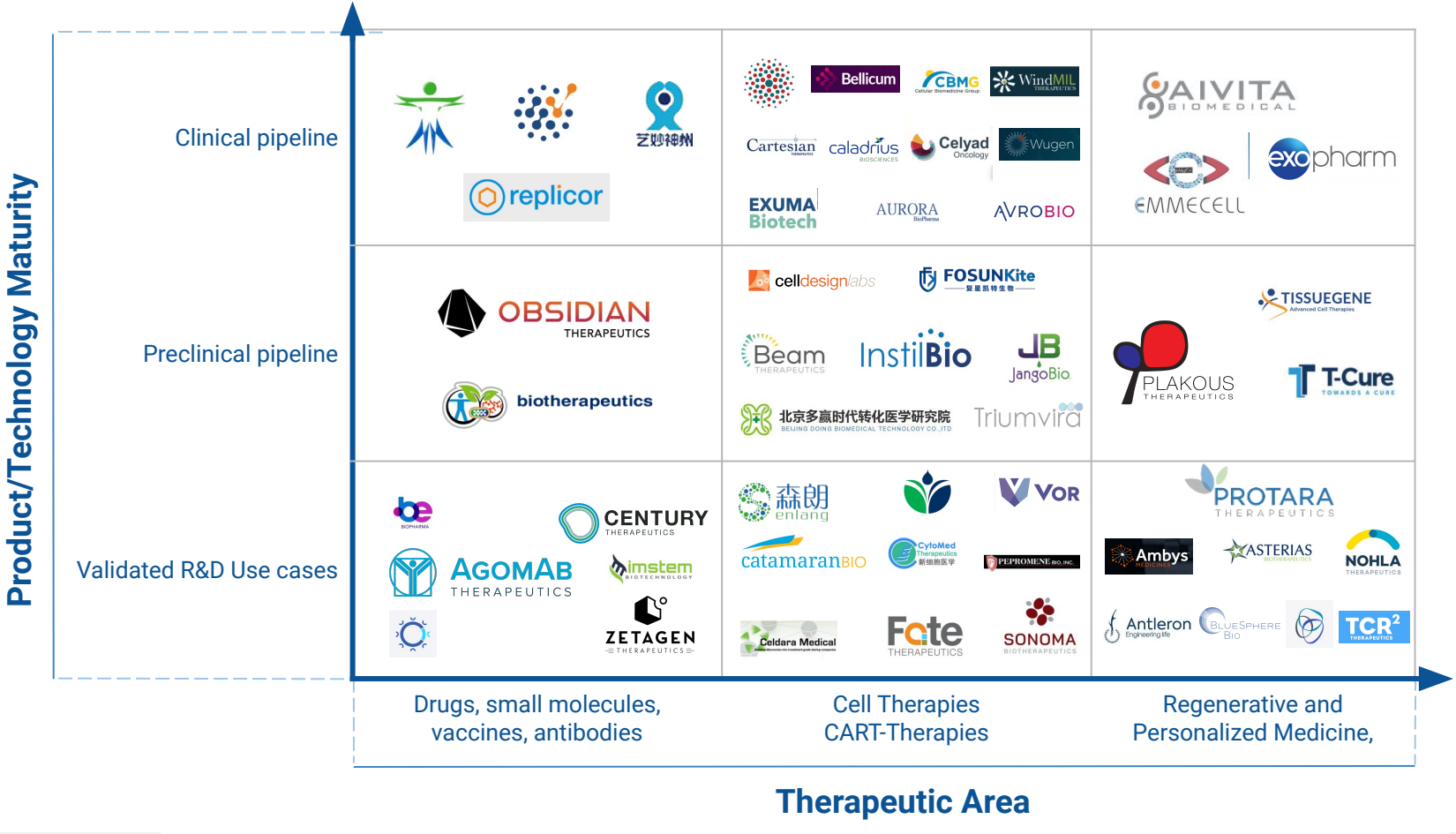
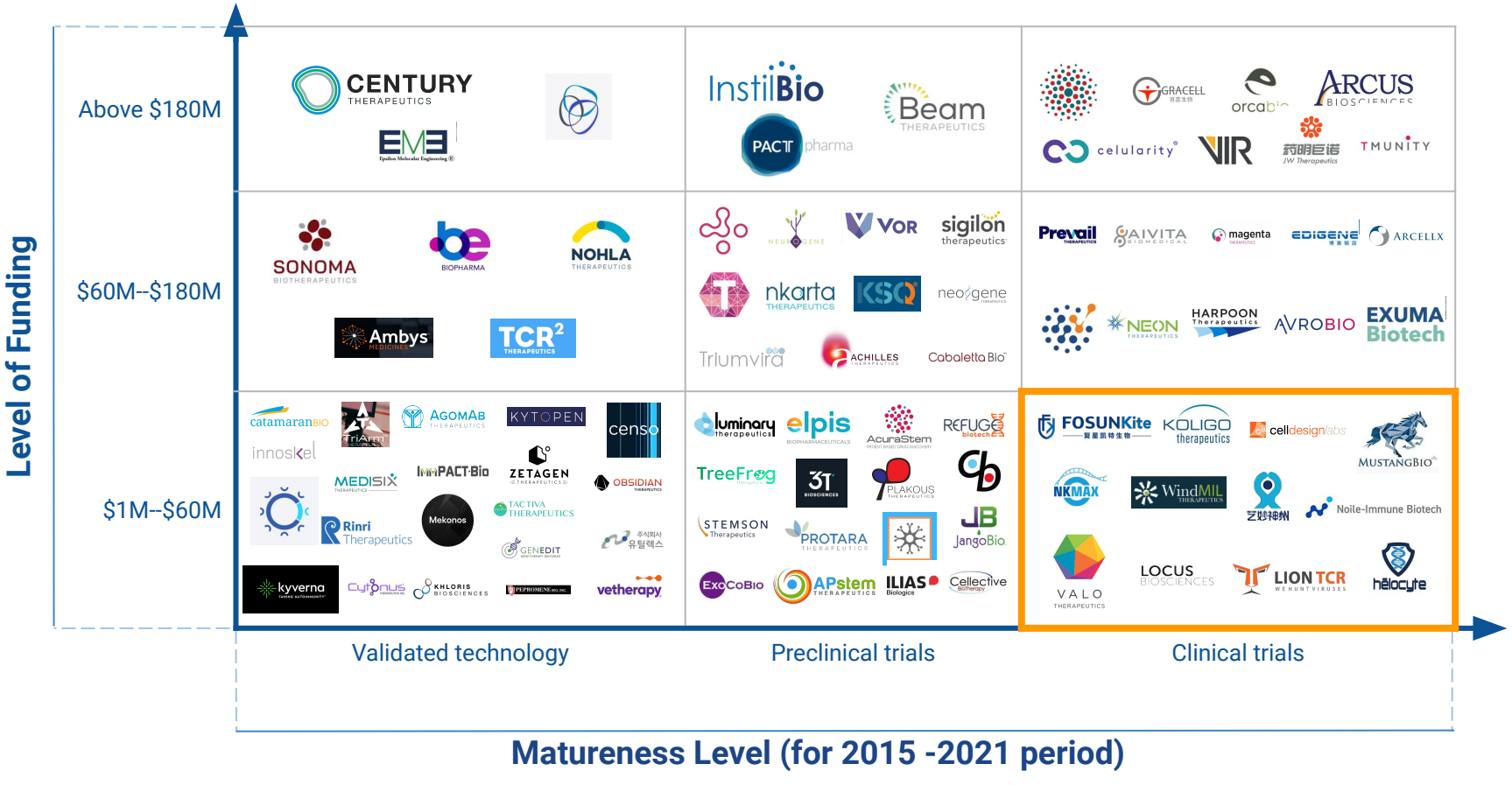
Analysis of Top 50 Cell Therapy Companies: R&D Maturity vs Application Focus



Comparison of Top 50 Cell Therapy Companies: R&D Maturity vs Funding Level



50 Leading Companies in Cell Therapy Industry

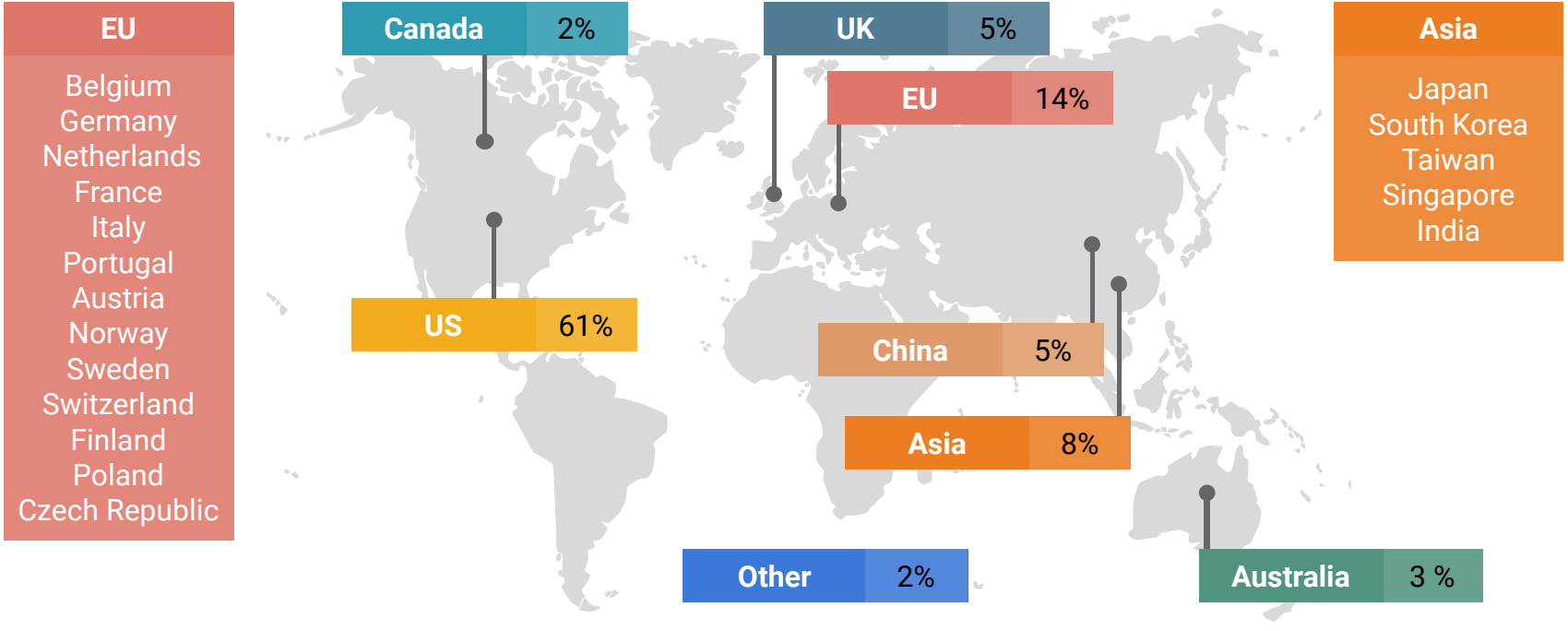
1	BioNTech
2	Nektar Therapeutics
3	Vir Biotechnology
4	Allogene Therapeutics
5	Precigen
6	Fate Therapeutics
7	Poseida Therapeutics
8	Juno Therapeutics (aq by Celgene)
9	Celularity
10	Autolus
11	Ziopharm oncology
12	CARsgen Therapeutics
13	Century Therapeutics
14	Adaptimmune Therapeutics
15	Rubius Therapeutics
16	ViaCyte
17	Tmunity Therapeutics
18	Vital Therapies
19	Mesoblast
20	BlueRock Therapeutics
21	Talaris Therapeutics
22	Berkeley Lights
23	Instil Bio
24	Gamida Cell
25	Orca Bio

50 Leading Companies in Cell Therapy Industry

26	JW Therapeutics	
27	Gracell Biotechnologies	
28	Cellectis	
29	Precision BioSciences	
30	Organogenesis	
31	TCR2	
32	ReNeuron Group	
33	SQZ Biotech	
34	Pluristem Therapeutics	
35	Eureka Therapeutics	
36	EdiGene	
37	Sangamo Therapeutics	
38	Cabaletta Bio	
39	Avrobio	
40	Applied Genetics Technologies Corporation	

41	Aspen Neuroscience	
42	BrainStorm Cell Therapeutics	
43	Mogrify	
44	Kadimastem	
45	EpiBone	
46	BriaCell Therapeutics	
47	Caladrius Biosciences	
48	Celgene Corporation	
49	ReproCELL	
50	Stem Cell Technologic	

Cell Therapy Companies: Regional Proportion



The US is still in the lead in terms of its proportion of cell therapy companies. Interestingly, Asia Pacific region currently has almost the same proportion of cell therapy companies as Europe. 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 cell therapy companies located in the Asia-Pacific region generally, and in China particularly.

Executive Summary

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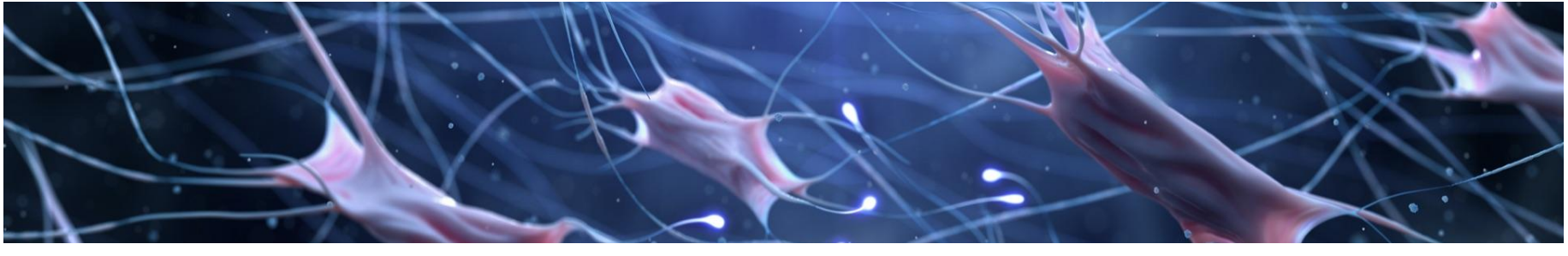
This Report at a Glance

This 115-page report **"Cell Therapies In Healthcare Landscape Overview 2021"** is the first in a series of reports on cell therapies and regenerative medicine, produced by Deep Pharma Intelligence to inform key decision makers about the industry, trends, opportunities, and challenges associated with this complex area, driven by transformative breakthroughs and technologies in biology and medicine.

The main aim of this series of reports is to provide a comprehensive overview of the industry landscape in what relates to the advent of stem cell-based technologies and protocols and CAR-T therapies in medicine, biotech, drug discovery, and basic research -- and understand the key players, in the industry, the industry's growth dynamics, the investment landscape, and economical and scientific drivers moving the industry forwards. This overview highlights trends and insights in a form of informative mind maps and infographics as well as performance benchmarks of key players that form the space and relations within the industry. This is an overview analysis to help the reader understand what is happening in the industry nowadays and possibly give an idea of what is coming next.

Along with information about **400** leading public and private biotech companies, using stem cells, CAR-T technologies, or their combinations, the report profiles the lists of **400** most active investors having sufficient involvement in the industry. Besides, the report provides an overview of practical application use cases of applying the technologies in various sub-sectors -- ranging from purely R&D focused, to industrial and commercial.

The companies are clustered and reviewed using our industry analytics framework, which is designed to provide strategic understanding of the industry, and uncover specific actionable insights for a wide variety of needs -- for clients from investment organizations, technology scouts, pharma and biotech industry executives, and specialized life science consulting agencies.



Report Value Proposition

1. Who are the leading companies actively developing and implementing in practice stem cells and CAR-T therapies? How is the industry segmented?
2. What is the dynamics of investment flow in the cell therapies industry? What are the leading investors and what companies they choose for their portfolios?
3. What innovations, technologies, and fundamental breakthroughs are driving the cell therapies industry? How has research in stem cells and CAR-T technologies been advancing over the last several years?
4. What are the practical application use cases of stem cells in medicine, biotech, and drug discovery?

Those above topics, along with other aspects, are covered in our 115-page report **"Cell Therapies In Healthcare Landscape Overview 2021".** This is the first edition of a series of report about cell therapies and regenerative medicine to be produced by Deep Pharma Intelligence in 2021-2022, and the first edition is specifically focused on stem cells and CAR-T therapies.

The parties who will have early access to this report will gain expertise about stem cells industry and the growing role of stem cells in CAR-T therapies – one of the most promising technologies in modern medicine. The parties will be able to navigate in the complex landscape, identify investment opportunities, collaboration partners, technology licensing opportunities, and gain general understanding of the landscape and forces driving this sector's growth.

Introduction

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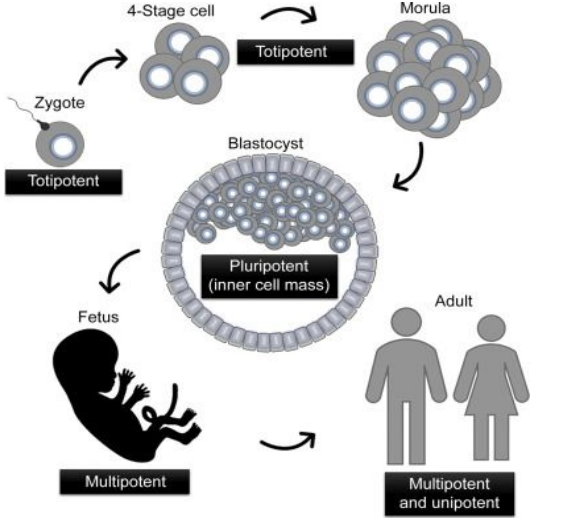
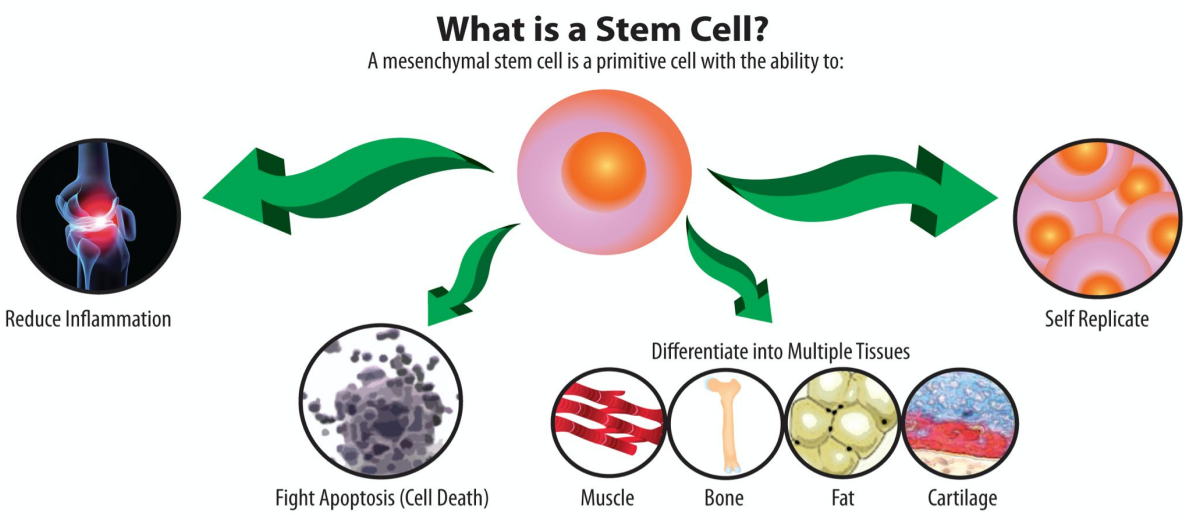
Stem Cells Introduction

Stem cells (SCs) are progenitors of all cell and tissue types in the body, they generate daughter somatic cells and have high potency for differentiation. Stem cells are able to activate different genetic patterns, it gives them the ability to produce a variety of daughter cells with many functions.

Gene activation potential, also called potency, separates stem cells in categories: totipotent (SCs that are able to differentiate into any type of other cells in an organism, e.g. – zygote), pluripotent (SCs that can produce intraembryonic cells, but not extraembryonic cells like those that form placenta), multipotent (SCs that can generate specific range of cells, e.g. – blood stem cells (hematopoietic) can produce erythrocytes, leukocytes, neutrophils etc.)





Photos: Bisturmed, Science Direct

Overview of Stem Cell Sources

Stem cells are unspecialized cells that can develop various functions and divide indefinite number of times. Many applications of stem cells are emerging – treatment of incurable diseases, regenerative and precision medicine, novel drug testing systems.

There are 5 main types of stem cells:

I. Embryonic Stem Cells (ESCs)
Harvested from human embryos three to five days old during *in vitro* fertilization procedures. ESCs carry higher differentiation potential than adult stem cells, however their origin is ethically controversial.

II. Adult Stem Cells
Harvested from adult tissues, mostly bone marrow **(hematopoietic SCs)** and fat **(adipose tissue-derived SCs, ADSCs)**. They have restricted ability to differentiate, but last studies showed that hematopoietic SCs can become bone or heart muscle cells, clinical studies show their therapeutic effect in neurological and cardiological disorders.

III. Induced Pluripotent Stem Cells (iPSCs)
Adult body cells genetically reprogrammed into stem cells with ESCs-like characteristics. For this discovery J. Gurdon and S. Yamanaka were awarded **2012 Nobel Prize for Physiology or Medicine**.

IV. Very Small Embryonic-Like Stem Cells (VSELs)
Present in various organs, primitive and small progenitors of adult stem cells. They are known for possible tumorigenic potential, yet, their ability to survive oncotherapy makes them promising candidates in cancer treatment.

V. Perinatal Stem Cells (PSCs)
Derived from umbilical cord blood, amniotic fluid, fetal membranes or placental tissue. Posses both characteristics of adult cells and ESCs. PSCs are used to treat in utero & pregnancy-related diseases, in regenerative medicine, for neural protection.

Discovery of iPSCs – Nobel Prize in 2012

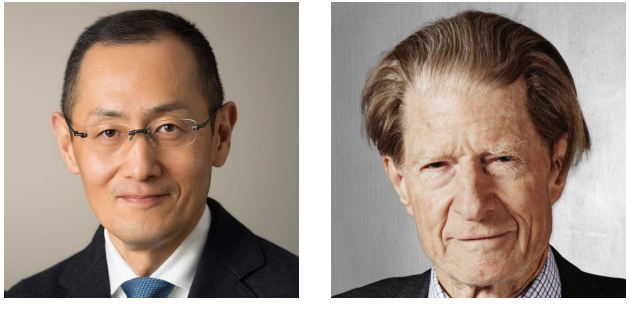
Induced pluripotent stem cells (iPSCs) are thought to be a revolutionary technology that opens a possibility to treat various conditions that have no treatment so far. iPSCs are obtained from somatic cells like lymphocytes, melanocytes, pancreatic β cells using Yamanaka factors – specific proteins that regulate genes transcription. iPSCs are an alternative to ESCs, however they are easily accessible and their origin has no ethical concerns. With help of different inducing factors they can become a source of multiple human cell types.

A few examples of iPSCs applications include:

First clinical studies in 2014 tested treatment of macular degeneration with iPSCs-derived retinal pigment epithelial cells, and reported that it **improved patients vision**.

Nowadays **more than 130 clinical trials** are identified where iPSCs are used, majority of which are aimed on ophthalmic and metabolic diseases, genetic syndromes, cardiovascular diseases, neurological and psychiatric disorders.

iPSCs-derived **3D organoids** have been used to model organs development, study diseases pathogenesis, test cell transplantation options.



2012 Nobel Laureates in Physiology or Medicine Dr. Shinya Yamanaka and Sir John B. Gurdon
"for the discovery that mature cells can be reprogrammed to become pluripotent"
Photos: The Royal Society, U. Montan

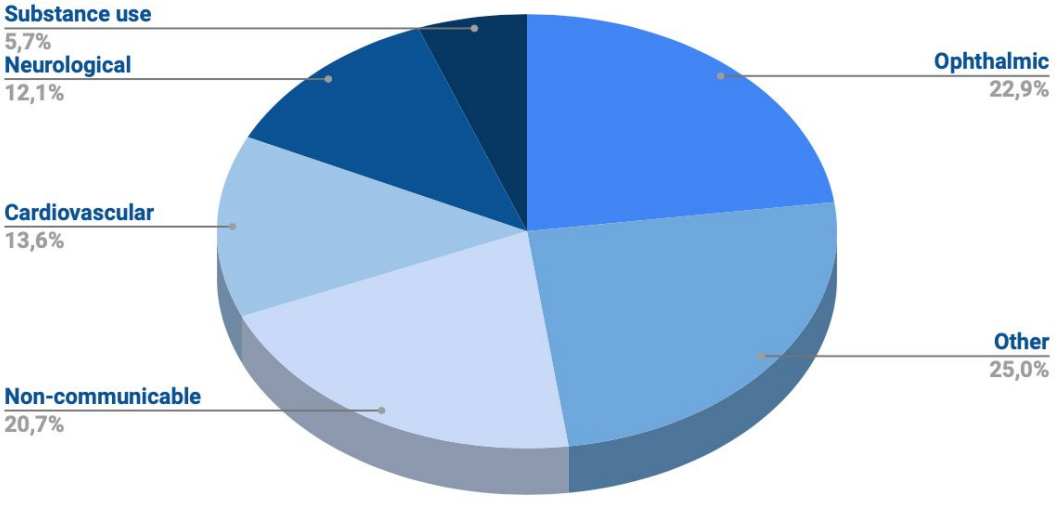
Clinical Trials Involving iPSCs by Disease Category in 2020

Non-communicable Diseases

- Otolaryngologic Diseases;
- Hematologic Disorders;
- Immune System Disorders;
- Reproductive & Urogenital Disorders;
- Genetic Syndromes;
- Metabolic Disorders.

Other Conditions

- Mental Disorders;
- Neoplasms;
- Diabetes & Kidney Diseases;
- Chronic Respiratory Diseases;
- Digestive Diseases;
- Musculoskeletal Disorders;
- Skin & Subcutaneous Disorders.



Total Number of Clinical Trials: 130

Source: Nature. Npj Regenerative Medicine

Cell Therapy-Related Technologies: Use of Stem Cells

Drug Research & Development

Stem cells-based banks are used to identify new drug targets, screen large compound libraries, test efficacy and safety of drugs; stem cells potential to divide numerous times and ability to reconstitute disease-specific phenotypes are used

Prochymal

The only approved in Canada stem cells therapy to treat graft-versus-host disease (GVHD); uses allogeneic mesenchymal stem cells derived from adult bone marrow; prochymal technology is also tested in Phase ⅔ for patients with Acute Respiratory Distress Syndrome

Stem cell-derived exosomes

Vesicles obtained from mesenchymal stem cells, that are developed as nanoscale drug carriers, have diagnostic applications (first diagnostic kit ExoDX Lung was approved by FDA in 2016), are used in tumor therapy, immunoregulation and cosmetics (ASCE+, stem cells exosomes-based product by ExoCoBio)

3D stem cell technologies & bioprinting

Use of stem cells as a source material for artificial organs printing and regenerative medicine

Hematopoietic stem cells transplantation

Transplantation of stem cells from bone marrow, blood or umbilical cord blood to treat blood or bone marrow cancers. Transplant can be autologous (patient's own stem cells), allogeneic (donor's cells) or syngeneic (identical twin's cells)

Toxicology tests

iPSCs are perfect *in vitro* models for developmental toxicity assays, reprogramming of iPSCs into adult body cells is used to obtain cultures for all other types of toxicity tests, especially for those tissues that are hard and to harvest from people (e.g. neurons)

Source: istockphoto.com

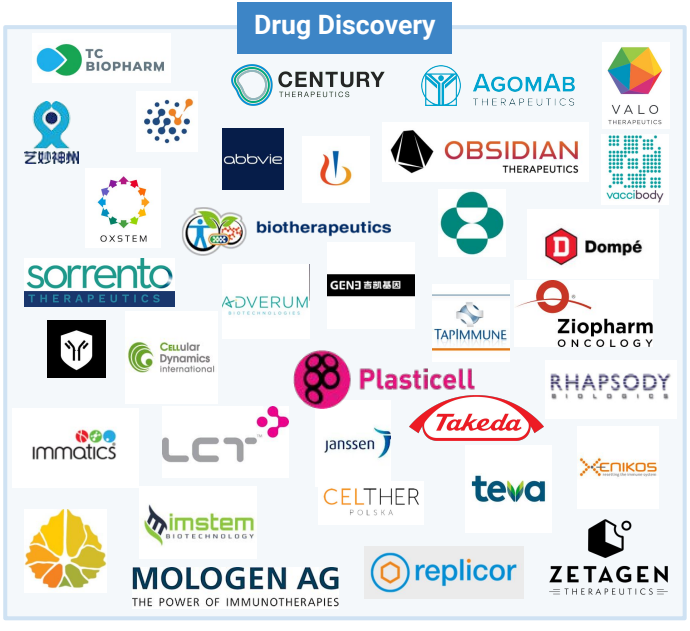
Application of Cell Therapies (Stem Cells and CAR-T) in Pharma R&D and Medicine

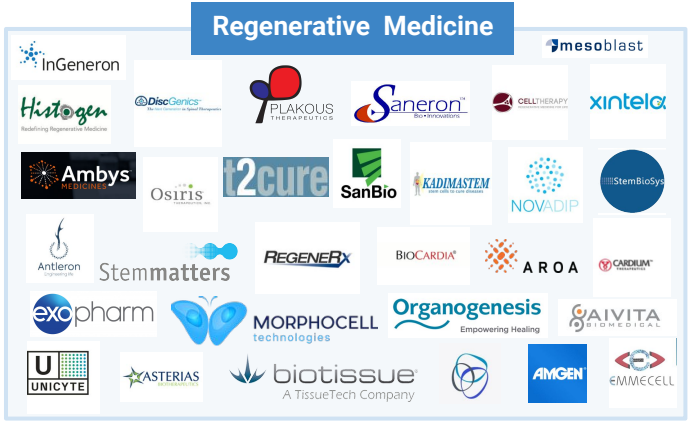
CAR-T Therapies

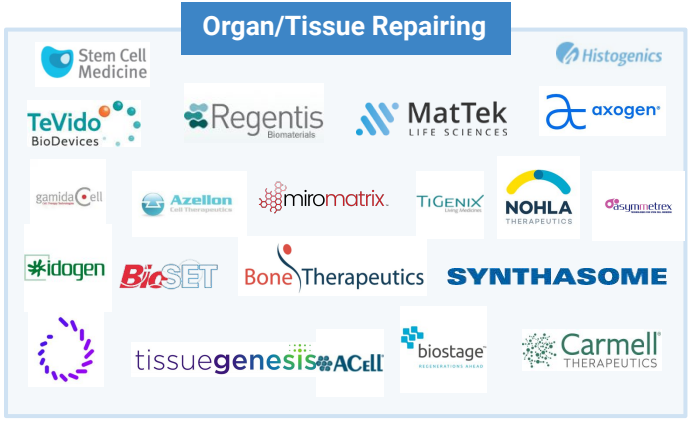
Cell/Cellular Therapies

Gene Therapies/Editing

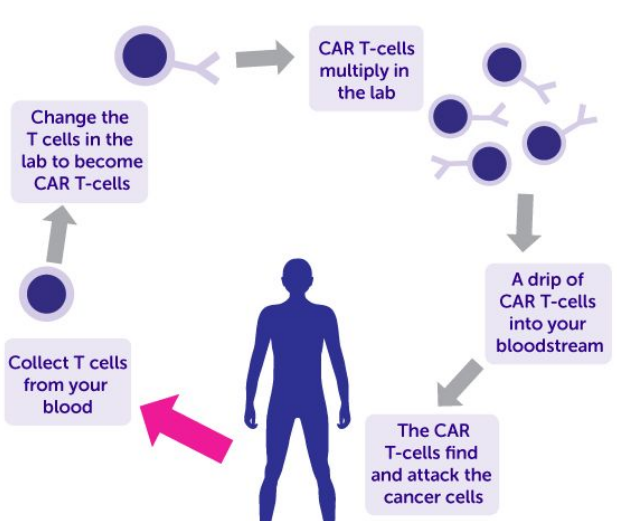
Application of Cell Therapies (Stem Cells and CAR-T) in Pharma R&D and Medicine

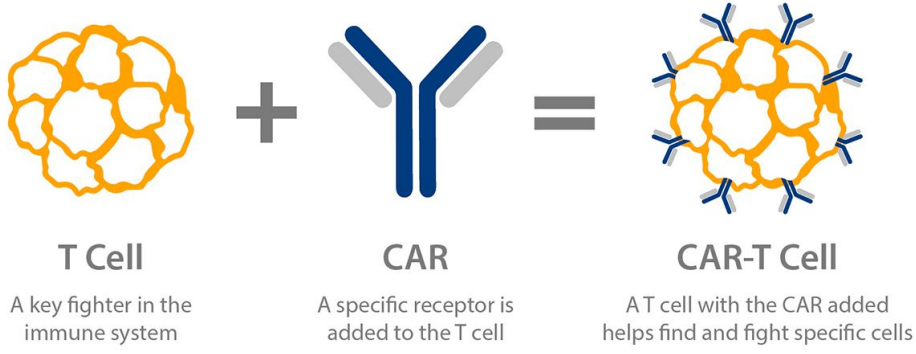






CAR-T Technology and Stem Cells Application in Immunotherapy





Chimeric Antigen Receptors (CARs) are artificially engineered receptors that give human T cells ability to recognize specific targets, e.g. cancer cells. In addition to target-recognizing characteristics CARs activate T cell cytotoxicity – ability to destroy aims via different methods like expression of soluble factors. To perform this procedure, patient's T cells are harvested from the blood, transformed in the laboratory setting to express CARs and infused back to a patient.

Due to the complexity of T cells collection in some groups of patients, immunoreactive answer to allogeneic CAR-T transplantants, latest developments propose to use patients autologous SCs and induce them into T cells with following genetic modifications. This approach potentially improves efficiency of CAR-T therapy in patients with low leukocyte levels and reduces rejection reactions like graft-vs-host disease.

Photos: Cancer Research UK, CrownBio's Oncology Blog

Cell Therapy-Related Technologies: CAR-T

Chimeric antigen receptor (CAR)-engineered T cells **(CAR-T cells)** are genetically engineered T leukocytes that can target specific proteins on the cell surface and destroy recognized cells. CAR-T cell therapies are efficient to treat various cancers, ranging from solid tumors to leukemias. CAR-T cell therapy was approved by FDA in 2017 and since then 5 types of CAR-T are used in medicine.

Procedure starts with harvesting of T cells from patient's own blood (**autologous**) or another healthy donor blood (**allogeneic**) that follows by insertion of genes of receptors located on cancer cell surface. It is crucial to use cancer cell antigens that are not present on somatic (body) cells to prevent autoimmune reaction. Genetically altered T cells are injected back to a patient, when they meet targeted tumors they start to divide and become cytotoxic – express factors that kill cancer cells.

CAR-T cell	Brand name	Company	Targeted disease
Tisagenlecleucel	Kymriah	Novartis	B-cell acute lymphoblastic leukemia(ALL), Diffuse Large B-cell lymphoma (DLBCL)
Axicabtagene Ciloleucel	Yescarta	Kite Pharma / Gilead	DLBCL, Follicular lymphoma
Brexucabtagene Autoleucel	Tecartus	Kite Pharma / Gilead	Mantle Cell Lymphoma(MCL)
Lisocabtagene Maraleucel	Breyanzi	Juno Therapeutics / BMS	DLBCL
Idecabtagene Vicleucel	Abecma	Bluebird Bio / BMS	Multiple myeloma

Source: Wikipedia

FDA Approved Stem Cell & CAR-T Therapies

Company	Cell Therapy Name	Indication	Year of Initial US Approval	Type of Cell Therapy
Bristol Myers Squibb	Lisocabtagene maraleucel	Relapsed or refractory large B-cell lymphoma	2021	CAR-T
Kite Pharma	Tecartus (brexucabtagene autoleucel)	Relapsed or refractory mantle cell lymphoma	2020	CAR-T
Novartis	Kymriah (tisagenlecleucel)	Acute lymphoblastic leukemia	2017	CAR-T
Kite Pharma	Yescarta (axicabtagene ciloleucel)	Non-Hodgkin lymphoma	2017	CAR-T
SSM Cardinal Glennon Children's Medical Center	Allocord (Hpc, Cord Blood)	Hematopoietic disorders	2012	Stem Cell Therapy
Cleveland Cord Blood Center	Clevecord (Hpc Cord Blood)	Hematopoietic disorders	2016	Stem Cell Therapy
Duke University School of Medicine	Ducord (Hpc Cord Blood)	Hematopoietic disorders	2012	Stem Cell Therapy
Organogenesis Incorporated	Gintuit	Mucogingival conditions	2012	Stem Cell Therapy
New York Blood Center, Inc	Hemacord	Hematopoietic disorders	2019	Stem Cell Therapy
Clinimmune Labs, University of Colorado Cord Blood Bank	HPC, Cord Blood	Hematopoietic disorders	2012	Stem Cell Therapy

FDA Approved Stem Cell & CAR-T Therapies

Company	Cell Therapy Name	Indication	Year of Initial US Approval	Type of Cell Therapy
Md Anderson Cord Blood Bank	Hpc, Cord Blood – Md Anderson Cord Blood Bank	Hematopoietic Disorders	2018	Stem Cell Therapy
Lifesouth Community Blood Centers, Inc.	Hpc, Cord Blood–lifesouth Community Blood Centers, Inc	Hematopoietic Disorders	2013	Stem Cell Therapy
Bloodworks	Hpc, Cord Blood – Bloodworks	Hematopoietic Disorders	2016	Stem Cell Therapy
Biovex, Subsidiary Of Amgen	Imlygic (Talimogene Laherparepvec)	Melanoma	2015	Stem Cell Therapy
Fibrocall Technologies	Laviv (Azficel-t)	Nasolabial Fold Wrinkles	2011	Stem Cell Therapy
Spark Therapeutics	Luxturna	Leber Congenital Amaurosis	2017	Stem Cell Therapy
Vericel	Maci (Autologous Cultured Chondrocytes On A Porcine Collagen Membrane)	Cartilage Injuries	2019	Stem Cell Therapy
Dendreon Corp	Provenge (Sipuleucel-t)	Prostate Cancer	2010	Stem Cell Therapy
Avexis	Zolgensma (Onasemnogene Abeparvovec-xioi)	Spinal Muscular Atrophy	2019	Stem Cell Therapy

Stem Cell Therapies: Outlook

Product Outlook

- Adult Stem Cells
  - Neuronal
  - Hematopoietic
  - Mesenchymal
  - Umbilical
  - Dental
  - Adipose-derived
  - Dedifferentiated fat cells (DFAT)
- Human Embryonic Cells
- Induced Pluripotent Stem Cells
- Very Small Embryonic Like Stem Cells
- Perinatal Stem Cells
- Other Product Types

Regional Outlook

- North America
- Europe
- Asia Pacific
- Latin America
- Middle East & Africa
- Australia

Therapy Outlook

- Allogeneic Stem Cells
- Autologic Stem Cells
- Syngeneic Stem Cells

Technology Outlook

- Cell Production
  - Therapeutic Cloning
  - In-vitro Fertilization
  - Cell culture
  - Isolation
- Cell Acquisition
  - Bone Marrow Harvest
  - Umbilical Blood Cell
  - Apheresis
- Cryopreservation
- Expansion and Sub-Culture

Application Outlook

- Regenerative medicine
  - Neurology
  - Orthopedics
  - Oncology
  - Hematology
  - Cardiovascular
  - Injures
  - Diabetes
  - Liver disorder
- Drug discovery and Development

Cell Therapy Industry at a Glance (Stem Cells and CAR-T)

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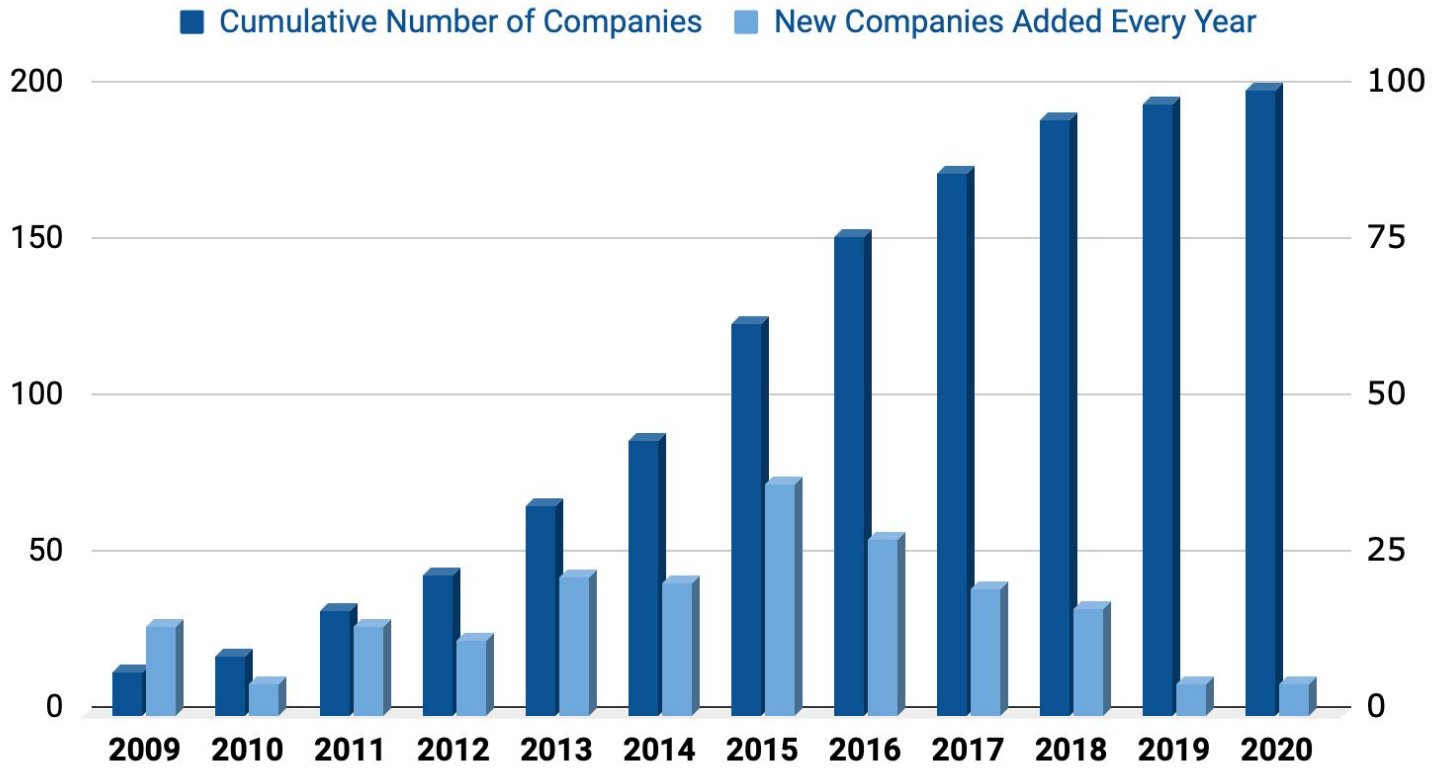
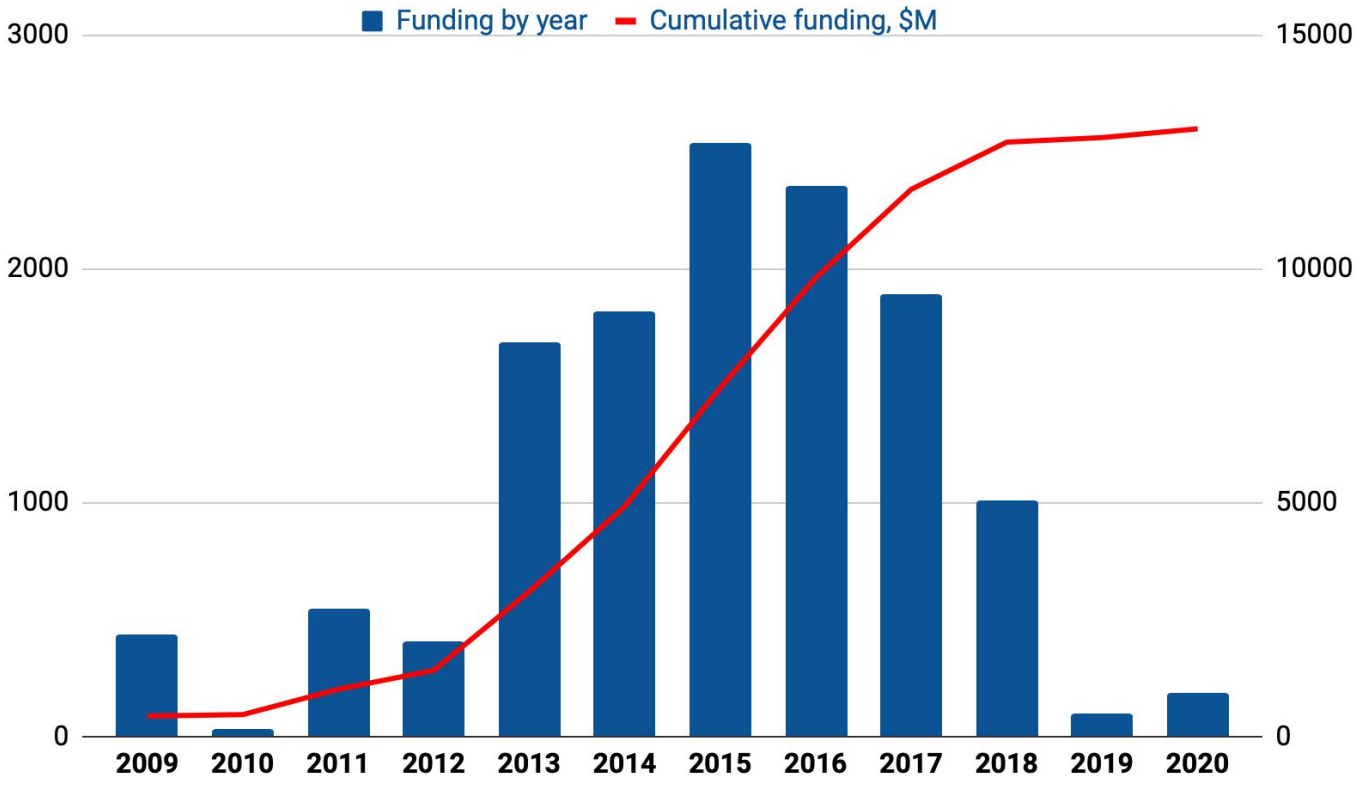
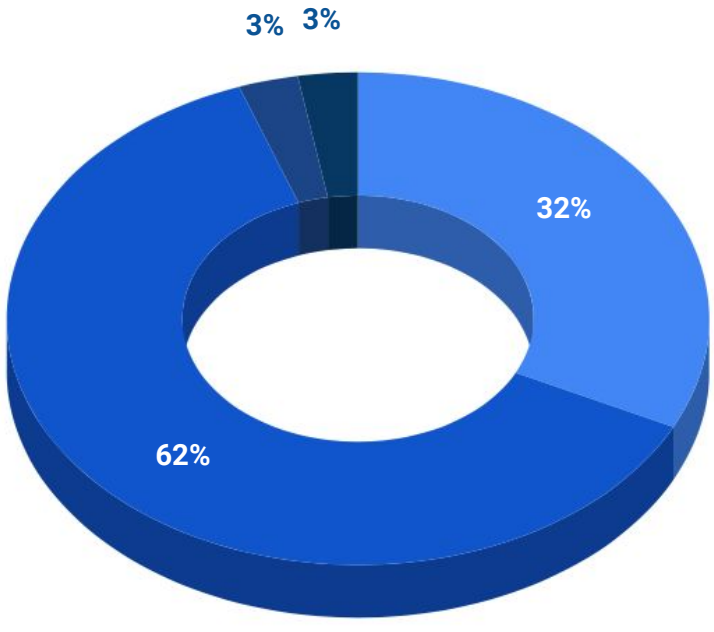
Growths of Cell Therapy Industry by Number of Companies



Cell Therapy Companies Funding in 2009 — 2020



Public Vs Private Cell Therapy Companies



- Public Companies – 130
- Private Companies – 250
- Delisted Companies – 10
- No Information – 10

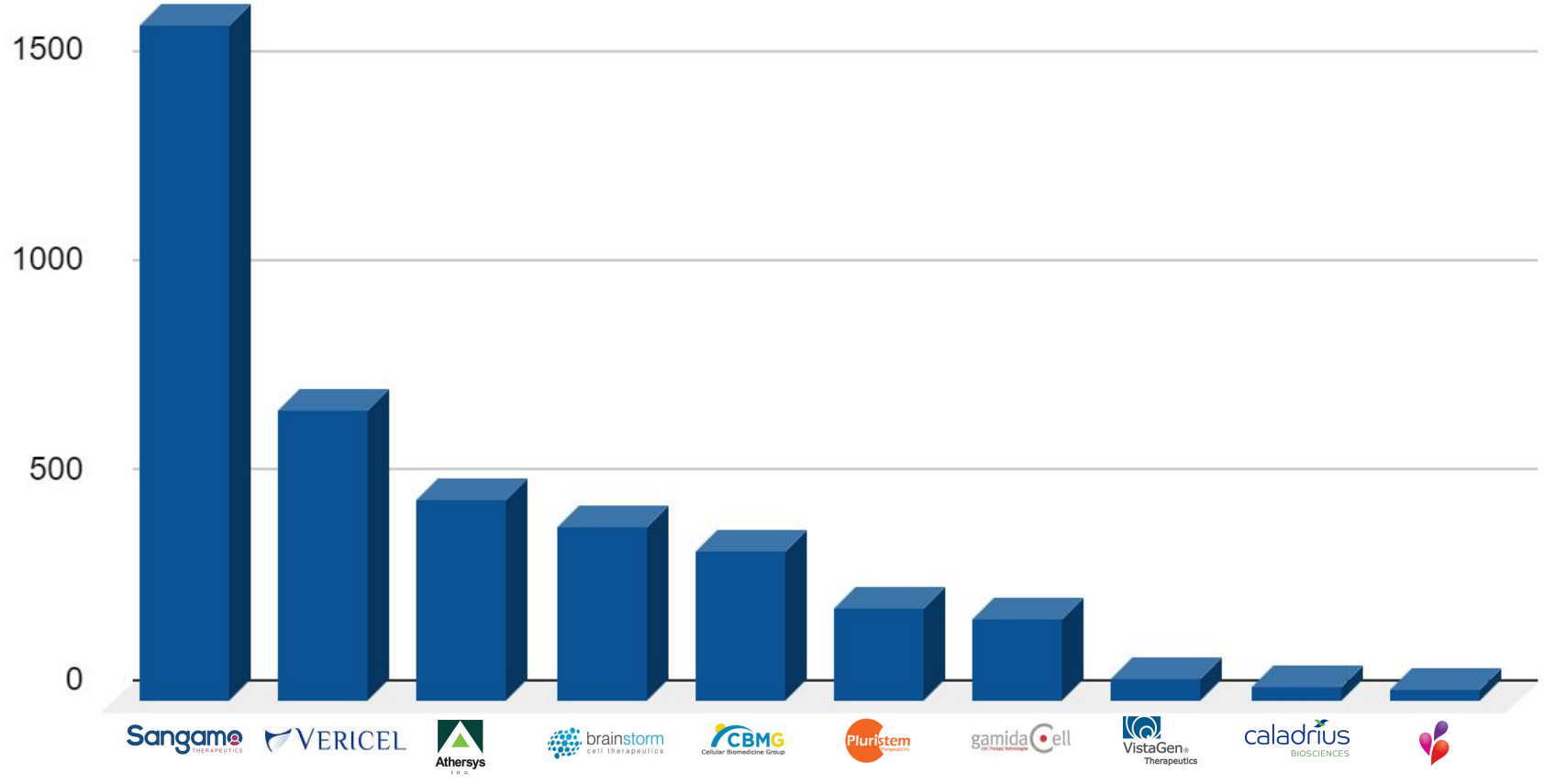
5 Notable Public Companies

- ExoCoBio
- Allogene Therapeutics
- Fate Therapeutics
- bluebird bio
- Neon Therapeutics

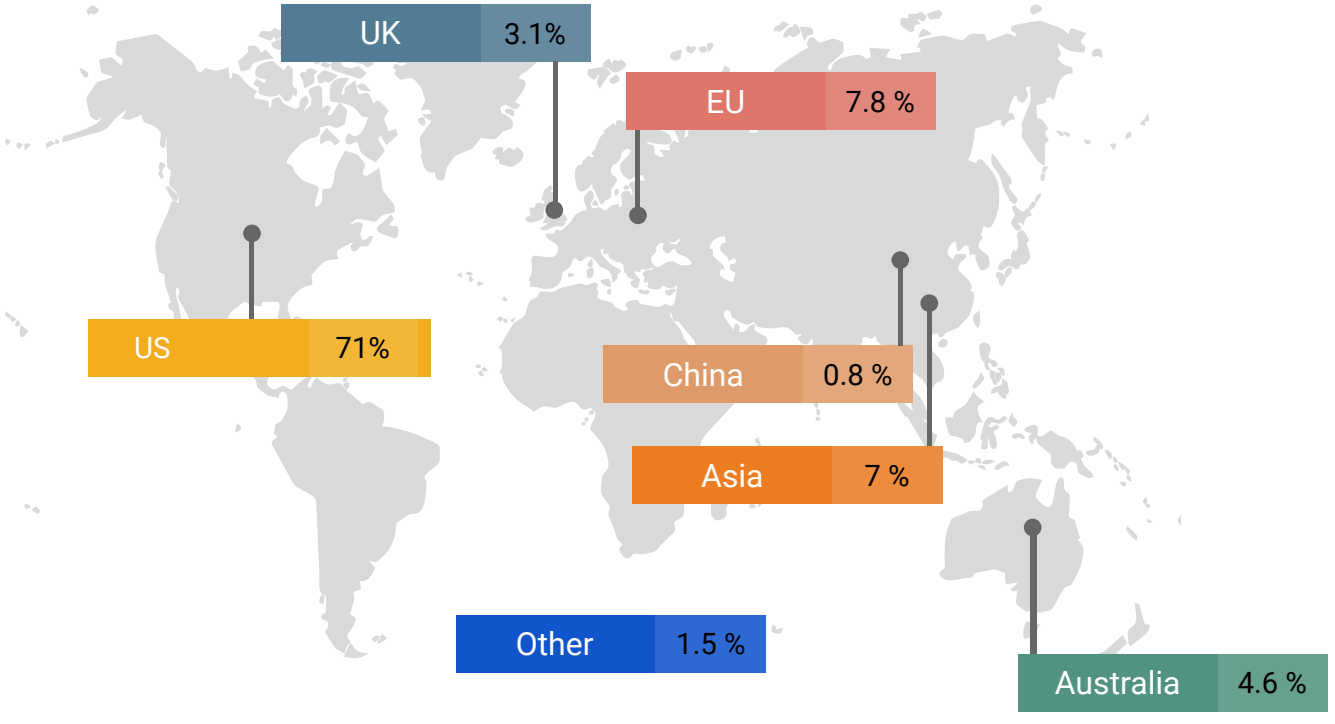
5 Notable Private Companies

- BioNTech
- CARsgen Therapeutics
- Tmunity Therapeutics
- eGenesis
- Obsidian Therapeutics

Market Cap of Public Cell Therapy Companies in Million US$ (NASDAQ)



Public Cell Therapy Companies: Regional proportion



The US is still in the lead in investments of its proportion of cell therapy companies. Interestingly, Asia Pacific region also had 15% of investments into cell therapy 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),

20 New Players in Cell Therapy Industry (2018 - 2020)

2020	Be Biopharma	2018	Ambys Medicines
2020	BlueSphere Bio	2018	Bioinova
2020	Catamaran Bio	2018	Century Therapeutics
2020	Innoskel	2018	CytoMed Therapeutics Pte Ltd
2020	Sonoma BioTherapeutics	2018	Cytonus Therapeutics
2019	Antleron	2018	Emmecell
2019	Arsenal Biosciences	2018	Instil Bio
2019	Artiva Biotherapeutics	2018	Kyverna Therapeutics
2019	Cellares	2018	Medisix Therapeutics Pte Ltd
2019	Luminary Therapeutics	2018	Neogene Therapeutics

Cell Therapies: Funding Timeline

Company	Funding, M $	Series	Year
Autolus	173	A, B, C	2017
BioNTech	270	A	2018
Celularity, Inc.	250	A	
JW Therapeutics	90	A	
Allogene Therapeutics	411	A	
Medisix Therapeutics	20	A	
Precision BioSciences	110	B	
BioNTech	250	B	2019
Immunochina	900	C	
Autolus	100	Post-IPO	
Poseida Therapeutics	142	C	

Cell Therapies: Funding Timeline

Company	Funding, M $	Series	Year
Hrain Biotechnology	31	B	2019
Tmunity Therapeutics	75	B	
Legend Biotech	150	A	2020
Poseida Therapeutics	110	D	
Gracell Biotechnologies	100	C	
CARsgen Therapeutics	186	C	
JW Therapeutics	300	IPO	
Edigene	62	B	2021
Chimeric Therapeutics	35	A	
Immunochina	20	C	

Cell Therapies: Collaborations & Acquisitions Timeline

COLLABORATIONS

COMPANY	M $	YEAR
BioAlta LLC/F1 Oncology, Inc.	50	2017
Bluebird Bio, Inc/ TC BioPharm, Ltd.	16	
Cellular Biomedicine Group/Novartis	40	2018
Astellas/Adaptimmune	57.5	2020
Cellectis/Servier	437.6	
Fate Therapeutics/ Janssen Biotech	100	
Bristol-Myers Squibb/ bluebird Bio	200	
Bayer/Atara Biotherapeutics	670	
AbbVie/Caribou Biosciences	340	2021

ACQUISITIONS

COMPANY	M $	YEAR
Gilead Sciences/Kite Pharma	11900	2017
Gilead Sciences/Cell Design Labs	567	
Celgene Corp./Juno Therapeutics	9000	2018
Bristol-Myers Squibb/Celgene	74000	2019
Astellas Pharma/Xyphos	655	2020

Industry Developments 2018 - 2021

FEB 2018

Teva Pharmaceutical Industries' stock price increased by more than 7% after Warren Buffet's firm, **Berkshire Hathaway**, disclosed that it spent $358 million to purchase 19 million shares in the drug company, representing 2% of Teva's outstanding shares.

MAR 2018

SanBio and **Hitachi Chemical** have reached an agreement to manufacture SB623, **SanBio's** regenerative medicine product. Under the terms of the agreement, **Hitachi Chemical's** global facilities will be used to manufacture late-stage clinical products and commercial products of SB623 for the US and Japanese markets.

MAY 2018

Xenikos, a clinical-stage biopharmaceutical company developing a novel therapy for the treatment of aGVHD, has announced a $30 million Series B financing. The financing round included two new investors in the Company, **Medicxi** and **RA Capital Management**.

OCT 2018

Kadimastem, an Israeli biotech firm, raised $5.15 million in a private placement. The **Altshuler Shaham Investment House** ($2.5 million) participated in the round, increasing its stake in the company to approximately 20%.

Industry Developments 2018 - 2021

JAN 2019 – **Immunochina Pharmaceuticals**, a cell therapy company based in Beijing, China, has completed its 140 million RMB Series C financing (approximately $20.4 million). Financing was led by Chinese and international investors, including **Shougang Fund** and **Sherpa Venture Capital**.

APR 2019 – A biotech company **Transgene**, that designs and develops virus-based immunotherapies for cancer and infectious diseases, has secured a €20 million revolving credit facility from **Natixis**, a French Corporate and Investment bank.

– **Roivant**, **Sinovant** and **MediGene** form **Cytovant Sciences** to develop cellular therapies in East Asia. **MediGene** received a $10 million upfront payment, as well as potential development, regulatory, and commercial milestones and low double-digit royalties.

JUN 2019 – **PluriCell** has received an angel investment of US$1 million from **Libbs Farmacêutica**, and the company intends to continue developing cardiac cells from stem cells in the laboratory.

SEP 2019 – **Genenta Science Srl** has received $14.6 million in new funding to advance its genetically engineered autologous hematopoietic progenitor cell therapy, which is intended to reprogram the immunological milieu within the tumor microenvironment.

Industry Developments 2018 - 2021

JAN 2020

BioNTech has completed the acquisition of **Neon Therapeutics** for $67 million. The new subsidiary, based in Cambridge, Massachusetts, will be known as BioNTech US Inc. and will serve as BioNTech's US headquarters.

FEB 2020

Valo Therapeutics has raised 1.1 million EUR in funding. It had received additional funding to advance its PeptiCRAd platform into first-in-human clinical trials as a result of positive pre-clinical data.

NOV 2020

JW Therapeutics, a joint venture between **Juno** and **WuXi AppTec**, raised $300 million in its Hong Kong Stock Exchange IPO, adding to the $190 million in venture capital raised since its inception in 2018.

Mesoblast Limited announced an exclusive worldwide license and collaboration agreement with **Novartis** for the development, manufacture, and commercialization of **Mesoblast's** Remestemcel-L.

InnoSkel, a platform biotechnology company pioneering gene therapies for rare skeletal diseases, announced a €20 million Series A funding round. **Jeito Capital** and **Vida Ventures** co-led the fundraising, with additional support from **Turenne Group**

Industry Developments 2018 - 2021

JAN 2021

Caladrius Biosciences, a clinical-stage biopharmaceutical company dedicated to the development of cellular therapies with the potential to reverse disease, announced it has closed a $25 million private placement. The offering exclusive placement agent was H.C. Wainwright & Co.

FEB 2021

Autolus Therapeutics PLC rised a $100 million underwritten public offering. Before moving on to the next stage of development, Autolus intends to seek a partner for the AUTO3 program, which is a CAR-T product candidate for relapsed/refractory diffuse large B cell lymphoma.

MAR 2021

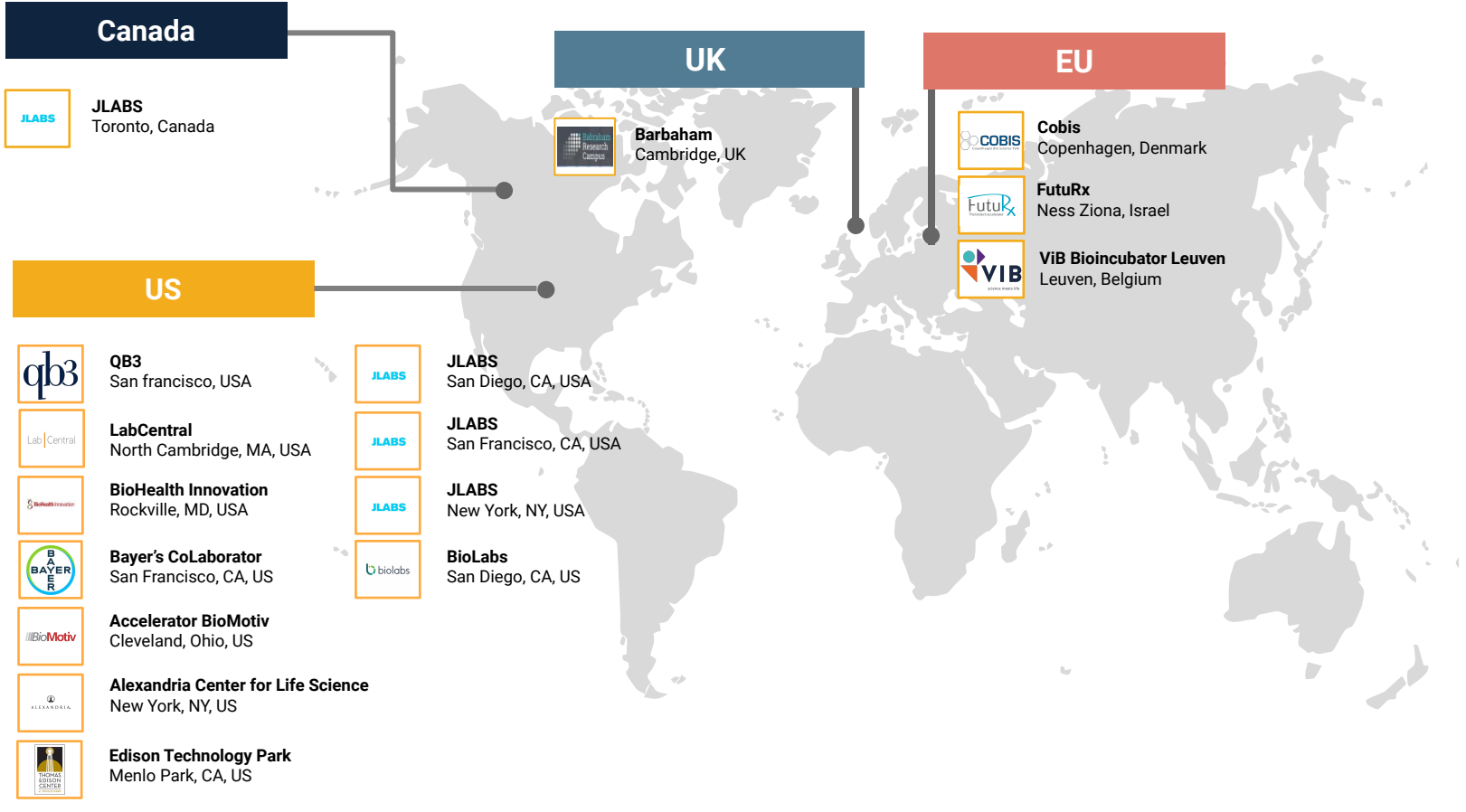
Takeda purchased **Maverick Therapeutics** in order to advance T-Cell engager therapies for solid tumors and expand its novel immuno-oncology portfolio. **Takeda** will exercise its right to acquire **Maverick** for up to $525 million in upfront and potential milestone payments, subject to certain adjustments, at the end of a multi-year, “build to buy” collaboration.

AgomAb Therapeutics N.V. announced today the completion of a $74 million Series B financing round led by **Redmile Group**, with participation from Cormorant Asset Management. The proceeds of the Series B will be used to fund clinical proof of concept studies for the lead program AGMB-101, an HGF-mimetic agonistic antibody that is currently undergoing INDenabling studies.

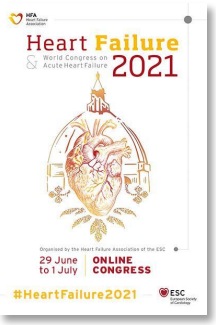
Top 12 Bioincubators in Cell Therapy Industry

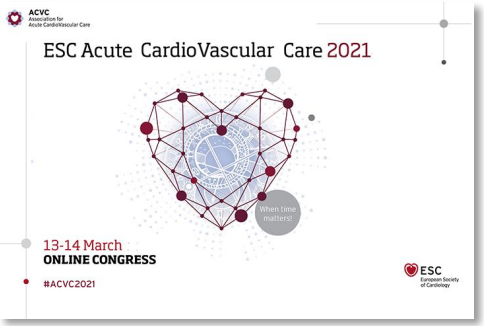
Bioincubator	Location	Stem Cell Companies
BioHealth Innovation	Rockville, MD & Germantown, MD, USA	ARCELLX, NEURALSTEM INC, orgenesis
JLABS	US & Canada	nkarta THERAPEUTICS, CHIMERIX, EPIBONE, AVROBIO
Lab Central	North Cambridge, MA, USA	3D BIOLABS, EDIGENE 博雅辑因
Biolabs	San Diego, CA & Durham, NC, USA	Cell Line GENETICS
Babraham Incubator	Cambridge, United Kingdom	censo, Talisman
VIB BioIncubator Leuven	Leuven, Belgium	TiGenix, Antleron
Alexandria Center for Life Science	New York, NY, US	celledis
QB3	Ness Ziona, Israel	BriaCell
COBIS	Copenhagen, Denmark	Oscine
FutuRx	Ness Ziona, Israel	IMMPACT-Bio
Accelerator BioMotiv	Cleveland, OH, US	orcabio
Bayer's CoLaborator	San Francisco, CA, US	CASEBIA THERAPEUTICS

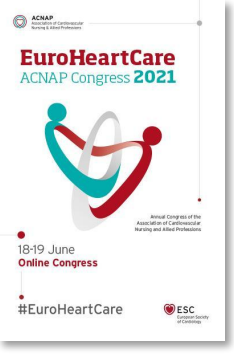
Bioincubators: Regional proportion

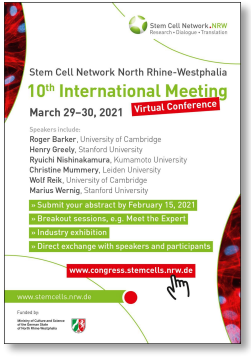


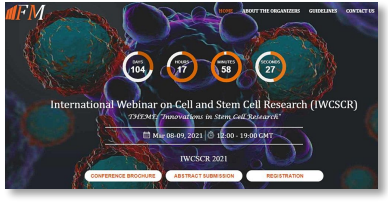
Cell Therapy Conferences 2021



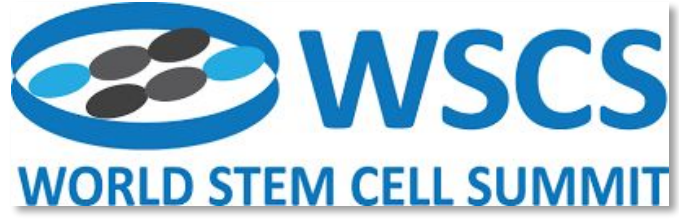








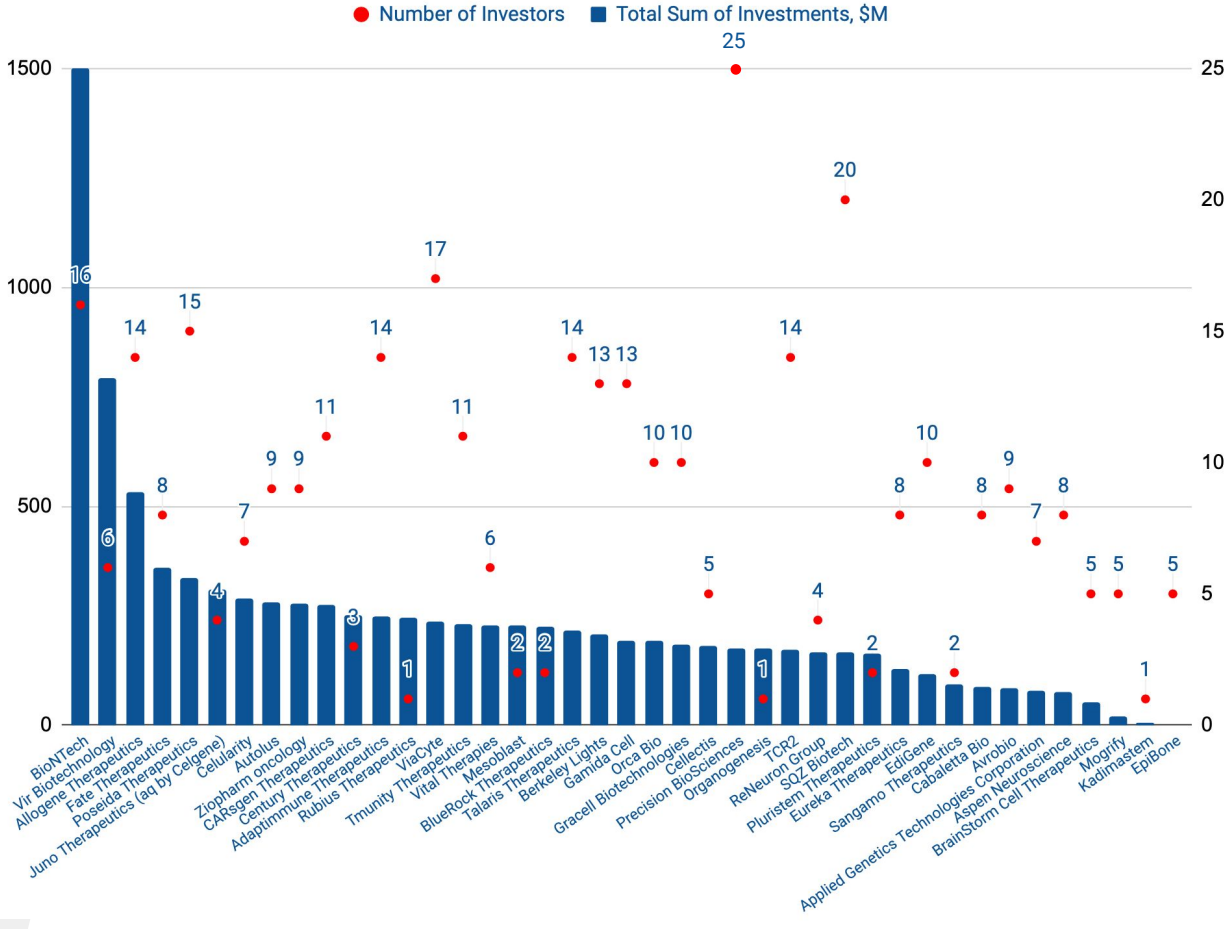
Cell Therapy Conferences 2021



Cell Therapy Investment Landscape (Stem Cells and CAR-T)

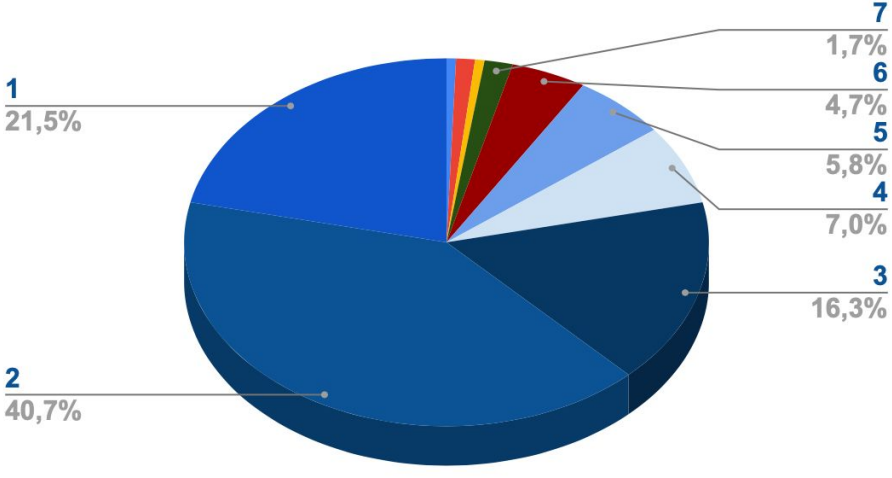
DEEP
PHARMA
INTELLIGENCE

50 Cell Therapy Companies by Total Sum of Investments & Number of Investors



Investments Deals in Cell Therapy Industry

Investors by Number of Deals with Cell Therapy Companies



The Most Active Investors in Cell Therapy Area

ARCH Venture Partners
13 Deals

RA Capital Management
9 Deals

New Enterprise Associates
9 Deals

Lilly Asia Ventures
8 Deals

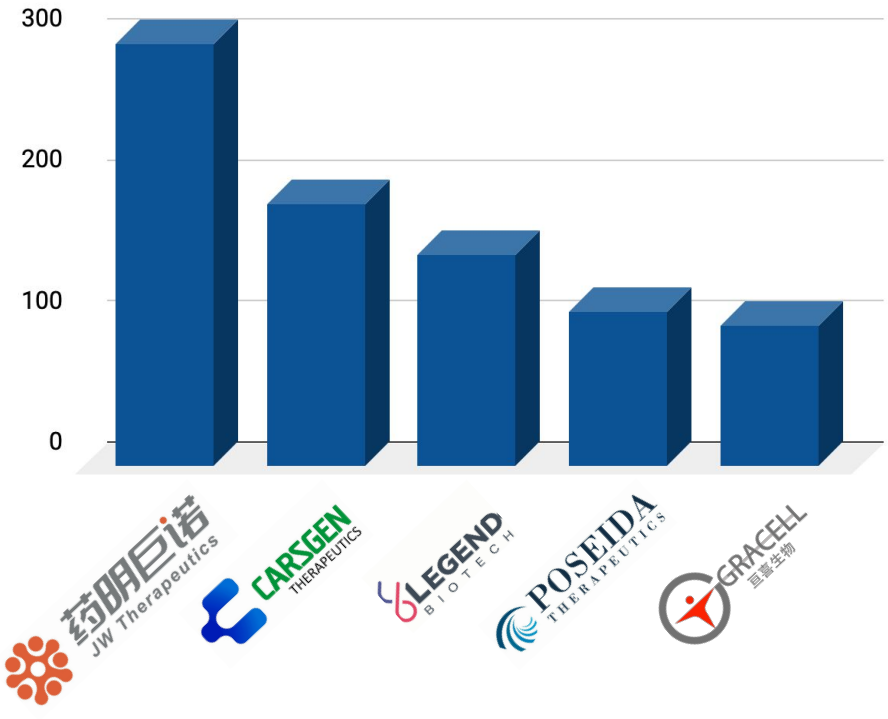
Redmile Group
7 Deals

Investment Landscape at a Glance (2020 — 2021)

Some of the major deals included:

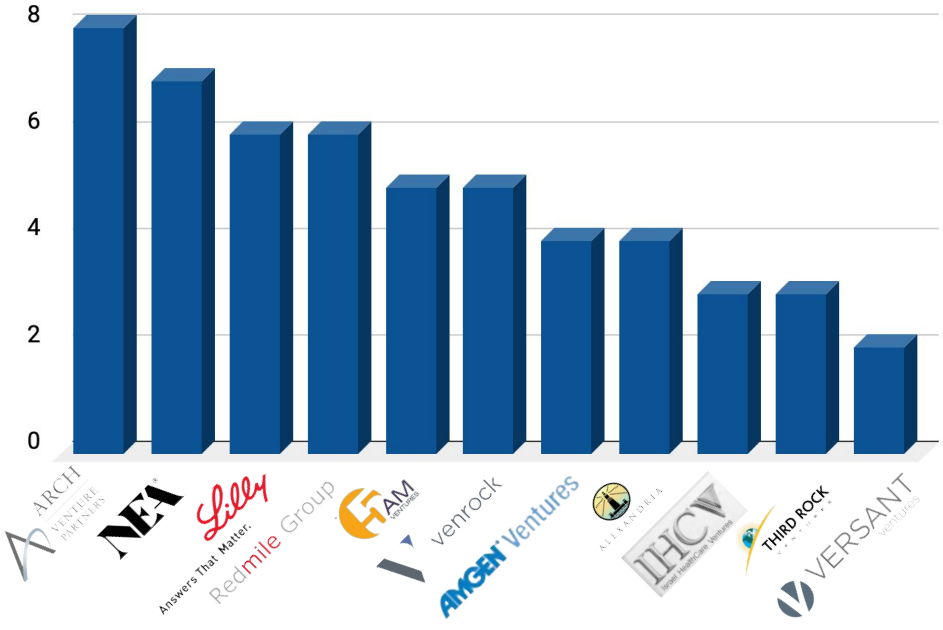
- **JW Therapeutics** raised **$300 million** on IPO in Hong Kong Stock Exchange, bringing new CAR-T immunotechnology to China.
- **CARsgen Therapeutics** pulled off **$180 million** in Series C investment round. The company attracted 5 investors, with a lead investor Loyal Valley Capital.
- **Legend Biotech** received a funding of **$150 million** over one Series A round in April 2020. Following that, Legend Biotech went on IPO in June 2020.
- **Poseida Therapeutics** has raised a total of **$110 million** during Series D round in June 2020.
- **Gracell Biotechnologies** attracted 7 investors in Series C funding with a total investment of **$100 million**.

Notable Investment Deals in 2020 (in million US$)



Top 10 Leading Investors by Number of Cell Therapy Deals

Leading VC Investors



Leading Institutional Investors

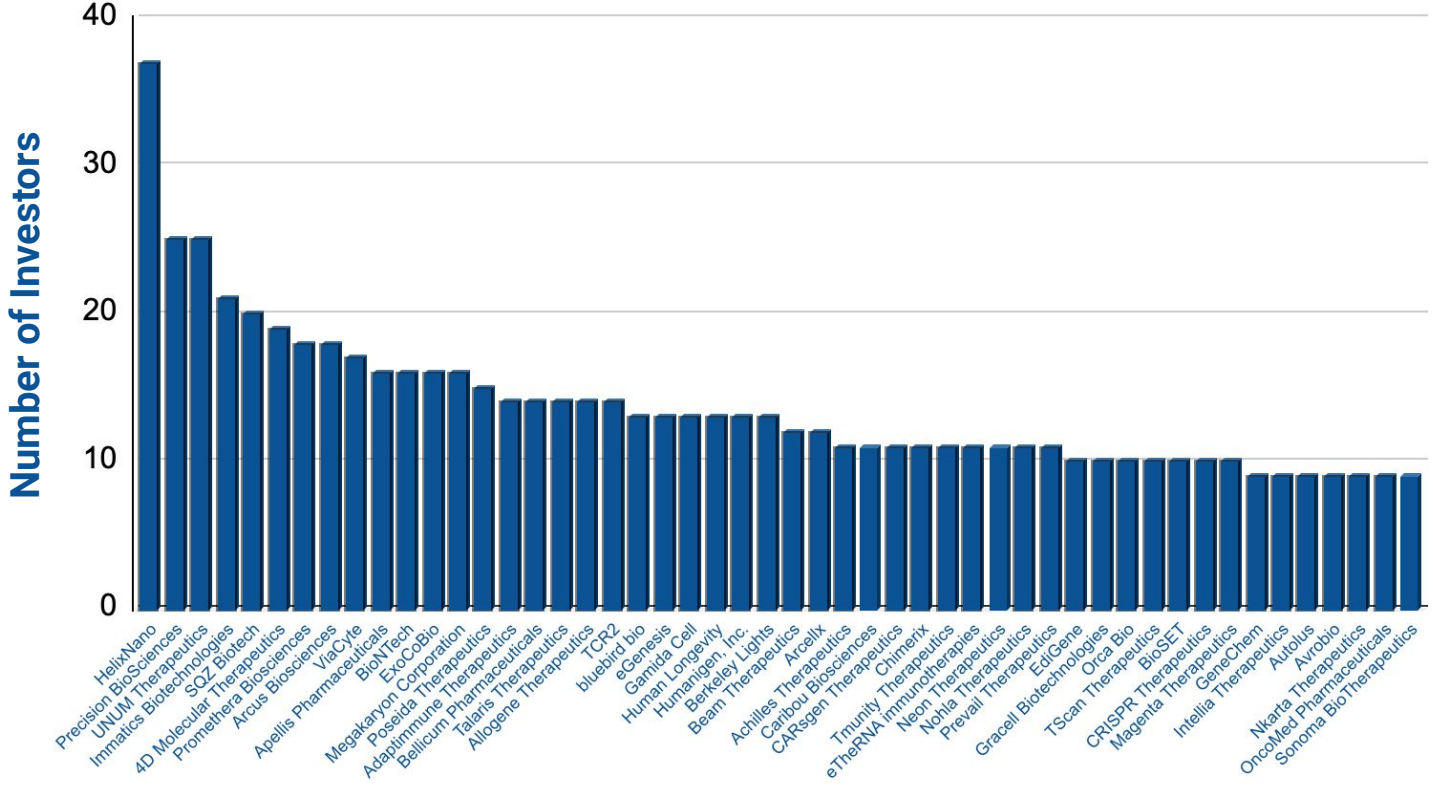
Top 20 Venture Investors in Cell Therapy Industry

Cell Therapy Companies	Investors	Investors	Cell Therapy Companies
bluebirdbio, Juno, Beam, SONOMA, Fate, VIR, KSQ	ARCH Venture Partners	THIRD ROCK	magenta, bluebirdbio
TRILLIUM, ARCELLX, CHIMERIX, NexImmune, CRISPR, nkarta, NEKTAR	NEA		ViaCyte, CHIMERIX
Cabaletta Bio, VOR BIOPHARMA, CARSGEN	FAM	8VC	SONOMA, orcaDIO
EDIGENE, LEGEND BIOTECH, TMUNITY, SONOMA, GRACELL, KSQ	Lilly	VERSANT	CENTURY, CRISPR
Cabaletta Bio, Beam, ADVERUM, ACHILLES, immatics, Bellicum	Redmile Group	本草资本 3E Bioventures	NeoImmune, REFUGE
Juno, ADVERUM, geron, cogent, Fate	venrock	illumina VENTURES	SQZ BIOTECH, Human Longevity Inc
ATARA BIO, VOR BIOPHARMA, OBSIDIAN, PRECISION BIOSCIENCES	Alexandria	clarus	AVROBIO
Intellia, AVROBIO, cogent, be		BAYER	egenesis
brainstorm cell therapeutics, gamida cell, LINEAGE CELL THERAPEUTICS	IHCV	BANKINVEST	celledis
ATARA BIO, NexImmune, OBSIDIAN, nkarta	AMGEN Ventures	Menlo	3T

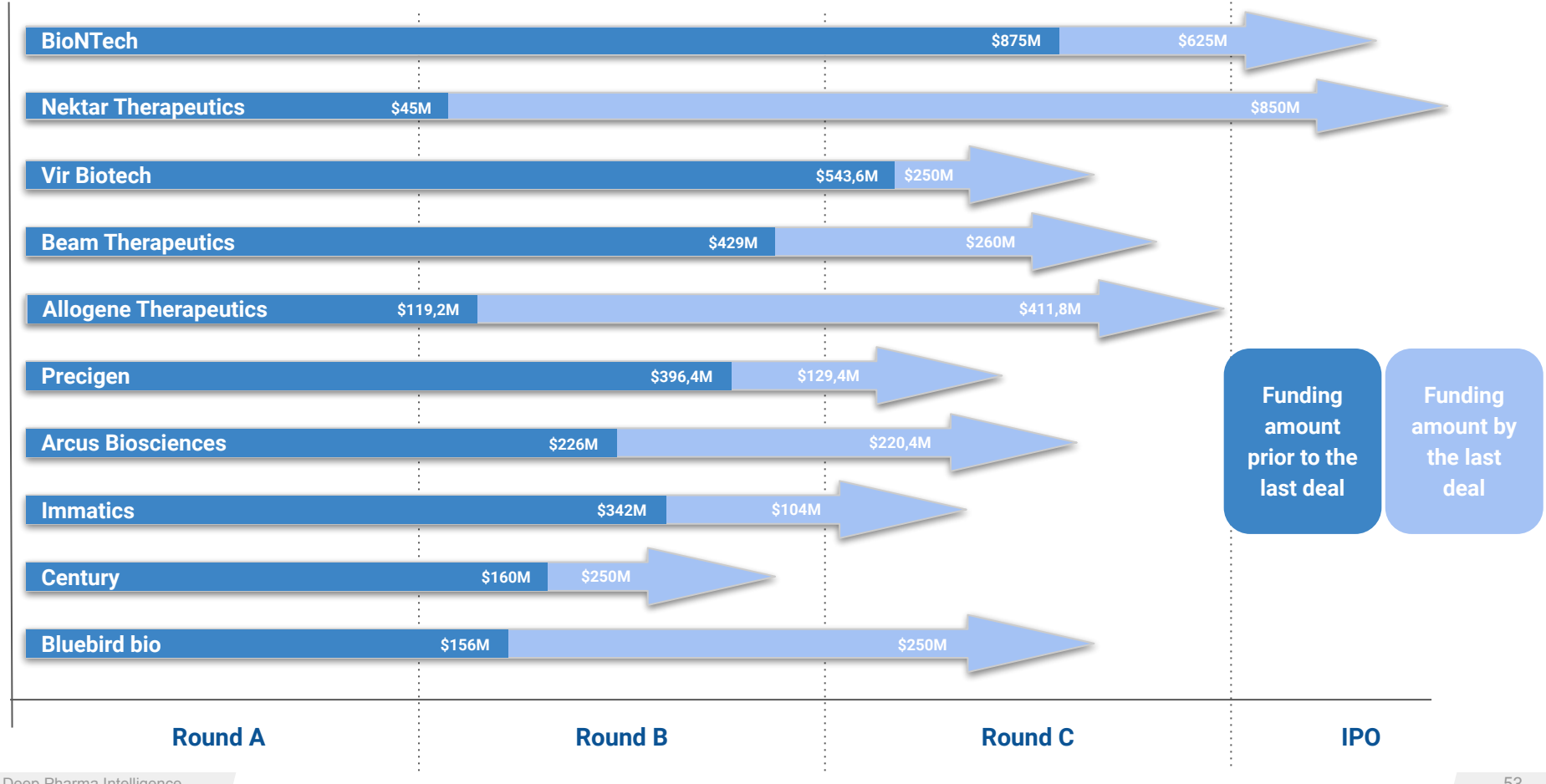
Top 20 Strategic Investors in Cell Therapy Industry

Pharma Companies Investors	Cell Therapy Companies				
Takeda	catamaranBIO	ARCELLX		be BIOPHARMA	OBSIDIAN THERAPEUTICS
	Adicet Bio		gamida Cell		Intellia THERAPEUTICS
J&J INNOVATION	Adicet Bio	VOR BIOPHARMA	LEGEND BIOTECH		
GILEAD		TMUNITY			
BAYER		egenesis			
FOSUNPHARMA 复星医药	FOSUNKite 复星凯特生物				
	KYTOPEN				
SHANGPHARMA INNOVATION	OBSIDIAN THERAPEUTICS				
Pfizer	NexImmune				
SANOFI	Fate THERAPEUTICS				

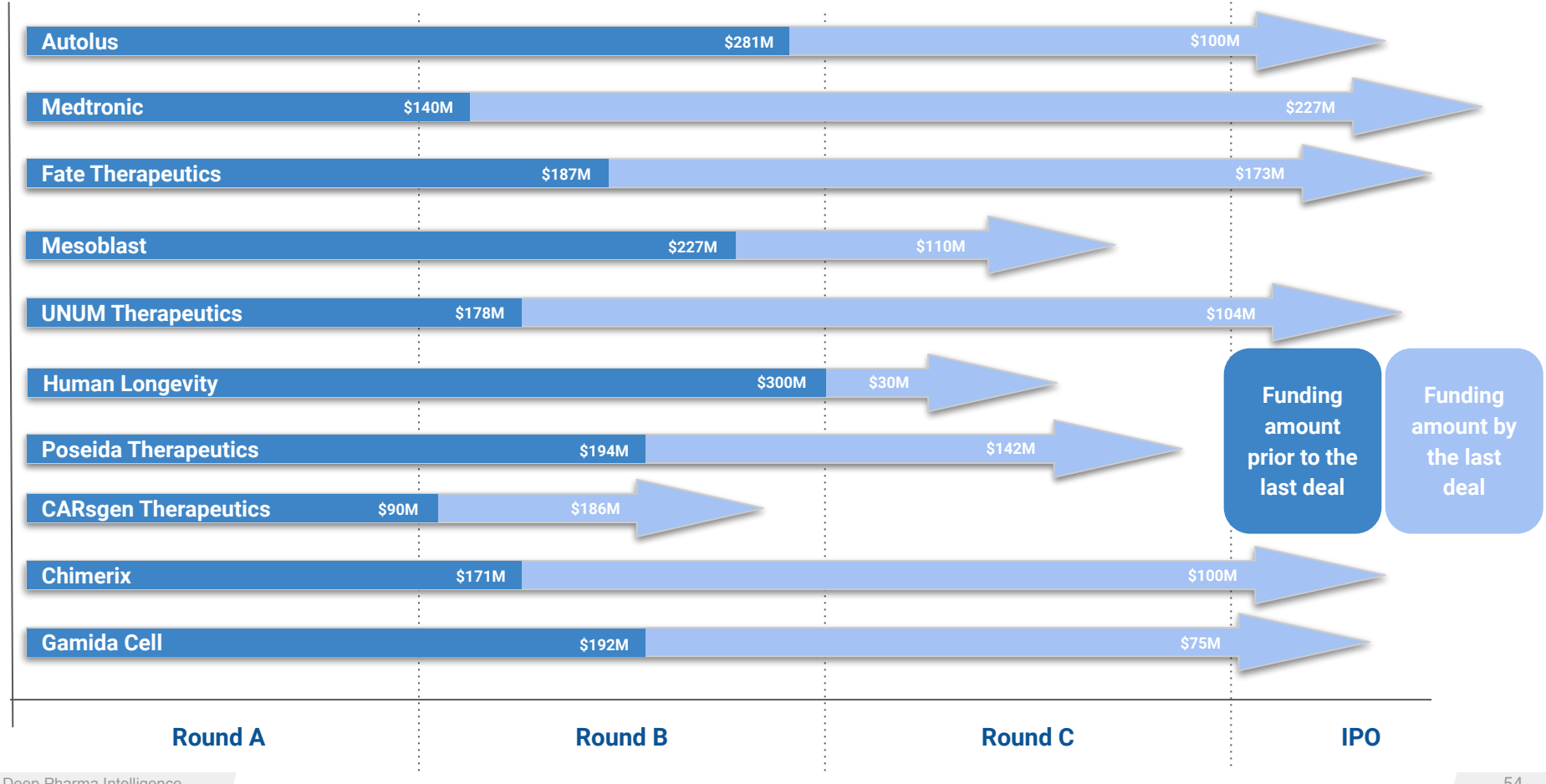
50 Leading Cell Therapy Companies by Number of Investors



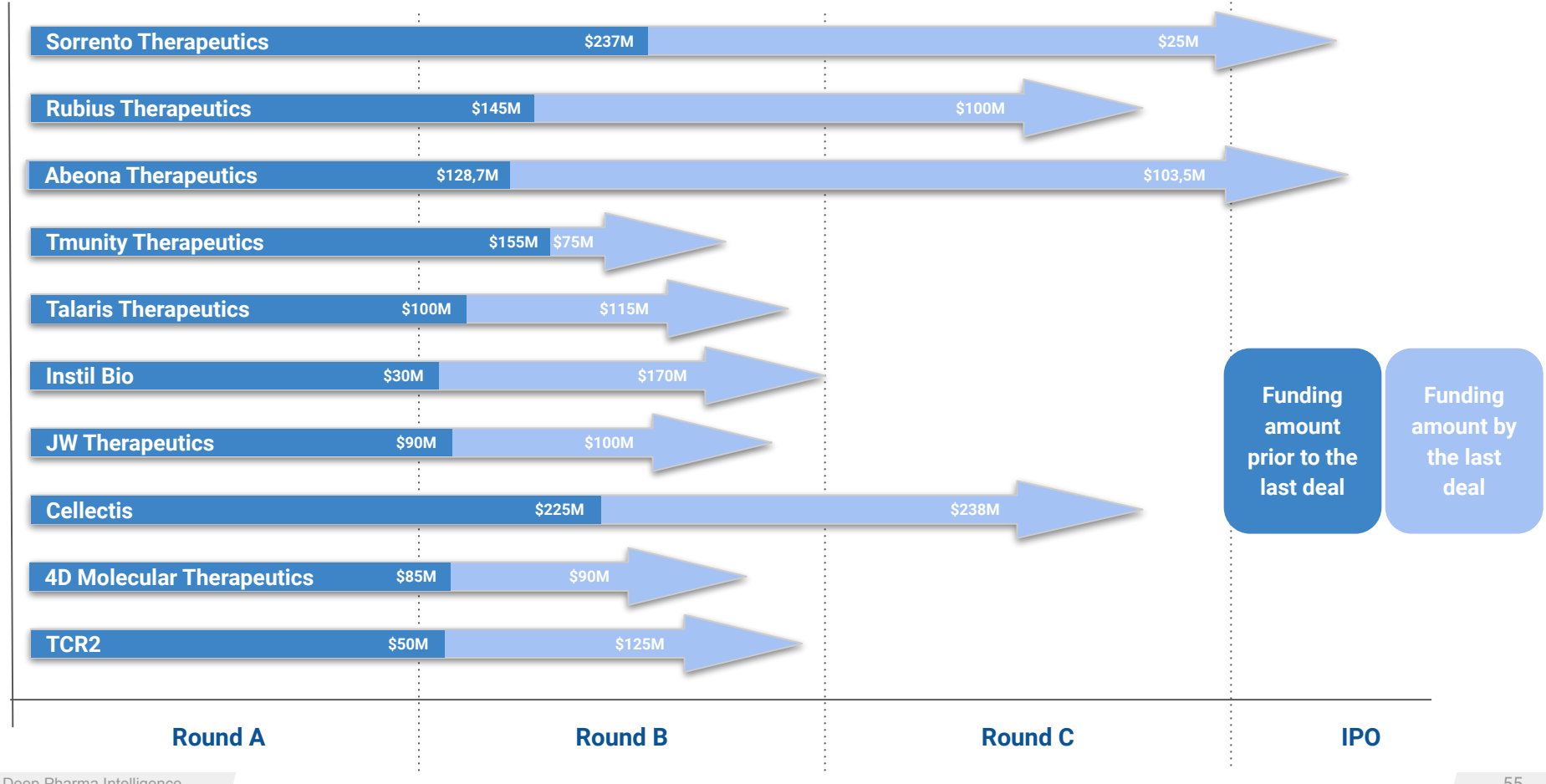
Leading Companies by Amount and Stage of Funding



Leading Companies by Amount and Stage of Funding



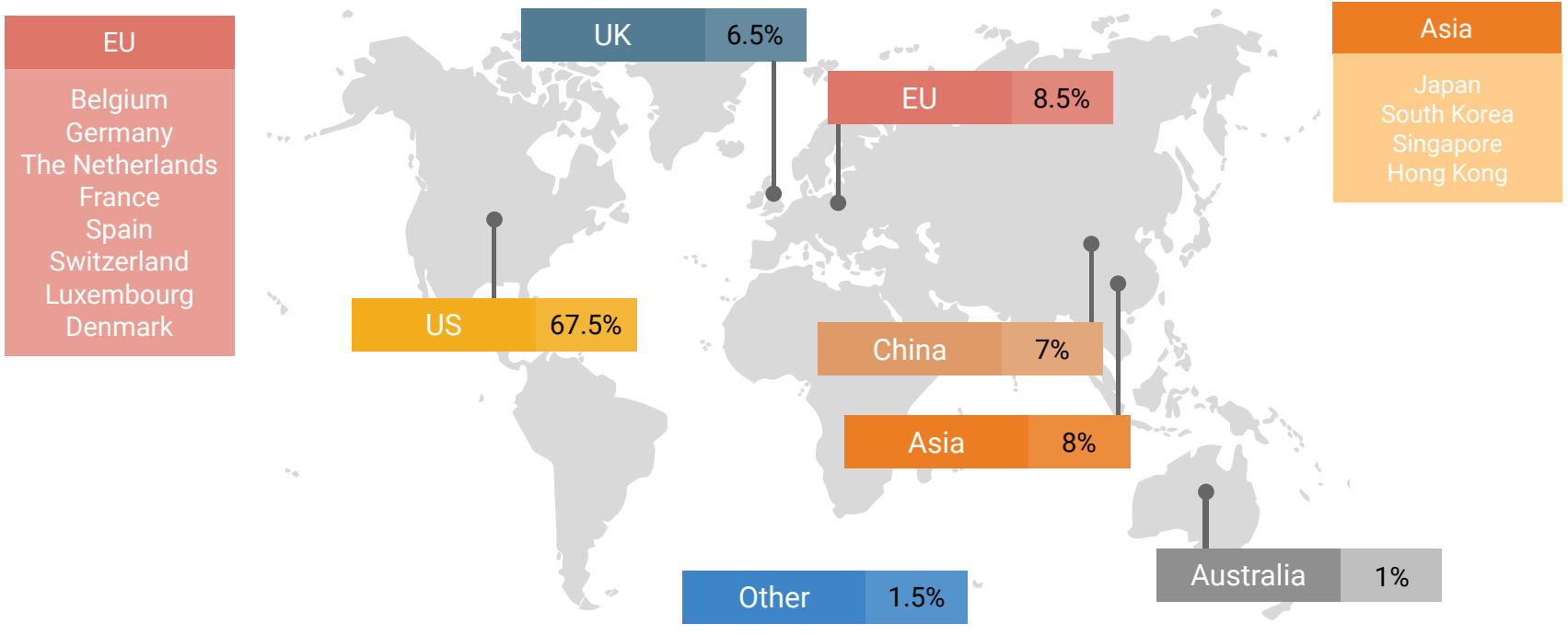
Leading Companies by Amount and Stage of Funding



Dynamics of Investments in Cell Therapy Companies (million US $)

Organization	Last Funding Date	Last Funding Amount (in Million US $)
The Howard Hughes Medical Institute	2017	1.0
Plum Alley	2017	1.7
StartUp Health	2018	19.3
Novartis	2018	6.5
Bayer	2018	3711
BioLife Solutions	2018	2.6
Hackensack Meridian Health	2019	33
Horizon Technology Finance	2019	100
Berkshire Hathaway	2019	3.5
Cedars Sinai Medical Center	2020	1.0
Fresenius Medical Care	2020	6.0
Lyell Immunopharma	2020	492
Apple Tree Partners	2020	50

200 Cell Therapy Investors: Regional Proportion



The US is still in the lead in investments of its proportion cell therapy companies. Interestingly, Asia Pacific region also had 15% of investments into cell therapy 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 cell therapy 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 up to 67%.

Investments Deals in Cell Therapy Industry

Number of Investors	Cell Therapy Companies
10	BIONTECH, 4DMT, ARCUS BIOSCIENCES, GRACELL, Prevail THERAPEUTICS, Beam, gamida cell, TCR², NEON THERAPEUTICS, Apellis, BERKELEY LIGHTS, Bellicum PHARMACEUTICALS, CHIMERIX, bluebirdbio
9	Autolus, nkarta THERAPEUTICS, Intellia THERAPEUTICS, Ziopharm ONCOLOGY, OncoMed PHARMACEUTICALS, AVROBIO
8	Fate THERAPEUTICS, ATARA BIO, Abeona THERAPEUTICS, Histogenics, Cabaletta Bio
7	agtc, Spark, HARPOON Therapeutics, Capricor
6	VIR, VITAL THERAPIES, ADVERUM BIOTECHNOLOGIES, Kiadis pharma, Healios
5	SanBio, Histogen, sigilon therapeutics, axogen, brainstorm cell therapeutics, cellectis, LEGEND BIOTECH
4	Celyad Oncology, Athersys, IOVANCE BIOTHERAPEUTICS, aevi genomic medicine, ReNeuron, organovo, agios
3	MaxCyte, TRILLIUM THERAPEUTICS, Organogenesis, Bone Therapeutics
2	Medtronic, CBMG, RepliCel, Pluristem, VistaGen Therapeutics, ImmunoCellular Immunocellular Therapeutics Ltd., biostage, FORTRESS BIOTECH, Sangamo THERAPEUTICS, mesoblast
1	Takeda, astellas, RubiusTherapeutics, sorrento THERAPEUTICS, GILEAD, KADIMASTEM, TAPIMMUNE, teva, VERICEL, transgene

Investments of Cell Therapy Companies in Cell Therapy Industry

Investors	Cell Therapy Parental Companies	Number of Deals	Cell Therapy Companies (Related Companies, Joint Ventures)
		7	GRACELL 亘喜生物, Adicet Bio, Intellia Therapeutics, cogent Biosciences
		6	immatics, Atara Bio, Human Longevity, Inc., CRISPR Therapeutics, celularity
National Institute on Drug Abuse	astellas	3	AVROBIO, be Biopharma
STARTUP +HEALTH	上海未名旭衍生物 Shanghai Sinobioway Suntera Biotech	2	EXUMA Biotech
	VIVA	1	Triumvira
	sorrento Therapeutics	1	celularity
Australian Government	mesoblast	1	Osiris
ARCH Venture Partners	juno Therapeutics	1	药明巨诺 JW Therapeutics
illumina Ventures, GE Ventures	Human Longevity, Inc.	1	celularity
Heritage Group, Pontifax, Mission Bay Capital, Genoa Ventures		1	Intellia Therapeutics
	Calmedica	1	Capricor
Third Rock, RACapital, Forbion Capital Partners, ARCH Venture Partners	bluebirdbio	1	TC Biopharm

Cell Therapy Investors in US

United States

Menlo Park

- Menlo Ventures — Menlo Park, California, US
- Astellas Venture Management — Menlo Park, California, US
- 5AM Ventures — Menlo Park, California, US
- Sofinnova Investments — Menlo Park, California, US
- Canaan Partners — Menlo Park, California, US
- Kleiner Perkins — Menlo Park, California, US
- Khosla Ventures — Menlo Park, California, US

San Francisco

- Redmile Group — San Francisco, California, US
- Amgen Ventures — San Francisco, California, US
- EcoR1 Capital — San Francisco, California, US
- Alexandria Venture — San Francisco, California, US
- VenBio Partners — San Francisco, California, US
- Alta Partners — San Francisco, California, US
- CIRM — San Francisco, California, US

Massachusetts

- Atlas Venture — Cambridge, Massachusetts, US
- Polaris Partners — Boston, Massachusetts, US
- Flagship Pioneering — Cambridge, Massachusetts, US
- Third Rock Ventures — Boston, Massachusetts, US
- Fidelity — Cambridge, Massachusetts, US
- RA Capital Management — Boston, Massachusetts, US
- Adage Capital Management — Boston, Massachusetts, US

New York

- Cormorant Capital — New York, New York, US
- OrbiMed — New York, New York, US
- Invus — New York, New York, US
- Aisling Capital — New York, New York, US
- Casdin Capital — New York, New York, US

Illinois

- Deerfield Capital Management — Rosamond, Illinois, US
- ARCH Venture Partners — Chicago, Illinois, US
- Tactics II Stem Cell Ventures — Northbrook, Illinois, US

Palo Alto

- Venrock — Palo Alto, California, US
- Vivo Capital — Palo Alto, California, US

California

- Thiel Capital — Los Angeles, California, US
- Domain Associates — San Diego, California, US
- Sanderling Ventures — San Mateo, California, US
- Illumina Ventures — Foster City, California, US

Cell Therapy Investors in Europe & Asia

Europe

UK

- **Syncona Partners LLP**
  London, England, United Kingdom
- **4BIO Capital**
  London, England, United Kingdom
- **AlbionVC**
  London, England, United Kingdom
- **Arthurian Life Sciences**
  London, England, United Kingdom
- **Cancer Research Technology**
  London, England, United Kingdom
- **Eight Roads Ventures**
  London, England, United Kingdom
- **Innovate UK**
  Swindon, Wiltshire, United Kingdom

Germany

- **Bayer**
  Leverkusen, Germany
- **Fresenius Medical Care**
  Bad Homburg, Hessen, Germany
- **TVM Capital**
  Munich, Bayern, Germany
- **Wellington Partners**
  Munich, Bayern, Germany

Belgium

- **S.R.I.W.**
  Liège, Liege, Belgium

Spain

- **Grifols**
  Barcelona, Catalonia, Spain
- **Suma Venture**
  Barcelona, Catalonia, Spain

Switzerland

- **Novartis**
  Basel, Basel-Stadt, Switzerland
- **HBM Healthcare Investments**
  Zug, Zug, Switzerland
- **Nextech Invest**
  Zurich, Zurich, Switzerland

Asia

Japan

- **Kyoto-iCAP**
  Kyoto, Kyoto, Japan
- **Mitsubishi UFJ Capital**
  Tokyo, Japan

China

- **IDG Capital**
  Beijing, China
- **Sequoia Capital**
  Beijing, China
- **Morningside Group**
  Shanghai, China
- **Lilly Asia Ventures**
  Shanghai, China

Top-50 Investors in Cell Therapy Industry

Investors	Cell Therapy Companies	Investments overall
ARCH Venture Partners	13 Cell Therapy Companies	351
RA Capital Management	9 Cell Therapy Companies	166
Lilly Asia Ventures	8 Cell Therapy Companies	99
OrbiMed	7 Cell Therapy Companies	418
Redmile Group	7 Cell Therapy Companies	104
Novartis	7 Cell Therapy Companies	47
Venrock	6 Cell Therapy Companies	738
Alta Partners	6 Cell Therapy Companies	237
5AM Ventures	6 Cell Therapy Companies	151
Perceptive Advisors	6 Cell Therapy Companies	142

Investors	Cell Therapy Companies	Investments overall
Celgene	6 Cell Therapy Companies	65
Sequoia Capital China	5 Cell Therapy Companies	634
Atlas Venture	5 Cell Therapy Companies	523
Wellington Partners	5 Cell Therapy Companies	207
Invus	5 Cell Therapy Companies	115
Deerfield Capital Management	5 Cell Therapy Companies	48
CIRM	5 Cell Therapy Companies	13
Cormorant Capital	5 Cell Therapy Companies	8
Polaris Partners	4 Cell Therapy Companies	551
Mitsubishi UFJ Capital	4 Cell Therapy Companies	329

Top-50 Investors in Cell Therapy Companies

Investors	Cell Therapy Companies	Investments overall
Domain Associates	4 Cell Therapy Companies	290
Flagship Pioneering	4 Cell Therapy Companies	217
Fidelity	4 Cell Therapy Companies	122
Amgen Ventures	4 Cell Therapy Companies	85
EcoR1 Capital	4 Cell Therapy Companies	61
Alexandria Venture	4 Cell Therapy Companies	40
Tactics II Ventures	4 Cell Therapy Companies	4
Kleiner Perkins	3 Cell Therapy Companies	1218
Canaan Partners	3 Cell Therapy Companies	645
Sofinnova Investments	3 Cell Therapy Companies	274
Frazier Healthcare Partners	3 Cell Therapy Companies	176
Morningside Group	3 Cell Therapy Companies	160
Intersouth Partners	3 Cell Therapy Companies	158
Vivo Capital	3 Cell Therapy Companies	138
Third Rock Ventures	3 Cell Therapy Companies	109
Aisling Capital	3 Cell Therapy Companies	96
Casdin Capital	3 Cell Therapy Companies	93
S.R.I.W.	3 Cell Therapy Companies	92
Sanderling Ventures	3 Cell Therapy Companies	88
Pontifax	3 Cell Therapy Companies	72

Top-50 Investors in Cell Therapy Companies

Investors	Cell Therapy Companies	Investments overall
Johnson & Johnson Innovation	3 Cell Therapy Companies	57
Adage Capital Management	3 Cell Therapy Companies	54
VenBio Partners	3 Cell Therapy Companies	50
Astellas Venture Management	3 Cell Therapy Companies	43
Illumina Ventures	3 Cell Therapy Companies	34
Syncona Partners LLP	3 Cell Therapy Companies	26
Thiel Capital	3 Cell Therapy Companies	13
Eventide	3 Cell Therapy Companies	3
IDG Capital	2 Cell Therapy Companies	1244
Khosla Ventures	1 Cell Therapy Companies	806

R&D Cell Therapy Breakthroughs 2019-2021

DEEP
PHARMA
INTELLIGENCE

Cell Therapies: R&D Stats

The overall preclinical and clinical research landscape in cell therapies industry is highly reliant on the fundamental research and advances in certain enabling technologies, such as genetic reprogramming, CRISPR-Cas9, sequencing technologies, delivery technologies, mass cell culturing methods, stem cell production (generation of iPSCs) and many others.
The industry is characterized by a high risk-high reward dynamics, where ongoing breakthroughs can substantially change the business landscape, by disrupting legacy approaches and protocols.
There is also a substantial growth potential, once certain technological questions are addressed, for instance, identification of new targets for the CAR-T, which would allow expanding applications from purely liquid cancers, to also solid tumors.

	CLINICAL TRIALS	PUBLICATIONS	GRANTS FUNDING	PATENTS
2017	422	17508	$2,2 Billion	6304
2018	423	17490	$2,3 Billion	6340
2019	476	17497	$2,5 Billion	7500
2020	526	13083	$2,2 Billion	7719

Cell Therapies: Timeline of Key Events 2014 – 2021

First Therapeutic Applications — 2014-2015

- Breakthrough for manufacturing stem cells.
- First embryonic stem cells cloned from a man's skin.
- First patient received experimental stem cell treatment for age-related macular degeneration.

Genetics & Stroke Treatment — 2016-2017

- First Human Embryos Edited in U.S. using CRISPR Technique.
- Stem cells reported to provide substantial recovery in patients disabled by stroke.

Bioprinting & Cancer Treatment — 2018

- First 3D-printed cornea made from algae and human stem cells.
- Mouse and human skin cells reprogrammed into immune cells to fight cancer.

Development of Immunotherapies — 2019

- Second patient reported free of HIV after receiving stem-cell therapy.
- Gene therapy shown to be promising in treating infants born with X-linked severe combined immunodeficiency (SCID-X1).

New Stem Cells Discovered — 2020-2021

- New type of pluripotent stem cell isolated from mice, horses, and humans, named XPSCs, which are capable of generating chimeras and germ cell precursors.

Scientific Breakthroughs 2019 – 2021

2019 – Stem cell therapy was efficient and cured a patient with cancer from HIV in the United Kingdom. This was the second case of HIV treatment, doctors used allogeneic haematopoietic stem cell therapy against Hodgkin's lymphoma and after the treatment patient went into long-term 18 months HIV remission.

AUG 2020 – Stem cells are found to be useful to treat enteric nervous system diseases like Parkinson's disease. Using induced pluripotent stem cells (iPSCs) scientists learned the process of enteric nervous system formation and were able to generate enteric neurons in the lab.

OCT 2020 – Investigators in the Stem Cell Institute of the University of Minnesota have made a breakthrough in accelerated manufacturing of neurons from induced pluripotent stem cells to treat various neurological conditions. With the help of this method, unlimited number of neurons can be produced from iPSCs weeks faster than before.

NOV 2020 – New discovery in mechanism of infinite stem cell division was made – scientists showed that telomeres in pluripotent stem cells are protected in a very different way than in adult somatic cells. This finding was called a major breakthrough in stem cell immortality question within last 20 years and gives many promises for future studies.

Scientific Breakthroughs 2019 – 2021

NOV 2020 – Two teams have learned how to grow 3D lung organoids from stem cells in order to investigate pathological impact of SARS-CoV-2 virus on human lungs. With help of stem cell organoids scientists already discovered new COVID-19 pathogenesis findings.

DEC 2020 – A team of scientists led by University of Texas Southwestern has received a new "intermediate" embryonic stem cell type from multiple species that can be helpful in creation to chimeras and deriving precursors to sperm and eggs in a culture dish.

JAN 2021 – Scientists at Children's Hospital Los Angeles developed a new modified CAR-T cell therapy that shows promise in treatment of solid tumor neuroblastoma that refrains from killing healthy brain tissues and effectively eliminates cancer cells. Currently this work entered a preclinical phase.

FEB 2021 – Researchers learned how to read what T cells recognize and target their cytotoxicity to. Newly developed platform with a barcoding system is also used to study interactions between T cells and cancer cells – this is potentially valuable for breakthroughs in the area of CAR-T therapies.

Scientific Breakthroughs 2019 – 2021

FEB 2021

- Researchers from U.S. and China combined human and monkey embryons into so-called “chimeras”, created by injecting human potent cells in animal embryos. So far chimeras are just a bunch of cells in lab dishes, however this breakthrough has already raised multiple ethical concerns.

- Scientists in the University of Alberta in Canada found a way to control breast cancer stem cells evasion from treatment, process responsible for resistance and breast cancer progression. Method uses improved T-cell immunotherapy with the use of atypical for this procedure gamma delta-like T cells that do not cause graft-versus-host reaction.

- Japanese scientists revealed a way to grow small intestinal cells from induced pluripotent stem cells (iPSCs). This was previously possible only using embryonic stem cells (ESCs) that are ethically controversial source for tissues and organs culturing.

APR 2021

- Stem cells demonstrated healing potential for multiple sclerosis treatment. Expanded cord tissue-derived umbilical cord cells appeared to help to regulate immune system and prevent further degradation of myelin – Phase 2 double blind clinical trials in multiple sclerosis patients showed amazing results.

List of Journals in Cell Therapy Field

Journal	Country	Issn	IF	Pubs
PLoS ONE	United States	1932-6203	2.766	4468
Bone Marrow Transplantation	United Kingdom	0268-3369	4.497	2839
Biology of Blood and Marrow Transplantation	Netherlands	1523-6536	4.484	2262
Blood	United States	1528-0020	15.132	1775
Scientific Reports	United Kingdom	2045-2322	4.122	1719
Stem Cells and Development	United States	1557-8534		1632
Cell Stem Cell	United States	1875-9777		1621
Methods in Molecular Biology (Clifton, N.J.)	United States	1940-6029		1584
Bone Marrow Transplantation	England	1476-5365		1429
Stem Cell Research	England	1876-7753		1407
Stem Cell Research and Therapy	United Kingdom	1757-6512	4.963	1327
Oncotarget	United States	1949-2553		1319
Biomaterials	Netherlands	1878-5905		1262
Stem Cells International	United States	1687-966X		1134
Proceedings of the National Academy of Sciences of the USA	United States	1091-6490	9.504	1067
Biochemical and Biophysical Research Communications	United States	1090-2104		1015
Haematologica	Italy	1592-8721		999

List of Journals in Cell Therapy Field

Journal	Country	Issn	IF	Pubs
Stem Cells	United States	1066-5099	5.587	96
Zhongguo bing li sheng li xue hui (Journal of Experimental Hematology)	China	1009-2137		949
International Journal of Molecular Sciences	Switzerland	1422-0067	3.687	919
Stem Cell Reports	United States	2213-6711	6.537	914
British Journal of Hematology	United Kingdom	0007-1048	5.128	843
Tissue Engineering. Part A	United States	1937-335X		819
Development (Cambridge)	United Kingdom	1477-9129	5.413	787
Cell transplantation	United States	1555-3892		738
Nature Communications	United Kingdom	2041-1723	12.353	737
Stem Cells Translational Medicine	United States	2157-6564	4.929	717
Leukemia and Lymphoma	United Kingdom	1029-2403	2.644	709
Acta Biomaterialia	England	1878-7568		686
Journal of Cellular Physiology	United States	1097-4652	3.923	686
Rinsho ketsueki (Japanese journal of Clinical Hematology)	Japan	0485-1439		654
Zhonghua xue ye xue za zhi (Chinese journal of Hematology)	China	0253-2727		653
Cancer Research	United States	1538-7445		637
Annals of Hematology	Germany	1432-0584	2.845	594

Notable Use Cases of Cell Therapy Applications in Pharmaceutical R&D and Medicine

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Selected R&D Collaborations

Cell therapy industry is increasingly evolving towards more collaborative environment, which is driven by an rapidly increasing sophistication of the technological landscape.

JAN 2020

– **Astellas** and **Adaptimmune** have collaborated to develop allogeneic chimeric antigen receptor T-cell (CAR-T) and T-cell receptor (TCR) therapies. As part of the agreement, **Astellas** was to pay $50 million up front and commit to many times that amount in milestone payments to work with **Adaptimmune** to identify targets and develop cell therapies against them.

FEB 2020

– **Cellectis**, a biopharmaceutical company focusing on developing immunotherapies based on gene-edited allogeneic CAR T-cells, and **Servier**, an international pharmaceutical company, have signed a binding term sheet to amend a 2014 agreement.

APR 2020

– **Kite**, a **Gilead** Company, and **Teneobio, Inc**. announced a license and collaboration agreement in which Kite will receive exclusive rights to certain antibodies directed at BCMA. One such antibody, with a fully human variable heavy chain, is currently being tested in a CAR format for the treatment of patients with multiple myeloma in a Phase 1 clinical trial at the National Cancer Institute.

– **Fate Therapeutics** has signed a global collaboration agreement with **Janssen Biotech** to develop new cancer cell therapies derived from stem cells, with a $100 million upfront payment. **Fate Therapeutics** has developed a pipeline of experimental cell therapies based on iPSCs, including CAR T-cell and CAR natural killer cell therapies.

Selected R&D Collaborations

Companies in the cell therapy sector are actively collaborating to achieve growth milestones and diversify technological portfolios.

MAY 2020

- **bluebird bio, Inc.** announced that it has amended its current co-promotion/co-development agreement with **Bristol Myers Squibb (BMS)** to enable the companies to concentrate their efforts on the efficient commercialization of idecabtagene vicleucel, the company's lead investigational BCMA-directed CAR T-cell immunotherapy in the United States.

SEP 2020

- **Precision BioSciences**, Inc., a clinical stage biotechnology company developing allogeneic CAR-T and in vivo gene correction therapies using its ARCUS genome editing platform, announced a collaboration with Servier, an independent global pharmaceutical company, to add two additional hematological cancer targets beyond CD19 and two solid tumor targets to its CAR-T development and commercialization pipeline.

DEC 2020

- **Atara Biotherapeutics** and **Bayer** entered into an exclusive worldwide license agreement and research, production, and manufacturing partnership for mesothelin-directed CAR T-cell therapies for the treatment of solid tumors, with a $60 million upfront payment and the potential for an additional $610 million in milestone payments.

FEB 2021

- **AbbVie** and **Caribou Biosciences, Inc.** announced a partnership and license agreement for CAR-T cell therapeutic research and development. Under the multi-year deal, **AbbVie** will study and produce two new CAR-T cell therapies directed at **AbbVie**-specified targets using Caribou's genome editing and cell therapy technologies.

Introduction into Practical Application of Cell Therapies: Notable Use Cases

Both Stem Cell and CAR-T therapy areas are developing dynamically these days. Stem cells are used in regenerative medicine, bioprinting, drug research and discovery, toxicity tests etc. CAR-T technology aims to fight different types of cancer: lymphomas, myelomas, leukemias. Last developments allow to improve CAR-T technique with the use of induced pluripotent stem cells – they are used instead of donor's T cells for genetical engineering and are infused back to a patient.

There are many innovative applications of cell therapies and this section describes notable use cases, highlighting companies that developed state-of-art stem cell and CAR-T treatments and technologies.

SANGAMO THERAPEUTICS

ATHERSYS

GAMIDA CELL

CALADRIUS BIOSCIENCES

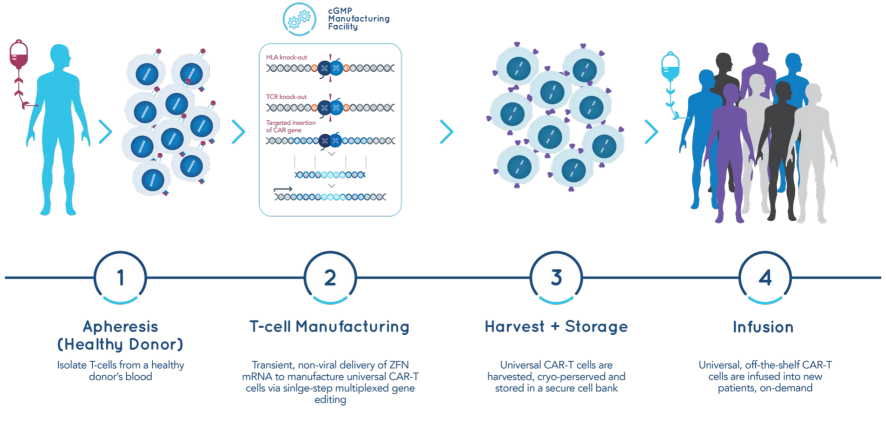
ABBVIE

KITE PHARMA

BLUEBIRD BIO

Cell Therapy Application Use Case: Sangamo Therapeutics

Sangamo Therapeutics uses gene-edited cell therapies to address different blood disorders, including thalassemia and sickle cell disease, immunological disorders and various types of cancer. Using Zinc Finger Nucleases (ZFN) gene-editing technology *ex vivo*, Sangamo knocks out or inserts genes in autologous (own patient's) or allogeneic cells.
To fight hemoglobinopathies and treat patients with sickle-cell disease, Sangamo uses autologous cells. Moreover, in case of sickle-cell disease treatment, Sangamo entered a cooperation with big pharma company Sanofi. With help of CAR-Treg cells, Sangamo develops a therapeutics for immunological disorders - Crohn's disease and multiple sclerosis.
Other Sangamo's universal T cell therapies showed themself as therapeutic for blood-based and rare forms of cancer, as well as graft-vs-host disease.



Collaborators & Partners

Kite, A GILEAD Company
Biogen
Takeda
SANOFI
NOVARTIS
Pfizer

Cell Therapy Application Use Cases: Athersys

Athersys develops proprietary stem cell-based product called MultiStem® , obtained from Multipotent Adult Progenitor Cells, or MAPC. These cells are harvested from healthy donor bone marrow, do not undergo any genetic manipulations, are manufactured on a high-scale basis and frozen in vials. This makes MultiStem® "off-the-shelf" product candidate, meaning it can quickly be thawed and administered to a patient via simple intravenous infusion.

Currently, MultiStem® therapeutic effect is studied in many clinical trials in different disease categories – neurological and inflammatory disorders, cardiovascular diseases. Special clinical focus is put on neurological traumas and regenerative medicine, where MAPCs are used to regenerate tissues after traumatic brain injuries, spinal cord injuries and in case of multiple sclerosis.

Collaborators & Partners

Healios

Nikon

Cell Therapy Application Use Case: Gamida Cell

Gamida Cell is developing proprietary advanced cell therapies to address blood-based disorders and cancers. Its R&D tries to solve the issue of massive cell production without a loss of therapeutic functionality. Gamida's technology allows to expand stem cells and natural killer (NK) cells keeping them with the original phenotype and potency.

Gamida Cell has also developed Omidubicel product based on allogeneic hematopoietic stem cell (bone marrow) transplant for blood malignancies.. Now Omidubicel is in Phase 3 clinical study and its impact on severe aplastic anemia is also under investigation in Phase 1/2. Another Gamida's product – GDA-201 is an innate Natural Killers (NK) cell therapy is designed to fight hematologic and solid tumors together with standard antibody therapies.

Collaborators & Partners

WMDA matching donors · serving patients

BE THE MATCH BioTherapies®

Cell Therapy Application Use Case: Caladrius Biosciences

caladrius BIOSCIENCES

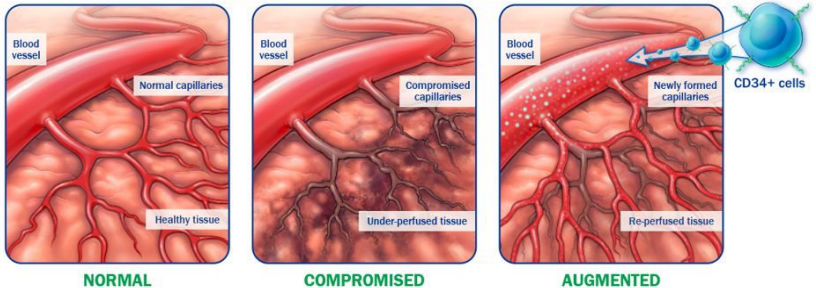
Collaborators & Partners

NEOSTEM-ECO

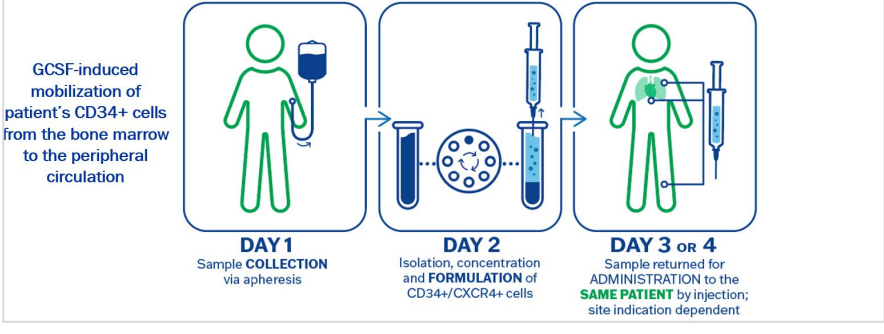
Caladrius Biosciences, Inc. is a clinical-stage biopharmaceutical company that focuses on first-in-class cell therapies to treat diseases using cells self-repair potential.

Company develops product candidates that successfully show themselves in clinical trials: HONEDRA® that is eligible for early conditional approval to treat critical limb ischemia (CLI); Regenerative Medicine Advanced Therapy (RMAT) designed to help patients with no-option refractory disabling angina;; CLBS16 in Phase 2b to address coronary microvascular dysfunction. Besides that, Caladrius is working on CD34+ stem cell therapy to cope with lung damage resulting from coronavirus disease.

CD34+ cells have a well characterized mechanism of action



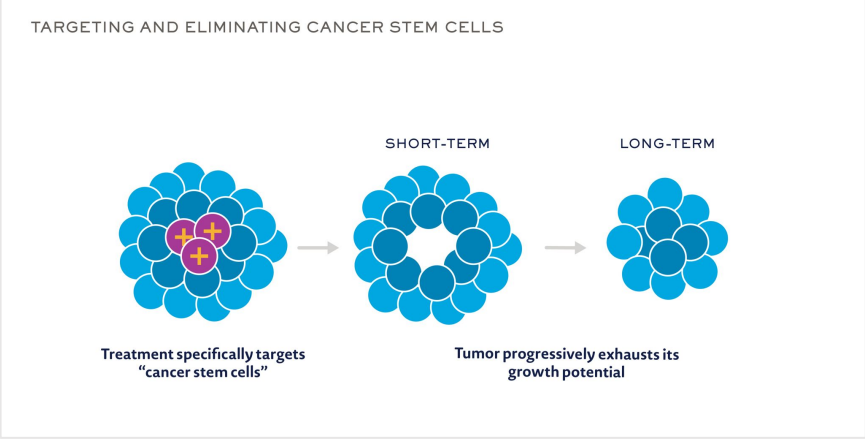
Caladrius' CD34+ cell process is rapid/economical/scaled



Cell Therapy Application Use Cases: Abbvie

AbbVie is a global pharmaceutical corporation that in addition to standard therapeutics concentrates on cell therapy developments as well. Just in February 2021 AbbVie signed a partnership with Caribou Biosciences to work on CAR-T cell allogeneic products that will not be rejected by host immune system.

AbbVie already has a CLBR001 CAR-T product that is developed in a partnership with Calibr and further both companies are planning to cooperate to design switchable T cell therapies for AbbVie's tumor targets. AbbVie's R&D department is investigating cancer stem cells (CSCs) to target them with novel therapeutics and eliminate these cells to prevent tumors from growing.



Collaborators & Partners

National Foundation for Cancer Research – Research for a Cure
The University of Texas MD Anderson Cancer Center
pharmacyclics – An AbbVie Company
Genentech – A Member of the Roche Group
Calibr – California Institute for Biomedical Research
CARIBOU BIOSCIENCES

Cell Therapy Application Use Case: Kite Pharma

Kite
A GILEAD Company

Collaborators & Partners

Genentech
A Member of the Roche Group

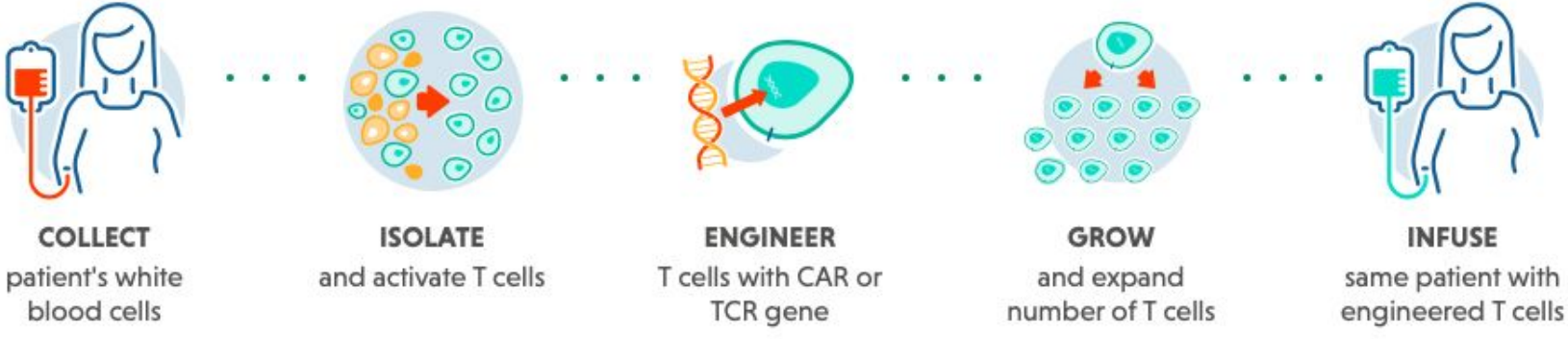
Humanigen

Pfizer

NIH National Institutes of Health

Kite Pharma engineers cell therapies to address both solid tumors and blood malignancies. Now Kite Pharma has two cell therapies that are already available through REMS Program: YESCARTA and TECARTUS. YESCARTA is designed to treat large B cell lymphomas TECARTUS is used to fight mantle cell lymphomas (MCLs).

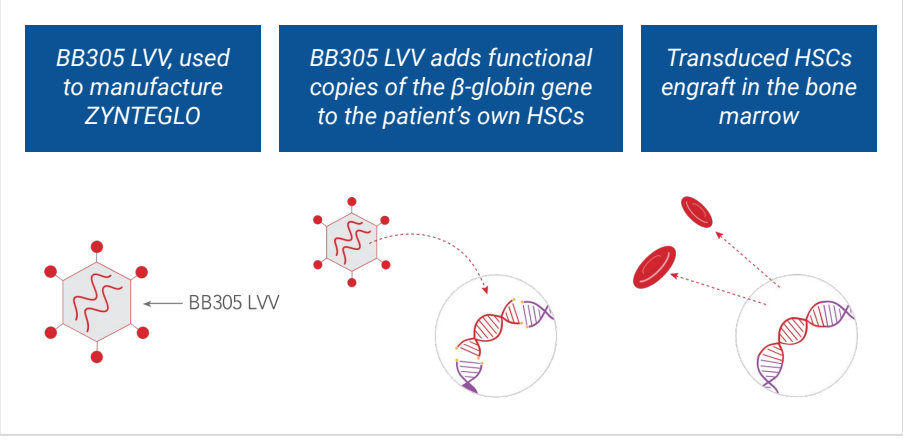
In addition to that Kite Pharma develops Brexu-cel therapy in Phase 2 to address leukemia and KITE-718 in Phase 1 to help patients with solid tumors.



Cell Therapy Application Use Cases: bluebird bio

At **bluebird bio**, various cell therapies and gene therapies are being developed. Zynteglo – cell therapy product developed by bluebird bio is used to treat blood disorders like beta thalassaemia. Zynteglo is made from active stem cells substance that has been taken from healthy donors and genetically modified to express beta-globin. When infused into patient's bloodstream, these stem cells result in bone marrow and produce healthy red blood cells that are expected to produce the whole lifespan effect for a patient.

One more therapy named ABECMA from bluebird bio is a B-cell maturation antigen (BCMA)-directed genetically modified autologous T cell immunotherapy targeted to fight relapsed or refractory multiple myeloma. More bluebird bio CAR-T cell therapies with oncological focus are currently in preclinical stage of development.

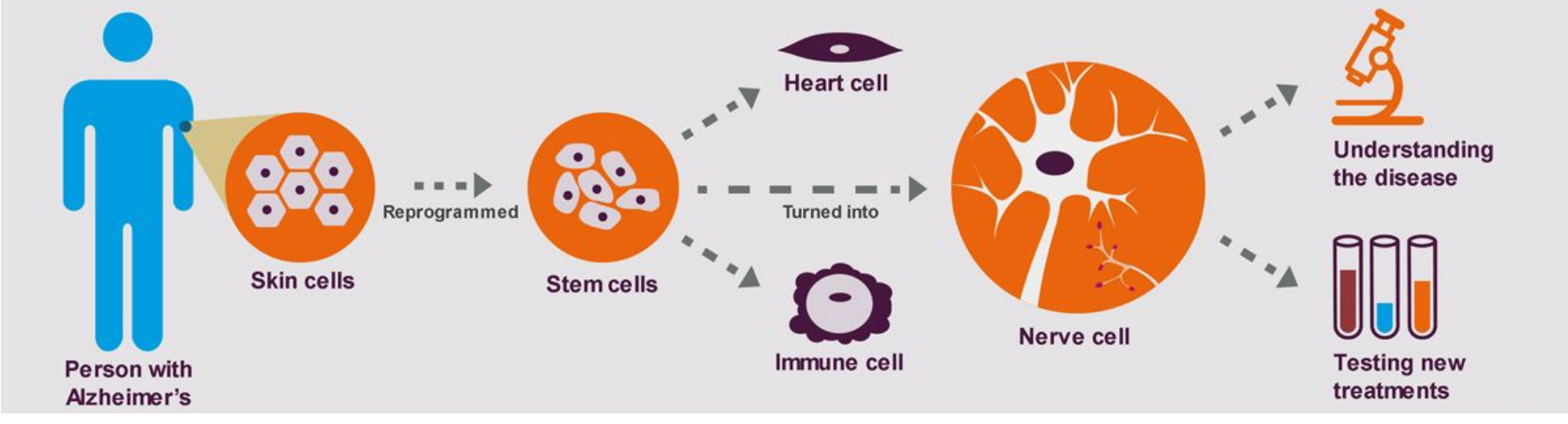


Collaborators & Partners

FortySeven, TC BIOPHARM, gritstone ONCOLOGY, Lonza, MINARIS REGENERATIVE MEDICINE, medigene, Bristol Myers Squibb, REGENERON

Largest iPSC Genetic Project: Fighting Alzheimer's Disease

National Institutes of the Health (NIH) scientists launched one of the most ambitious projects to study development of Alzheimer's disease and other neurodegenerative dementias with help of induced pluripotent stem cells (iPSCs). Researchers are planning to make more than 100 stem cell lines, each of them will carry different Alzheimer's-related mutations. First step of the project will be to establish mass manufacturing system to genetically integrate mutations with CRISPR technology into iPSCs and obtain cell lineages, next, all of them will be analyzed to understand what processes lead to neurodegeneration. These cell cultures can be shared with labs all around the world, what makes project even more powerful. Results of analysis will be used to develop innovative gene therapies to fight Alzheimer's and other disorders.



Source: Alzheimer's Research UK, istockphoto.com

Conclusions and Takeaways

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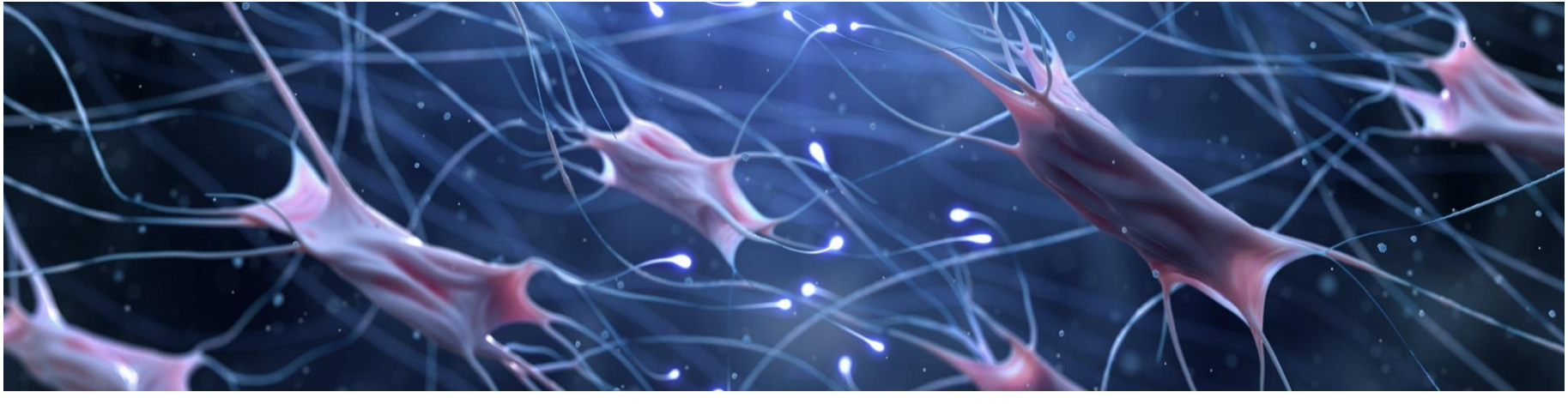
Conclusions

With more than 100.000 research publications and above 1000 clinical trials taking place globally, the area of cell therapies research (stem cell and CAR-T) is steadily expanding in terms of new knowledge and understanding of fundamental biological processes associated with production and application of stem cells, CAR-T technologies, and other cell therapies in general. The area is characterized by a steady flow of scientific breakthroughs with high translational potential, which opens up a landscape of opportunities for prospective investors.

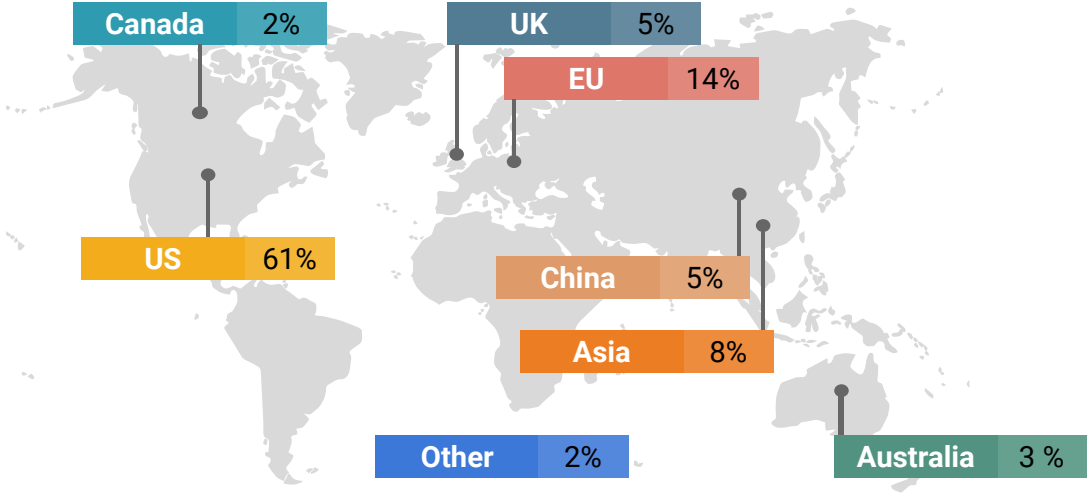
However, notwithstanding of substantial amount of clinical data showing relative safety and efficacy of cell therapies, related to stem cells and CAR-T, the overall presence of commercially available medical products and services is still rather limited, which is reflective of the fact that the market is in early days of development -- with substantial growth potential overall. Up to now, only 5 CAR-T therapies has been approved by FDA, including Abecma by Bluebird Bio and Bristol Myers Squibb, Tecartus™ by Kite Pharma, and others, as well as 19 Stem Cell products -- all being blood-forming stem cells (also known as hematopoietic progenitor cells) that are derived from umbilical cord blood. These products are approved for use in patients with disorders that affect the production of blood.



Conclusions

The current global landscape of leading cell therapy-focused companies, reviewed in this report, is represented by around 400 players, of which above 30% are public companies – the industry is largely unconsolidated and is still in early stage of maturity. Leading pharmaceutical players are actively involved in the cell therapies market with the aim of diversifying their existing research pipelines and trying to win the race in the emerging biotech competition -- this is reflected increasing activity in terms of internal programs, as well as R&D partnerships and direct investments into smaller biotechs, focused on stem cells and CAR-Ts.

US is still a main player in stem cells industry, accounting for the largest share of companies (more than 60%), both in R&D-stage clinical stage, and medical applications of stem cells of all companies in this sector globally. The stem cells sector is characterized by a growing activity in the venture capital investment landscape, which is reflected in the overall growth of investments in 2020 vs previous years. **Asian region is increasingly entering the global cell therapy market,** accounting for around 8% of all companies, with 2/3rds of them being in China. Europe and UK account for around 20% of all companies, around 1/4rd of them located in UK.

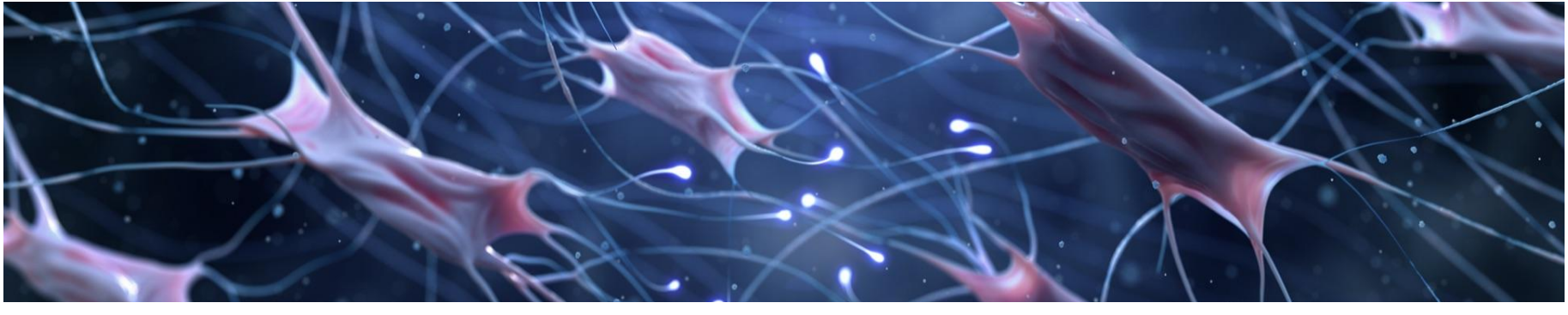


Key Takeaways

While the area of stem cells and CAR-T technologies possesses disruptive potential in terms of the impact on the future of healthcare, the current value proposition is still extremely limited to patients due to a number of technological limitations, the overall high cost, and logistical complexities of applying such cell therapies and related treatments in practise. This is rapidly changing with a variety of ongoing technology improvements, and we expect rapid increase in FDA approvals and commercial products over the course of 5 years.

While the scope of applications for Stem Cells is wide, we believe that the most significant impact of this technology can be achieved in the field of treatment of neurodegenerative diseases, including Parkinson, Alzheimer's disease, and Multiple Sclerosis. Considering the absence of any meaningful progress with the current scope of treatments and research successes available in tackling the increasing the problem of neurological decline in eldergly population, latests research and early results associated with stem cells give hope for change.

The market of cell therapies is currently a growing opportunity for the private and institutional investors, and we expect the acceleration of funding inflow into the segments of stem cells and CAR-T technologies in the upcoming 2-5 years. Especially interesting opportunities emerge when companies develop specialized R&D platforms, capable of producing results with a wide variety of products and therapeutics areas.

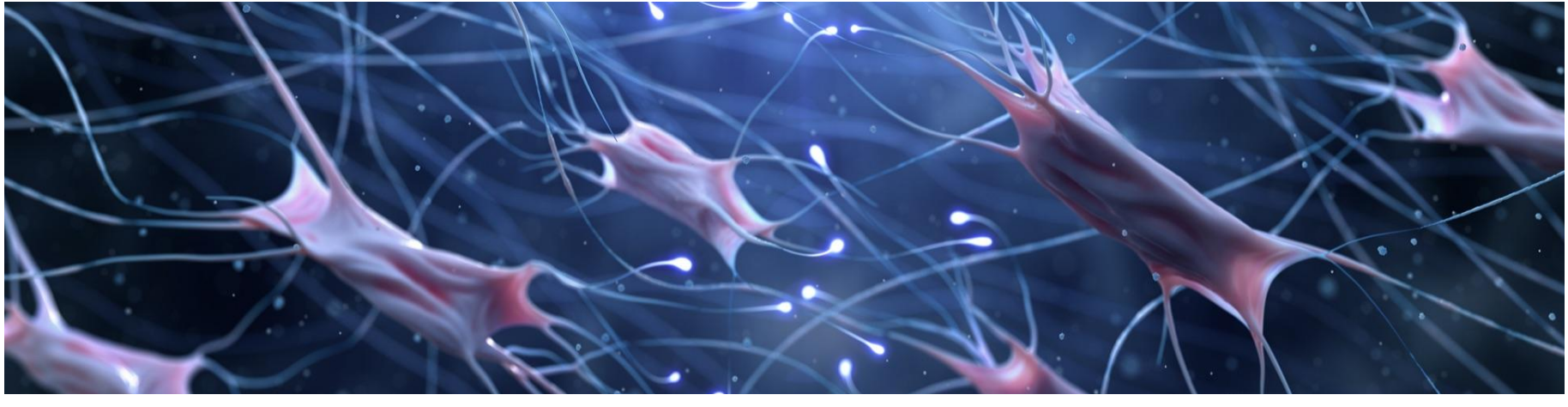


Key Takeaways

While the overall market of stem cells is experiencing a cautious optimism of investors, due to a number of setbacks in the past, the area of CAR-T technologies is increasingly attractive due to the large number of practical validations and success stories. There are, however, apparent limitations for the CAR-T technologies, which are currently limited to treating liquid forms of cancer, including lymphomas, leukosis.

We expect significant and widespread market growth once the problem of targeting solid tumours with CAR-T technologies is solved conceptually -- which might be related to identification of specific antigens, other than CD19. Once the technology is applicable to treatments of tumor cells, it will be targeting a much larger market and substantially wider range of applications.

A substantial market of stem cells applications is in the non-therapeutic applications, such as creating drug discovery models, 3D-bioprinting, regenerative medicine, industrial biotechnology, and other areas.



Appendix: List of Entities

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15 Pharma Corporations Active in Cell Therapy R&D

Company Name	Location	Website
AbbVie	Chicago, Il, USA	https://www.ab bvie.com
Athersys	Cleveland, OH, USA	https://www.athersys.com/
Apellis Pharmaceuticals	Waltham, MA USA	https://apellis.com/
Astellas Pharma	Tokyo, Japan	https://www.astellas.com/
Baxter International	Deerfield, Il USA	https://www.baxter.com/
bluebird bio	Cambridge, MA, USA	https://www.bluebirdbio.com/
Dompé	Milano, Italy	https://www.dompe.com/en
Gilead Sciences	Foster City, CA, USA	https://www.gilead.com/
Kite Pharma	Santa Monica, CA, USA	https://www.kitepharma.com/
Kiadis Pharma	Amsterdam, The Netherlands	https://www.kiadis.com/
Merck	Kenilworth, NJ, USA	https://www.merck.com/
Novartis	Switzerland	https://www.novartis.com/
PACT Pharma	South San Francisco, CA, USA	https://pactpharma.com/
Takeda Pharmaceutical	Tokyo, Japan	https://www.takeda.com
Teva Pharmaceutical Industries	Petach Tikva, Israel	https://www.tevapharm.com

List of 400 Cell Therapy Companies

1	3T Biosciences	12	Adverum Biotechnologies	23	Amgen	34	APstem Therapeutics, Inc.
2	4D Molecular Therapeutics	13	Aevi Genomic Medicine	24	Amniox Medical	35	Arcellx
3	AbbVie	14	Agios Pharmaceutical	25	Anagenesis	36	Arcus Biosciences
4	Abeona Therapeutics	15	AgomAb Therapeutics	26	Angiocrine Bioscience	37	Aroa Biosurgery Ltd
5	Accellta	16	Aivita BioMedical	27	Anixa Biosciences, Inc	38	Arsenal Biosciences
6	ACell	17	Aldagen	28	Antleron	39	Artiva Biotherapeutics
7	Achilles Therapeutics	18	Alliance Regenerative Medicine	29	Antion Biosciences	40	Aruna BioMedical
8	AcuraStem	19	Life Medical Science and Technology Co., Ltd.	30	Ankasa Regenerative Therapeutics	41	Applied Genetics Technologies Corporation
9	Adaptimmune Therapeutics	20	Allogene Therapeutics	31	Apeiron Biologics	42	Aspen Neuroscience
10	Adicet Bio	21	Ambys Medicines	32	Apellis Pharmaceuticals	43	Astellas Pharma
11	Advancells	22	American Gene Technologies	33	Ascend BioPharmaceuticals	44	Asterias Biotherapeutics

List of 400 Cell Therapy Companies

45	Asymmetrex	56	Azellon Cell Therapeutics	67	BioCell Center	78	Bio-Tissue
46	Atara Biotherapeutics	57	Baxter International	68	BIoEclipse Therapeutics	79	bluebird bio
47	Atelerix	58	Be Biopharma	69	Bioheart	80	BlueRock Therapeutics
48	Athersys	59	Beam Therapeutics	70	Bioinova	81	BlueSphere Bio
49	Aurora Biopharma, Inc.	60	Beijing Doing BioMedical Co., Ltd.	71	Bioneer	82	Boehringer Ingelheim
50	Autolus	61	Beike Biotechnology	72	BioNTech	83	Bone Therapeutics
51	Autolus Therapeutics	62	Bellicum Pharmaceuticals	73	BioRestorative Therapies	84	Boston BioMedical
52	Avalon GloboCare Corp	63	Berkeley Lights	74	BioSET	85	BrainStorm Cell Therapeutics
53	AVM Biotechnology	64	Binex	75	Biostage	86	BriaCell Therapeutics
54	Avrobio	65	BioAxone BioSciences	76	Biostem Technologies Inc	87	Cabaletta Bio
55	AxoGen	66	BioCardia	77	Biotherapeutics	88	Caladrius Biosciences

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89	Calibr	100	Celgene Corporation	111	Cellerant Therapeutics	122	Century Therapeutics
90	Capricor Therapeutics	101	Cell Care Therapeutics	112	Celling Biosciences	123	Chimera Bioengineering
91	CardioCell	102	Cell Design Labs (Acquired by Gilead Sciences)	113	Cellis	124	Chimerix
92	Cardium Therapeutics	103	Cell Guidance Systems	114	Celltex Therapeutics	125	CiMaas
93	Caribou Biosciences	104	Cell Line Genetics	115	Cellular Biomedicine Group	126	co.don
94	Carmell Therapeutics	105	Cell Therapies	116	Cellular Dynamics	127	CombiGene
95	CARsgen Therapeutics	106	Cell Therapy	117	Cellular Therapeutics Ltd	128	CONNECT TO CRM
96	Cartesian Therapeutics	107	Cellares	118	Celther Polska	129	Cook MyoSite
97	Casebia	108	Cellectis	119	Celularity	130	CRISPR Therapeutics
98	Catamaran Bio	109	Cellective BioTherapy	120	Celyad	131	Cryo-Cell International
99	Celdara Medical	110	Cellenkos	121	Censo Biotechnologies	132	Cynata Therapeutics LTD

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133	CytoMed Therapeutics Pte Ltd	144	Enochian BioSciences	156	Fortress Bio	167	Glycostem Therapeutics
134	Cytonus Therapeutics	145	EpiBone	157	Fosun Kite Biotechnology Co. Ltd.	168	Hebei Senlang Biotechnology Inc., Ltd.
135	Cytori Therapeutics	146	Epsilon Molecular Engineering	158	Gamida Cell	169	Green Cross Lab Cell
136	CytoSen Therapeutics	147	eTheRNA immunotherapies	159	GammaDelta Therapeutics	170	Gracell Biotechnologies
137	Dendreon	148	Eureka Therapeutics	160	GEMoaB Monoclonals	171	Harpoon Therapeutics
138	DiscGenics	149	Eutilex	161	GeneChem	172	HelixNano
139	Dompé	150	ExoCoBio	162	GenEdit	173	Helocyte
140	EdiGene	151	Exopharm	163	Genenta Science	174	Histogen
141	eGenesis	152	EXUMA Biotech	164	GenExosome Technologies	175	Histogenics
142	Elpis BioPharmaceuticals	153	Fate Therapeutics	165	Gilead Sciences	176	Holostem Tarapie Avanzate
143	Emmecell	154	Flexcell	166	Glycosan	177	Hope Biosciences

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178	Human Longevity	189	Imstem Biotechnology	200	JointechLabs	211	KSQ Therapeutics
179	Humanigen, Inc.	190	International Stem Cell Corporation	201	Juno Therapeutics (aq by Celgene)	212	Kytopen
180	iCell Gene Therapeutics	191	Innoskel	202	JW Therapeutics	213	Kyverna Therapeutics
181	Idogen	192	Innovacell	203	Kadimastem	214	Laboratoires Genevrier
182	Immatics Biotechnologies	193	Instil Bio	204	Kangstem Biotech	215	Legend Biotech
183	ImmPact BIO	194	Intellia Therapeutics	205	Khloris Biosciences	216	Likarda
184	Immune Therapeutics	195	Intercytex Group	206	Kiadis Pharma	217	Lineage Cell Therapeutics
185	Immunicum	196	InGeneron	207	Kite Pharma	218	Lion TCR
186	ImmunoCellular Therapeutics	197	Iovance Biotherapeutics	208	Klogene	219	Living Cell Technologies
187	Immunochina	198	JangoBio	209	Koligo Therapeutics	200	Locate Bio
188	Immunovative Therapies	199	Janssen Biotech	210	Kolon Life Science	201	Locus Biosciences

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202	Luminary Therapeutics	213	Megakaryon Corporation	224	Mustang Bio	235	Neurona Therapeutics
203	Magenta Therapeutics	214	Mekonos Inc.	225	Nanjing Legend	236	NexImmune
204	MangoGen Pharma	215	Merck	226	Nano3D Biosciences	237	Nkarta Therapeutics
205	Marker Therapeutics	216	Mesoblast	227	NantKwest	238	NKMax America
206	MatTek Corp.	217	Miltenyi Biotec	228	Nektar Therapeutics	239	Nohla Therapeutics
207	MaxCyte	218	Minerva Biotechnologies Corp.	229	Neogene Therapeutics	240	Noile-Immune Biotech
208	Medigene	219	Miromatrix Medical	230	Neon Therapeutics	241	NovaBone Products
209	MediGene	220	Mogrify	231	NEOVII Biotech	242	Novadip Biosciences
210	Medipost	221	MolMed	232	NeuralStem	243	Novartis
211	Medisix Therapeutics Pte Ltd	222	Mologen AG	233	Neurogene	244	Obsidian Therapeutics
212	Medtronic	223	Morphocell Technologies	234	NeuroGeneration	245	Oncoimmune

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246	OncoMed Pharmaceuticals	257	PACT Pharma	268	Prescient Therapeutics	279	Regeneus
247	Opexa Therapeutics	258	PCT Cell Therapy Services	269	Prevail Therapeutics	280	Regenicin
248	Orca Bio	259	PDC*line Pharma	270	PrimeVax Immuno-Oncology	281	Regentis Biomaterials
249	Organogenesis	260	PeproMene Bio Inc.	271	Promethera Biosciences	282	Regentys
250	Organovo Holdings	261	Plakous Therapeutics	272	Protara Therapeutics	283	ReNeuron Group
251	Orgenesis	262	Plasticell	273	Protokinetix	284	RenovaCare
252	ORIG3N	263	Pluricell Biotech	274	Q Therapeutics	285	RepliCel Life Sciences
253	Orthocell	264	Pluristem Therapeutics	275	Qrons	286	Replicor
254	Osiris Therapeutics	265	Poseida Therapeutics	276	QuinXell Technologies	287	ReproCELL
255	Oxford BioMedica	266	Precigen	277	Refuge Biotechnologies	288	Rhapsody Biologics
256	OxStem	267	Precision BioSciences	278	Regen BioPharma	289	RHEACELL Therapeutics

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290	Rinri Therapeutics	301	SiBiono GeneTech	312	StemCells	323	Tactiva Therapeutics
291	Roslin Cells	302	Sigilon Therapeutics	313	Stemedica Cell Technologies	324	Takara Bio Inc.
292	Rubius Therapeutics	303	Sonoma BioTherapeutics	314	StemGenex	325	Takeda Pharmaceutical
293	SanBio	304	Sorrento Therapeutics	315	Steminent Biotherapeutics	326	Talaris Therapeutics
294	Saneron CCEL Therapeutics	305	Spark Therapeutics	316	Stemline Therapeutics	327	Talisman Therapeutics
295	Sangamo Therapeutics	306	SQZ Biotech	317	Stemmatters	328	TapImmune
296	SAVE	307	STEM CELL TECHNOLOGIC	318	Stempeutics Research	329	TC BioPharm
297	SciKon Innovation	308	Stem Cell Center of Thailand	319	Stemson Therapeutics	330	TCR2
298	Servier	309	Stem Cell Medicine	320	Stratatech Corporation	331	T-Cure Bioscience
299	Shanghai Sinobioway Sunterra Biotech	310	Stem Cell Treatment & Research Institute (STRI)	321	Synthasome	332	Tessa Therapeutics
300	Shire	311	StemBioSys	322	t2cure	333	Teva Pharmaceutical Industries

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334	TeVido BioDevices	345	Transgene	356	Vaccibody	367	VistaGen Therapeutics
335	The Pregene (ShenZhen) Biotechnology Company	346	Tissue Regeneration Therapeutics	357	Vaccitech	368	Vital Therapies
336	ThermoGenesis	347	TriArm Therapeutics	358	Valo Therapeutics	369	VitroBioPharma
337	TiGenix	348	Trillium Therapeutics	359	Vectorite Biotech	370	Vor Biopharma
338	Timmune Biotech Inc.	349	Triumvira Immunologics	360	Vericel Corp	371	WindMIL Therapeutics
339	Tissue Genesis	350	TScan Therapeutics	361	Stemmatters	372	WntResearch
340	TreeFrog Therapeutics	351	TVAX BioMedical	362	Vetherapy	373	Wugen
341	TissueGene	352	Unicyte AG	363	VET-STEM INC.	374	Xcelthera Inc
342	Tmunity Therapeutics	353	Universal Cells Inc.	364	ViaCell	375	Xenikos
343	Toleranzia AB	354	UNUM Therapeutics	365	ViaCyte	376	Xintela
344	ToolGen, Inc.	355	US Stem Cell	366	Vir Biotechnology	377	ZetaGen Therapeutics

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1	Domain Associates	12	Samsung Ventures	23	Huagai Capital	34	European Investment Bank
2	DS Asset Management	13	Singapore Bio-Innovations	24	IDG Capital	35	Forbion Capital Partners
3	FUJIFILM	14	BioScience Managers Limited	25	KUNLUN	36	Fresenius Medical Care
4	Green Cross Lab Cell	15	GBS Ventures	26	Lilly Asia Ventures	37	Grifols
5	Kolon Investment	16	Sixty Degree Capital	27	Morningside Group	38	HBM Healthcare Investments AG
6	Kyoto University Innovation Capital	17	3H Health Investment	28	Qiming Venture Partners	39	Nextech Invest
7	Majuven	18	6 Dimensions Capital	29	Quan Capital	40	Novartis
8	Medivate Partners	19	Alwin Capital	30	Sequoia Capital China	41	Novo Holdings
9	Mitsubishi UFJ Capital	20	Green Pine Capital Partners	31	Anterra Capital	42	S.R.I.W.
10	NS Investment	21	GP Capital	32	Bayer	43	Sofinnova Partners
11	Real Tech Fund	22	Hillhouse Capital Group	33	Calmedica	44	Suma Venture

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45	TVM Capital	56	Eight Roads Ventures	67	5AM Ventures	78	Apple Tree Partners
46	Wellington Partners	57	Excalibur Fund Managers	68	Acorn Campus Ventures	79	ARCH Venture Partners
47	Ally Bridge Group	58	Innovate UK	69	Acorn Pacific Ventures	80	ArmaVir Partners
48	Horizons Ventures	59	Matrix Corporate Capital	70	Adage Capital Management	81	Aspire Capital Partners LLC
49	Yuan Capitala	60	MVM Life Science Partners	71	Aisling Capital	82	Astellas Venture Management
50	Axon Ventures	61	Sixth Element Capital	72	Alexandria Venture	83	Atlas Venture
51	Pontifax	62	University of Oxford	73	Alloy Ventures	84	Baker Brothers Advisors LLC
52	AlbionVC	63	Syncona Partners LLP	74	Alta Partners	85	Berkshire Hathaway
53	4BIO Capital	64	Woodford Investment Management	75	Amgen Ventures	86	Bill & Melinda Gates Foundation
54	Arthurian Life Sciences	65	301 Ventures	76	Amino Capital	87	BioLife Solutions
55	Cancer Research Technology	66	43North	77	Amzak Health Investors	88	Biomatics Capital Partners

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89	BioMed Ventures	100	CNF Investments, LLC	111	EcoR1 Capital	122	F-Prime Capital
90	Blackstone Life Sciences	101	Cormorant Capital	112	Elementum Ventures	123	Frazier Healthcare Partners
91	Boxer Capital	102	Cowen Healthcare Investments	113	Emerging Technology Partners	124	GE Ventures
92	Brace Pharma	103	CRCM Ventures	114	Equity Group Investments	125	Good AI Capital
93	Broadview Ventures	104	DAG Ventures	115	Euclidean Capital	126	Grand Central Tech
94	California Institute for Regenerative Medicine	105	Deerfield Capital Management	116	Eshelman Ventures	127	Fountainhead Investment Partners
95	Canaan Partners	106	Deerfield Management	117	Eventide	128	Hackensack Meridian Health
96	Casdin Capital	107	DHVC	118	Fidelity	129	Harbert Growth Partners
97	Celgene	108	Dynamk Capital	119	First Analysis	130	Harbinger Ventures
98	Citadel	109	Eastern Capital	120	Flagship Pioneering	131	Hike Ventures
99	Clarus Ventures	110	Easton Capital	121	Foresite Capital	132	Horizon Technology Finance

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133	Illumina Ventures	144	Menlo Ventures	156	Perceptive Advisors	167	RiverVest
134	Intersouth Partners	145	Merlin Nexus	157	Pfizer Venture Investments	168	Rose Tech Ventures
135	Iroquois Capital	146	Mission Bay Capital	158	Piper Jaffray	169	Samsara BioCapital
136	Johnson & Johnson Innovation	147	MPM Capital	159	Pivotal bioVenture Partners	170	Sanderling Ventures
137	Khosla Ventures	148	New Leaf Venture Partners	160	Plum Alley	171	Sanofi Ventures
138	Kleiner Perkins	149	Omega Funds	161	Polaris Partners	172	Section 32
139	Leerink Partners	150	OrbiMed	162	PureTech Health	173	Sibling Capital
140	Lightstone Ventures	151	OS Fund	163	RA Capital Management	174	Silicon Valley Bank
141	Longwood Fund	152	Pappas Ventures	164	Redmile Group	175	Sixth Floor Investors
142	Lyell Immunopharma	153	Parker Institute for Cancer Immunotherapy	165	Regeneron Pharmaceuticals	176	Sofinnova Investments
143	Maverick Ventures	154	Partnership Fund for New York City	166	Ridgeback Capital	177	SR One

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178	Starlight Ventures	189	Threshold	200	+ND Capital	211	Altitude Life Science Ventures
179	StartUp Health	190	Tullis Health Investors	201	24 Haymarket	212	Alumni Ventures Group
180	SV Health Investors	191	venBio Partners	202	3E Bioventures	213	aMoon2 Fund
181	Tactics II Stem Cell Ventures	192	Venrock	203	8VC	214	Andera Partners
182	Takeda Ventures	193	Versant Ventures	204	Abbhi Capital	215	Angus Mitchell
183	Tall Oaks Capital Partners	194	Vida Ventures	205	Abingworth	216	Apax Partners
184	The Aurora Funds	195	Vivo Capital	206	Access Industries	217	ArrowMark Partners
185	The Column Group	196	Westlake Village BioPartners	207	Ahren Innovation Capital	218	Asset Management Partners
186	The Howard Hughes Medical Institute	197	William Blair	208	Aju IB Investment	219	AVICT Global Holdings
187	The Howard Hughes Medical Institute	198	Wisconsin Alumni Research Foundation	209	Alexsis de Raadt St. James Founder and Managing Partner @ Merian Ventures	200	Australian Government for Research & Development
188	Third Rock Ventures	199	Penn Medicine C	210	Alaska Permanent Fund	201	BAMS Angel Fund

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202	BVF Partners	213	Clal Biotechnology Industries	224	Draper Esprit	235	FoxKiser
203	California Technology Ventures	214	Clough Capital Partners	225	Duke Management Company	236	Franklin Templeton Investments
204	Camden Partners	215	Commodore Capital	226	Eclipse Ventures	237	Friedli Corporate Finance
205	Canada Pension Plan Investment Board	216	CRCP Life Science Fund	227	EDBI	238	Fund+
206	Caribou Biosciences	217	CureDuchenne Ventures	228	EFung Capital	239	G.N. Tech Venture
207	Cedars Sinai Medical Center	218	Dalton Venture	229	Eli Lilly	240	GBA Fund
208	Cell Ceuticals Skin Care	219	Daniel Curran Founder	230	F1 BioVentures	241	GeneMatrix
209	Centre for Commercialization of Cancer Immunotherapy	220	Darrin Disley	231	Fan Ventures	242	Genoa Ventures
210	Chengdu Miaoji Medical Technology	221	DCI Partners	232	Farallon Capital Management	243	German Federal Ministry of Education and Research
211	ChiNext Qianhai Capital	222	DCVC Bio	233	Felicis Ventures	244	Gilead Sciences
212	CID Capital	223	dievini Hopp Biotech Holding	234	Fosun Pharma	245	Global Health Investment Fund

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246	GV	257	ITOCHU Technology Ventures	268	Karst Peak Capital	279	Logos Capital
247	Heliconia Capital Management	258	Janus Capital Group	269	King Star Capital	280	Lombard Odier
248	Heraeus	259	JDRF (The Juvenile Diabetes Research Foundation)	270	Korea Investment Partners	281	Longevity Vision Fund
249	Heritage Group	260	Jeito Capital	271	Kreos Capital	282	Longitude Capital
250	HM Capital	261	Jennison Associates	272	KTB Ventures	283	Lordship Ventures
251	Hunza Ventures	262	JIC Genesis Fountain Healthcare Ventures	273	Leaps by Bayer	284	Malcolm Currie @ Innovative Micro Technologies
252	Idinvest Partners	263	Jolly Innovation Ventures	274	Legend Capital	285	Malin Corporation
253	Innovative Medical Management	264	Junchenda Capital	275	Leonard Lavin	286	Massachusetts Clean Energy Center
254	Integrale Advisors	265	JVC Investment Partners	276	Life Sciences Partners	287	MedSciences Capital
255	Israel Biotech Fund	266	Kaiser Family Foundation	277	Lifeforce Capital	288	Mercia Asset Management PLC
256	Israel Healthcare Ventures	267	Kaitai Capital	278	Lightspeed Venture Partners	289	Merck

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290	Midlands Engine Investment Fund	301	NCL Technology Ventures	312	ODYSSEE VENTURE	323	Pentwater Capital Management
291	National Multiple Sclerosis Society	302	Neptune Investment Management	313	Oriza Holdings	324	Peter Thiel Partner @ Founders Fund
292	Misgav Technology Center	303	New Enterprise Associates	314	Osage University Partners	325	Photon Fund
293	Mission Bay Capital	304	New Science Ventures	315	OVP Venture Partners	326	Piedmont Capital Partners
294	Mizuho Bank	305	NewVa Capital Partners	316	Oxford Sciences Innovation	327	Pitango Venture Capital
295	Montaur Capital Partners	306	Nipro Corporation	317	Pagliuca Family Office	328	Platinum Asset Management
296	NanoDimension	307	Nivelinvest	318	Pamoja Capital Group	329	Qingzhe Capital
297	OCV	308	Nomis Bay	319	Panacea Venture	330	Quogue Capital
298	National Institutes of Health	309	Ocean Pine Healthcare Fund	320	Parkwalk Advisors	331	Randal J. Kirk @ Third Security
299	Mirae Asset Capital	310	Octagon Capital Partners	321	Partners Innovation Fund	332	Rapha Capital Management
300	Nausicaa Ventures	311	National Institute of Diabetes Digestive and Kidney Diseases	322	Penn Medicine CoInvestment Program	333	Renaissance Capital Partners

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334	Ridgeway Capital Partners	342	SFC Co	350	SMBC Venture Capital	358	Sean Parker CoFounder @ Causes
335	RimAsia Capital Partners	343	Shanghai Sinobioway Sunterra Biotechnology	351	Sony Innovation Fund	359	Shougang Fund
336	Sabby Capital	344	ShangPharma	352	SOSV	360	Scottish Enterprise
337	SAIKYO	345	Shavit Capital	353	South China Venture Capital	361	Shiyu Capital
338	Sam Altman CoFounder & CEO @ OpenAI	346	ShengJing360	354	Sphera Funds Management	362	Sansei Capital Investment
339	Sanford Health	347	Sherpa Venture Capital	355	Shu Duan Director @ Credit Suisse	363	Shinsei Corporate Investment Limited
340	Sangel Capital	348	Shibuya Kogyo	356	Sectoral Asset Management		
341	Sansei Capital Investment	349	Shinsei Corporate Investment Limited	357	Sansei Capital Investment		

Overview of Proprietary Analytics by Deep Pharma Intelligence

About Deep Pharma Intelligence

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

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

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

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

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

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

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

Overview of Proprietary Analytics by Pharma Division of Deep Pharma Analytics

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

While DPI is regularly producing open industry reports, covering high-growth sectors, including artificial intelligence, digital health, new therapies, more in-depth research is only available to our clients and strategic partners under the "Proprietary Analytics" category.

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

Services:

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

Overview of Proprietary Analytics by Pharma Division of Deep Pharma Analytics

Proprietary Reports

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

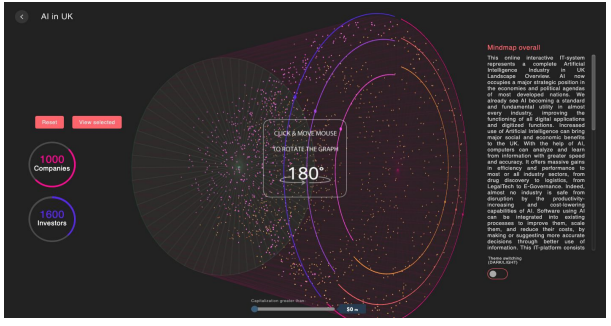
Our reports are supported by our rapidly developing data mining engine, data visualization platform and analytics dashboards.

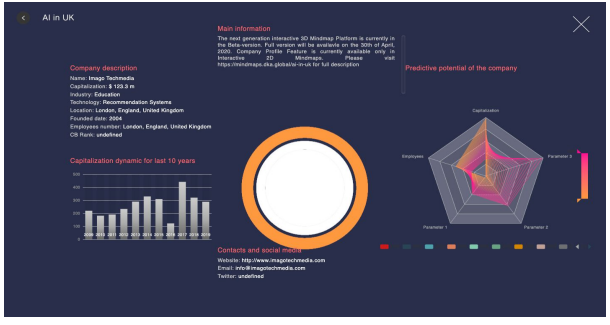
The value our reports can deliver:

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

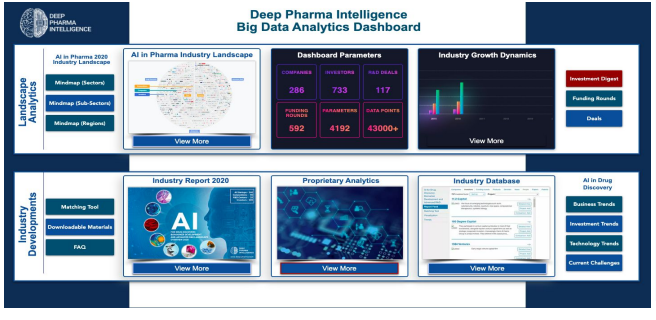
The parties who gain early access to these reports will have deep expertise on how their strategic agendas can be optimized in order to leverage novel research, new technologies, and emerging market opportunities, and stay competitive in a rapidly-changing technological environment, and taking into account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

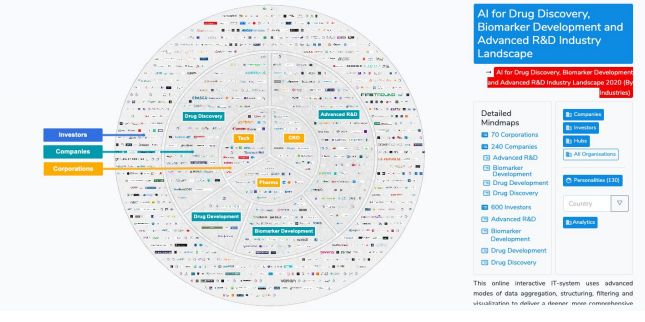
Deep Pharma Intelligence:
Upcoming Projects and Analytical Tools





3D Visualisation Prototypes





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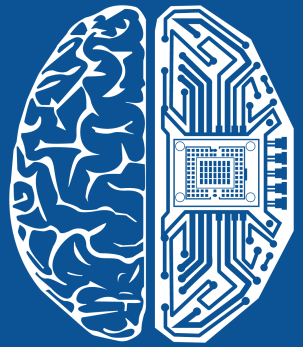

Link to the Report: analytics.deep-pharma.tech/Cell-Therapies-Landscape-Overview.pdf

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