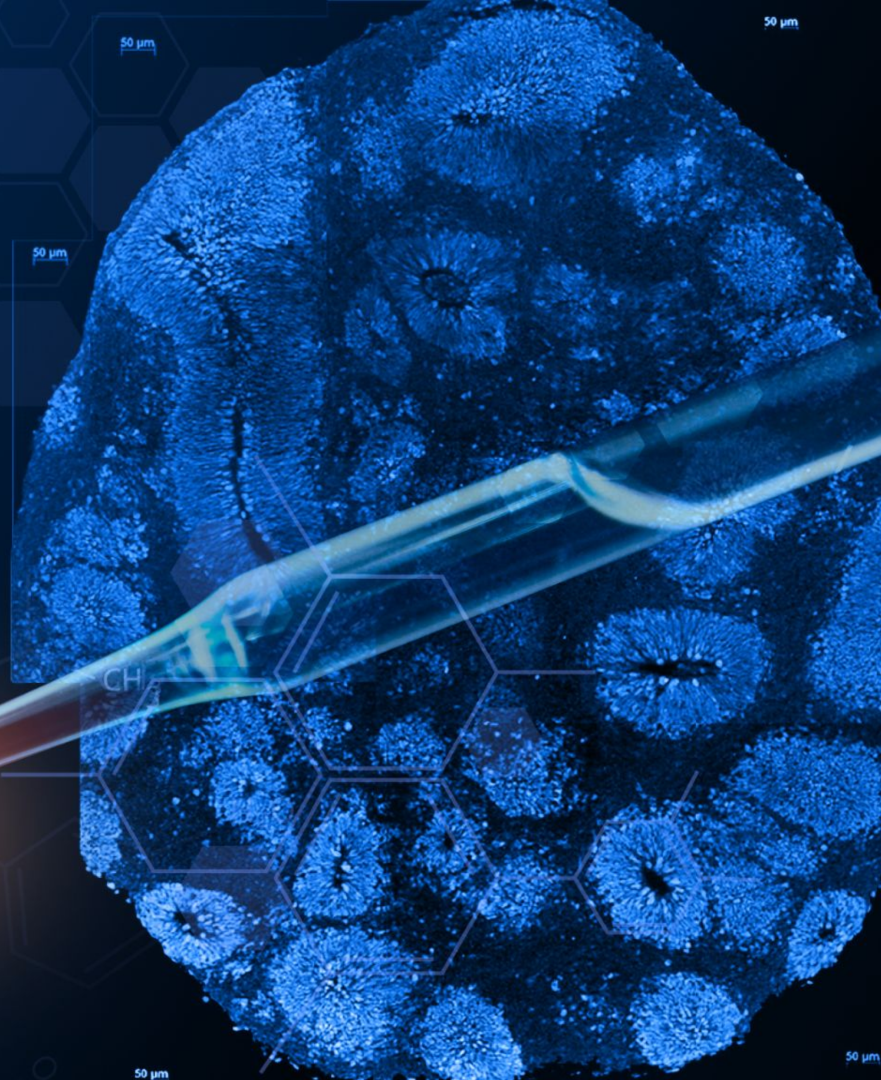
DEEP PHARMA INTELLIGENCE

Modern Technologies for Preclinical and Clinical Optimisation



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Report Approach

Database

70
Clinical Trials

165
Companies

260
Investors

The database was formed based on:

- the **identification of companies** that conduct or have conducted clinical or preclinical research of drugs
- the **identification of companies** that research or develops biomarkers

Applied Research and Analytics Methods

Descriptive Analysis

Mixed Data Research

Data Triangulation

Comparative Analysis

Qualitative Data Collection

Data Filtering

Data Sources

Media Overview
(Articles and Press Releases)

Industry-Specialised Databases

Publicly Available Sources
(Websites)

Industry Reports and Reviews

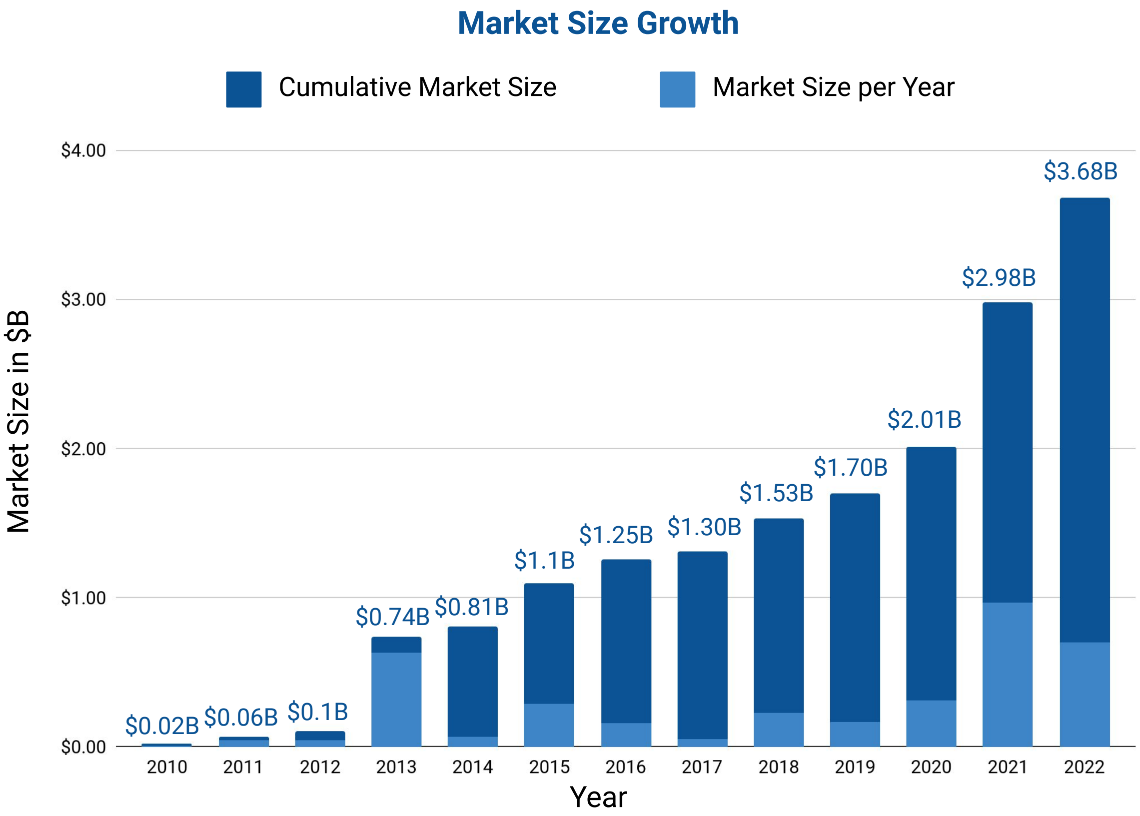
Relying on various research methods and analytics techniques, the analysis provides a comprehensive overview of the Preclinical and Clinical Trials Industry. This approach has certain limitations, especially when using publicly available data sources and conducting the secondary research. DPI is not responsible for the quality of the secondary data presented herein; however, we do our best to eliminate the said risks using different analytics techniques and cross-checking data. Please note that we did not deliberately exclude certain companies from our analysis. Nor was it due to the data-filtering method used or difficulties encountered. The main reason for their noninclusion was incomplete or missing information in the available sources.

Market Size Overview

Technologies for preclinical and clinical optimization are becoming increasingly popular over the last few years. More and more companies specialising in the development of technologies for preclinical and clinical optimization are opening every year, and even more companies are starting to implement these technologies in their R&D.

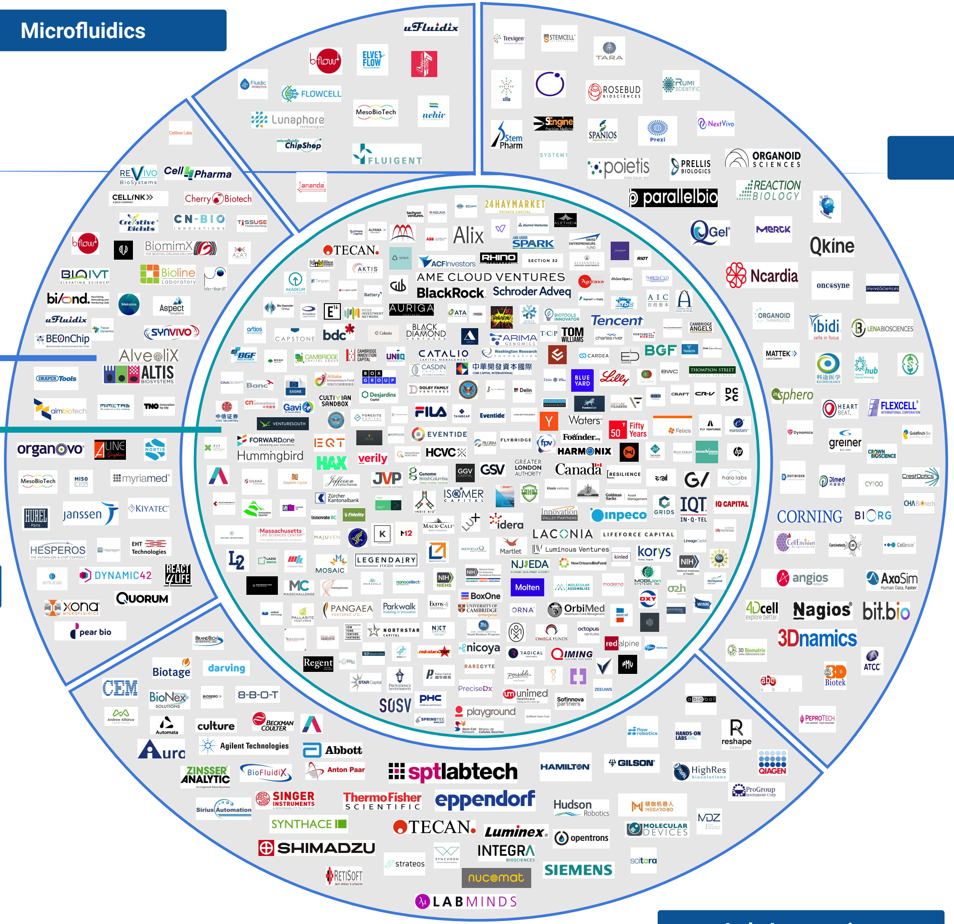
In 2021, the **market size** of organoids, organ-on-a-chip, microfluidics, and lab automation technologies was estimated at **$2.98 billion**, and it will reach **$3.68 billion in 2022**.

Considering this tendency, it is reasonable to say that preclinical and clinical optimization technologies start forming **separate branches of industry**.



Preclinical and Clinical Optimisation

Companies – 165
Investors – 260



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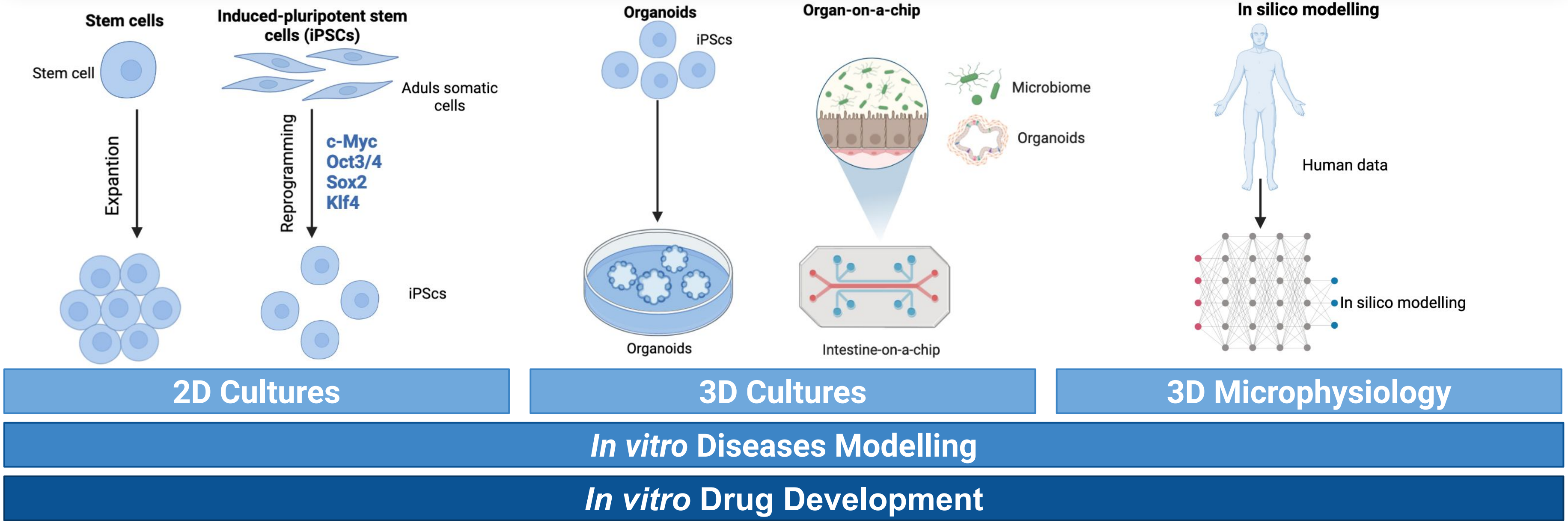
Introduction: Innovative *in Vitro* Models

To maximise effects and lower costs for both new and existing treatments, **Personalised Medicine** is receiving a lot of attention in **drug development** today. Thus far, drugs have often been approved based on their safety and effectiveness in a variety of patients. The goal of Personalised Medicine is to create **patient-tailored treatment** plans by accounting for individual variability in medication response. It is the antithesis of this 'one drug fits all' approach. Particularly, with regard to *ex vivo* treatment response prediction and associated medication dose optimisation, patient- and disease-specific drug testing systems based on current advancements in **stem cell**, **organoid**, and **organ-on-a-chip technology** would be a great value. In this report, we are focusing on **3D human (multi)cellular assays**, including **organoids and organ-on-a-chip models,** as well as on technologies that potentially can be used for their development, which includes **microfluidics** and **lab automation**.

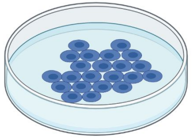


Sources: Berlo et al (2021). Current Opinion in Toxicology.

Introduction: Innovative *in Vitro* Models

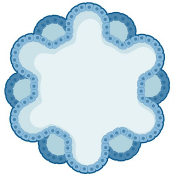
2D Models (Cell Culture)

Two-dimensional (2D) cell culture is performed on a flat substrate such as a petri dish. In this method, cell growth and division take place in a **single plane**. The cells are placed onto a coated surface to help them adhere and proliferate. It is a stable, successful, and well-established technique used in all types of in vitro research studies. Cells are easy to observe and measure in 2D culture. The downside is that it **does not represent a real cell environment.** In addition, there are a few issues caused by the expansion of cells and growth media.



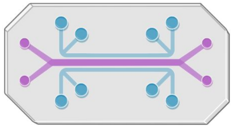
3D Models (Organoid)

3D cell culture is a culture environment that allows cells to grow and interact with the surrounding extracellular frameworks in **three dimensions. Organoid is three-dimensional (3D) cell structures** that contain a multitude of **organ-specific cells** formed by self-organisation and differentiation of stem cells. **Organoids** are better at representing **cellular environments** found in vivo than conventional two-dimensional cell cultures.

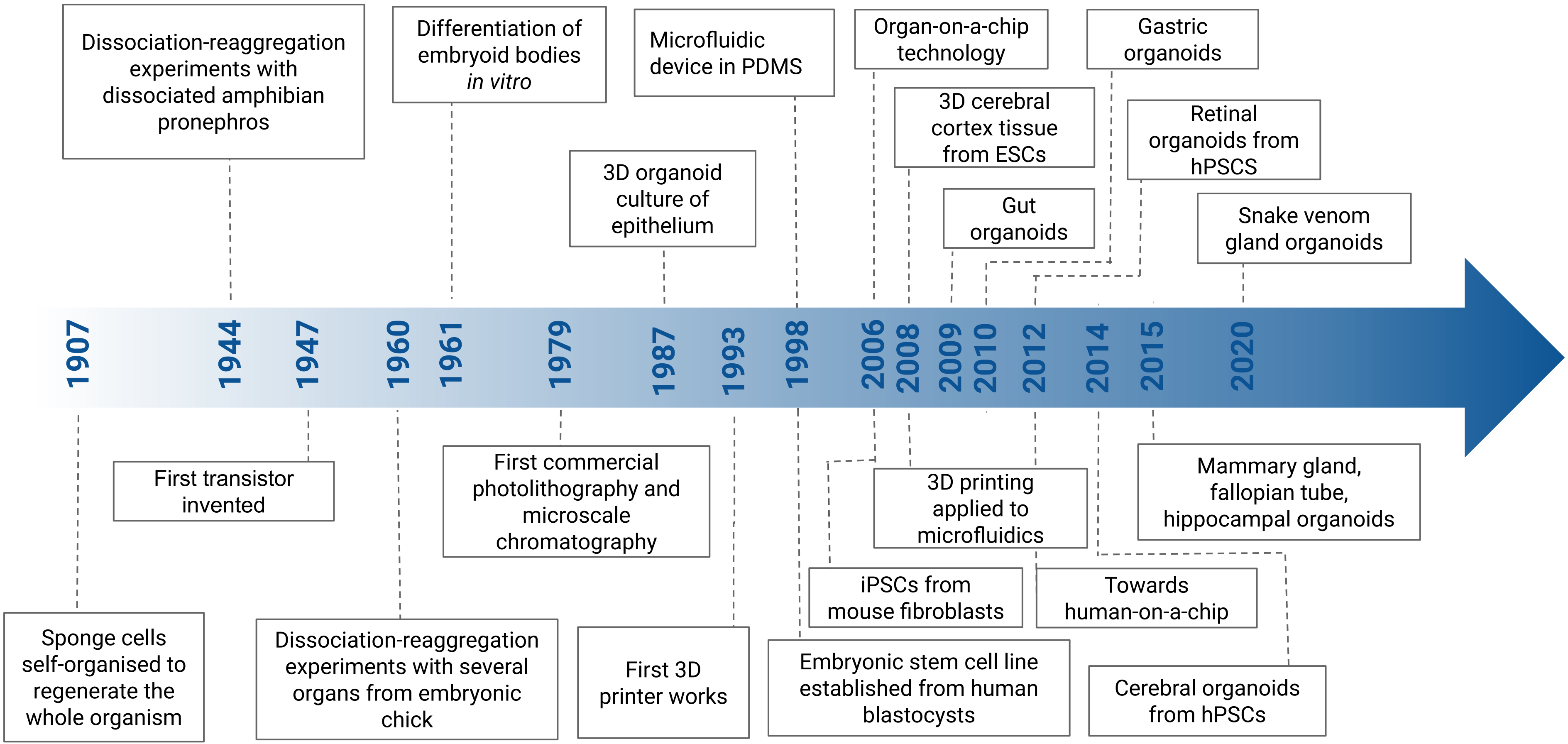


Microfluidic chip (Organ-on-a-Chip)

Organ-on-a-chip is a form of an artificial organ that **simulates** the functions, mechanics, and physiological responses of an entire organ or organ system using a **multichannel 3D microfluidic cell culture** integrated circuit (chip). The chips are lined with living human cells, and their tiny fluidic channels reproduce blood and/or airflow similar to those in the **human body**. Their flexibility allows the chips to recreate breathing motion or undergo muscle contractions.



Historical Overview of *in Vitro* Models Development



Sources: Corro et al (2020). American Journal of Cell Physiology.

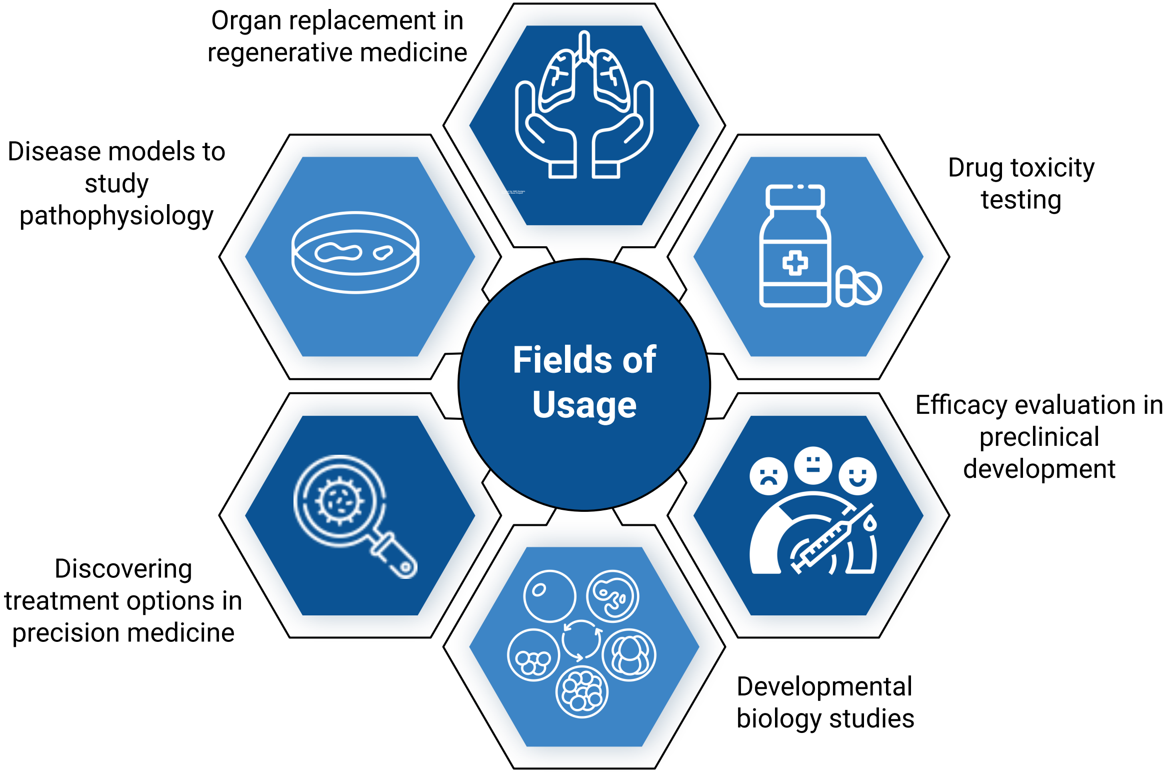
What Can *in Vitro* Models Be Used for?

***In vitro* models** are the starting point in biological and medical research. With scientific progress and the emergence of different *in vitro* models, **knowledge of the entire organism's behaviour is growing**.

Since these cells and microorganisms are isolated from their natural environment, these models may not completely or precisely predict the effects on the entire organism, but they can open **a lot of possibilities** for **medicine and drug discovery.**

In vitro models can be used in medicine to **develop models of different diseases** and study pathophysiology or to **develop organs for replacement**.

In the drug development process, these models are used for **testing drug toxicity** and for **evaluation of drug efficacy in preclinical studies**. With the availability of *in vitro* models, **personalised drug testing** in the laboratory has become within reach.

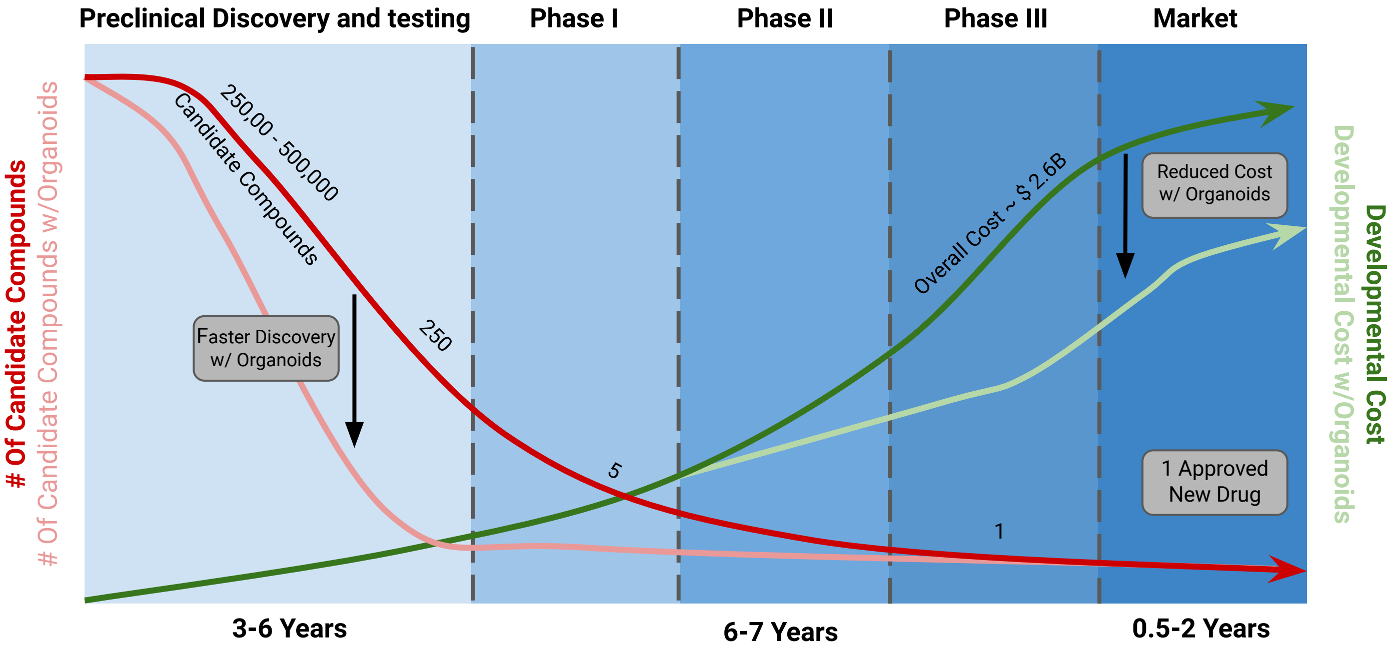


Benefits of *in Vitro* Models: Financial Reason

The potential impact of **organoid and orphan-on-a-chip models** on the drug discovery pipeline is a primary driver for their development and application. The 3D culture modalities are **significantly more predictive and informative.**

Integration of physiologically relevant **3D organoid models** could improve the drug development pipeline by eliminating toxic or ineffective compounds in preclinical testing.

Pharmaceutical development is mostly cost-driven by **Phase I–III clinical trials**. Organoids decrease the number of unsuccessful compounds that reach this stage, **reducing cost and increasing the number of approved medications**.



This graph demonstrates drug development costs and candidates vs. time, with and without organoids.

Sources: Devarasetty et al (2018). BioDrugs.

Benefits of *in Vitro* Models: Biological Reason

The immensely complex processes of the human body **cannot be accurately modeled by in vivo animal models**, and there is growing concern regarding **the morality of animal research**. A system like an in vitro 2D cell culture model is frequently employed since it is reasonably priced, simple to use, and capable of gathering a lot of reference data. These models, however, **are devoid of an actual extracellular physiological context**.
Organoids and **organ-on-a-chip** technologies have enormous advantages compared to 2D cultures and animal models, which make them a practical **platform for different experiments**, **modeling diseases**, and **high-throughput screening**. In a culture dish, patient-derived organoids can serve as models of human disease. The development of numerous organoids and organ-on-a-chips for drug screening and testing has increased international competition for patents.

	Animal Model	2D Cell Culture	3D Cell Culture	Human Organoid	Organ-on-a-Chip
Biobanking	✓	✓	✓	✓	✓
Vascularisationand immune system	✓	✗	✗	✗	✗
Heterogeneity	✗	✗	✓	✓	✓
High-throughput screening	✗	✓	✓	✓	✓
Modeling for human physiology	✗	✓	✓	✓	✓
Modeling cellular/mechanical communications	✗	✓	✓	✓	✓
Modeling patient-derived organoids	✗	✗	✓	✓	✓

Sources: Heydari et al (2021). Bio-Design and Manufacturing.

Organoids

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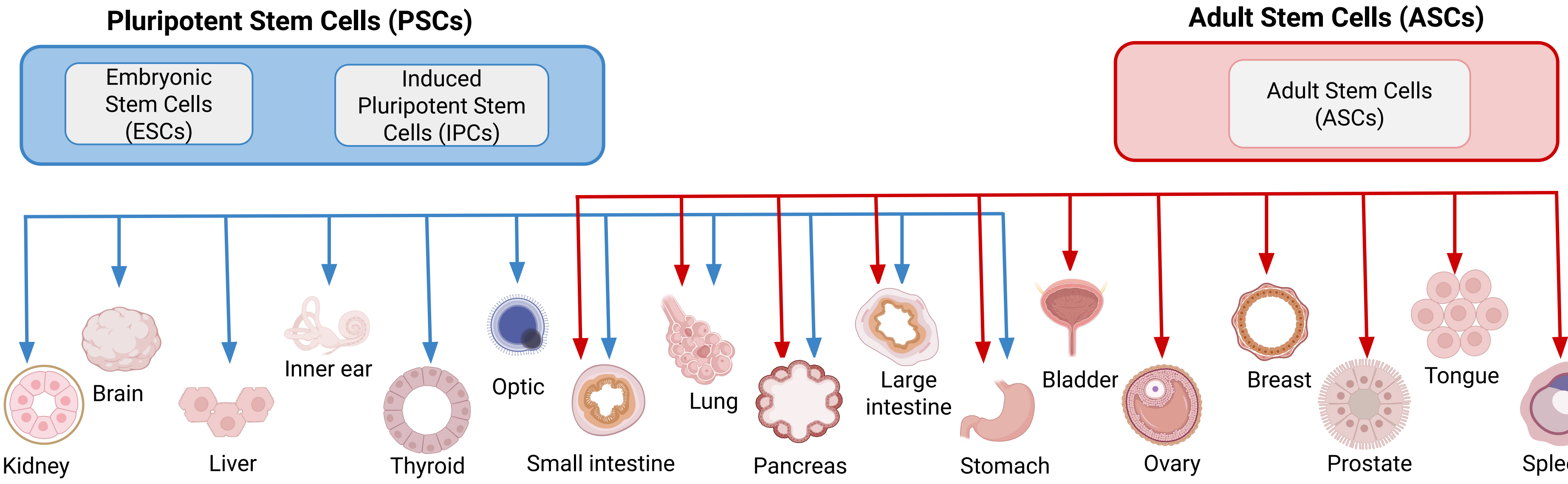
Types of Organoids

Organoids can be divided into two categories based on the stem cells used. The first type is formed from **pluripotent stem cells** (**PSCs**), which also include **embryonic stem cells** (**ESCs**) and **induced pluripotent stem cells** (**iPSCs**). The second type is derived from **adult stem cells** (ASCs) that are specialised for particular organs. Organoids such as the **colon, intestine, liver, prostate, pancreas, fallopian tube, stomach, tongue**, and **endometrial** can all be grown from **human ASCs**. **Organoids of the digestive system, liver, lungs, kidneys, pancreas, stomach,** and **retina** can all be cultured from **PSCs**. The **cerebral, optic cup,** and **renal organoids** serve as examples of how alterations to the aforementioned methodology can be used to culture PSC-derived organoids that are not produced from endoderm.



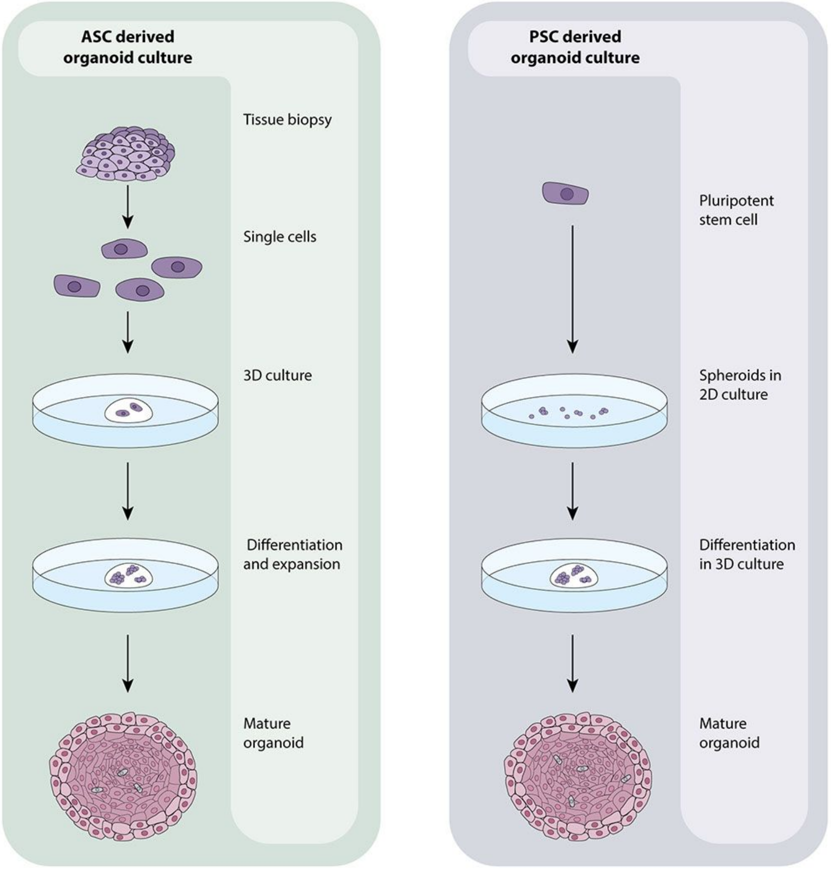
Process of Organoid Development

ASC-derived organoids are grown from **healthy or tumorous tissue biopsies.** A single-cell suspension made from processed tissues is then immediately enmeshed in an extracellular matrix. Until organoids have developed, media containing a variety of growth agents, which vary depending on the tissue being grown, is continuously added to. ASC-derived organoids can provide complementary adult epithelium to investigate mature tissue responses to pathogenic attacks or medications.

PSC-derived organoids originate with **2D cultures of PSCs** that are grown into aggregates/spheroids. At this point, they may be embedded in an extracellular matrix and expanded to maturity using a growth factor-rich media specific to the tissue of interest.

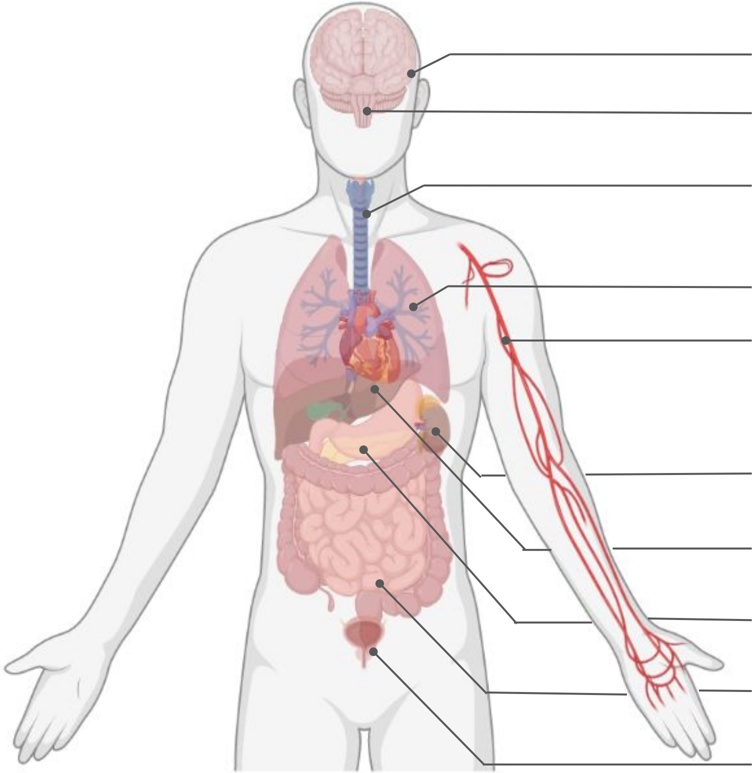
The composition and organisation of cells within organoids are dictated by the **identity of the tissue being grown,** which, in turn, affects the overall size and shape of the organoid.

It is obvious that **organoid systems** are already **being widely and productively used** in a **variety of clinical and fundamental research** situations, and it is only natural that the infectious diseases community would take notice.



Sources: Lakobachvili et al (2017). Frontiers in Microbiology.

Human Organoid Systems by Tissue of Origin



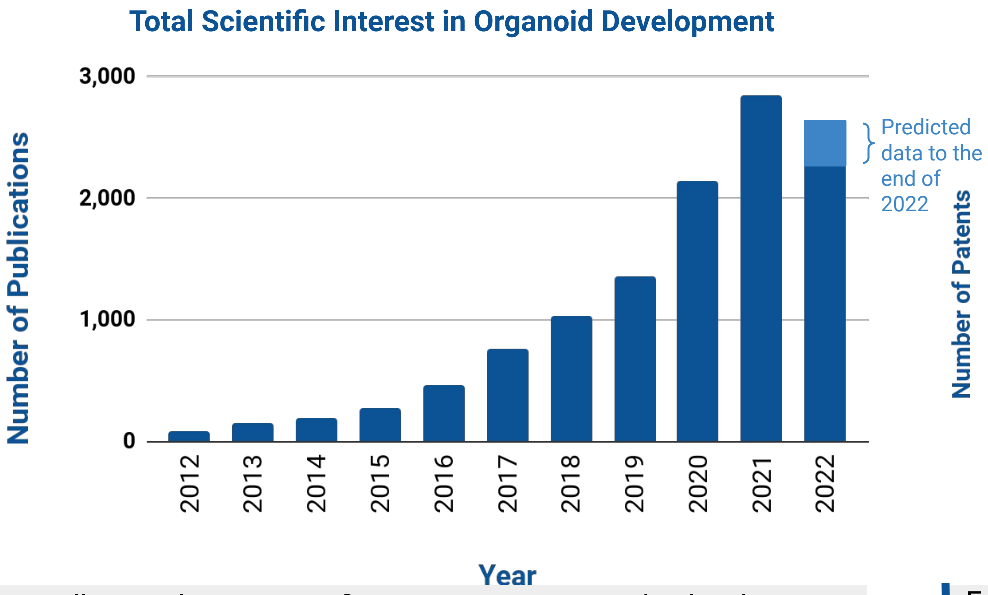
	AdSC-derived	PSC-derived	Cancer biobank	Disease modeling
Brain	✗	✓	✓	✓
Optic cup	✗	✓	✗	✗
Thyroid	✗	✓	✗	✓
Lung	✓	✓	✓	✓
Blood vessel	✗	✓	✗	✓
Mammary gland	✓	✓	✓	✓
Kidney	✓	✓	✓	✓
Liver	✓	✓	✓	✓
Stomach	✓	✓	✓	✓
Intestine	✓	✓	✓	✓
Bladder, prostate	✓	✗	✓	✓

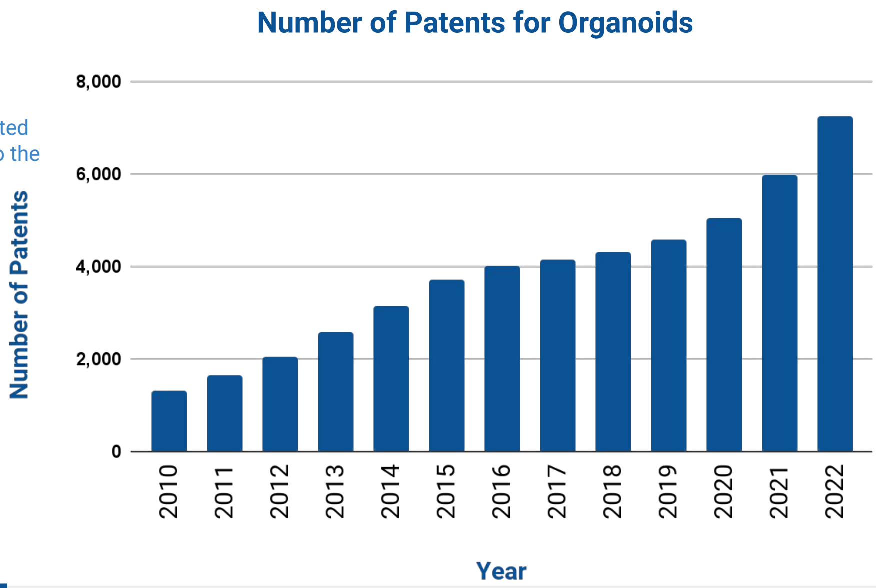
Note: The table provides information on the type (either pluripotent stem cell (PSC)-derived or adult stem cell (AdSC)-derived), biobanking status, and uses in disease modeling of the human organoid systems reported to date, summarised by organ.

PSC-derived organoids are available for all mentioned human organs. AdSC-derived human organoids have also become widely available. They have been generated from almost all endoderm-derived tissues and from gender-specific tissues.

Sources: Kim et al (2020). Nature Reviews

Rise of Organoids Development





Broadly speaking, scientific interest in organoids development **growths through the years**. More recent **advances in stem cell biology**, combined with decades of fundamental biological studies in **cell signaling** and **biomechanics**, have accelerated the development of organoids. Over a decade, the annual publishing has grown more than **2.5 fold** and is expected to continue increasing.

For the last decade, the growth of the number of projects working on organoids development **has increased.** In 2010-2022, the number of registered patents **reached 7,244**. This quantification includes **only granted patents**. Such continuous growth, driven by the **huge market potential**, was made possible by the concomitant **diffusion of multidisciplinary approaches**.

Sources: PubMed.com, patents.google.com

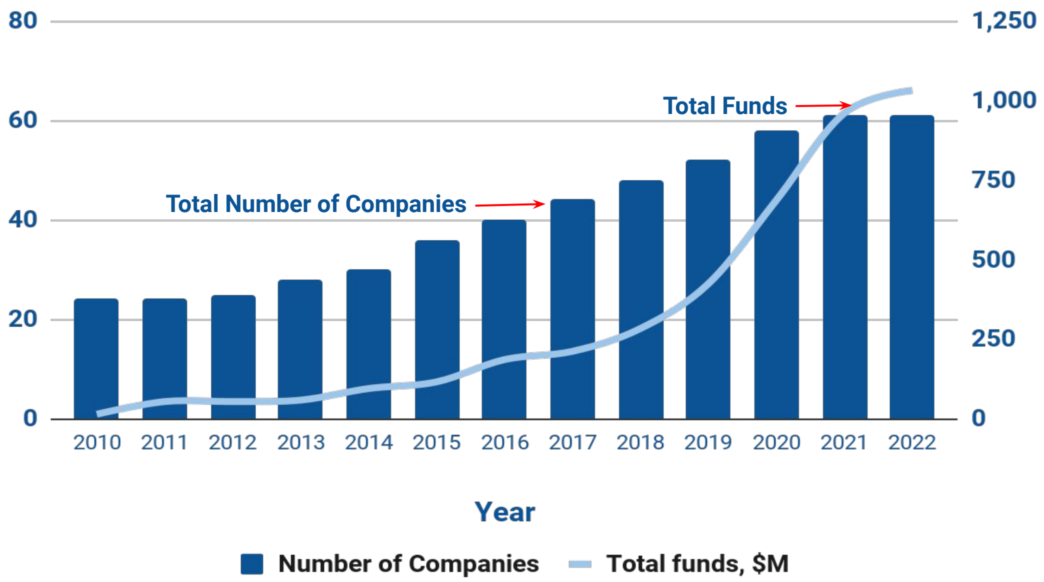
Organoids: Key Players

Key Providers	Key R&D Centers	Key R&D Companies
STEMCELL Technologies	NIH National Cancer Institute	SEngine
bit.bio	Maastro	poietis – make tissues real
HUB Organoids	Inserm	NextVivo
xilis	Duke University	丹望医疗 D1Med
DefiniGEN – Disease Model Innovation	Cambridge University Hospitals NHS Foundation Trust	Cell Envision – the expert to rare cells
Ncardia	Centre de Lutte contre le Cancer François Baclesse – unicancer Normandie - Caen	oncosyne
Cellesce	Chongqing University Cancer Hospital	MERCK
TARA	Fudan University 1905	CancerFree Biotech
insphero	Friedrich-Alexander-Universität	Heartbeat.
AxoSim – Human Data, Faster.		Reaction Biology Corp.
Carcinotech		科途医学 K2 Oncology
Organoid Therapeutics		Rumi Scientific
SUN bioscience		
PeproTech – Our support, your discovery		

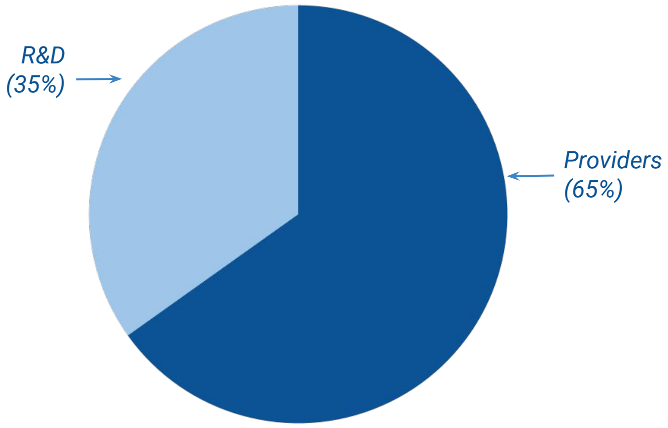
Note: This list was generated by database creation followed by the detailed analysis of every individual use case by the quantitative and qualitative features such as organoid category complexity and development possibilities of the technology, number of similar products on the market/development pipelines, the novelty of the product, addressment of the unmet needs, etc.

Growths of Organoids Industry

Cumulative Number of Companies and Total Value of Their Funds, 2010-2022



Distribution of Organoid Companies by Type

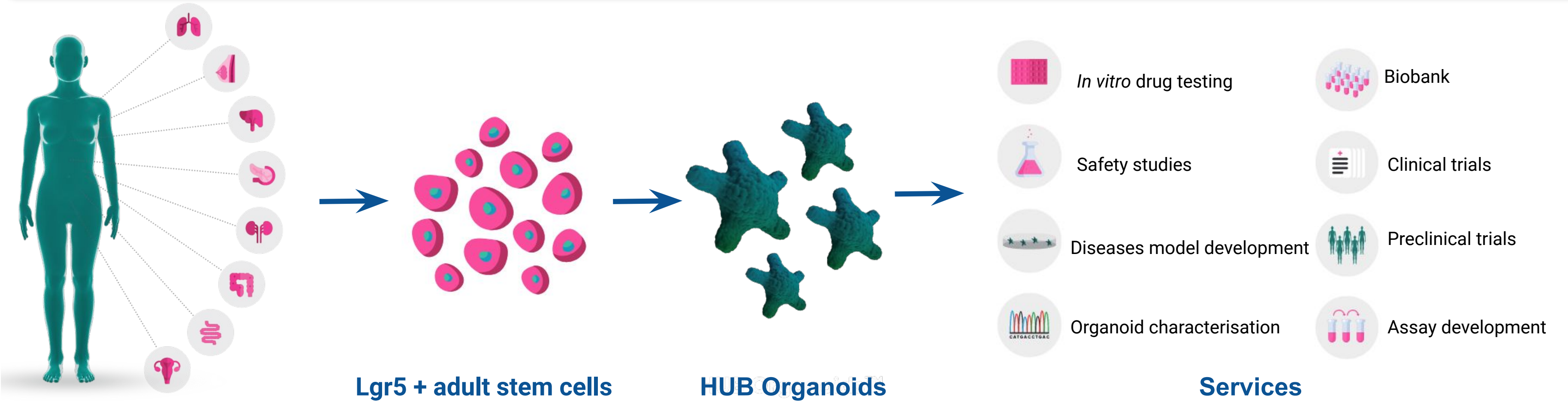


The organoid market growth significantly over the last 10 years. The share of new companies from the 2010 to 2020 period is **64%**. Organoids development market is valued at approximately **$1,031,384 million** in Q4 2022. Growth in the historic period (from 2010 to 2022) in the organoids market resulted from the **increase in investments in organoids development**, growth in research and development, **a rise in public-private partnerships**, increased healthcare expenditure, and **rising pharmaceutical R&D expenditure**.

Organoids: Key Study

HUB ORGANOIDS

HUB Organoids (Hubrecht *Organoid* Technology) is the global leader in the field of **adult stem cell-derived organoids** based in the Netherlands. HUB Organoid Technology is based on the ground-breaking discovery of **Lgr5+ stem cells** in the adult intestine by **Hans Clever´s lab**, which subsequently led to the development of the first **'mini-gut in a dish'**. HUB Organoid Technology does not require reprogramming or transformation of stem cells, therefore, enabling the **development of diseased, as well as healthy organoids,** which preserve the original tissue genetic and epigenetic makeup, including clinically-relevant mutations.

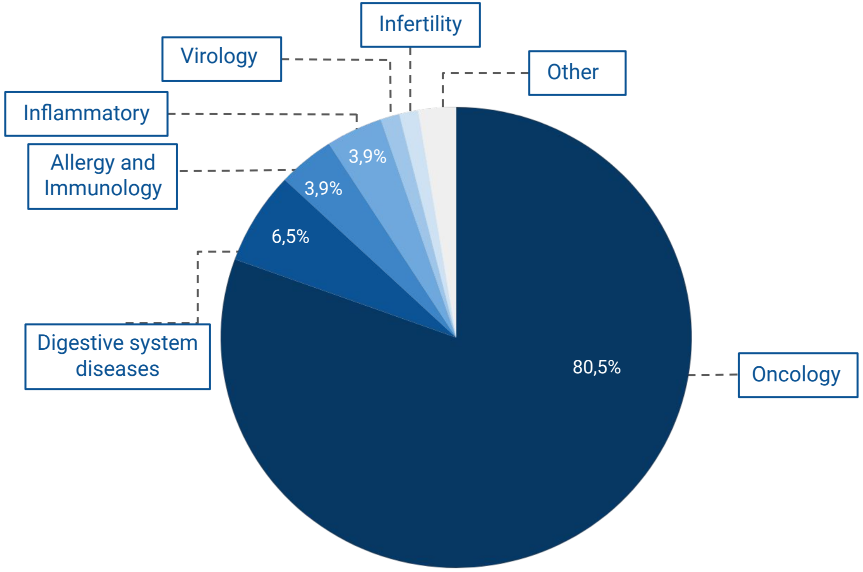


The technology captures both disease biology and the patient-specific (epi)genetic phenotype. Therefore, for the first time, a preclinical model directly represents the treatment outcome that can be expected in the patient in the clinic.

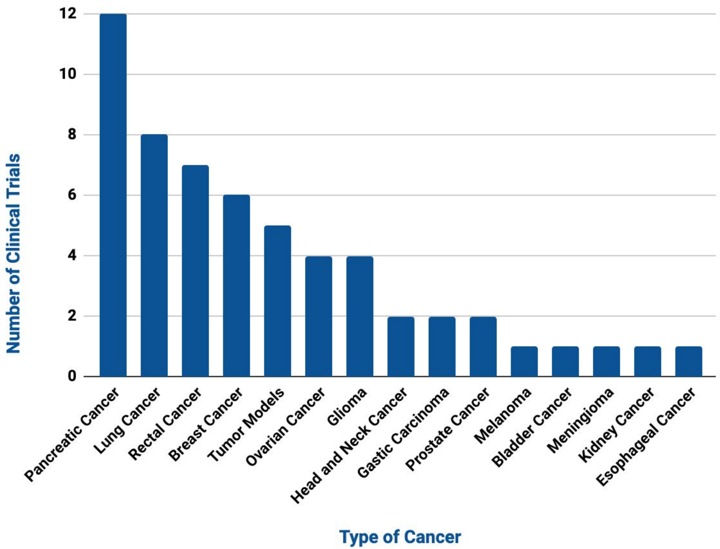
Sources: huborganoids.nl

Clinical Trials Based on Organoids

Clinical Trials Based on Organoids by Therapeutic Area



Clinical Trials Based on Organoids by Type of Cancer



We found **72 registered clinical trials** that study the potential use of **organoids for drug development.** On this pie chart, you can see a distribution of these clinical trials based on the **therapeutic area**. As expected, the most popular area is **oncology** and **80.5% of clinical trials** are focused on the development of organoids for cancer treatment. **Digestive system diseases** are in the second place and **6.5% of clinical trials** develop intestinal and gut organoids. All other areas are much less frequent.

On this graph you can see **distribution of registered clinical trials** by **type of cancer** for which organoids are developed. The most frequent are **pancreatic organoids** and **12 clinical trials** are developed them for studying **pancreatic cancer**. There are **eight**, **seven** and **six clinical trials** for studying **lung**, **rectal** and **breast cancer** respectively. **Five clinical trials** were registered for developing organoids to treat **tumors**. All other types of cancer are less frequent.

Sources: Clinicaltrials.gov

Organ-on-a-Chip

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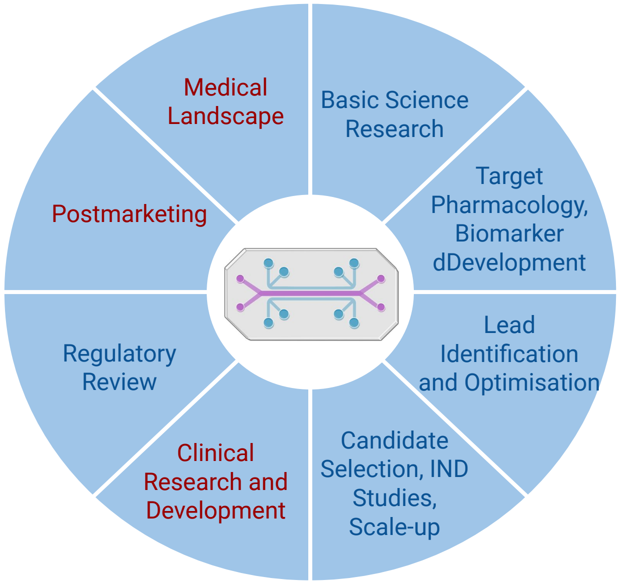
Utility of Organ-on-a-Chip Models

The table below lists the major (technical and biological) **uses of organ-on-a-chip in academia and industry**, as well as the traits that should be present for them to be successful in the **clinic**. Numerous other uses and distinguishing characteristics could not be included in the list of applications and attributes. The table's '+' symbols, with '+++' representing the greatest value, **indicate the significance of each use** in research, business, and clinical settings.

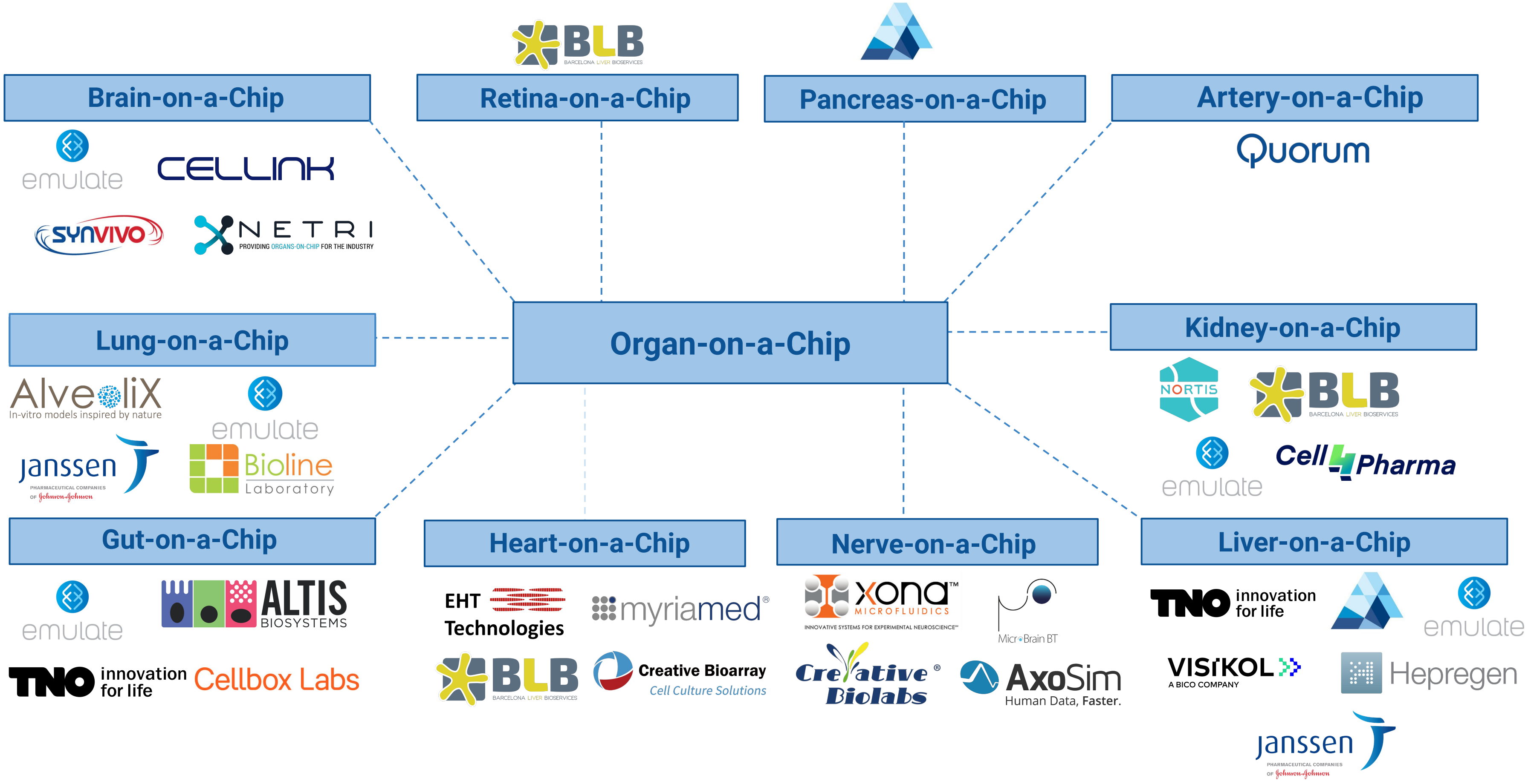
	ACADEMIA	INDUSTRY	CLINICS
Disease Pathophysiology	+++	+	+
Toxicology	+	+++	+++
Drug action mechanism	+++	++	++
Drug screening	++	+++	+++
Drug discovery	+	+++	+
Therapy assay	+	+	+++



These dynamic maps provide a **framework for understanding modern drug development**. Blue components reflect the **organ-on-a-chips** known current use or soon anticipated future utility, while red components show both the potential and expected utility in this schematic surrounded by several drug development phases and processes. The '**basic science research stage**' is where many **organ-on-a-chip** are right now.

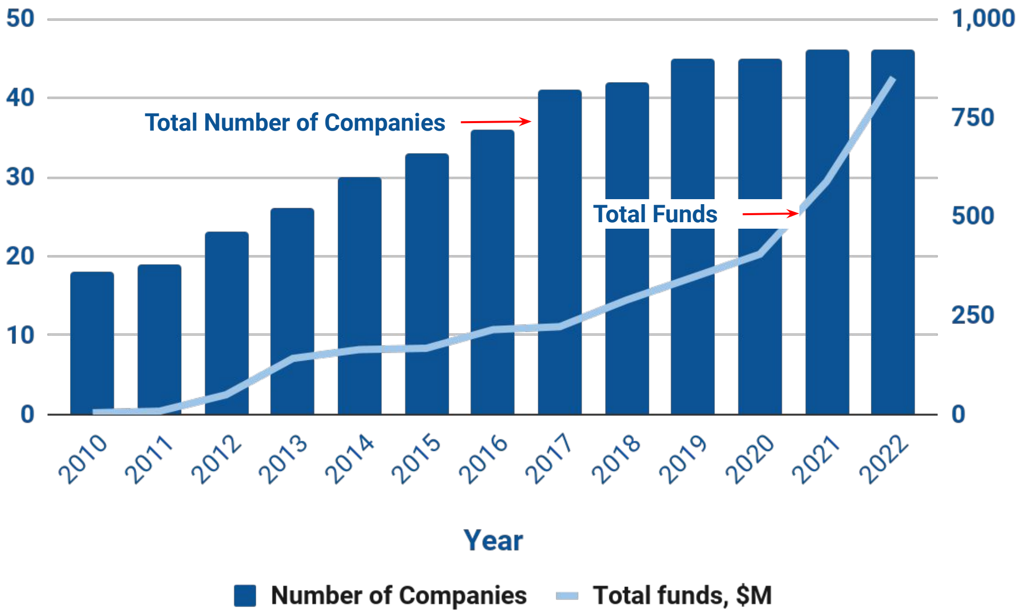
Sources: Lucie et al (2020). Nature Reviews.

Organ-on-a-Chip Diversity



Growths of Organ-on-a-Chip Industry

Cumulative Number of Companies and Total Value of Their Funds, 2010-2022



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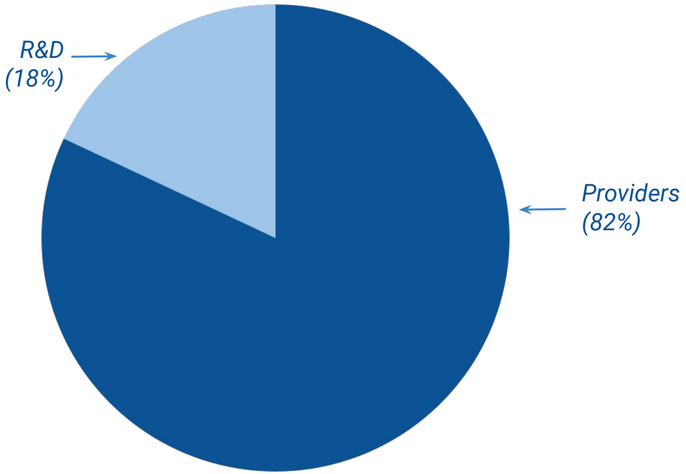
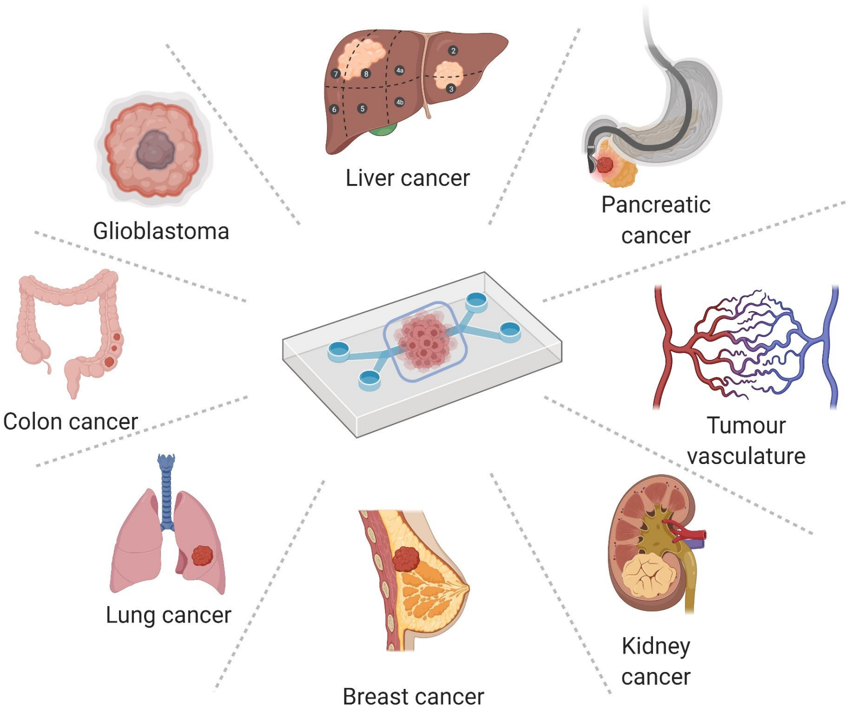


Organ-on-a-hip market was developed equally during the last 10 years. However, in the past 2 years, the market has been showing increased stagnation. The share of new companies from 2010 to 2020 is **60%**.The market is valued at approximately **$851,26 million** in Q4 2022. Some **82%** of the companies are related to **Providers,** and only **18%** are involved in R&D.

Cancer-on-a-Chip Platforms

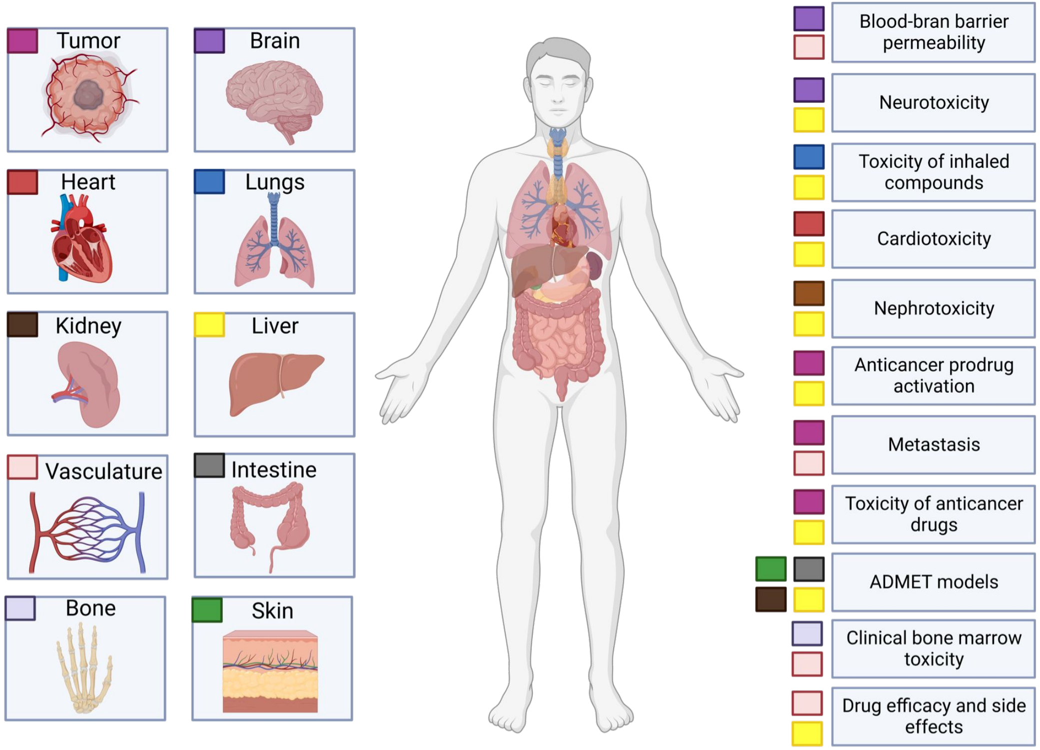
The World Health Organization lists **cancer** as one of the **main causes of death** globally. The evaluation of new anticancer medications' impact on cells must be done in a high throughput, cost- and time-efficient manner. The innovative **'cancer-on-a-chip'** technique, which combines microfluidics and 3D cancer models, overcomes this difficulty. It is a promising technique that can be used for **drug screening**, as well as to examine events like the **genesis** and **spread of metastasis**. It is also a promising tool for better simulating the cancer environment encountered in vivo.



Key Companies

Sources: Goncalves et al (2022). Cancers.

Multi-Organ-on-a-Chip



For each application (right side), a minimal set of organs necessary to build an accurate systemic model is indicated, those organs being highlighted with colored squares (left side).

Multiple organ interactions are necessary to guarantee the human body is able to function physiologically. Although organs are physically separated *in vivo*, communication between them is maintained through a variety of signals (soluble substances, exosomes, cells, etc.) through the blood and lymphatic circulation. Cross-organ communication and a systemic dimension must be included, as shown in figure, and this is most frequently accomplished by employing animal models. In a significant recent development, a **multiorgan platform that models numerous organs** in a single device has been created. Several companies like **Hesperos**, **TissUse,** and **CN Bio** create the entire human **body-on-a-chip** or **multiple-organ-on-a-chip platforms.**

Sources: Picollet-D’hahan et al (2021). Trends in Biotechnology.

Organ-on-a-Chip: Key Study

HESPEROS
THE HUMAN-ON-A-CHIP COMPANY

Hesperos, Inc. is a leader in efforts to characterise an individual's biology with **Human-on-a-Chip microfluidic systems**. With a mission to revolutionise toxicology testing, as well as efficacy evaluation for drug discovery, the company has created pumpless platforms with **serum-free cellular mediums** that allow multi-organ system communication and integrated computational PKPD modeling of live physiological responses utilising functional readouts from neurons, cardiac, muscle, barrier tissues, and neuromuscular junctions, as well as responses from liver, pancreas, and barrier tissues.

2 Organ
Base efficacy and toxicity models

3 Organ
A more complete view of the human body

4 Organ
Most advanced standard system

2-5 Organ+
Reconfigure the platform to include the relevant organ tissues for your application.

Heart-Liver

An effective test of the acute and chronic effects on the heart and liver.

Heart-Liver-Cancer

Understand the effects of both single and multidrug treatments.

Heart-Liver-Neuron-Muscle

Better understand the mechanisms of neurodegenerative diseases in our most advanced standard system.

Customised

The platform can be easily configured to include virtually any organ, barrier tissue, or tumor.

Neuromuscular Junction

Better understand disorders impacting the connection between the nervous and muscular systems, such as ALS.

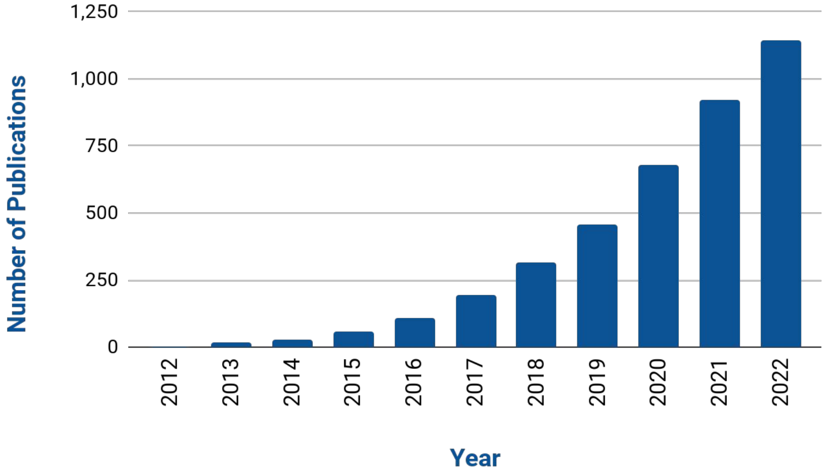
Heart-Liver-Skin

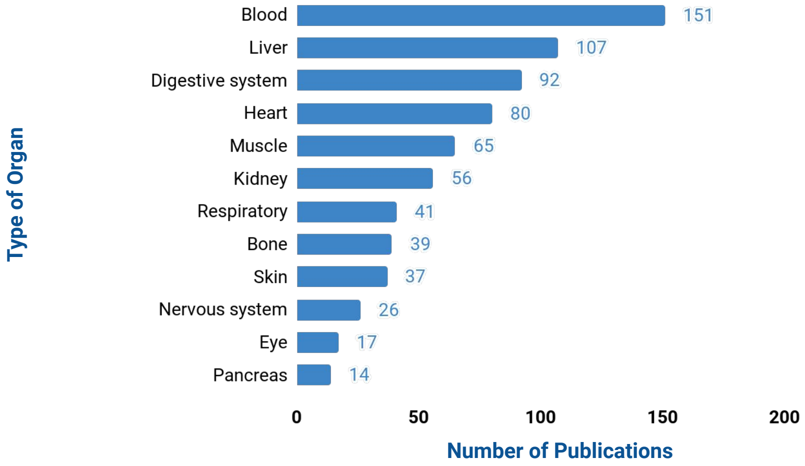
Evaluate the safety and efficacy of topically applied products.

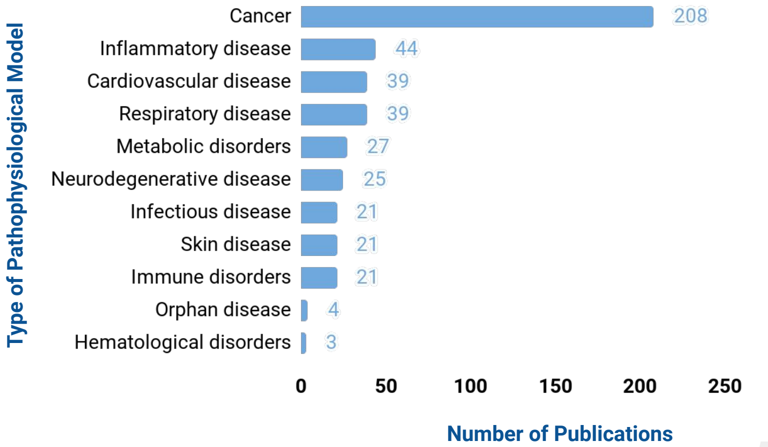
Barrier Tissue Modules
Adding these modules to the HoaC systems enables determination of transport characteristics of novel compounds as well as their responses as toxicity targets.

Sources: hesperosinc.com

Total Scientific Interest in Organ-on-a-Chip Development







Research on organ-on-a-chip technology **has grown exponentially** during the last 10 years. Explanations of such growth are dramatic advances in the sophistication of biology and engineering, in the demonstration of physiological relevance, and in the range of applications. According to **PubMed**, the most popular types of organ-on-a-chip are **vascular system**, **liver,** and **digestive system**. Among pathophysiological models, the most popular are models of **cancer**, **inflammatory**, **cardiovascular,** and **respiratory diseases**.

Sources: PubMed.com

Microfluidics

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Microfluidics: Main Developers

What is Microfluidics?

Microfluidics relates to the design and study of devices that move or analyse the tiny amount of liquid **smaller than a droplet.** Microfluidic devices have **microchannels,** ranging from submicron to few millimeters. Microfluidics has been increasingly used in the biological sciences because **precise** and **controlled** experiments can be conducted at a lower cost and faster pace.

How do Microfluidics work?

Microfluidics systems work by using a **pump and a chip.** Different types of pumps precisely move liquid inside the chip with a rate of **1 μL/min to 10,000 μL/min.** For comparison, a small water drop is ~10 microliter (μL). Microfluidic channels located inside the chip allow the liquid to be processed through **mixing**, **chemical**, or **physical reactions**. Small particles like cells or nanoparticles may be carried by the liquid. The microfluidic device makes it possible to process these particles, for instance, by capturing and collecting cancer cells from healthy blood cells.

Main developers

Microfluidics: Usage in Drug Development

Drug synthesis, **drug distribution**, and **drug evaluation** are the three primary components of the protracted process of developing new drugs. **Microfluidics** has emerged as a ground-breaking technique as compared to conventional drug development methods, because it provides a highly controlled, compact environment for bio(chemical) interactions to occur. It is also compatible with analytical strategies to implement integrated and high-throughput screening and evaluations.

Microfluidics for Drug Synthesis

Compound Generation

- ➔ Microchannel reactors
  - ◆ Single-step transformation
  - ◆ Multistep transformations
- ➔ Droplet microplates
  - ◆ In enclosed channel
  - ◆ In the open environment

Microfluidics for Drug Screening

Preliminary Drug Screening

- ➔ Continuous-flow screening
- ➔ Successive droplet screening
- ➔ Droplet array screening

Microfluidics for Drug Delivery

Microfluidic Micropumps for Direct Drug Delivery

- ➔ Powered micropumps
- ➔ Nonpowered micropumps

Microfluidic Fabrication of Drug Carries

- ➔ Emulsions
- ➔ Microparticles
- ➔ Microcapsules
- ➔ Microfibers

Microfluidics for Drug Evaluation

Safety & Efficacy

- ➔ Microfluidic single-cell platform
- ➔ Microfluidic cell spheroids platform
- ➔ Microfluidic organ-on-a-chip platform
  - ◆ Single- ogan-on-a-chip
  - ◆ Multi-organ-on-a-chip

Sources: Liu et al (2021). ACS Publications

Lab Automation

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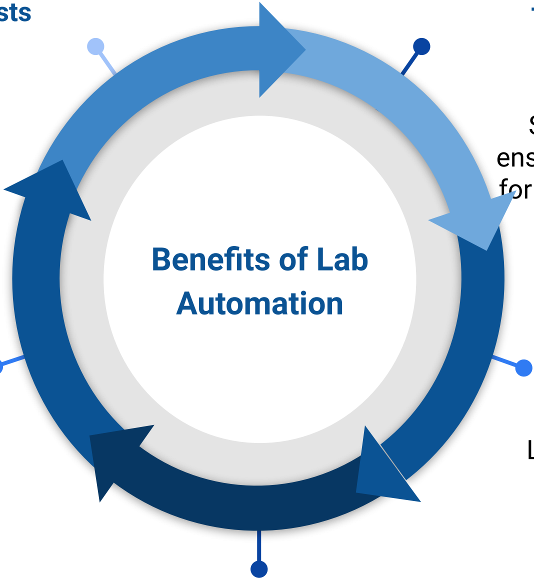
Lab Automation: Usage in Drug Development

As technology has advanced, there are more opportunities to automate procedures in the lab. Automated equipment can be used throughout the entire workflow and is a vital part of many laboratories nowadays. Automation now includes integrating the laboratory environment to provide more precision and improve the correctness of outcomes in R&D, going beyond high throughput alone.

Pre-analytical, **analytical,** and **postanalytical** stages can be distinguished in laboratory automation. Pre-analytical errors are thought to be responsible for more than **two-thirds of all laboratory errors.** Mistakes in the analytical phase and post-analytical phase account for **one-third of all laboratory errors.**



Reduced Costs

Automation has enabled large-scale testing. It has also reduced utilities and equipment costs.

Time and Resources Optimisation

Save a lot of time and ensure their skills are used for other more specialised tasks.

Reduced Human Error

Output data can be streamed directly into electronic laboratory notebook, which minimises the risk of human errors.

Efficiency and Flexibility

Laboratory automation systems can be customised to meet a given laboratory's needs.

Maximise Data Generated

Automation can produce extra data that are not usually collected.

Main Developers of Lab Automation Services

Liquid Handling

- BioFluidiX
- BioNex Solutions
- CEM
- HighRes biosolutions
- MDZ
- Synchron
- Beckman Coulter
- sptlabtech
- Siemens
- Integra Biosciences
- Zinsser Analytic
- opentrons
- Andrew Alliance
- Qiagen
- Biotage
- Tecan
- Gilson
- Sirius Automation
- 8-B-O-T
- flow robotics
- Aurora
- Hudson Robotics
- BrandTech Scientific, Inc.
- Shimadzu
- eppendorf
- ThermoFisher Scientific

Electronic Lab Management

- culture
- strateos
- Automata
- Synthace
- Andrew Alliance
- Agilent
- Biosero
- Tecan
- scitara
- Hands-On Labs
- Abbott
- Qiagen
- abiobot
- Integra Biosciences

Sample Preparation

- opentrons
- Synchron
- MDZ
- Zinsser Analytic
- 8-B-O-T
- Siemens
- Labminds
- CEM
- Hamilton
- nucomat
- sptlabtech
- Aurora

Robotics Hardware

- Molecular Devices
- Anton Paar
- Automata
- Andrew Alliance
- MegaRobo 镁伽机器人
- darving
- Sirius Automation
- abiobot
- Singer Instruments
- reshape biotech
- Gilson
- ProGroup Instrument Corp

Automated Sample Storage

- HighRes biosolutions
- Synchron
- sptlabtech

Quality Control

- Zinsser Analytic
- nucomat
- Siemens

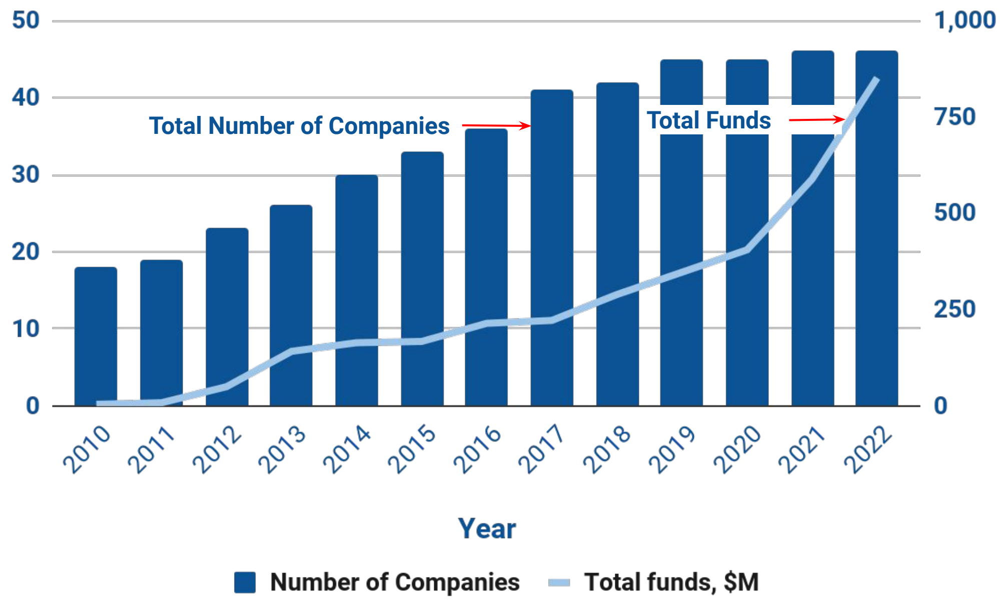
Multiplex Analysis

- Beckman Coulter
- 8-B-O-T
- Tecan
- Luminex
- ThermoFisher Scientific

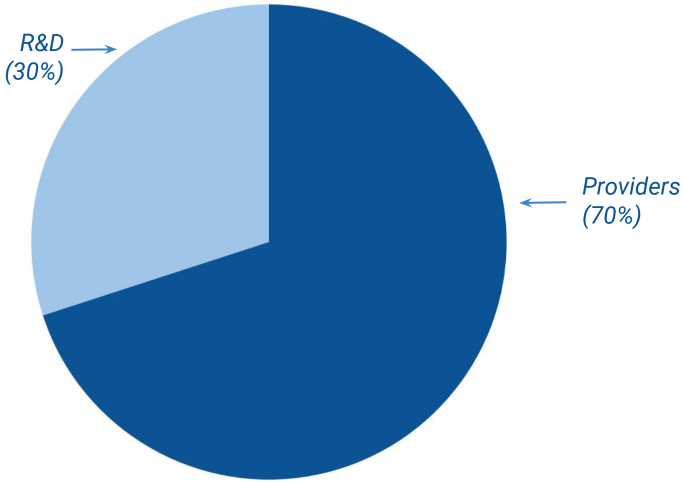
Note: This slide represents the main developers on the market of Lab automation services. It is evident that liquid handling is the most popular type of lab automation services due to its demand and prevalence. Other fields are actively growing for now.

Growth of Lab Automation Industry

Cumulative Number of Companies and Total Value of Their Funds, 2010-2022



Distribution of Lab Automation Companies by Type



Lab automation market was developing equally during last 10 years. However, during the last 2 years, the market shows increased stagnation. The share of new companies from the 2010 to 2020 period is **30%**. The market is valued at approximately **$23.44 billion** in Q4 2022. Some **70%** of the companies are related to **Providers,** and only **30%** are involved in **R&D**.

Market Overview

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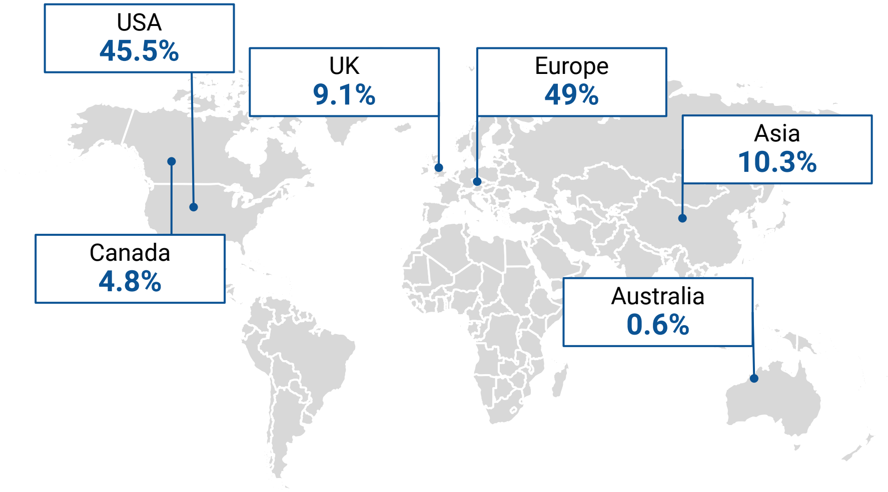
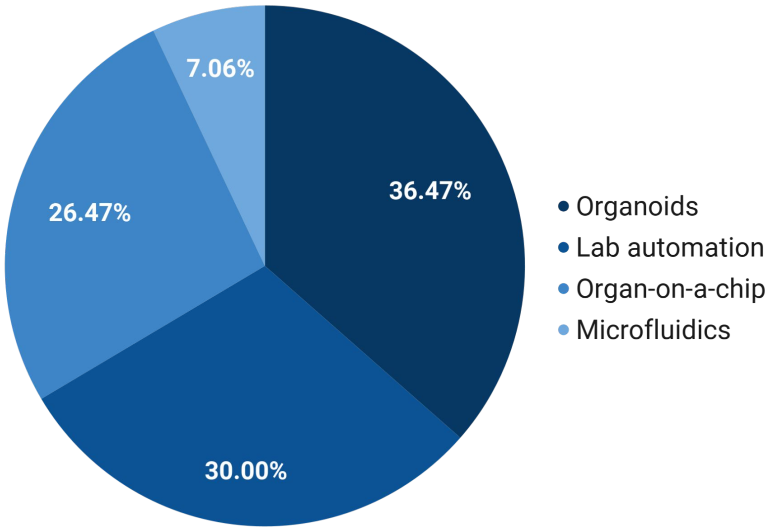
Market at a Glance: Companies

Distribution of Companies by Country, %



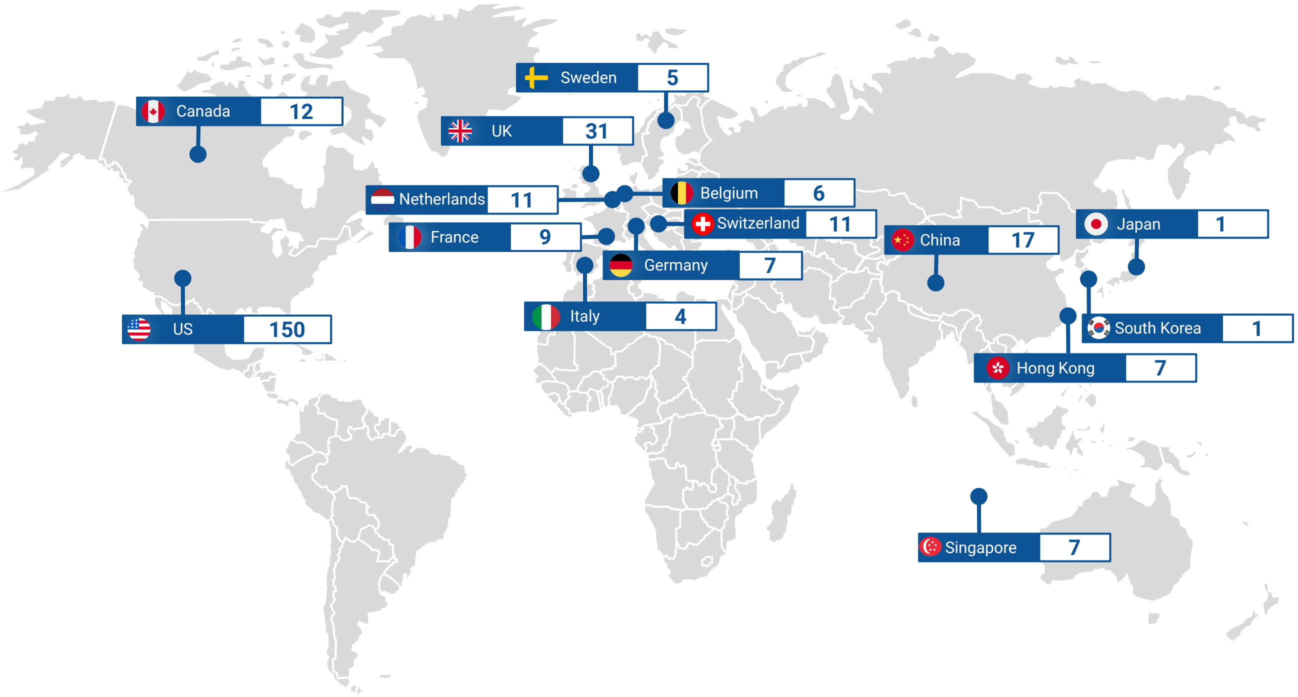
Distribution of Companies by Category, %



The **vast majority** of companies that conduct preclinical and clinical optimisation services is located in **Europe** and accounts for **49%** of the whole range of analysed companies. The European region is followed by the United States, with the total companies amounting to **45.5%** of all companies in both regions.

The main domains in which companies are being conducted are **Organoids**, **Lab automation**, **Organ-on-a-chip**, and **Microfluidics,** which account for **36.47%**, **30%**, **26.47%,** and **7.06%** of all companies, **respectively**.

Market at a Glance: Investors



More than half of the investors in **preclinical and clinical optimisation companies** are from the **United States** (around **55%). Some 11%** of investors are located in the UK; 6% of the investors are located in **China**; 4% – in **Canada, Switzerland,** and **the Netherlands each**. **Germany, France, Belgium,** and **Hong Kong** each host 3% of all investors. Overall, the **first 10 countries** by number of investors locate **87%** of all investors.

Key Takeaways

Only one in 10 medications will pass Phase I clinical trials and receive FDA approval, demonstrating the inefficiency of the drug-discovery process. In light of this, medication makers have continued to use **cutting-edge new technology** to maximise their efforts in drug discovery and development. Technology advancements in areas like ***in silico* modeling**, **high content imaging**, and **multiparametric analysis** (using methods like impedance and kinetic-based measurements, for example) have made it possible to make more exact and nuanced discoveries at a deeper level of biology.

Three-dimensional (3D) *in vitro* models in the drug development pipeline can help selecting the most promising and safe drug candidates prior to clinical trials, reducing and sometimes even replacing animal studies. Additionally, the **creation of 3D organoids from patient-derived cells** has created new pathways towards a personalised medical strategy. Advances in 3D tissue models have yielded new approaches, such as **organ-on-a-chip systems**.

To help biopharmaceutical R&D in important therapeutic areas, manufacturers of 3D tissue models are utilising **high-fidelity biology** inside specialised disease model systems. Beyond drug screening, 3D models have potential for **new drug target discovery**, **accelerated drug design**, and the **identification of trial populations for Personalised Medicine**. As 3D models gain popularity, biopharma companies and enablers must address a number of issues. There is also an increased development of **lab automation developers** that can potentially simplify R&D studies.

Overview of Proprietary Analytics by Deep Pharma Intelligence

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Deep Pharma Intelligence — New Era in Pharma Analytics

Deep Pharma Intelligence (DPI), an analytical subsidiary of Deep Knowledge Group, is a highly specialised think tank in the area of BioTech innovation profiling, market intelligence, and BioTech development advisory. The company is dedicated to producing powerful data mining and visualisation systems, interactive analytics tools, and industry reports, offering deep technical insights, market intelligence, and strategic guidance in the high growth and significant opportunity areas.

DPI is Focusing on Three Key Activities:

Conducting Market Intelligence

Producing regular **open-access** and **proprietary reports** on the emerging topics and trends in the pharmaceutical and healthcare industries. All reports are supported by our back-end analytics systems and tools that allow to receive fresh insights and updates about opportunities and risks.

Creating Big Data Analytical Dashboards

Building a comprehensive **Big Data Analytical Dashboard** (SaaS) as a one-stop-platform for all market and business intelligence operations our customers may need, including profiling thousands of companies, market signals and trends based on tens of millions of constantly updated data points.

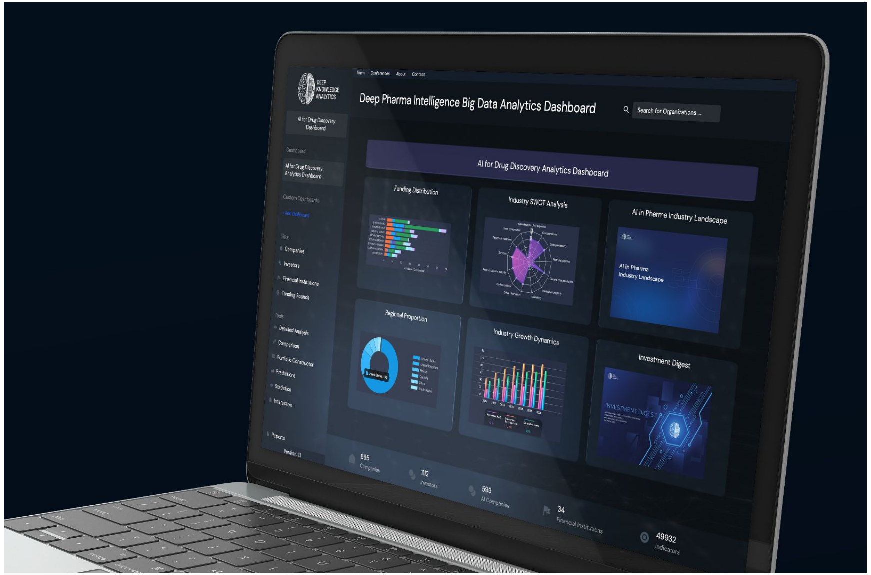
Producing Scientific Content

DPI provides a **full-cycle development of articles, scientific journals, and books**. We are ready to develop a detailed Requirement Specifications document, including layout of the journal, fully designed brand book, with example templates for each chapter.

AI in Drug Discovery Analytical Dashboard

AI in Drug Discovery Analytical Dashboard is a fundamental tool for strategic insights, opportunity evaluation, competitor profiling, and other purposes relevant to Pharma and BioTech decision-makers, life science investors, consulting companies, and regulatory agencies.

600	Companies
1,100	Investors
290	R&D Collaborations
120	Clinical Trials
170	Parameters of Automated SWOT Analysis



Market Intelligence Focus

- Automated SWOT Analysis
- Stock Price Forecasting
- Interactive Chart Builder
- Automated Competitive Analysis
- Financial Portfolio Constructor
- Matching Tool for Investors

Comprehensive Market Intelligence

Deep Pharma Intelligence's proprietary services include **custom consulting projects based on the specific customer needs**, as well as a collection of preproduced 'ready-to-use' proprietary reports, developed by our research team and covering general trends and specific action ideas and strategy insights related to the most promising business prospects (e.g. new technologies, BioTech start-ups), M&A prospects (e.g. pipeline development targets), and strategic growth ideas (trends profiling, industry overviews, etc.).

Selected Open Access Reports

Artificial Intelligence for Drug Discovery Landscape Overview, Q3 2022 is an analytical report that aims to provide a comprehensive overview of the AI in drug discovery industry, clinical research, and other aspects of pharmaceutical R&D.

Epigenetic Drugs Q2 2022 report aims to provide a comprehensive overview of the current state of the epigenetic drugs market and research. The aim of this report is to provide insights into the diversity of possible epigenetic targets, mechanisms of their action in treating cancer and other diseases.

Landscape of Advanced Technology Companies in Pharmaceutical Industry Q4 2021 is an analytical report providing insights into the expansion of technology developers and vendors in the pharmaceutical space, as well as their increasing role in the pharmaceutical business.

Business Consulting Services

Deep Pharma Intelligence offers a comprehensive range of **consulting services**, including **market and competitor research, technology scouting and due diligence, investment landscape profiling, and comprehensive analytics support for investment decision-making.**

Investment Landscape Profiling

Identifying investment trends in the pharma, BioTech, medicine, healthcare, drug development technological space, investments risk profiling based on risk tolerance, risk capacity, and risk requirements.

Technology Scouting and Due Diligence

Identifying, locating, and evaluating existing or developing technologies, products, services, and emerging trends. The service includes business, science and technology, intellectual property (IP) profiling, and potential assessment.

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Market Research

Thorough market assessment within a specific industry in the field of pharma, BioTech, medicine, healthcare, drug development, AI, and others.

Competitor Research

Competitive analysis of companies, technologies, technological sectors, etc. Competitive analysis includes SWOT analysis and competitive profiling.

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Link to the Report: www.deep-pharma.tech/clinical-trials-q4-2022

E-mail: info@deep-pharma.tech | Website: www.deep-pharma.tech