Biotechnology, big data and artificial intelligence

From drastically improving diagnostics and treatment decisions, to accelerating patient recruitment for clinical trials, the combination of AI and Big Data is changing healthcare for the better. For the world of data to achieve its full potential however, we need to break up individual silos and create a collective global intelligence within the medical community.”

Jurgi Camblong | SOPHiA GENETICS

Over the past 20 years, Swiss-invented AI patents in biotech have followed global trends. An impressive 40% of all AI patents in biotechnology worldwide, and almost half of those invented in Switzerland, qualify as world-class – substantially higher for biotechnology or AI alone.”

Christian Moser & Anna-Maria Villa | Swiss Federal Institute of Intellectual Property

Biology is complex and delivers noisy data. To base conclusions on a solid foundation and deliver personalized healthcare, standards must be established on how to generate, handle and analyze the data. The Swiss Personalized Health Network, the Swiss Biobanking Platform, and the National Research Program “Big Data” (NRP 75) are all working to make this a reality.”

Florian Fisch | Swiss National Science Foundation (SNSF)

“The availability of Foundation Medicine’s genomic profile data and Flatiron’s clinical data, set under the common roof of the Roche Group, now allows what some have described as the Holy Grail of cancer research: the combination of genomic and clinical data into a clinico-genomic database (CGDB).”

Jan Lucht | Head Biotechnology, scienceindustries

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HIGHLIGHTS OF 2019: YEAR IN REVIEW
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I have always regarded Switzerland as being in the vanguard of life science innovation. Having established a leadership role in the commercialization of therapeutic antibodies and personalized medicines, Swiss companies are now at the forefront of cell and gene therapy developments and the incorporation into the pharma R&D process of disruptive approaches such as gene-editing, insights from the microbiome, and the welcome theme of this report, artificial intelligence and machine learning.

I recently listed the “Transformational Power of Computing” as one of the Top Ten Drivers of Biotech. The use of “omics” technologies and large sample sizes has generated massive amounts of data sets and a wealth of information for different diseases and their links to intrinsic biology. In turn, this has driven the development of sophisticated computational and statistical methods for their analysis. Healthcare applications of artificial intelligence and machine learning are attracting both venture capital and corporate investment, and Switzerland already has a strong presence, witness SOPHIA GENETICS in Lausanne, closing a Series E round, raising CHF77m, to accelerate the democratization of data-driven medicine.

A successful innovation ecosystem and attractive business environment, including an effective tax strategy and patent box approach, are also paying dividends and resulting in Switzerland consolidating its position as a major location for emerging biotech companies. Indeed, 2019 was a busy year for the Swiss cluster with biotechs raising more than CHF1.2 billion from private and venture capital investors, accounting for 34% of the total amount raised by European companies. Public biotechs raised a further CHF77m, while Swiss companies were a major acquisition and partnering target for asset-hungry global pharma companies.

Some highlights that caught my eye were the CHF1.35bn follow-on round conducted by Zymed-based gene editing pioneer CRISPR Therapeutics, Lausanne-based oncology-focused antibody–drug conjugate biotech ADC Therapeutics, completing a final close of a $1.10bn Series E financing expansion; Anconion’s autoimmune disease, Lausanne’s $40m Series B round, Oculis (ophthalmology, Lausanne) adding a further CHF15.5m to conclude a Series A round at CHF35.5m, and Polyneuron Pharmaceuticals (immune disorders, Basel) raising CHF22.5m in a Series A round. Also interesting and illustrative of Swiss biotech’s international outlook, was women’s health-focused pharma Ferring Pharmaceuticals teaming up with US private equity group Blackstone Life Sciences and committing $570 million to create gene therapy-focused FerGene.

On the M&A side, Japan’s Sumitomo Dainippon Pharma confirmed the attractiveness of Swiss biotech by paying Rochei Sciences close to CHF1.5bn for five of its subsidiaries – Myovant, Urovent, Enzyvant, Alzantut, and Spirinvent. They also took an 11% stake in Roche, access to two technology platforms, DrugOme and Digital Innovation Technology, as well as options to acquire six additional subsidiaries. Furthermore, part of the transaction Sumitomo created Sumitovant Biopharma, which will operate as the parent company of the newly acquired assets and will serve as one of the core growth engines for the Japanese pharma.

Other major transactions involving Swiss biotechs include Pfizer’s CHF810m acquisition of Therachon Holding, Swedish Orphan Biovitrum’s CHF155m purchase of Einno3, a newly established company from the Novimmune stable which owns FDA-approved Gammabrum emapalumab and related assets, and Boehringer Ingelheim’s CHF425m acquisition of University of Geneva spinout Amal Therapeutics.

As an outside observer of this dynamic environment, I can only conclude that Switzerland owes its strength to a century of experience in mastering the close cooperation between first-class research facilities, leading SMEs and strong multi-national companies – a network which continues to attract researchers and capital from all over the world.
The global biotechnology industry in 2019 was again performing well, irrespective of the macroeconomic and external environment: the global economy is showing resilience in the face of elevated geopolitical, trade and tariff concerns. IPOs were still “en vogue” and a record level of M&A activities could be noted at the global level, primarily driven by the need for growth of some of the large biopharmaceutical players.

The IPO class of 2019 was playing in a league of its own with a total of 57 IPOs (2018: 77), which generated more than US$4.8 billion (2018: US$ 4.0 billion) of new capital. Some 46 US IPOs were able to harvest fresh money to the tune of approximately US$5.6 billion (2018: 58 US IPOs/US$5.3 billion). And there were 11 European IPOs, which raised US$0.8 billion (2018: 19 European IPOs / US$1.2 billion).

Swiss biotech landscape
The Swiss biotech industry generated revenues of almost CHF 4.8 billion, compared to CHF 4.0 billion in 2018. This boost in revenues was primarily driven by the need for growth of some of the large biopharmaceutical players.

Swiss biotech financing
Financing reported a year which was clearly below the previous two “record years”, with a total CHF 1.2 billion. The split between public and private companies was almost even, with the “better end” for the public companies. However, there was not a single IPO of a Swiss biotech company in 2019.

Of the money collected by the public entities, the vast majority went to CRISPR Therapeutics AG with an equity round of US$ 315 million, as well as an ATM program of another CHF 121 million.

Other public companies which were able to get fresh money included AC Immune and ObsEva through debt and/or equity financings, as well as an A TM program of another CHF 121 million. SimplicityBiologics, an early-stage healthcare AI company based in Lausanne, has been acquired by US-based Precision for Medicine, the first biomarker-driven clinical development organization.

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Swiss Outlook: Industry and segment performance

- Numab Therapeutics was busy with entering a license agreement with Intarcia for anti-inflammatory ND016, signing a global R&D/option agreement with Eisai and forming a partnership with 3SBio to develop various antibodies in immuno-oncology
- SOPHIA GENETICS teamed up with ADC Therapeutics on biomarker discovery for lymphoma treatment
- BC Platforms providing complete data management solutions for Debiopharm’s oncology development portfolio
- Santhera entering into an out-licensing agreement with Chiesi Group for Raxone in Leber’s hereditary optic neuropathy (LHON)
- Molecular Partner’s collaboration partner Allergan filed for its compound Absicipar for a biological license application with the FDA, as well as a marketing authorization with EMA
- Insphero and Akero Therapeutics partnering for a human liver disease platform
- Genedata and Merck co-developing a digital platform for translational and clinical biomarker research
- BioVersys receiving a CARB-X award for developing first-in-class standalone anti-virulence small molecule drugs
- Idorsia collaborating with Antares for the development of a novel self-administered drug-device for selatogrel

Product development

The global biotechnology industry saw fewer approvals by the FDA (48 compared with 59 in 2018) and a reduction in European approvals by EMA (66 compared with 84 in 2018). Swissmedic itself approved 29 new drugs in 2019, which was two fewer than the 31 approvals for innovative new drugs in 2018.

In early October 2019, the FDA approved BEOVU (treatment for neovascular wet Age-related Macular Degeneration (AMD)). The origin for this new drug was initially developed by the former biotech company ESBA Tech AG (based in Schlieren), which was acquired back in 2009 by Alcon, before Alcon itself became part of Novartis.

Nevertheless, there were also some setbacks to be noted during 2019. For example, ObsEva reported that its Nolasiban implant 4 study did not meet the primary endpoint.

Several Swiss biotech companies also received awards in 2019:

- InterAx Biotech received the “Seal of Excellence” from the European Commission
- Daniela Marino, CEO of Cutiss, in 2019 won the “Female Innovator of the Year Award” and the company itself also was the winner of the “Swiss Technology Startup Award”
- Insphero won the “Sino-European Innovation Award” for its human liver disease discovery and safety testing platform
- Cellestia Biotech was the winner of the “Sino-European Business Award”
- Tolremo won the Swiss Innovation Challenge

All of these awards are another clear indication of the strength of the Swiss biotech sector and a reflection of all of the significant progress made over the past years.

The year in charts

Number of Biotech Companies in Switzerland 2009–2019

Number of Swiss Biotech Employees 2017–2019
The year in charts

Capital investments in Swiss biotech companies
Private & Public Swiss Biotech Companies

Source: EY (Capital investments include convertible bonds)

Revenues, R&D expenses, Profit/loss, Liquidity
Total Swiss Biotech Companies

Source: Annual Reports, website information and EY

Revenues, R&D expenses, Profit/loss, Liquidity
Public Swiss Biotech Companies

Source: Annual Reports, website information and EY

Revenues, R&D expenses, Profit/loss, Liquidity
Private Swiss Biotech Companies

Source: Annual Reports, website information and EY

Note: The 2019 data in the above tables is based on information that was available up until April 3 when this report was compiled and went to press. At this time, some of the companies had not yet disclosed their financial figures for 2019. Therefore some figures were carefully extrapolated on the basis of the latest interim data publicly available (i.e. Q3 or Q4 2019).

Source: EY
85% of the chemistry, pharma and life sciences exports are contributed by the life sciences subsector (pharmaceuticals, vitamins and diagnostics), with a significant proportion of biopharmaceuticals and biotech products. More than a third of exports from this subsector are derived from immunological products, including monoclonal antibody therapeutics. While Swiss exports from all sectors have increased by 112% since the year 1999 to reach CHF 242.3 billion in 2019, the contribution of the life sciences subsector grew by 362% from CHF 21.1 billion to CHF 97.54 billion. This growth demonstrates the strong dynamics of the life sciences sector.

Favorable framework conditions in Switzerland for high-tech industries like the biotech sector support strong economic development. Compared to all Swiss exports, the share of the chemistry, pharma and life sciences sector has increased from 29.7% in 1999 to 47.3% in 2019, reaching a record value of CHF 114.56 billion. Since 2009, it has been Switzerland’s largest export industry.
How AI and Big Data are changing medicine

From drastically improving diagnostics and treatment decisions, to accelerating patient recruitment for clinical trials, the combination of artificial intelligence (AI) and Big Data is changing healthcare for the better. Progress has been made possible thanks to the massive increase in computing power and the growing amounts of patient information stored in various databases around the world.

Scientists predict that the world’s genomic databanks will soon contain more data than all earth sciences and the endless flow of information on social media combined. How we leverage these growing datasets to uncover new healthcare solutions, will define the next decade.

Cancer medicine in front

AI and real-world clinical data will eventually transform healthcare across the spectrum, from neurodegenerative diseases to diabetes. But it is in the world of cancer medicine where we have to date seen the biggest benefits from this combination. This is due, in part, to the intrinsic nature of the disease and how it progresses over time.

Cancer is not only a multifaceted disease but also a constantly evolving one. Understanding its dynamics therefore requires a large amount of statistical power. This can only be derived from cleaned and labelled real-world datasets that are more easily annotated.

Training AI algorithms on clinical datasets has already demonstrated effectiveness in identifying subgroups of cancer patients who respond best to particular treatments. The AI revolution is also coming to the lab.

In the coming years, cancer treatment is likely to become more precise as a result of digital pathology, one of the fastest moving areas in oncology. Pathologists worldwide will soon digitize immunohistochemistry information, generating a new class of data which has been dubbed ‘histomics’.

We believe this will make it easier for smart algorithms to step in and speed up the diagnostic process. They will do this by learning to detect the earliest signs of cancer, rapidly directing clinicians to areas of abnormality in tissue samples, as well as enabling more accurate treatment recommendations.

Computer-assisted AI technology will be able to use this data, for example, to obtain a better signal for PD-L1 tests. Having this data will be extremely important at all stages of a patient’s longitudinal journey. If you have CT or MRI scans of the tumor, or its molecular characterisation, and can combine these sources of information, you can make much more accurate predictions of how patients will respond to treatments.

This is because you aren’t looking at just one source of data or one ‘picture’. By combining these multiple sources of health data, individual frames of reference become more like a ‘movie’. This ‘moving picture’ shows us the progression of the disease in a way that you could never see by focusing on a single frame.

Future of clinical trials

Real-world evidence is changing the way we study drug safety and effectiveness. Medical product development is at the brink of a new age of evidence generation. In addition to optimizing the choice of existing treatments for patients, the combination of AI and real-world clinical data is also playing a role in identifying new treatments for the future.

One of the on-going problems with clinical trials, is their skyrocketing cost. A randomized clinical trial is trying to show efficacy. It depends on a comparator or control arm and asks, how well does a drug work under highly controlled circumstances? In contrast, a real-world evidence study tries to show how well something works in a real-world scenario compared to an existing treatment.

This is not only extremely valuable from a product development perspective, it can also reduce costs by eliminating the need for the traditional ‘control arm’ in favour of what has come to be known as a ‘synthetic arm’. Fortunately, regulatory bodies such as the FDA are now shifting towards utilising clinical grade real-world data as a way of making trials more efficient and effective.

Instead of recruiting a control group of patients to receive a placebo, more and more trials will compare new drugs to a synthetic control arm. This models a comparison group using previously collected data through sources such as historical clinical trials and selected platforms that are computing the data from electronic health records.

AI platforms can also help accelerate recruitment for trials. As many as 80% of clinical trials fail due to insufficient patient recruitment, but intelligent systems are likely to improve this situation by acting as a digital matchmaker. They can recommend patients who could benefit from the trial, and make it simpler and less time consuming for hospitals to run them.

This could accelerate the drug development cycle, which may mean more successful drugs earlier, and hopefully trials, and ultimately drugs, that cost less.

Teasing out the algorithm

Intelligent computing is the engine and datasets the fuel. But the performance of even the most powerful engine will be limited if the fuel is of poor quality. The challenge is getting the right signal from the data. How do we obtain datasets of sufficient statistical integrity for intelligent algorithms to be able to extract a signal which is truly representative of the patient population?

Indeed, real-world data has the potential to change the way we execute many of tomorrow’s clinical trials, but we will have to ensure the data is not only accurate but also standardized. This requires not only real-world data, but clinical-grade, real-world data. Data has to be collected, cleaned and labelled to meet regulatory-grade criteria and to enable the building of better algorithms.

Selected platforms not EHRs

One of the keys to increasing the statistical power of datasets is through standardizing the data across clinical centers. However, despite the introduction of electronic health records (EHRs), smoothing out the differences between hospitals remains a sizeable hurdle.

EHRs will not help to standardize the data anytime soon. The standardization of data will only come through many hospitals around the world using platforms like the SOPHIA Platform, to improve treatment decisions. These selected platforms are then able to collate the information together from multiple centers.

Break up the silos

The coming decade is likely to see even more medical breakthroughs arising through the combination of intelligent algorithms and mass, combined datasets. The combination of all health data, organized together in new ways that can help discover breakthrough medicines and patient care solutions, will prove to be very powerful. However, for the world of data to achieve its full potential, we need to break-up individual silos and create a collective global intelligence within the medical community. This will not be easy, but it is essential. It is a paradigm shift in the way all players in the sector need to think.

The more knowledge we’re able to collect and share, while still respecting patient privacy, the more we can leverage it to develop better treatments and help them get to market faster. We already have the computing power and the technology to build solid algorithms. The major challenge awaiting the healthcare industry over the next decade is mutualising the data to create a collective intelligence that is so needed to improve treatments, for the benefit of all.

Reference

Big Data in medicine: hype and reality

Florence Fisch
Swiss National Science Foundation | Science editor
Big data promises better and faster diagnoses. But managing the increasing volume of data, creating common standards and guaranteeing patient privacy will require medical researchers to coordinate their efforts. Many Swiss organizations are working on it.

THE PROBLEM: Why data is continually getting bigger

On first hearing, ‘big data’ sounds great. The more we know about the human body, brain or gene expression, the better we can treat patients. So many researchers and companies try to sell their project or their product using this buzzword. But on closer examination, it quickly becomes clear that bigger data does not mean better knowledge. Often people are overwhelmed by the flood of data and struggle to make sense of it – especially in life sciences.

Take the intensive care unit. Every day, one single, critically ill patient generates up to 100 gigabytes of data according to Switzerland’s National Research Program big data (NRP 75). This data comes from patient monitoring, computer and magnetic resonance tomography of the brain, or laboratory results and biosensors. The monitoring system triggers about 700 alarms a day, one alarm every two minutes and thereby enable early detection of epileptic seizures and diagnose secondary brain damage, caused by cellular processes.

With data mining and machine learning, the researchers want to improve the quality of the alarm system and rapidly propose innovations to the medical community. “With this project, we want to initiate a fundamental development in emergency and intensive care medicine – and thus significantly improve the way hospitals work in day-to-day practice”, says Emanuela Keller, professor at the University Hospital Zurich, in the NRP 75 press release.

Less urgent, but no less important, is to decide what therapy is suitable to treat a special type of cancer or any other disease. This means looking for informative biomarkers – these include “omics” data (like DNA sequences, gene expression profiles and metabolite levels), images, data from biosanks, doctor diagnoses, and environmental data. “Thanks to bioinformatics methods and tools and because we have now hundreds of thousands of data points, researchers can use tailor-made algorithms to identify biomarkers or common patterns. We can ask the algorithm: ‘please find a difference, between patients with disease X and healthy individuals’”, says Valérie Barbié from the Swiss Institute of Bioinformatics (SIB).

This could help to make the treatment decision for a cancer more precise, find unknown environmental factors that influence a lung problem or make it possible to diagnose a very rare bowel disease. SIB is working on the technical infrastructure, analysis methods, software tools and knowledge bases to make that dream come true.

THE DREAM: Better and Faster diagnoses

Once it becomes possible to make sense of this big flood of data – and currently life scientists are struggling to stay afloat – there are many interesting uses. Take safety of the critically ill patient in the intensive care unit. A research project from the University Hospital Zurich, the ETH Zurich and IBM Research is working on procedures to filter the false alarms that occur almost every two minutes and thereby enable early detection of epileptic seizures and diagnose secondary brain damage, caused by cellular processes.

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AN OBSTACLE: Biology is complex and delivers noisy data

The term big data comes from information technology: all mobile phone connection data or all the petabytes (1015 bytes) CERN has gathered. This is all very well structured. Not so in the life sciences where the data is very heterogeneous – meaning varying between healthy individuals and very sensitive to small perturbations. In addition, there is an astronomical number of possible interactions with molecules or physical factors. “And you can easily trick your data to get a significant p-value with almost any data. Whatever you are putting into your algorithm, you will get the answer you want”, warns Valérie Barbié.

To base conclusions on a solid foundation and deliver on promises, standards have to be established on how to generate, handle and analyze the data. The way data is produced has to be described clearly. The exact type of assay might also be important. Algorithms need to be able to distinguish between medium quality data from a smart watch for example and high quality data from a medical brain scan. One of the challenges for the Swiss Personalized Health Network (SPHN) is therefore to implement standards, which are essential to aggregate, compare and analyze data stemming from different sources, like hospitals from different parts of the country. Such standards are long and well established in other industries like the banking sector.

ANOTHER OBSTACLE: Physicians lack clear standards

“If the data you put into the analysis is not well characterized, the answers you get out will lead to wrong diagnoses”, says Valérie Barbié. That is a problem because every country, every hospital and every medical field has its own vocabulary and its own categories. A condition named colorectal cancer in one place can be defined as colorectal adenocarcinoma in another, just to name one simple example. This means that the data is not comparable. And, only now are hospitals across Switzerland starting to implement electronic health records (EHRs).

The way hospitals are run adds to the confusion. Huldrych Günthard from the Zurich University Hospital is the head of the Swiss cohort survey on HIV that collects data that is comprehensive, well-structured and consistent over long time periods. He struggles with this. As he explained to the Swiss research magazine Horizons in 2016: “Specific diagnoses in hospitals are sometimes distorted by economic factors, such as codifying invoices according to flat-rate payments.”

Here again, the SPHN comes into play. Meetings are held to agree on international standards on how to name the information and store it. To allow the exchange of data among researchers, the Swiss Academy of Medical Sciences (SAMS) has implemented a general consent for patients to agree on the use of their data. Therefore, in principle, the way is open for big studies.
THE DANGER: It's difficult to guarantee privacy

Genomic data contains a lot of information. Information, we hope to be able to use to decide how to best treat many conditions. But more is hidden in there: for example, information about other family members who may not agree to be part of the research. Many risk factors are genetic too, and might tell you something people do not want to know. Maybe because it scares them or they cannot do anything about it. Maybe they don't want their insurance to know, as it might increase the premium or exclude them from its services.

In a connected world, data is easily exchanged and also easily stolen. Many companies have fallen victim to attacks on their IT systems – even places considered to be safe. Hospitals with their decentralised structures and different systems – even places considered to be safe. Many companies have fallen victim to attacks on their IT because it scares them or they cannot do anything about it.

How can we guarantee that the data is safe? Of course, data has to be anonymized. It has to be encrypted. Researchers should not be allowed to download data but have to work on secured research platforms. This is possible. Nordic and Baltic countries like Estonia, Sweden and Denmark have shown that it is possible to go digital without having to suffer major security breaches. This is important. After all, research relies on the general consent of patients and study participants.

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THE PARTICIPANTS: Switzerland is developing big data

- Swiss Personalized Health Network (SPHN)
  The federal initiative rallies all decision-makers around the table and contributes to the development, implementation and validation of coordinated infrastructures for personalized health research across Switzerland. The goal is to access health data nationwide, while preserving individual’s privacy. The initiative is coordinated by the Swiss Academy of Medical Sciences (SAMS) and the Swiss Institute of Bioinformatics (SIB). https://sphn.ch

- Swiss Biobanking Platform (SBP)
  The national coordination platform for human and non-human biobanks aims at improving the quality and the interconnectedness of biobanks for research purposes. SBP was initiated by the Swiss National Science Foundation (SNSF). The SNSF also issues Biobank grants to network biobanks for research purposes in collaboration with SBP. https://swissbiobanking.ch

- National Research Program Big Data (NRP 75)
  The program supports research projects that provide foundations for effective and appropriate use of big data. Commissioned by the Swiss Federal Council it is run by the Swiss National Science Foundation (SNSF). The research projects dispose of a total of 25 million and will run until 2021. http://www.sfp75.ch

- Swiss Clinical Trial Organization (SCTO)
  The organization coordinates a network of 7 Clinical Trial Units (CTU) across Switzerland and is the central cooperation platform for patient-oriented clinical research. The aim is to improve the quality, efficiency, and transparency of clinical research and make it more visible. The SCTO has been jointly founded by the Swiss National Science Foundation (SNSF) and the Swiss Academy of Medical Sciences (SAMS) and is today funded by the State Secretariat of Education, Research and Innovation (SERI) and the SNSF. https://www.scto.ch

- Longitudinal studies
  This funding instrument of the Swiss National Science Foundation (SNSF) allows the support of multi-centric, population-based or disease-oriented studies with a longitudinal design. Studies of this nature allow to follow a group of people sharing a defining characteristic over a long period of time. They are dedicated to a topic of high relevance to the Swiss health system. http://www.snf.ch/en/funding/programmes/longitudinal-studies

- Switzerland’s Systems Medicine Platform (SfP)
  The National Research Programme “Switzerland’s Systems Medicine Platform (SfP)” is a 5-year national research program supported by the Swiss National Science Foundation (SNSF). The program focuses on the development of innovative approaches for the systematic and comprehensive understanding of disease at the systems level. The program coordinates and integrates research efforts of the Swiss research community toward the development of a Swiss Systems Medicine Platform. http://www.sfp-2014.ch/en

- MyomeDB
  MyomeDB is a public, open access database that contains a comprehensive collection of biological and clinical data from large muscle biopsies collected from patients undergoing procedures with potential relation to muscle disorders. The data is collected from patients with different muscle diseases and healthy donors. The database is designed to be a valuable resource for researchers and clinicians to identify biomarkers that could be used for diagnostic and prognostic purposes. http://www.myome-db.org

- PopMedDB
  PopMedDB is a database that collects and organizes information from many different sources, such as clinical trials, genomics, and other health-related research. The information is extracted not only from electronic medical records, but also from unstructured data, like laboratory and imaging results. The application of high-powered data analytics to this huge and highly representative clinical data set makes it possible to generate real-world evidence about treatment outcomes, suggesting better treatment options and facilitating clinical trials especially for rare cancers. The de-identified data are used by cancer researchers worldwide to advance treatments. The availability of Foundation Medicine's genomic profile database and Flatiron's clinical data sets under the common roof of the Roche Group now allows what some have described as the Holy Grail of cancer research: the combination of genomic and clinical data into a clinic-genomic database (CGDB) to understand what drives disease. This allows a much better prediction of individual patient's developments, and a better selection of treatment options based on real-life experience from comparable cases. The CGDB also helps to bring precision medicine faster to patients. Using traditional approaches, it was almost impossible to set up clinical trials for the treatment of every rare cancer types

Data and collaboration at the core of precision medicine

Jan Lucht
scienceindustries | Head Biotechnology

Optimized treatment for every patient according to their unique situation promises huge improvements in healthcare. To reach this next level in personalized healthcare requires the aggregation, processing and analysis of large amounts of health data. For this to happen, even closer collaboration between the many players in the healthcare system is paramount.

Foundation Medicine’s genomic database, one of the world’s largest with information from more than 350,000 patients, is also used to match patients to clinical trials. The aim is to improve drug development and to support basic cancer research by sharing anonymized data with research institutions. In Switzerland, this service is offered in collaboration with the University Hospital Zurich.

In a complementary approach, Roche acquired US healthcare technology and services company Flatiron Health in 2018. Flatiron collects clinical data about oncology cases, treatments and outcomes in a massive database. This currently comprises more than 2.4 million patient records, derived from a close collaboration with a large network of cancer treatment and research centers. Information is extracted not only from electronic medical records, but also from unstructured data, like laboratory and imaging results.

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Roche lead with data, diagnostics and (bio)-pharmaceuticals

Roche, with its headquarters in Basel, Switzerland, is the world’s largest biotech company, with 17 biopharmaceuticals on the market, and the global leader in cancer treatments. At the same time, the company is the leading provider of in-vitro diagnostics.

This combination of competencies, together with strong partnerships that focus on the use of medical data to generate knowledge for the treatment of patients, has also made Roche a frontrunner in personalized healthcare.

For this, the combination of expertise in genomics and clinical data analysis was essential. In 2018, Roche merged with Foundation Medicine, a US company focusing on molecular information in oncology. By genomic profiling a patient’s tumor genome, the company identifies clinically relevant alterations, thus providing a service akin to SOPHIA GENETICS in Lausanne.

This genetic information is then combined with the world’s most up-to-date published cancer literature database to match patient’s genomic profiles with the best-known treatment option to support clinical decision-making.

Grail of cancer research: the combination of genomic and clinical data into a clinic-genomic database.
Swiss Personalized Health Network (SPHN)

In Switzerland, the Swiss Personalized Health Network (SPHN) has been working since 2017 to promote the development of personalized medicine and personalized health. The result is a national collaboration of unprecedented scale, involving 35 hospitals, research institutions and other organizations.

The main focus until 2020 is on building the necessary infrastructure to enable nationwide use and exchange of health data for research. Funded with CHF 68 million, the SPHN is working on the development of a national health data infrastructure and cutting-edge IT systems (BioMedIT). In the next funding period (2021 – 2024), the network will extend its activities and collaborations, possibly including public-private partnerships.

Challenges for Personalized Healthcare in Switzerland

While the huge potential of personalized healthcare is obvious, several obstacles slow down its development. The digital infrastructure for the collection and aggregation of health data is still only weakly developed.

A major challenge is Switzerland's pronounced regionalism and the sovereignty of the cantonal competencies in the health care sector. This makes collaborations on a national scale difficult.

Due to the limited number of patients and lack of a suitable control group, the COSI helps to quickly identify patients for the experimental arm of the study, and provides data for the control group, thereby supporting the development of novel treatments and more efficient clinical trials.

For Roche, the integration of diagnostics, (bio-)pharmaceuticals and big data analysis is an important building block of the company's personalized medicine strategy. But the benefits of these activities form a much larger group.

The close collaboration and the sharing of de-identified data between medical institutions, regulators, healthcare companies and scientists supports basic research, the development of better and more targeted active substances and diagnostics, and the optimization and adaptation of therapies for the benefit of patients all over the world. Similar approaches with a strong focus on big data are also used by other players and will provide new opportunities for healthcare biotechnology companies.

Data and collaboration at the core of precision medicine

CONTINUED

AI in biotech patents: the tip of the iceberg

Christian Moser and Anna Maria Villa
Swiss Federal Institute of Intellectual Property | Patent Experts

A new study by the Swiss Federal Institute of Intellectual Property finds the number of biotech patents where Artificial Intelligence (AI) is a core feature is small. But this is only the tip of a much larger AI / biotech iceberg where AI is an important assisting tool of invention.

The European Patent Office (EPO) defines a computer implemented invention (CII) as "one which involves the use of a computer, computer network or other programmable apparatus, where one or more features are realized wholly or partly by means of a computer program".

AI patents on a growth curve

The EPO defines Artificial Intelligence (AI) as "reasoning and decision-taking by machines rather than humans or animals." AI often implies an iterative training process (machine learning), which enables a machine to adapt to a specific problem before being able to take adequate decisions or propose interpretations autonomously. AI and machine learning often appear as synonyms in the patent literature.

During the past decade, the number of patents relating to AI has grown exponentially, as documented in recent reports from both the WIPO (World Intellectual Property Organization) and the UK’s Intellectual Property Organization (UK IPO). Swiss AI patent volume is catching up with the slower growing biotech sector, reflecting a process of portfolio consolidation of the largest patent owners or big pharma (Figure 1).

AI patents challenge the current IP system

Inventions involving CII, and AI in particular, challenge the current IP system in several ways. The issues center on patentability, "inventorship", and ownership. Evidence of this can be found in the World Economic Forum 2018 white paper; Hu 2019; and WIPO’s decision in 2019 to launch a public consultation on AI and intellectual property.
AI in biotech patents: the tip of the iceberg

Most current patent laws and conventions require a patent application to designate a natural person as the inventor, thereby excluding AI. In a recent case, both the EPO and the UK IPO have rejected two patent applications, which explicitly declared an AI system as the inventor (see AI Inventorship Project in 2019). Biotechnology, Big Data and Artificial Intelligence Patent Applications article in IP Watchdog (2019)

AI enhances the ability to collect, categorize, and analyze large datasets, to simulate complex processes, and to predict their outcomes. Thus, the classical topics of biotechnological patents offer attractive applications for AI: compound design/discovery, diagnostics, prognostics, or control of complex biological processes.

Biotechnology was among the first areas of application for AI, and it continues to be an important topic (see Oliveira et al., Goh et al., Shah et al. 2019, 2017). A recent article on drug discovery proposes five levels of AI involvement, ranging from analytical assistance to entirely autonomous activity without human input (Table 1). With regard to patent quality, an impressive 40% of all AI patents in biotechnology worldwide qualify as world-class. This is true for patents invented in Switzerland (shown in red) are world class in each of the three categories (Figure 2).

A Semantic Sunburst Graph (SSG) (Figure 3) provides an overview of the topics covered by the 3,136 documents. SSGs are created by automated text analysis algorithms, which qualify as unsupervised machine learning, i.e., AI.

Swiss performance in global context

Over the past 20 years, both global and Swiss-invented AI patents in biotechnology show similar growth curves. In contrast, the larger sets - biotechnology and AI - reveal very distinct dynamics for the global and the Swiss portfolios (Figure 1).

AI as an assisting tool in biotechnology patents

The overlap found between AI patents and biotechnology patents seems surprisingly small. However, this selection is restricted to patents in which AI represents a core feature of the invention, as illustrated by the examples in Table 1. These patents correspond to levels 4 and 5 according to the classification proposed by Green et al. Beyond these AI-centered biotech inventions, AI may have served as an assisting tool in many more biotechnology inventions. Accordingly, if the patents had not prominently disclosed the use of AI, the classifications and keyword concepts applied would have failed to capture them.

In conclusion, AI patents with biotechnology overlap for which AI is a core component are just the visible tip of a much larger iceberg of biotechnology-AI patents.

Patents: applying AI to biotechnology

In order to identify the patents disclosing AI applications in biotechnology, we created the intersection of two independent and comprehensive patent collections: one relating to AI/machine learning and the other to biotechnology. Each of them comprises more than 300,000 active patent families.

The overlap yielded 3,136 patent families, accounting for less than 1% of each parent technology field, and including 52 patents from Swiss inventors. Despite this small number, the contribution of Swiss inventors in this set is larger in proportion (1.7%) than in biotechnology (1.2%) or in AI (0.5%).

With regard to patent quality, an impressive 40% of all AI patents in biotechnology worldwide qualify as world-class. This is substantially more than in biotechnology or AI alone (17% for both). This is true both globally (shown in green) and in Switzerland (shown in red).

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Figure 3: Technology Clustering of the intersection between AI and biotechnology patents (sunburst chart generated by AI-based semantic analysis) The overlap between AI and biotechnology yields 3,163 patent families and is spread across a wide array of disciplines, from microbiology and polymorphisms to “information” and “computation.”

Table 1: Level of AI involvement in drug discovery patents Adapted from table 1 in Greene et al. (2018)
Axel Nemetz
Head of IBM Life Sciences Switzerland

Sirpa Tsimal
Director Investment Promotion Switzerland Global Enterprise

Today IBM is best known for its work in the areas of artificial intelligence, blockchain and other leading software, services and technology products. But as far back as 1911 it was developing the first electronic patients’ records for the US military. Axel Nemetz, Head of IBM Life Sciences Switzerland, talks to Sirpa Tsimal, Director Investment Promotion with Switzerland Global Enterprise about his company’s role in life-sciences and healthcare and why Switzerland is the perfect place to be.

Tsimal: IBM is a long-time and prominent foreign investor in Switzerland. What makes Switzerland a good location for establishing a research center?

Nemetz: IBM’s Swiss affiliate was founded in 1927 and our Research Lab was established in 1956 in the Zurich area. Switzerland’s stable business environment, high level of education, global attraction for talent as well as its central location in Europe made it the first choice for a research lab outside the US.

Today IBM has 19 research locations around the world, but no other IBM lab gave rise to so many Nobel Prize winners as our Rueschlikon facility. Georg Bednorz, Gerd Binnig, Karl Alexander Müller and Heinrich Rohrer received the Nobel Prize for their work with IBM on the scanning tunnel microscope that can provide images down to individual atoms and for high temperature superconductivity which has the potential of a more careful use of energy. Switzerland’s strong infrastructure and multiple other benefits certainly helped to accomplish these achievements.

Tsimal: What value does Switzerland add to IBM as a location for emerging tech?

Nemetz: Besides having brought forward 4 Nobel laureates, our Rueschlikon lab also played host to the global coordination role for our research activities in security, blockchain, Internet of Things. And it has close collaborations with renowned universities such as ETH and EPFL.

Switzerland is in particular interesting to us since it allows us close collaborations with corporate headquarters not only of leading global bio-pharma but also with leading global banking, insurance, technology assembly and nutrition companies. This is an interesting playground to jointly develop new technologies, hand-in-hand with our clients and in close collaboration with academia.

Tsimal: What trends do you see in Switzerland when it comes to AI and life sciences?

Nemetz: Switzerland’s legislation and commonsense-driven admin processes allow for the swift setting-up of pilots using new technologies. Take Medgate App, a “Doctor on an app” providing “teleconsultation” services. Medgate was developed here in Switzerland and is now a leading provider of digitally enabled remote health services with an established global reputation.

The local proximity to innovators like Medgate allows us to develop new technologies faster. Medgate and IBM jointly developed an augmented intelligence powered algorithm to remotely identify medically critical situations.

Looking at the macro picture, the biggest trend we observe in life sciences and healthcare in Switzerland is working to make high quality healthcare more affordable. This is a global trend that often embraces the benefits of new technologies like AI, blockchain and robotics; and that is no different from what we see in other countries. We believe that is one of the key drivers for change and potentially technology-enabled disruptions in the healthcare space.

Tsimal: Large tech companies like IBM, or Alphabet, Apple, Samsung, and Amazon, are getting into the healthcare space, while traditional pharma like Novartis and Roche are acquiring tech capabilities. Industry lines are blurring in the digital age. Do you see yourself as a healthcare disruptor?

Nemetz: We see ourselves as an enabler. Of course, sometimes the deployment of our technology can give rise to disruptions. However, since IBM focuses on B2B relations the level of disruption is mainly driven by our clients. Moreover, true disruptions are often a result of cross-stakeholder collaborations.

In the healthcare and life sciences field we currently only see initial models on the scale of these cross-stakeholder collaborations which are often initiated by payers. For example, the electronic medical record portal of “Techniker Krankenkasse (TK)” in Germany. TK initiated this model to allow patients to automatically upload their data to this portal. Stories like this can become a trigger point for true disruption in the healthcare industry.

Tsimal: Can you tell us about some of IBM’s current projects and use cases in biotech?

Nemetz: We are working, alone or in association with partners, e.g., on price modeling, companion diagnostics, clinical protocol design and trial-matching, to name a few.

Recruitment challenges and protocol amendments can lead to study delays and failures. These can often be traced back to the study design. IBM Study Advance can help overcome these problems. It’s built to optimize the protocol development process by providing both the power of data insights to make informed decisions and a collaboration platform to improve efficiency (https://www.ibm.com/products/study-advance).

Clinical trial-matching can shorten long drug development times. We have also developed a tool which streamlines clinicians search to identify a list of clinical trials for an eligible patient (https://www.ibm.com/downloads/cas/BSGVRKNK and https://www.ibm.com/us-en/marketplace/clinical-trial-matching-oncology).

On pricing, we have developed smart algorithms that allow pharma and biotech companies to model the impact of new product launches or loss of exclusivity.

Last but not least I would like to mention companion diagnostics. For example, in the area of diabetes we are working closely with pharma, biotech and diagnostics companies to better predict the impact of insulin dosage on the patient’s blood sugar levels in order to reduce medium term complications and improve the quality of life for patients.

Tsimal: In AI healthcare applications, what has IBM decided to focus on and why?

Nemetz: The healthcare environment is complex, not only because of the complexity of diseases and treatments but also because of the need for well-orchestrated coordination between the many stakeholders in a highly regulated environment.

If we divide AI into three phases – narrow AI, broad AI, and revolutionary – we are currently in the narrow AI phase. The implication is that we are focusing on the most promising areas where only few stakeholders are involved.
Examples would be our medical imaging collaboration with France-based Guerbet, that has its Swiss affiliate in Zurich, to support liver cancer diagnostics and care utilizing MRI and CT imaging. Another example is our collaboration with US-based Medtronic, that has its European headquarters in Vaud, to make living with diabetes a little easier with the power of our cognitive computing tools.

Finally, we are also working on ethics in AI to address topics like accountability, value alignment, ‘explainability’, fairness and user data rights.

Tsimal: Let’s talk about the IBM Watson health platform: Where do you see the future of this business and is IBM planning to develop other AI-powered systems for the other ‘omics’ such as proteomics, metabolomics, and transcriptomics?

Nemetz: Indeed, we are collaborating with the Geneva university hospitals that are using our IBM Watson for Genomics® solution to help them deliver personalized oncology care. In this context, I would like to mention a challenge we still see; namely the not yet sufficiently automated exchange of, sometimes anonymized or ‘pseudonymized’, data across providers and with payers or patients.

This is a key challenge we are trying to address with our Open Health Platform which allows different stakeholders across the industry to store, exchange and work with data in a regulated and secure environment. We see this as another required step before moving from narrow or broad AI to revolutionary AI in the healthcare space.

Tsimal: Based on the IBM experience, how advanced is the use of Real World Data (RWD) in medicine, and what is IBM’s role in working with RWD?

Nemetz: This is a field of great demand. Pharma and biotech companies are highly interested to better understand patient pathways which can lead to innovations based on RWD. Other examples involve the use of clinical trial data with RWD data to accelerate decisions. As an example I would like to point to a joint paper by Roche and IBM published in Nature Medicine (Vol 25, January 2019, 57-59) last year. This paper looks into predicting the early risk of chronic kidney disease in patients with diabetes using real-world data.

“Switzerland is particularly interesting to IBM since it allows us close collaborations with corporate headquarters not only of leading global bio-pharma but also with leading global banking, insurance, technology and nutrition companies. This is an interesting playground to jointly develop new technologies, hand-in-hand with our clients and in close collaboration with academia.”

Axel Nemetz, Head of IBM Life Sciences Switzerland
in an interview with Sirpa Tsimal, SGE
Swiss Biotech: A dynamic hub with all the ingredients innovators need to make their venture a success

Michael Altorfer
Swiss Biotech Association | CEO

The best physicians have always treated patients with an individual focus, applying tailored treatment. Yet, many of the 20th-century medical advances have been based on a one-size-fits-all approach. The power of computing is changing all this, slowly making personalized medicine a reality, with oncology at this revolution’s forefront.

The Al revolution in Switzerland has come to drug development, clinical research, and the lab, as well as to doctors and hospitals. Switzerland’s base is solid: it benefits from world-renowned academic hospitals and universities such as the Swiss Federal Institute of Technology Zurich (ETHZ) and Lausanne (EPFL). It is also the home of major corporate research powerhouses including IBM and Google. The two companies have their oldest and largest research centers outside the US in the Zurich area. Roche is a global leader in databases combining genomics and clinical data, while innovative companies such as SOPHIA GENETICS are helping hospitals around the world to improve treatment decisions by identifying subgroups of patients who respond best to particular treatments.

Switzerland is known for its innovative capacity and strong economy, and consistently tops major international rankings for innovation. A landlocked Alpine country that lacks raw materials, it has had continually to reinvent itself over the centuries. The Swiss chemicals sector became an economic force in the 19th century and set the stage for the establishment of Novartis and Roche. Today Switzerland is fast embracing the rapid developments in bio- and information technology to become one of the world’s most innovative smart health hubs. The country stands at the forefront of medical breakthroughs arising from the combination of intelligent algorithms and combined, clean and labelled, clinical and genomic real-world datasets.

The combined expertise of these entities is substantial, and sure to act as a catalyst for Switzerland’s further development of knowledge in personalized medicine in oncology and beyond. Stay tuned for more smart health innovation.

Swiss biotechs thrive with winning formula

The formation of new biotech start-ups is a function of four fundamentals underpinning the translation of research into commercial capital: scientific research output, biomedical patent activity, presence of VCs with an interest in the biomedical field, and the abundance of human capital flowing from top universities. Switzerland abounds in all four of these areas and was ranked as number one of 16 countries analysed on a per capita basis, in Nature Biotechnology’s five-year comparative assessment (2019).1

According to Start up Ticker, a leading Swiss start-up news channel, there is a clear point of difference for Swiss biotech start-ups versus other players in the Swiss innovation ecosystem: they disproportionately account for companies which were valued at more than CHF 100 million.2 While software exits were far more numerous, biotech accounted for almost 50% of Switzerland’s higher valuation exits in 2019.

How do biotech actors manage? Many biotech companies establish proprietary technology platforms that can be applied in different indications or develop a portfolio of development candidates to mitigate the inherent attrition risk in drug development. Some investors, however, have increasingly adopted the asset-centric model whereby drug candidates are decoupled from the heavy infrastructure necessary to develop them. Francesco de Rupertis, then at Geneva-based Index Ventures, was among the first to promote this model back in 2010, giving preference to start-ups with a single or perhaps two assets and a team of interdisciplinary experts coalescing around the asset to ensure its success.

Swiss innovation in personalized medicine

Switzerland is a global leader in databases combining genomics and clinical data, while innovative companies such as SOPHIA GENETICS are helping hospitals around the world to improve treatment decisions by identifying subgroups of patients who respond best to particular treatments.

Switzerland is the number one country in innovation and competitiveness

Switzerland is a global leader in databases combining genomics and clinical data, while innovative companies such as SOPHIA GENETICS are helping hospitals around the world to improve treatment decisions by identifying subgroups of patients who respond best to particular treatments.

A fully networked ecosystem with a vast choice of prime locations

Switzerland abounds in incubators, accelerators, bio- and innovation parks. These can be found in the university cities of Zurich, Basel, Bern, Lausanne, Lugano, and Geneva and beyond.

They provide an all-important forum to facilitate collaboration between universities, research institutes and the private sector, combining research with innovation management and financing competencies to create synergies. There are over 40 science parks in Switzerland, hosting 2,000 companies in Switzerland. Choose your preferred region and join us.

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Nasdaq Biotechnology
SPI
IPO / Listing
30

Figure 1: SXI Bio+Medtech Index Jan 2015 to Jan 2020

To reiterate the high importance of this sector, a special index - the Swiss Bio+Medtech Index (SXI) - was created in 2004. The index increases the visibility of companies in this sector and meets the needs of investors who wish to participate in this attractive segment.

The SXI Bio+Medtech Index currently comprises 19 companies.

The rewards of volatility

It is generally known that biotech stocks are subject to specific risks and thus susceptible to larger volatility of returns, both upward and downward. These include regulatory setbacks, clinical failure, commercialization challenges such as market access, and patent expiration.

However, the risk-return chart (see Figure 2) - with selected indices for the year 2019 - shows that in the case of the SXI Bio+Medtech Index, investors have nonetheless been adequately compensated for higher risks taken. Compared to the NYSE Arca Biotechnology and NASDAQ Biotechnology Index, the risk-return profile is even highly attractive.

The X-axis reflects volatility and the Y-axis, yield achieved. The further a company positioned to the upper left on the index chart, the better its risk/return profile. 2019 was an excellent year for equity securities with the SPI reaching new record levels. Biotech stocks also benefited from this general upward trend, achieving about the same returns but showing a slightly higher volatility.

Consider a longer time horizon however, and the SXI Bio+Medtech succeeds in outperforming all benchmarks listed in the chart. This is also reflected in the Sharpe Ratio - also known as the Reward to Volatility Ratio - which has established itself as a widely used and recognized method of calculating risk-adjusted returns. With a 5-year Sharpe Ratio of 0.70%, the SXI Bio+Medtech Index lies above the SPI (0.57%) and even further above the other indices.

Investment opportunities on SIX

On SIX, investors can invest in the biotech sector either directly - in single stocks of listed biotech companies or the listed biotech investment companies - or through other listed products. For example, investors can participate in the performance of the SXI Bio+Medtech with a tracker certificate (ISIN CH0002080197).

SIX also offers trading in two Exchange Traded Funds (ETFs) and six investment funds, which are specifically dedicated to the biotech sector.

The end of January 2020 saw assets in investment funds amounted to reach CHF 6 billion, which is well above those of the ETFs on SIX. Even taking into account that these ETFs have not existed as long as investment funds, it seems clear, contrary to the general trend towards passively managed investments, that when it comes to the biotech sector, investors in Switzerland seem to prefer actively managed solutions.

Various promising pieces of news in the first weeks of 2020 have led to the SXI Bio+Medtech index gaining 5% as of 31 January 2020, with several biotech stocks being among the best performing stocks in the SPI. Nevertheless, in the future volatility will remain higher than in other sectors, not least because of investors’ high expectations.

Innovations from SIX

In 2016, SIX launched the “Stage Program” to support listed companies in expanding their market presence and visibility among key stakeholders. The aim was to reduce uncertainty (and hence volatility) and better manage investors’ expectations.

With this program SIX supports companies in the process of building their presence in the market and achieving appropriate valuation through research coverage. Two listed biotech companies - Addex Therapeutics and Neuron Pharmaceuticals - are currently participating in the program and more are to follow.

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Figure 2: 2019 Indices volatility and returns

Figure 1: SXI Bio+Medtech Index Jan 2015 to Jan 2020

“Over the past five years to end Jan 2020, the SXI Bio+Medtech Index has clearly outperformed both the Swiss Performance Index (SPI) by 38% and the NASDAQ Biotechnology Index by 46%. This impressive performance is backed up by the high importance of this sector, a special index - the Swiss Bio+Medtech Index (SXI) - was created in 2004. The index increases the visibility of companies in this sector and meets the needs of investors who wish to participate in this attractive segment.

The SXI Bio+Medtech Index currently comprises 19 companies.

To be included in the index, a company requires a primary listing on the Swiss Stock Exchange with a minimum free-float market capitalization of at least CHF 100 million. The weighting of individual stocks on the index is limited to 10%, whereby small- and medium-sized enterprises are gaining in importance. The index currently comprises 19 companies.

Latest SIX inclusions

Of the biotech listings in the last five years, Idorsia (16 June 2017), Polyphor (15 May 2018) and Obseva (13 July 2018) have made it into the index. Polyphor’s IPO was one of the largest European biotech IPOs in recent years in terms of proceeds raised, enabling the company to raise CHF 155 million to finance the development of its pipeline.

Obseva, on the other hand, undertook a dual primary listing on SIX, after its U.S. listing, to further strengthen its profile among Swiss and European investors. This strategy provides Obseva with an additional robust market for future potential financing activities and allows it to protect its shareholders through Swiss takeover rules.

Idorsia’s stock price has risen considerably since its market debut on SIX, whereas a different picture emerges in the case of Polyphor and Obseva. Both securities have been subject to major fluctuations in value since their respective IPOs, each supported by trading volumes significantly above their annual average volume at the respective points in time.

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Innosuisse’s role in fostering innovation

Bettina Ernst
Innosuisse Innovation Council | Vice-Chairperson

Johanne Stettler
Innosuisse | Communication Specialist

Dr. Bettina Ernst, Vice-Chairperson, Innosuisse Innovation Council explains why she believes Switzerland ticks all the boxes when it comes to being a leading player in the development of biotechnology. Interview by Johanne Stettler, Communication Specialist at Innosuisse.

Switzerland is one of the most innovative countries in biotech, leading the way in many fields and attracting capital and researchers from all over the world. As a scientist, Dr. Bettina Ernst is familiar with this ecosystem. She also has extensive experience in fundamental immunology in Europe and the United States, as well as in the Swiss biotech and pharmaceutical sectors. She heads up her own company - Preclin Biostems AG - which specializes in drug validation and is committed to supporting research and development in science.

Johanne Stettler: In Europe, Switzerland is a major and innovative player in the biotech sector. What are the reasons for its leadership position?

Dr. Bettina Ernst: There are various reasons. Switzerland has excellent universities of technology, such as the Federal Institutes of Technology in Zurich and Lausanne. The universities and university hospitals of Zurich, Basel, Bern, Lausanne and Geneva are also extremely prestigious.

Other key players include major pharmaceutical companies, such as Roche and Novartis. Bridging the gap between innovation and the market requires an ecosystem with scientific expertise, know-how and technology transfer and the experience of highly qualified specialists who have been working in biotech for decades and fully understand how it works.

Switzerland is also a country that enables those who work here to arrange meetings within an hour’s train journey of their home, which is a major advantage. The combination of these factors makes this small country a key location for the development of biotech solutions.

Johanne Stettler: What role does Innosuisse play in the development of innovation in Switzerland?

Dr. Bettina Ernst: Innosuisse’s role is to promote science-based innovation in the interests of industry and society in Switzerland. It especially promotes the partnership between academia and the market with innovation projects, networking, training and coaching. It took a while for everyone to get used to the new system brought about by the creation of Innosuisse in 2018.

Today, I believe these efforts have paid off, as we receive a large number of innovation applications every month. Supporting high-quality, but often fledgling and high-risk projects, is the task of Innosuisse – this is also a very important support mechanism in Switzerland.

Johanne Stettler: Who benefits from Innosuisse’s support?

Dr. Bettina Ernst: The scientific and innovation community, but also society as a whole. It is society that ultimately benefits from the projects that we support. In more specific terms, thanks to Innosuisse and its aim to help Swiss start-up and SMEs developing and prospering, the population benefits from high technological and scientific standards.

Johanne Stettler: What is the difference between Innosuisse’s funding instruments and other financing systems on the Swiss market?

Dr. Bettina Ernst: The Swiss National Science Foundation only supports academic research, for example. Innosuisse has a different mandate. Its goal is to support science-based innovations that create long-term value for society.

Johanne Stettler: Can interdisciplinary projects be submitted to Innosuisse?

Dr. Bettina Ernst: In each project, there are at least two partners (research institution and partner from the industry) whose skills complement each other and who mutually benefit from each other’s knowledge. And even if it involves a very specific field, successful project implementation means working on various aspects and objectives that need to be combined. In my view, an interdisciplinary approach is the very essence of Innosuisse’s mission.

Johanne Stettler: How would you define Innosuisse’s role in supporting the creation and development of biotech start-ups?

Dr. Bettina Ernst: Today, these new companies can benefit from excellent coaching in different subjects (pitching to investors, financing, regulatory, IP, etc.) but also general start-up coaching, which is a real opportunity for them. In addition, Innosuisse projects support these companies in advancing the company’s innovation in collaboration with an academic institution.

Johanne Stettler: Is there any special aspect that you would like to stress?

Dr. Bettina Ernst: Innosuisse’s role promoting partnerships between academia and the market with innovation projects, networking, training and coaching is starting to pay off and we now receive a large number of innovation applications every month. Our work not only helps the scientific and innovation community, but society as a whole benefits from high technological and scientific standards.*

At the same time, various other, mainly privately-funded initiatives such as Venturelab, Venture Kick, Venture Leader and +venture++ ‘competition’, are indispensable for the Swiss start-up ecosystem. All these initiatives support young companies, allowing them to progress and complete the stages of their development.

Johanne Stettler: In 2019, the number of successful innovation project applications in life sciences doubled compared to 2018. That’s encouraging.*

Dr. Bettina Ernst: Yes, the figures are very encouraging. But the most important thing is that the quality is also there and that the collaboration between the various project partners is successful. I take a very positive view of the future development of innovations in the biotech sector in Switzerland.

* 167 applications for funding were submitted in 2019 (100 were approved), as compared with 87 applications in 2018 (of which 45 were accepted)
The biotechnology sector includes a wide array of technologies and applications and a significant share of Swiss players. During 2019, biotechnet Switzerland continued to promote technology developments and implementation by supporting networking, scientific events and dedicated research projects involving both research organizations and industrial partners.

By these means, we aim to promote activities of specific interest to the Swiss biotechnet sector and help them achieve a maturity that will allow them to expand and acquire additional external funding. To this end, biotechnet Switzerland has maintained close links with Innosuisse and will evaluate the suitability of the recently launched ‘NTN - innovation booster’ to foster and promote specific research areas, incorporating a core-centric, design-thinking approach.

Concomitantly, biotechnet Switzerland is constantly reassessing the next “hot spots” in the biotech sector and is prepared to support exciting technological developments and new challenges faced by industry. It is clear that close communication and interaction with the Swiss biotech industry in general, and the SBA in particular, will be important in pursuing these goals.

In 2019, biotechnet supported the realization of two international summer schools, both held in the new Campus Muttenz of the School of Life Sciences (FHNW). The traditional ‘Summer School on Advanced Biotechnology’, organized in collaboration with Università degli Studi di Palermo, boasted an excellent scientific program and attracted the attendance of the Italian ambassador to Switzerland at the opening ceremony.

In addition, several industrial representatives discussed career opportunities and the current job market in Switzerland with students soon to achieve Bachelor and Master degrees in the field of biotechnology. Underlining the strong link with the biotech industry, the event featured a presentation by Kalvitech and a contribution by Dr. Michael Altuffer, CEO of the SBA.

Last year’s Summer School ‘Health and the Environment’, touching upon the cross-road of environmental sciences and medical research, also took place at the School of Life Sciences (FHNW). It was co-organized by FHNW, Nanjing University (China) and the International Institute for Environmental Studies (Canada) and was notable for the attendance of students from Switzerland, China and Canada.

The work of biotechnet Switzerland is defined by the needs of the biotechnology sector in Switzerland and it is continuously reshaped to optimally fit a very dynamic environment. The organization’s commitment to provide excellent scientific and technological know-how and to closely interact with the SBA to support the Swiss biotechnology industry is a constant in this ever-changing field. We are enjoying the present while looking forward to the future!

"Biotechnet has maintained its role of fostering interactions between key players in Swiss biotech. In this very dynamic environment, we have recently focused on tissue engineering, in vitro diagnostics and personalized medicine and have helped to bring about successful collaborations in applied research between industry and academia."
The Swiss Biotech Success Stories Awards recognize valuable accomplishments and honor those who have made important and sustainable contributions to the biotech industry in Switzerland. The awards are presented each year at the Swiss Biotech Day and reflect the diversity and achievements of this innovative industry.

10 Success Categories
1. Completed achievement with lasting impact
2. Scientific breakthrough
3. New technology
4. Strong impact on society
5. Product approval and sustainable revenues
6. Involvement of one or more Swiss citizens
7. Swiss-based company / institution
8. Creation of jobs in Switzerland
9. Enabler for the biotech industry
10. Swissness: Think global, made in Switzerland

Swiss Biotech Success Stories demonstrate the power and potential of Swiss biotech

Switzerland is one of the world’s leading biotech hubs and attracts many foreign companies, specialists and investors. It provides over 50,000 jobs and, together with the pharmaceutical and chemical industries, accounts for almost half of Swiss exports.

To make the industry’s impact more visible, the Swiss Biotech Success Stories initiative was launched in 2018. Selected success stories are showcased to illustrate how Swiss biotech companies help patients, improve healthcare worldwide, and make a valuable and significant contribution to the Swiss and global economy.

Laureates are individuals or groups who have earned extraordinary merits. Success is broadly defined as scientific, translational, medical or commercial, together with other aspects that have a positive impact on the biotech and life science industry and society in Switzerland.

“It is essential to share with the public the importance and success factors of biotech companies and to ensure that decision-makers understand what it takes for the industry to develop and remain competitive,” says Michael Altorfer, CEO of the Swiss Biotech Association. “At the same time, young talent should be inspired and motivated to take a closer look at the great variety of career profiles in biotech. As a successful and booming economic sector, the biotech industry depends on many passionate, visionary and well-trained up-and-coming talent.”
Headquartered in Zug, Biogen has been a key stimulus and model for the biotech industry. Its best-selling drug against multiple sclerosis or its latest Alzheimer’s candidate, as well as the new production facilities in Luterbach, creating 600 new jobs, are proof of Biogen’s success.

The Schlieren-based company has been an integral part of Roche Pharmaceutical Research and Early Development since 2005 and is a pioneer in antibody engineering in cancer immunotherapy. Its antibody glycosylation technology increases immune-mediated killing of cancer cells and builds the basis for improved cancer medicines.

Fully integrated into GlaxoSmithKline since 2013, Okairos from Basel developed innovative T-cell based vaccines for major infectious diseases such as malaria, hepatitis C, HIV, and Ebola. Its novel replication-incompetent adenovirus vectors could enable the development of important new vaccines and offer immunizations against illnesses that lack vaccines.

The advanced technologies in protein expression by Selexis provide biotech and pharmaceutical companies with a rapid, stable, and cost-effective solution for the production of recombinant proteins. Nearly a hundred drug candidates in clinical development and three commercial products utilize the technologies of the Plan-les-Ouates-based company.

This transformational joint venture provides Vifor Pharma direct access to dialysis patients, facilitating the product distribution and recruitment for clinical development. It transformed the company from Glattbrugg rapidly into a global nephrology corporation. Such vertical integration is a role model for the convergence of different life science sectors.

Find more info at swissbiotech.org/success-stories
Swiss Biotech Success Stories award winner 2020

Debiopharm

Debiopharm is a family-owned biopharmaceutical company founded in 1979 by Dr. Rolland-Yves Mauvernay and headquartered in Lausanne (Vaud/Waadt) with activities in drug development and digital health investment.

Research and manufacturing facilities are located in Martigny (Wallis/Valais). The oncology and bacterial infection-focused company identifies high-potential compounds for in-licensing, clinical development, and commercialisation with partners across the globe.

Headed today by Mr. Thierry Mauvernay, innovation plays a central role at Debiopharm. Each year, over 1.2 million patients benefit from the development of the company’s innovative therapies which target high unmet medical needs for cancer patients and those affected by hard-to-treat bacterial infections.

During the COVID-19 crisis, Debiopharm is evaluating its compound library for potential treatment solutions along with leveraging the diagnostics and monitoring know-how of its portfolio companies such as Kaiku and BC Platforms, and a growing pipeline of 12 specialised medicines that aim to ultimately bring patients closer to a cure. Their ongoing innovation in oncology currently includes antibody drug conjugates, DNA damage repair, pro-apoptotic and anti-tumor immunity enhancing therapies.

Debiopharm has a vision for healthcare that goes well beyond making new medicines available. They endeavour to improve treatment as a whole, from diagnostics to medication and monitoring, in order to impact the lives of patients throughout their overall journey. With over 400 employees in Switzerland, their 40 years of commitment to patients through translational and clinical research while keeping innovation central in all they do, has earned Debiopharm their title as a Swiss Success Story.

Swiss Biotech Success Stories award winner 2020

Actelion

Actelion, a Janssen pharmaceutical company of Johnson & Johnson, is an industry leader in pulmonary hypertension.

Established in 1997, the founding members set out to build a company based on groundbreaking innovation and an unwavering commitment to patients. After going public in April 2000, the company, led by CEO Jean-Paul Clozel M.D., launched its first product, Tracleer (bosentan), in the US in November 2001.

Since the beginning, Actelion, in addition to its focus on pulmonary hypertension, had built an active drug discovery and development organization specializing in the areas of immunology, central nervous system disorder, and rare diseases, which now continues in Idorsia. In addition, Actelion created a sales and marketing organization with global reach, leading to the launch of six new medicines, helping patients in the areas of pulmonary hypertension, lipid storage disorders, and skin cancer.

Actelion’s groundbreaking medicines have been a key contributor to the remarkable improvement in prognosis for people with pulmonary arterial hypertension (PAH). The median survival time has more than doubled over the past two decades to now greater than seven years with treatment.

After being acquired by Johnson & Johnson in June 2017, Actelion leveraged its established global presence and commercial strength bringing further resources, capabilities, and investment to change the future for people with PAH and other types of cardiopulmonary diseases. At the time of its acquisition, Actelion employed more than 2,600 people in over 30 affiliates, reaching more than 50 markets.

Since the acquisition, the development of one of Actelion’s compounds, ponesimod, was transitioned to the Neuroscience Therapeutic Area of Janssen. It is being investigated for the treatment of relapsing forms of multiple sclerosis in adults; last year encouraging Phase III trial results were published.

Despite much progress, PAH has no cure and four out of 10 patients die within seven years of diagnosis. However, building on its legacy of achievement, Actelion, as part of Johnson & Johnson, is committed to improving the lives of people affected by PAH and other types of pulmonary hypertension. The company remains the industry leader in the science and medicine of PAH.

Actelion’s and Janssen’s medicines have been a key contributor to the remarkable improvement in prognosis for people with pulmonary arterial hypertension (PAH). The median survival time has more than doubled over the past two decades to now greater than seven years with treatment.

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Helsinn is a fully integrated Swiss pharmaceutical group with a strong R&D pipeline and in-licensing targets ready for the next growth phase, thanks to a strong track record, a solid revenue stream in B2B and strong cash flow and cash position.

Helsinn is investing and building market differentiation in B2C in US and China and is owned by a third-generation healthcare entrepreneurial family.

Founded by Dr Gabriele Braglia in 1976 in Ticino, the Helsinn Group has grown globally with over 650 employees, creating jobs in Switzerland, USA, Ireland, Monaco, and in China, including last year’s opening of the Chinese commercial division in Shanghai. Led by Riccardo Braglia and Giorgio Calderari, Helsinn develops innovative solutions to improve the lives of cancer patients. At present, the R&D pipeline is made up of six product candidates in cancer care and rare diseases, including two in Phase III and a total of 26 clinical trials undertaken between 2015-2019 alone. Each year, the Group invests approximately 25% of its revenue in R&D.

All of the Group’s output is guided and underpinned by core values of quality, integrity, and respect. This belief system, along with strong alliances with service providers and over 80 commercial partnerships across 190 countries, has helped the Group to develop new treatments to fulfill more medical needs around the world.

Helsinn Group wants to play an active and central role in promoting a social transformation in favor of people and the environment. Corporate social responsibility is at the heart of our daily activities and this confirms our goal of including sustainable growth in the company’s strategic plan.

Further demonstrating its commitment to biotech innovation, the Helsinn leadership team established an investment fund to support the future of healthcare and advance early-stage opportunities: providing funding and strategic support to innovative companies.

This outward look at innovation and unwavering determination to push boundaries in healthcare truly makes Helsinn a Swiss Biotech Success Story.

To date, Venture Kick has supported 700 startup projects with CHF 30 million in seed capital. Eighty new projects will receive CHF 5 million in funding in 2020. Startups can receive up to CHF 150,000 in cash. In addition, promising entrepreneurs are offered professional guidance in developing their business through Kickers Camps and exposure to an incredible network of investors and industry experts.

According to Crunchbase, Venture Kick was the second most active seed investor in Europe in 2019. Overall, supported startups have raised CHF 3.5 billion in total and created more than 7,000 jobs. In 2020, Venture Kick has launched a dedicated Life Sciences Track to further increase the support for biotech and medtech startups.

Helsinn is a Swiss Biotech Success Stories award winner 2020

Venture Kick, >>venture>>, Venturelab

VENTURE KICK

>>venture>>

Since 1997, >>venture>> has been the leading competition for early-stage startups in Switzerland.

A joint initiative of ETH Zurich, McKinsey & Company, Knecht Holding, Innosuisse, and EPFL and organized in the >>venture>> foundation, perks of the competition include mentoring by >>venture>> extensive industry expert network, a McKinsey business consulting package, as well as visibility among the company’s high-profile Advisory Board and media partners.

With the added incentive of over CHF 500,000 in non-dilutive prize money, the competition has attracted and awarded many successful Swiss biotech startups such as Glycadd, Molecular Partners, Cowagen, and SOPHIA GENETICS.

VENTURELAB

Launched in 2004 as a national training program for high-tech startups, Venturelab supports the best Swiss start-up talents in closing financing rounds and accelerating business development with customized support modules.

World-class startups, Swiss made: In the last 15 years, Venturelab has trained more than 50,000 founders, including promising biotech startups like Amal Therapeutics, Bioenvis, Cellexis Biotech, Cutis, Insphere, Lunaphore, Polynear Pharmaceuticals, SOPHIA GENETICS, Versantis, etc.

The best startups are presented within the Venture Leaders investor roadshows around the globe. The so-called “Swiss National Startup Teams” are traveling to Silicon Valley, Boston, New York, Shanghai, Beijing, and Hong Kong. For 10 years now, Venturelab also presents the TOP 100 Swiss Startup Awards and invites global investors to Switzerland.

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Swiss Biotech Success Stories award winner 2020
Professor Werner Arber

Werner Arber is a Swiss microbiologist, geneticist, and Noble Prize winner.

Along with American researchers Hamilton Smith and Daniel Nathans, Arber shared the 1978 Nobel Prize in Physiology or Medicine for the discovery of restriction endonucleases and their application in molecular genetics.

In his studies of bacterial restriction/modification systems, Arber concluded that bacteria are able to distinguish foreign DNA upon its penetration into the cell from their own DNA. Restriction enzymes cut foreign DNA into fragments, and modification enzymes protect the cell's own DNA by site-specific methylation from restriction cleavage.

Without the discovery of restriction enzymes, the fields of recombinant DNA technology, biotechnology, and genomics as we know them today would not exist. Researchers rely on restriction enzymes to perform virtually any process that involves manipulating, analyzing, and creating new combinations of DNA sequences.

Credited with a long list of accomplishments within the biotechnology sector, Arber enjoys notable recognition for his research in the mechanisms of biological evolution and bacterial restriction and modification.

In December 1985, during his rectorate period, Arber proposed the inception of the Trinational Biotechnology Program. The program kicked off at the beginning of the 1990s at the Universities of Strasbourg, Basel, Freiburg i. Brsg., and Karlsruhe and continues to be taught today.

Professor Werner Arber is an embodiment of Swiss success, without whom the field of Biotechnology might be a very different place.
Swiss Biotech Events of 2019

**January 2019**

- AC Immune announces appointment of Dr. Mark Kaiser-Willy as Chief Scientific Officer
- CHF 15.6 million for two new treatments for rare diseases
- Cystinosis: fast track designation for CTX001; further indication for patient therapy
- CRISPR Therapeutics and Vertex announce FDA fast track designation for CTX001 for the treatment of cystinosis
- Basilea reports positive interim results from registrational Phase III trial of mupirocin compared to colistin for the treatment of multi-drug resistant gram-negative pathogens
- Cystic fibrosis patients treated with lung-transplant to regenerate lung tissue
- Genentech reports ORALITY-1 study demonstrating non-inferiority to existing treatment

**February 2019**

- Acis Medical announces full recovery of necrotic lung facility
- Polyphor announces initiation of the second trial (Phase Ib) for derazantinib in patients with KRAS-driven solid tumors
- Obevax initiates US Phase IIb clinical trial for the treatment of large B-cell / mantle cell lymphoma
- Acis Medical announces publication of new data highlighting use of its first-in-class drug delivery system to promote the resolution of fibro-endothelial membranes in healthy volunteers
- Acis Medical announces retrieval of master data
- Acis Medical announces completion of development of a novel brain-penetrant small molecule

**March 2019**

- Cystic fibrosis patients treated with lung-transplant to regenerate lung tissue
- Genetech reports ORALITY-1 study demonstrating non-inferiority to existing treatment
- Santhera's SYROS study shows long-term efficacy of bemegride in urothelial cancer
- ObsEva SA reports initial good safety of OBE022 in Phase Ib study of patients with severe bladder overactivity

**April 2019**

- Acis Medical announces completion of development of a novel brain-penetrant small molecule
- Genetic and Functional Medicine announces exclusive regional licensing agreement with May 2019
- Acis Medical announces publication of new data highlighting use of its first-in-class drug delivery system to promote the resolution of fibro-endothelial membranes in healthy volunteers
- Acis Medical announces retrieval of master data
- Acis Medical announces completion of development of a novel brain-penetrant small molecule

**May 2019**

- Acis Medical announces completion of development of a novel brain-penetrant small molecule
Polyphor announces enrollment of Phase III clinical trial for balixafortide in combination with eribulin in patients with metastatic breast cancer

Myovant Sciences announces positive Phase III results from LIBERTY 1 study evaluating once-daily oral combination therapy in women with active fibroids

Auris Medical announces closing of $19 million private placement of common shares and rights to receive additional $96 million in net proceeds upon exercise of remaining outstanding rights

Ose Medical announces closing of a $55 million Series A financing

Santhera’s idebenone in Duchenne muscular dystrophy

Relief Therapeutics Holding AG announces an ADC development and manufacturing partnership with Gamida cell and Lonza to establish manufacturing sites for omidubicel and c-CAR T cells

PIQUR Therapeutics kicks off first-in-human study of their lead drug candidate for the treatment of multiple myeloma

AC Immune announces positive results from second Phase III trial of their aducanumab in mild cognitive impairment

Genkyotex’s GKT831 prevents fibrotic candidate GKT831 demonstrated statistically significant improvements in GGT and ALP over full treatment period in patients with primary biliary cholangitis

Ose Medical begins enrollment in Phase 1b/2a clinical trial of their lead drug candidate for the treatment of advanced liver fibrosis

Auris Medical announces closing of Series A financing

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Auris Medical announces closing of Series A financing
Swiss Biotech Events of 2019

September 2019

- **InSphero** announces new IsoVista imaging platform: high-content live-cell imaging
- **AC Immune** receives new IND to develop cinemod for Alzheimer's disease
- **Lonza** announces collaborations with **InSilico Therapeutics** and **Memo Therapeutics**
- **LimmaTech Biologics** announces the start of Phase I/IIb trial in benign prostatic hyperplasia (BPH)
- **SOPHiA GENETICS** releases advanced genomic information handling, closes a CHF 9.3 million Series A financing extension and increases total CHF 13.5 million raised
- **CRISPR Therapeutics** and **Idorsia** announce an update on Cazyme Therapeutics

October 2019

- **CRISPR Therapeutics** and **Idorsia** announce an update on Cazyme Therapeutics
- **SOPHiA GENETICS** and **Idorsia** announce the initiation of the IDIOMR005 study
- **Lonza** announces reorganization of its Ibex™ Solutions to support **Genmab’s** growing clinical portfolio
- **Memo Therapeutics** to receive milestone and option payments from **Peter’s** for the supply, co-development and co-marketing of **Peter’s** drug candidate for the treatment of Duchenne muscular dystrophy by the UK MHRA

November 2019

- **Idorsia** enters into a collaboration with **Antares Diagnostics** to develop a tumor-localized immunotherapy for the treatment of cancer
- **Axovant Gene Therapies** receives orphan drug designation for its investigational CRISPR/Cas9 gene-editing therapy for the treatment of GM1 gangliosidosis
- **CRISPR Therapeutics and Vertex** announce positive safety and efficacy data from the first two patients treated in current investigational CRISPR/Cas9 gene-editing therapy CT6831 for severe hemoglobin disorders
- **GeneTec Therapeutics** receives orphan drug designation from FDA for KD-025, an oral small-molecule drug candidate for the treatment of GHT1-related genetic disorders

December 2019

- **Cellestia Biotech** wins Sino-Swiss Business Awards 2019
- **Addex Therapeutics** publicly lists ADSs representing shares of its Series B stock on the SIX Swiss Exchange
- **Versamem Biopharma** and **Azimio Biotech** announce an agreement to license and co-develop retinoic acid receptor modulator currently investigated for SLE
- **Molecular Partners receives orphan drug designation for its first-in-class n-terminal domain antibody candidates in oncology

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Swiss Biotech Association
The Swiss Biotech Association represents the interests of the Swiss biotech industry since 1998. To support its members in a competitive market, the Swiss Biotech Association works to secure favorable framework conditions and facilitate access to talents, novel technologies and financial resources. To strengthen and promote the Swiss biotech industry, the Swiss Biotech Association also collaborates with numerous partners and life science clusters globally under the brand Swiss Biotech™.

www.swissbiotech.org

EY
EY is a global leader in assurance, tax, transaction and advisory services. The insights and quality services we deliver help build trust and confidence in the capital markets and in economies the world over. Our Global Life Sciences Sector brings together a worldwide network of 15,000 sector-focused professionals to anticipate trends, identify their implications and help our clients create competitive advantage.

www.ey.com/lifesciences

scienceindustries
scienceindustries is the Swiss business association of chemistry, pharmaceutical and life sciences. It supports some 250 member companies: fostering an innovation-friendly environment in Switzerland, creating a competitive production and business framework, enabling attractive market conditions, and facilitating worldwide market access.

www.scienceindustries.ch

Swiss National Science Foundation
The Swiss National Science Foundation (SNSF) is the most important agency promoting scientific research in Switzerland. As mandated by the Swiss Federal Government, the SNSF supports research in all scientific disciplines, from philosophy and biology to the nanosciences and medicine. The best applicants are funded to the tune of over CHF 900 million each year. The SNSF supports over 6,000 projects involving more than 16,000 researchers annually.

www.snsf.ch

Swiss Federal Institute of Intellectual Property
The Swiss Federal Institute of Intellectual Property is the official government body for intellectual property rights in Switzerland and is responsible for examining, granting and administering these rights. The institute’s services also include training courses on various aspects of intellectual property and tailor-made searches for trademarks and patent information, including strategic patent analyses involving patent quality parameters.

www.ige.ch

Switzerland Global Enterprise
Switzerland Global Enterprise (S-GE) is mandated by the Swiss government for export and investment promotion. In its role as a center of excellence for internationalization, its mission is to help Swiss SMEs develop new potential for their international business and to strengthen Switzerland as an economic hub. S-GE assists foreign companies in evaluating Switzerland as a business and technology location, and together with its cantonal partners helps companies during the entire site selection and incorporation process.

www.s-ge.com/invest-biotech

SIX
The Swiss Stock Exchange combines the dynamism of Europe’s 4th biggest stock exchange with the stability and reliability of one of the industry’s most respected post-trade service providers. The Swiss Stock Exchange blends the geographical advantages of the Swiss financial center with first-class services making it an ideal listing location for companies of every origin, size and sector. The Swiss Stock Exchange is part of SIX, which offers comprehensive services in the areas of securities trading, clearing and settlement as well as financial information and banking services.

www.six-swiss-exchange.com

Innosuisse
Innosuisse is the Swiss Innovation Agency. Its mission is to promote science-based innovation for the benefit of the economy and society. It offers funding for up to half the cost of clearly defined innovation projects involving partners from industry and research. It also provides mentors, coaching and training courses free of charge in all regions of Switzerland. The "NTN – Innovation Booster" networks enable researchers and entrepreneurs in a particular field of innovation to get together at themed specialist events to help bring specific innovations to life.

www.innosuisse.ch

biotechnet
biotechnet Switzerland is the network of Universities of Applied Sciences, Universities and Research and Technology Organizations organized in 10 thematic platforms. As such, it represents an excellent means to channel access to a wide variety of competencies in biotechnology to support the biotech industry.

www.biotechnet.ch

The contributors have been listed in order of appearance in this report.