



Swiss Biotech Report 2020



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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Guest Editorial



Mike Ward

Global Head of Thought Leadership,
Decision Resources Group,
Clarivate

"I have always regarded Switzerland as being in the vanguard of life science innovation. Swiss companies are now at the forefront of cell and gene therapy developments, gene-editing, insights from the microbiome, and the welcome theme of this report – AI and ML."

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 \$77m, 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 CHF577m, while Swiss companies were a major acquisition and partnering target for asset-hungry global pharma companies.

Some highlights that caught my eye were the \$315m follow-on round conducted by Zug-based gene editing pioneer CRISPR Therapeutics, Lausanne-based oncology-focused antibody-drug conjugate biotech ADC Therapeutics, completing a final close of a \$103m Series E financing expansion; Anokion's (autoimmune disease, Lausanne) \$40m Series B round, Oculis (ophthalmology, Lausanne) adding a further CHF15.5m to conclude a Series B 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 Roivant Sciences close to \$3bn for five of its subsidiaries – Myovant, Urovant, Enzyvant, Altavant, and Spirovent. They also took an 11% stake in Roivant, access to two technology platforms, DrugOme and Digital Innovation Technology, as well as options to acquire six additional subsidiaries. Furthermore, as 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 \$810m acquisition of Therachon Holding, Swedish Orphan Biovitrum's CHF515m purchase of EmaCo, a newly established company from the Novimmune stable which owns FDA-approved Gamifant emapalumab and related assets, and Boehringer Ingelheim's €425m 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 over 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.

Into a new decade

As we enter a new decade, Switzerland can rely on a comprehensive life sciences ecosystem – from research to manufacturing – for Swiss biotech companies to continue to thrive. With more than 40 exciting new start-ups founded in 2019, addressing pressing medical needs, improving diagnostics options and developing new platform technologies, the start-up scene continues to be vibrant. At the same time, multi-national biopharma companies such as Biogen, CSL Behring, Novartis and Merck are investing heavily in expanding production capacity for the increasing number of complex biologicals and cell therapies gaining approval. Economically, life sciences are a major pillar of the Swiss economy, accounting for 40% of exports, with a truly global reach.

Funding into public and private Swiss biotech companies continues to be strong, exceeding 1 billion CHF per year. This attractive funding environment is supported by new specialized Swiss-based funds such as Medixi, ND Capital, Pureos Bioventures, Bernina BioInvest as well as an ever-increasing number of foreign funds which recognize the excellent investment opportunities on offer in Switzerland. Still, it is remarkable that large institutional investors shy away from this sector, despite its proven and attractive track record to deliver above average return on investment.

M&A activity, an indicator of sector maturity and attractiveness, remains strong: witness the Amal, NovImmune and Therachon deals. It is also pleasing to see the success of a growing number of companies such as Vifor Pharma, Helsinn and Debiopharm that have developed a viable path to stay independent and self-fund their international expansion. This continues to fuel a sustainable innovation pool of attractive applications of biotechnology and therapeutic treatment options for multi-national Pharma/Biotech companies and independent players.

It is reassuring to see that the Swiss biotech sector is not resting on its laurels. Over the last ten years, many new competitors have entered the arena, but there is a determination to stay in the vanguard of innovation. A perfect example of this is the way in which the possibilities of artificial intelligence are being exploited by companies such as SOPHiA GENETICS who provide our lead story, BC Platforms, GenomSys, Genedata, Insphero and SimplicityBIO. These companies are dedicated to use the power of artificial intelligence to enable the development of ever more targeted and effective therapies, supporting and accelerating the development of personalized medicine. Therefore, we have chosen the topic of big data, artificial intelligence and machine learning as the focus of this year's report and invite you to share our insights and to explore potential collaboration opportunities.



Michael Altorfer

CEO,
Swiss Biotech Association

"As we enter a new decade, Switzerland can rely on a comprehensive life sciences ecosystem – from research to manufacturing – for Swiss biotech companies to continue to thrive."

Swiss Outlook: Industry and segment performance

Jürg Zürcher

Partner, GSA
Biotechnology Leader



Frederik Schmachtenberg

Partner, Financial
Accounting Advisory Services



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\$6.4 billion (2018: US\$ 7.2 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\$6.3 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 mainly driven by favorable collaboration and licensing agreements for AC Immune, Basilea and CRISPR, as well as higher revenues for those biotechs already selling products/services in the market.

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 instruments, as well as Auris Medical and Biocartis (see Table 1).

COMPANY	CHF MILLION
CRISPR Therapeutics AG (Zug)	433
AC Immune (Lausanne)	50
Obseva (Geneva)	25
Auris Medical (Zug/Bermuda)	8
Biocartis (Lausanne/Mechelen)	64
Polyphor (Allschwil/Basel)	6
Santhera (Pratteln/Basel)	22
Addex & Relief Therapeutics (Geneva)	6
Total	614

TABLE 1: Largest 2019 public rounds

Among the private biotech companies in Switzerland, the largest financing rounds were achieved by ADC Therapeutics, with CHF 101 million in two rounds, and SOPHiA GENETICS with CHF 76 million. ADC Therapeutics was also a “hot IPO candidate” but decided shortly before the planned IPO date to instead do another financing round with private investors. (See Table 2)

COMPANY	CHF MILLION
SOPHiA GENETICS (Lausanne)	76
ADC Therapeutics (Lausanne)	101
Polyneuron (Basel)	29
Anokion (Lausanne)	40
Oculus (Lausanne)	16
Other	316
Total	577

TABLE 2: Major 2019 private transactions

M&A and collaborations

Several Swiss biotech companies were acquired in 2019 by either (big) pharma or other biotech companies. The following brief snapshot lists the most prominent transactions (see Table 3):

SimplicityBio, 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.

- ChromaCon AG (based in Zurich) was acquired by YMC Co., Ltd. (Kyoto, Japan)
- Pfizer acquired Therachon for \$340 million upfront and an additional \$470 million tied to the achievement of key R&D and commercial milestones for the drug candidate TA-46 for the treatment of achondroplasia
- Sobi purchased for the price of CHF 515 million (\$518 million) the immunology R&D capabilities from Novimmune (Geneva)
- Boehringer Ingelheim acquired Amal Therapeutics in a €325M deal
- Relief Therapeutics Holding SA sold its subsidiary Relief Therapeutics SA to Sonnet Bio-Therapeutics, Inc. to ensure the further development of Atexakin Alpha (Interleukin-6)

COMPANY	CHF MILLION
Simplicity Bio (Lausanne)	NA
ChromaCon AG (Zurich)	NA
Therachon (Basel)	781
Novimmune (Geneva)	515
Amal Therapeutics (Geneva)	358
Total	1,654

TABLE 3: Key 2019 M&A collaborations

But Swiss biotechs were also active as acquirers of other companies. For example, Lausanne based Anokion SA found an acquisition target in the US (Kanyos Biotech).

And it was not just on the financing front that the Swiss biotech sector recorded a lot of successful events. In the area of collaborations and licensing arrangements, several successful new partnerships were also established in 2019 (See Table 4).



PARTNERSHIPS

Numab Therapeutics (Wädenswil) 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 immune-oncology.

SOPHiA GENETICS (Lausanne) teamed up with ADC Therapeutics on biomarker discovery for lymphoma treatment

BC Platforms (Zurich) providing complete data management solutions for Debiopharm’s oncology development portfolio

Santhera (Pratteln/ Basel area) entering into an out-licensing agreement with Chiesi Group for Raxone in Leber’s hereditary optic neuropathy (LHON)

Molecular Partner’s (Zurich) collaboration partner Allergan filed for its compound Abicipar for a biological license application with the FDA, as well as a marketing authorization with EMA

Inspheo (Schlieren/Zurich area) and Akero Therapeutics (St Francisco) partnering for a human liver disease platform

Genedata (Basel) 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 (Allschwil/Basel area) collaborating with Antares for the development of a novel self-administered drug-device for selatogrel

TABLE 4: Key 2019 partnerships

Swiss Outlook: Industry and segment performance

- Numab Therapeutics was busy with entering a license agreement with Intarcia for anti-inflammatory NDO16; 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
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- Molecular Partner's collaboration partner Allergan filed for its compound Abicipar 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

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 ESBATech 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:

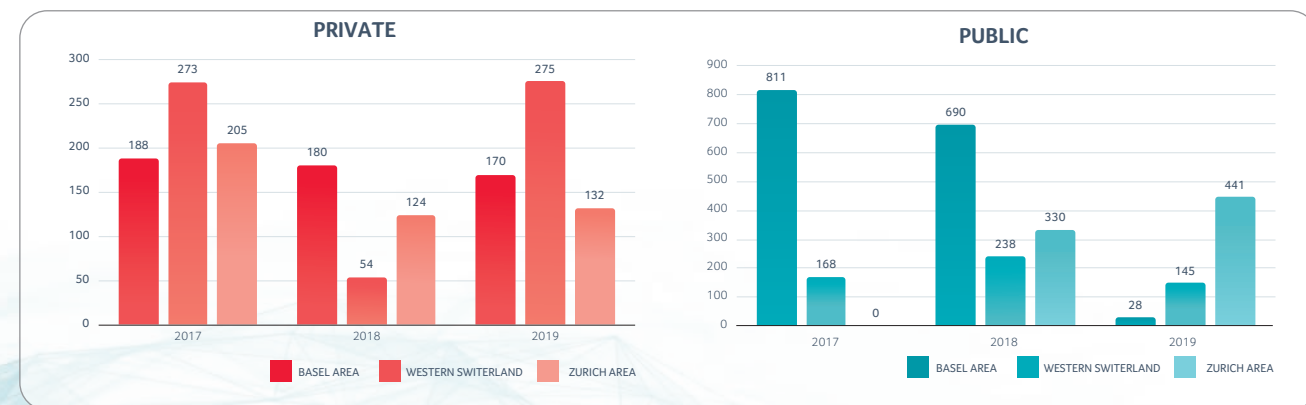
- InterAx Biotech received the "Seal of Excellence" from the European Commission
- Daniela Marino, CEO of Cutiss, in 2019 won the "Female Innovator of the Year Award" and the company itself also was the winner of the "Swiss Technology Startup Award"
- Insphero won the "Sino-European Innovation Award" 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.

Product development

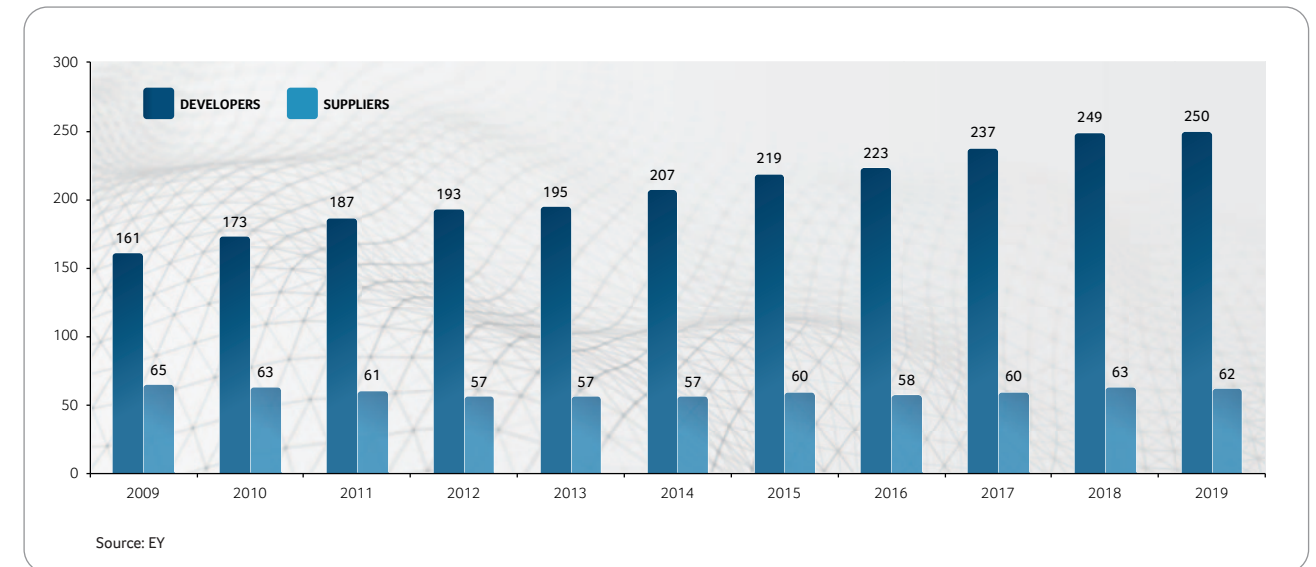
The global biotechnology industry saw fewer approvals by the FDA (48 compared with 59 in 2018) and a reduction in European

Private & Public Swiss Biotech Regional Financing - 2017-2019

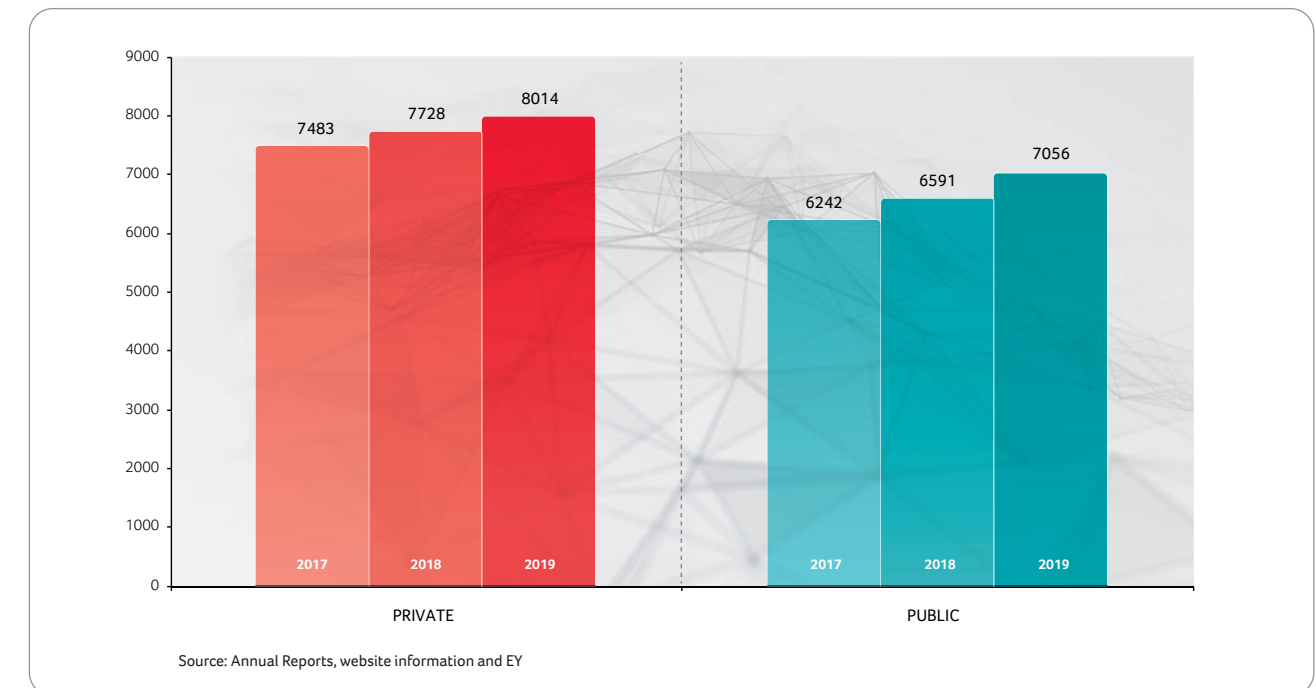


The year in charts

Number of Biotech Companies in Switzerland 2009-2019

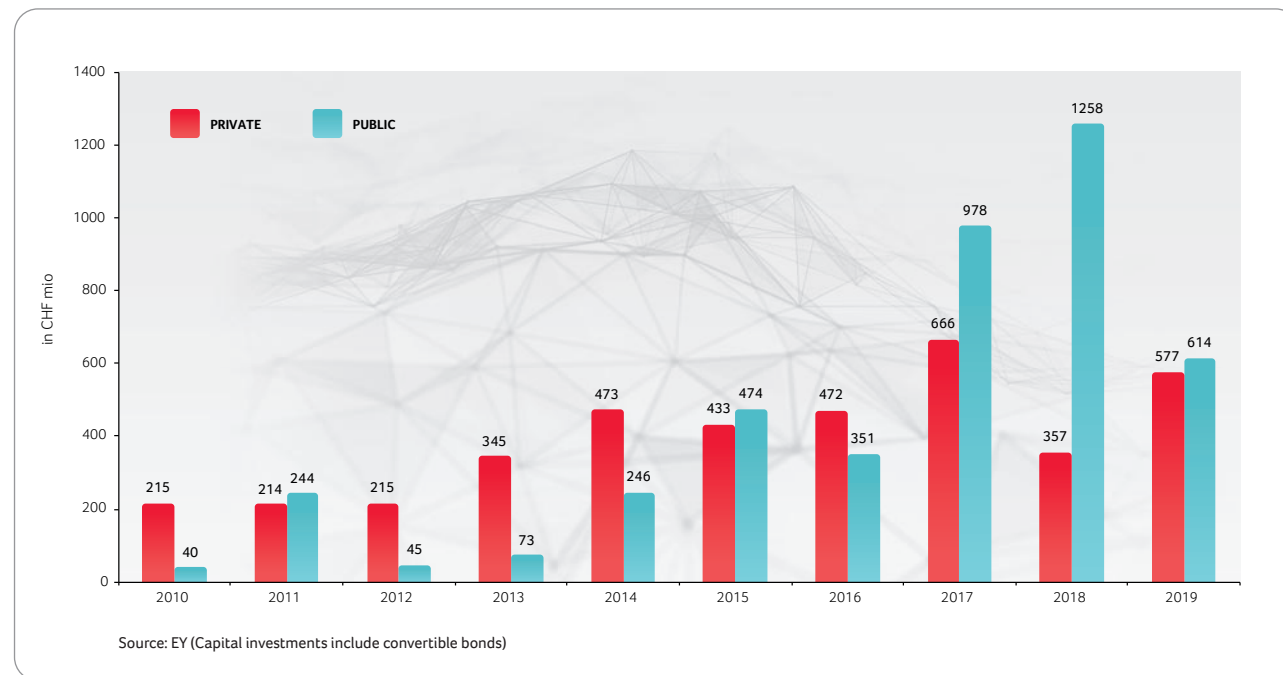


Number of Swiss Biotech Employees 2017-2019



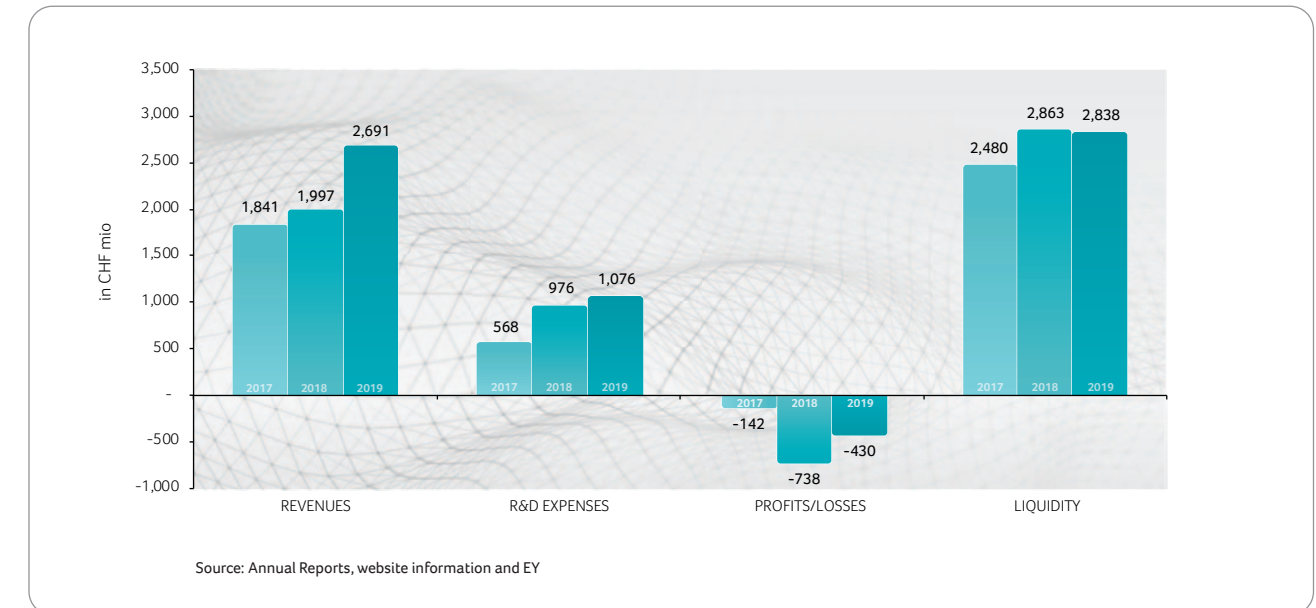
Capital investments in Swiss biotech companies

Private & Public Swiss Biotech Companies



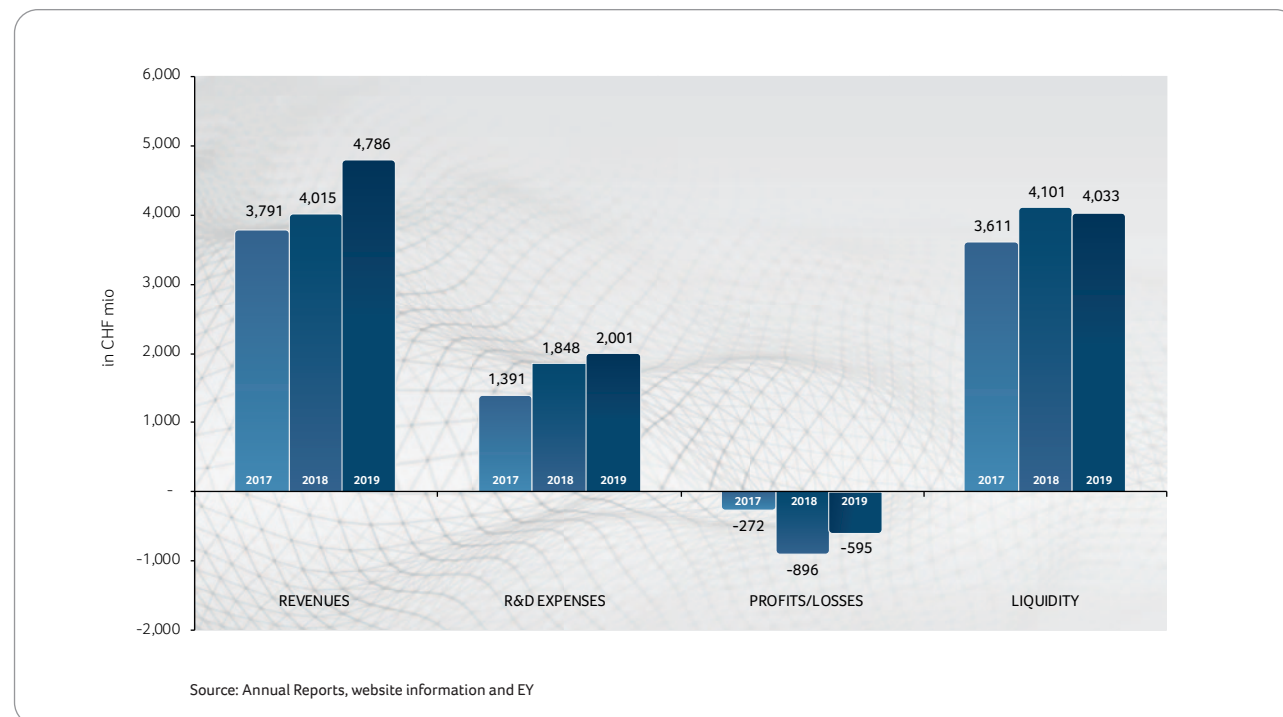
Revenues, R&D expenses, Profit/loss, Liquidity

Public Swiss Biotech Companies



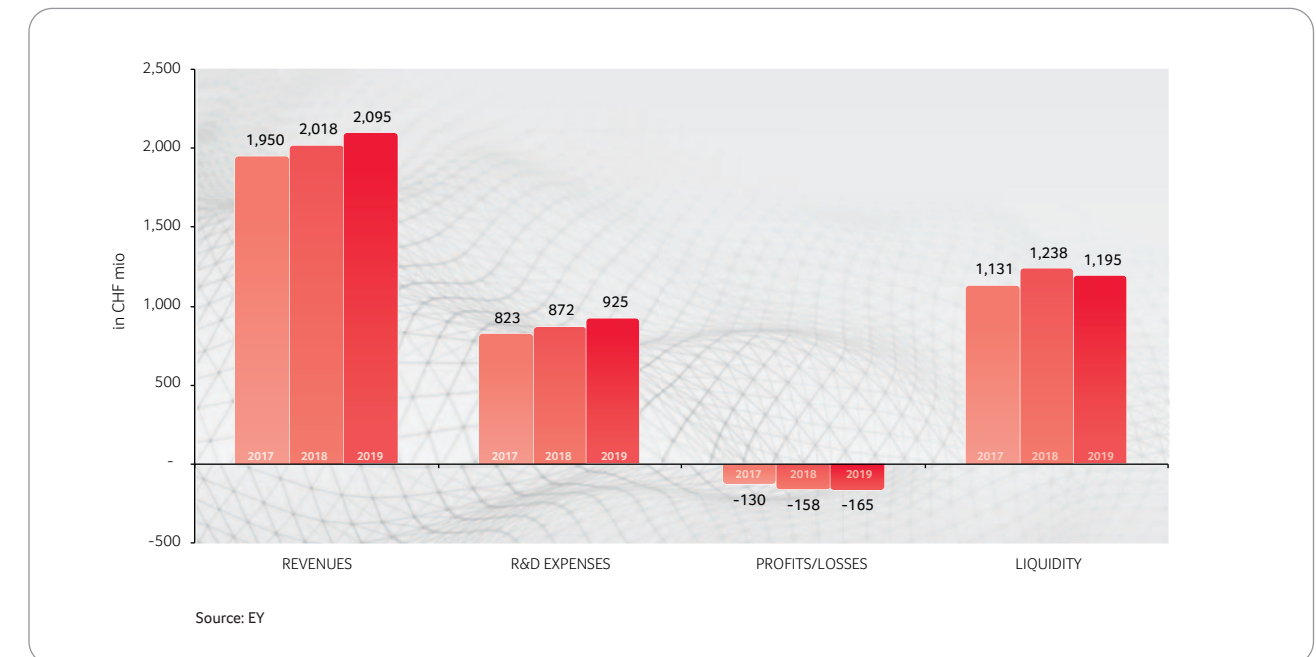
Revenues, R&D expenses, Profit/loss, Liquidity

Total Swiss Biotech Companies



Revenues, R&D expenses, Profit/loss, Liquidity

Private Swiss Biotech Companies



Note: The 2019 data in 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).

Swiss export performance

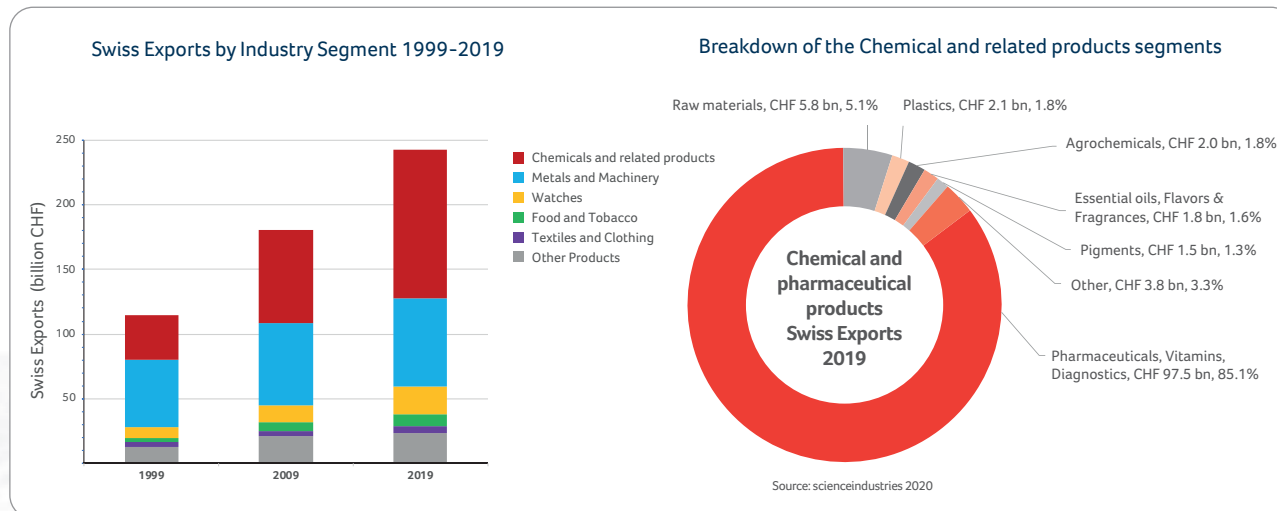


Jan Lucht

scienceindustries | Head Biotechnology

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.

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.



Swiss export statistics according to industry sector demonstrate the lead of the chemistry, pharma and biotech industry (scienceindustries/Federal Customs Administration 2020)



How AI and Big Data are changing medicine



Jurgi Camblong

SOPHiA GENETICS

The coming decade is likely to see even more medical breakthroughs arising through the combination of intelligent algorithms and mass, combined datasets. However, for the world of data to achieve its full potential, we need to breakup individual silos and create a collective global intelligence within the medical community.

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 combined¹. 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 digitalize 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 PDL1 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 utilizing 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?

Reference

1. Stephens ZD, Lee SY, Faghri F, et al. Big Data: Astronomical or Genomical?. PLoS Biol. 2015;13(7)

Indeed, real-world data has the potential to change the way we will 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.



Florian 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 continuously 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 most of these, false. It is clear that patient safety can be improved by getting to grips with that amount of information.

As we continue to use more apparatuses and more assays, the data continues to grow. It varies from gene expression data to daily activities recorded on smartwatches worn by patients or trial participants. Even environmental information from where these people live is recorded. It is an enormous quantity of data from different sources and of varying levels of quality. The data mountain gets bigger every day. That is a simple fact.

THE DREAM:

Better and faster diagnoses

Once it becomes possible to make sense of this big flood of data – and currently life sciences 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.

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 biobanks, 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.

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 (10^{15} 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 but 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 are not the safest places for data to start with. And with the introduction of electronic health records it becomes easier to access large quantities of data – to the benefit of research, but to the detriment of safety.

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.

Biology is complex and delivers noisy data. To base conclusions on a solid foundation and deliver on promises, standards have to be established on how to generate, handle and analyse the data.

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 BioLink 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.nfp75.ch>
- **Swiss Clinical Trial Organization (SCTO)**
The organization coordinates a network of 7 Clinical Trial Units (CTUs) 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>



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.

As every human is an individual, so every disease has unique aspects in each patient. Previously, treatments were derived from experiences with large groups of patients and therefore reflected an average approach that was suitable for a majority, but not all.

More stratified approaches, taking into account factors such as age, sex, and health status, have made it possible to better fit treatments to the needs of individual patients. But for a truly personalized healthcare approach, molecular health markers for the individual have to be analyzed using huge collections of population health data as a background.

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.

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.

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 data 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 clinico-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 very rare cancer types

due to the limited number of patients and lack of a suitable control group. The CGDB 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 beneficiaries 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.

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.

In fact, a recent international comparison of healthcare digital strategies by the Bertelsmann Foundation (#SmartHealthSystems, 2019) ranks Switzerland 14th out of the 17 evaluated countries for the digital health index.

The index captures national-level healthcare system digitalization on the basis of 34 indicators relating to strategy, technical implementation status, maturity, and the degree to which integrated health-data exchange is actually taking place. For the sub-index - actual use of data - Switzerland is ranked even lower at 16.

Despite several ongoing initiatives, actual progress and implementation is slow. For example, the introduction of the electronic patient record (EPR) system - a personal collection of treatment-related documents - has been plagued by delays and technical difficulties and will be only partially operable in 2020, starting in April.

Obviously, a concerted effort by all stakeholders is required to move Switzerland forward in the field of digital health and personalized healthcare. To take full advantage of new therapies made possible by personalized healthcare approaches, adjustments to the registration process by Swissmedic, the Swiss regulatory authority for therapeutic products, are required.

These should take into account the special properties of personalized medicines that distinguish them from more traditional products; such as the possibility of targeting only small patient groups. Also, new models for pricing and reimbursements for personalized drugs and diagnostic procedures have to be developed.

'The application of high-powered data analytics ... makes it possible to generate real-world evidence about treatment outcomes, suggesting better treatment options and facilitating clinical trials' 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.



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)¹ 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 Intelligence² (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 synonym terms 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;³ and WIPO's decision in 2019 to launch a public consultation on AI and intellectual property.⁴

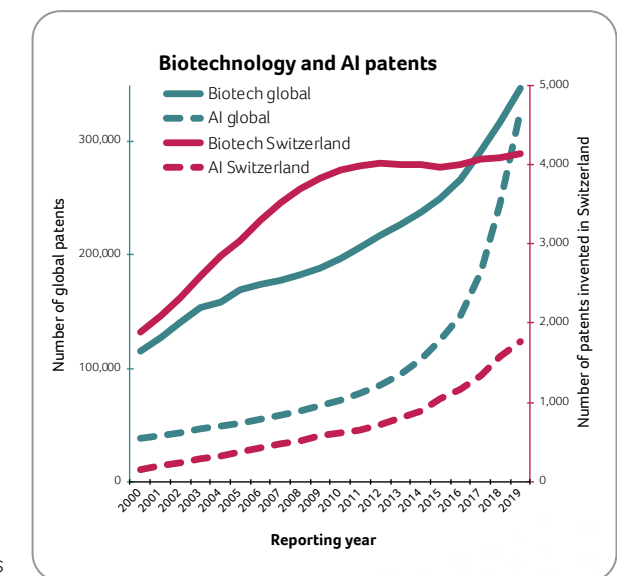


Figure 1: Biotechnology and AI Patents

The growth curve of Swiss AI patents (red dotted line) has experienced consistent growth, albeit not as fast as the global growth curve (dotted green line)

The growth curve of Swiss biotech patents (red solid line) has slowed since 2009 (mostly reflecting a process of portfolio consolidation of the largest patent owners)

(Graphs were generated using the patent analysis software PatentSight, see www.patentsight.com)

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 declare an AI system as the inventor (see AI Inventorship Project in 2019 WIPO Magazine⁵ and EPO and UKIPO Refuse AI-Invented Patent Applications article in IP Watchdog 2020⁶)

AI enhances the ability to collect, categorize, and analyze large datasets, to simulate complex processes, and/or 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.

Biology was among the first areas of application for AI, and it continues to be an important topic (see Oliveira⁷, Goh⁸, Shah⁹(2019) and Fuji (2017)¹⁰). 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)

1	Analytical assistance	Human design and synthesis with input from computational analysis
2	Partial design assistance	Human design and synthesis with occasional input from AI
3	Augmented design and partial synthesis assistance	Partial automated synthesis with significant input from humans
4	Conditional automation	AI design and automated synthesis with occasional input from humans
5	High automation	AI design and automated synthesis with minimal or no input from humans

Table 1: Level of AI involvement in drug discovery patents
Adapted from table 1 in Greene 2018¹¹

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%).

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).

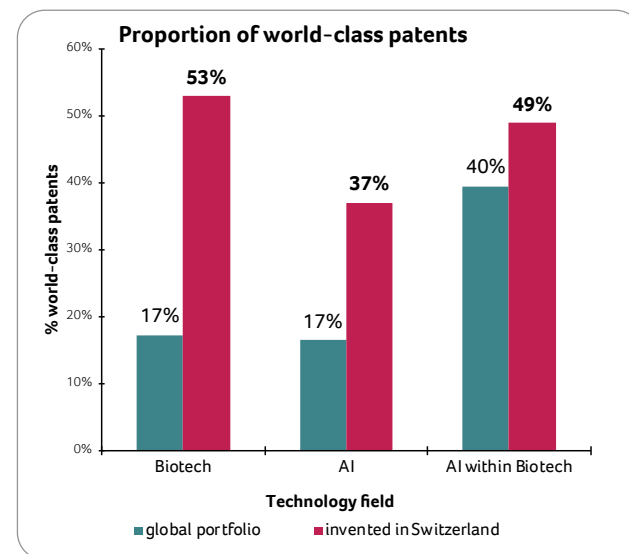


Figure 2: Proportion of world class patents

Bar charts 1-3 show a greater proportion of “invented in Switzerland patents” (shown in red) are world class in each of the three categories

Bar chart 3 shows 40% of global AI within biotech patents qualify as world-class, 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)

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, and close to the high values observed for patents invented in Switzerland (Figure 2), which have been presented in the Swiss Biotech Report 2018.

Notably, the majority of the patents of Swiss origin in all three sets are in fact international inventions, i.e. they designate inventors from Switzerland as well as from other countries. For 2019, the proportion of international inventions within the Swiss-invented portfolios are 77% in biotechnology, 62% in AI, and 74% for AI in biotechnology.

AI as an assisting tool in biotechnology patents

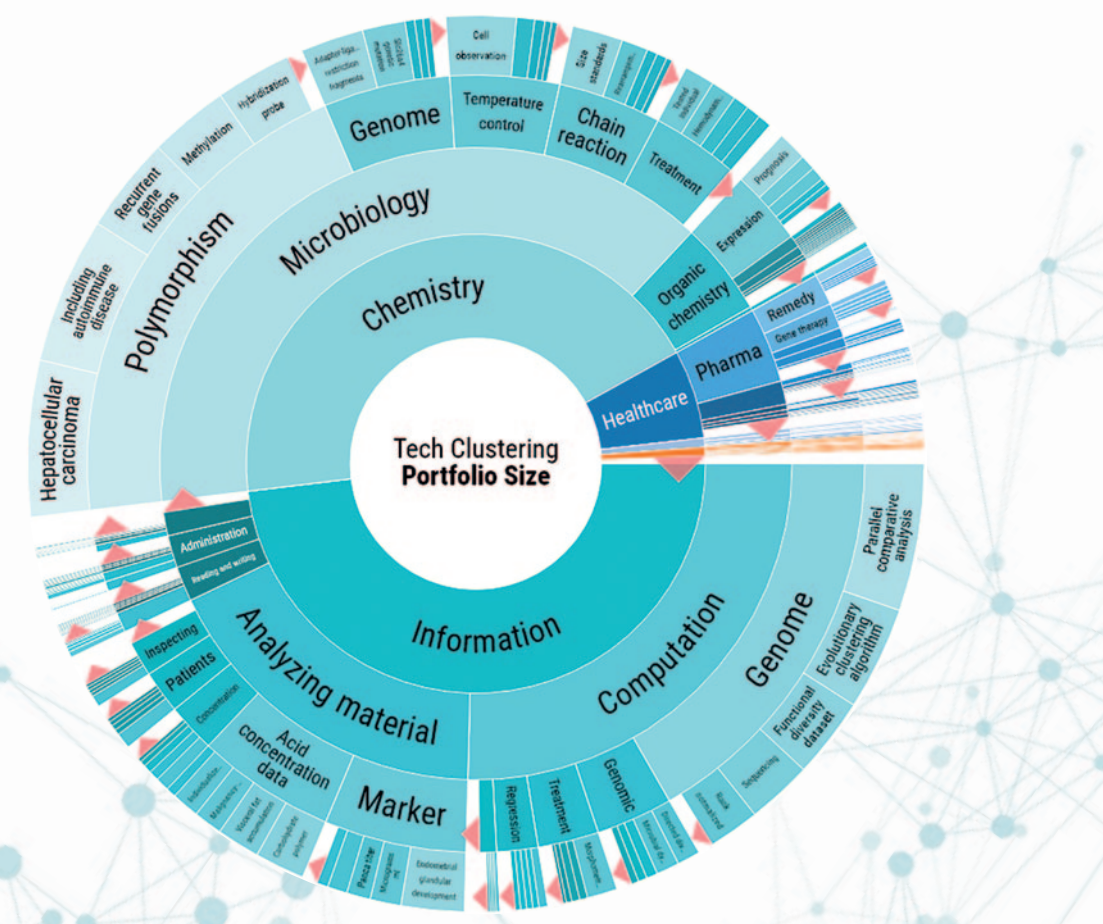
The overlap found between AI patents and biotechnology patents seems surprisingly small. However, this selection is restricted to patents in which AI represents a core feature of the invention, as illustrated by the examples in Table 1. These patents correspond to levels 4 and 5 according to the classification proposed by Green.¹¹

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!

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”



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AI in Life Sciences: Role of the outside disruptor

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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 have faster access to their medical records in the case of a medical emergency or when visiting new healthcare providers.

TK's approach was quickly adopted by patients and today, one year after its initiation, it already includes many providers who 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/B5JGXRNK> 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.

AI in Life Sciences: Role of the outside disruptor

CONTINUED

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 is 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



Marta Gehring
Swiss Biotech Association | Western Switzerland & Special Projects



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 to be at the forefront of medical breakthroughs arising from the combination of intelligent algorithms and combined, cleaned and labelled, clinical and genomic real-world datasets.

Swiss innovation in personalized medicine

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 AI 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 young innovators 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.

The interest of investors in partnerships and investment is strong – Vaximm for example is teaming-up with Tokyo-based AI specialist NEC to advance personalized neoantigen cancer vaccines, while the possibilities of artificial intelligence are being exploited by companies such as SOPHiA GENETICS, BC Platforms, Genedata, Insphero, GenomSys and SimplicityBIO.

The combined expertise of these entities is substantial, and sure to act as a catalyst for Switzerland's further development of know-how 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 quality 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 disproportionally account for companies which were valued at more than CHF 100 million². 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.

Bio manufacturing: driving a major resurgence in a traditional strength

While consistently ahead of the curve in product development, Switzerland's manufacturing prowess has experienced a revival in 2019, following years of "exporting" manufacturing capabilities abroad. Biogen invests more than 1 billion CHF into an antibody-manufacturing plant for biopharmaceutical products in Luterbach, CSL Behring is expanding its immunoglobulin production center in Bern, Novartis opened a cell and gene therapy site in Stein, while Merck announced a \$275 million investment in a new biotech development center in Vevey. Biotech manufacturing and manufacturing

development requires specialized knowledge, and Swiss sites benefit from abundance of human capital, greatly facilitating their task. *Switzerland's bio-manufacturing capabilities attract ever more international companies.*

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.*

Switzerland is the number 1 country in innovation and competitiveness



	INSEAD GLOBAL INNOVATION INDEX	IMD WORLD COMPETITIVENESS RANKING	WEF GLOBAL COMPETITIVENESS INDEX	UNDP HUMAN DEVELOPMENT INDEX	WORLD HAPPINESS REPORT	TOTAL AGGREGATE
Switzerland	1	4	5	2	6	18
Netherlands	4	6	4	10	5	29
Sweden	2	9	8	8	7	34
Denmark	7	8	10	11	2	38
USA	3	3	2	16	19	43
Finland	6	15	11	12	1	45
Norway	19	11	17	1	3	51
Singapore	8	1	1	9	34	53
Germany	9	17	7	4	17	54
Ireland	12	7	24	3	16	62
Canada	17	13	14	13	9	66
United Kingdom	5	23	9	15	15	67

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Five-year stellar performance by SIX Bio+Medtech Index



Fabian Gerber

SIX | Senior Relationship Manager Primary Markets

A look into the past, present and future of the SIX Bio+Medtech Index indicated it has been outperforming its benchmarks in the last five years to January 2020.

SIX is one of the leading biotech/life sciences stock exchanges and home to the most highly capitalized biotech companies in Europe. To reflect 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.

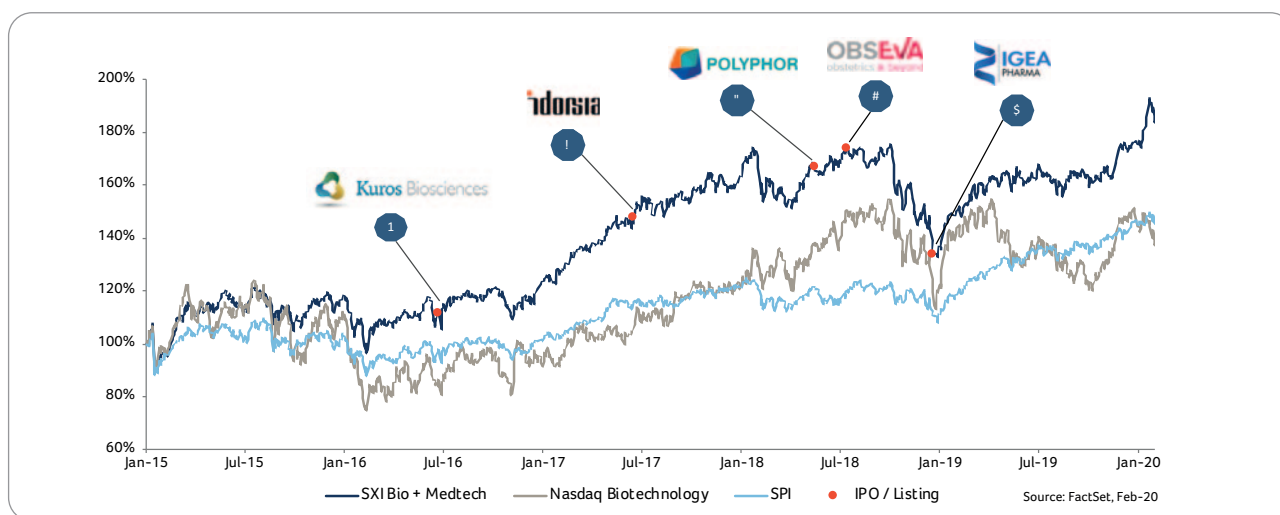


Figure 1: SIX Bio+Medtech Index Jan 2015 to Jan 2020

“Over the past five years to end Jan 2020, the SIX Bio+Medtech Index has clearly outperformed both the Swiss Performance Index (SPI) by 38% and the NASDAQ Biotechnology Index by 46%. This impressive development underlines the high quality of the listed biotech companies on SIX as well as the great interest of a large Swiss and international investor base.”

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

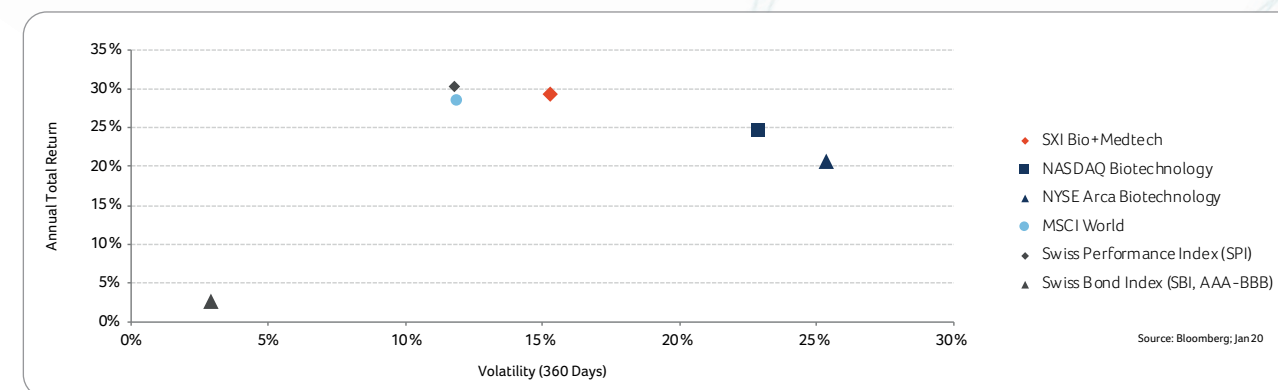


Figure 2: 2019 Indices volatility and returns

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.

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 SIX 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 SIX 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 SIX 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 SIX Bio+Medtech with a tracker certificate (ISIN CH0020040397). SIX also offers trading in two Exchange Traded Funds (ETFs) and six investment funds, which are specifically dedicated to the biotech sector.

By the end of January 2020, assets in investment funds amounted to around 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 SIX 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 Newron Pharmaceuticals – are currently participating in the program and more are to follow.

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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 Biosystems 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.

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

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 those 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.

Stettler: Who benefits from Innosuisse's support?

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.

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

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.

Stettler: Can interdisciplinary projects be submitted to Innosuisse?

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.

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

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.



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.

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

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.

* 161 applications for funding were submitted in 2019 (100 were approved), as compared with 87 applications in 2018 (of which 43 were accepted)

"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."



Laura Suter-Dick

biotechnet Switzerland | President

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.

Alongside Swiss Biotech Association (SBA), biotechnet Switzerland has maintained its role of fostering interactions between key players in Swiss biotech. Standing on its own feet financially, biotechnet has maintained its strategic focus on three key roles: enabler of collaborative projects, active supporter of scientific meetings and promoter of educational events that bring a qualified work force closer to industry.

biotechnet Switzerland was able to support all of its research platforms, while focusing its activities on identified priorities: tissue engineering and personalized medicine. All activities profited from the well-established networks, the know-how and infrastructure available at its member institutions and the good relationship with industrial partners and the SBA.

Enabling collaboration

A notable success story is the Innosuisse-funded project between the School of Life Sciences (FHNW) and InSphero AG. This was jointly presented by Prof. Laura Suter-Dick and Dr. Olivier Frey at a panel discussion organized by Innosuisse that took place during the Swiss Biotech Day meeting held in May 2019 in Basel.

This successful collaboration in applied research between industry and academia would not have been possible without the support of biotechnet, as the project originated from an interaction initially supported by seed money from biotechnet Switzerland.

It represents one of the many activities in the fast developing area of tissue engineering that remains a key focus area for biotechnet Switzerland. This is implemented through its successful platform TEDD (Tissue Engineering for Drug Discovery), led by Dr. Markus Rimann of Zurich University of Applied Sciences (ZHAW).

In the same scientific field, Prof. Michael Raghunath (former TEDD leader) was strongly involved in the organization of a specific TEDD-symposium at the TERMIS, European chapter 2019, under the title 'Tissue Engineering Therapies: From Concept to Clinical

Translation & Commercialization'. This international meeting, held in Rhodes, attracted many academic and industrial participants and focused strongly on applied science, industrial and medical needs.

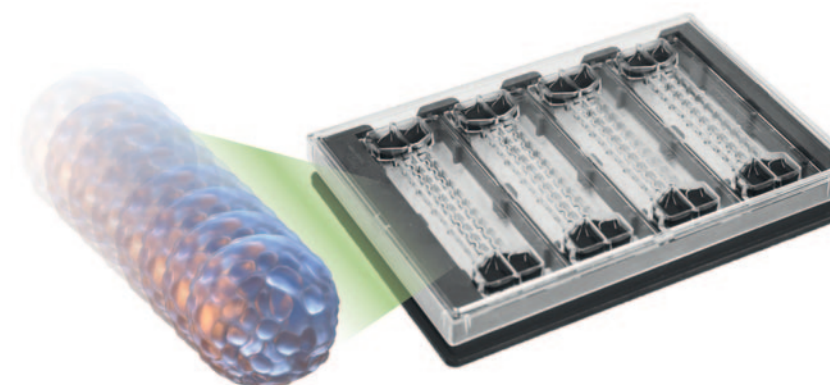
Appliance of science

With strong and consistent support from the tissue engineering sector, biotechnet continued to support the development of the recently founded 'Translational and Clinical Bio-Manufacturing' (TCBM) platform led by Prof. Eliane Müller (SCRM & University of Bern) and the successfully implemented events organized by the TEDD platform. These included a TCBM workshop, the traditional TEDD-annual meeting, and TEDD-organized visits to industrial and academic laboratories.

Biotechnet Switzerland is also active in the growing field of personalized medicine with its platform led by Prof. Silke Schneider (University of Zurich/ ETH). In this area, we sponsored the 'Personalized Oncology 2019' meeting held in Basel in June 2019. This event brought together world experts on translational oncology research.

The meeting highlighted the current developments and future perspectives of a patient-centric perspective on prevention, diagnosis, and treatment of cancer patients. Several internal discussions also focused on the field of in-vitro diagnostics (IVD), as personalized health care and diagnostics go hand in hand. The IVD-platform is now preparing the 3rd Swiss Symposium on 'Point of Care Diagnostics' that will take place in Visp in October 2020 (<https://www.pocdx.ch/>).

The focus on a few specific topics in 2019 - namely tissue engineering, personalized medicine and in vitro diagnostics - should in no way be seen as devaluing other scientific areas supported by biotechnet, which have been equally active during this time. On the contrary, it demonstrates the implementation of a consistent strategy aimed at focusing the organization's efforts and boosting specific areas of current interest.



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 customer-centric, design-thinking approach.

Concomitantly, biotechnet Switzerland is constantly re-assessing 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.

Accessing a qualified workforce

The current situation in Switzerland sometimes makes it difficult for small companies to recruit adequately trained personnel. Biotechnet Switzerland, as an organization with a strong academic component, is well placed to facilitate access to qualified workforce. In 2018, Prof. Daniel Gyax of University of Applied Sciences Northwestern Switzerland (FHNW) founded the platform 'Training for Pharma/Biotech' that promotes interactions between the industrial sector and the directors of universities of applied sciences in the field of life-sciences.

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 to 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 Italbiotech and a contribution by Dr. Michael Altorfer, CEO of the SBA.

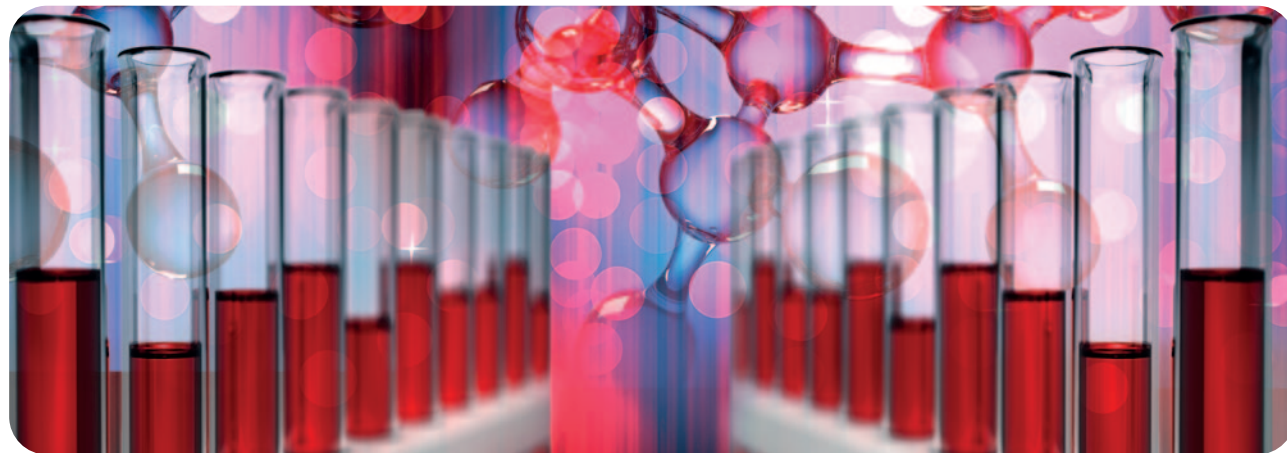
Last year's Summer School 'Health and the Environment', touching upon the cross-road of environmental sciences and medical research,

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 re-shaped 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"

About the Swiss Biotech Success Stories



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

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.

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 health care 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.

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

"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."



An independent jury of experts



Luca Bolliger
President of the jury
Vice President Swiss Biotech Association



Patrick Aebischer
President Emeritus EPFL
Professor, serial entrepreneur



Gabrielle Gache
President Swiss Healthcare Licensing Group



Ulrich Geilinger
Partner, HBM Partners



Robert Lussi
Branch Manager
Mirabaud Basel



Birgit Voigt
Business journalist
NZZ am Sonntag



Jürg Zürcher
Partner, Biotechnology Leader
GSA, EY



Thomas Staffelbach
Secretary of the jury

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The Swiss Biotech Success Stories Awards are also supported by



Basel-Stadt

INNOTIO

Award winners 2019



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-Quates-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 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.

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 Immunexpress, Biocartis, and Kaiku. This has led to EU approval of the sepsis triage test, SeptiCyte® RAPID, for COVID-19 patients and the use of the remote patient monitoring platform from Kaiku in hospital settings.

The team's quest to improve patient quality of life through excellence in research & development, drug & delivery system manufacturing, along with digital health solutions has led to the release of 2 standard-of-care cancer therapies, an FDA Breakthrough Therapy Designation in oncology, a series of successful investments in disruptive digital healthcare start-ups

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 Helsinn



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 profits 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 fulfil 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.

Swiss Biotech Success Stories award winner 2020 Venture Kick, >>venture>>, Venturelab

VENTURE KICK



Venture Kick was launched in 2007 as a three-stage philanthropic funding model with the vision to double the number of spin-off companies from Swiss universities, to accelerate their go-to market, and to raise their attractiveness among professional investors and industry

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.

>>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's>> 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 Glycart, Molecular Partners, Covagen, 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, Bioversys, Cellestia Biotech, Cutiss, InSphero, Lunaphore, Polyneuron 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.

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, analysing, and creating new combinations of DNA sequences.

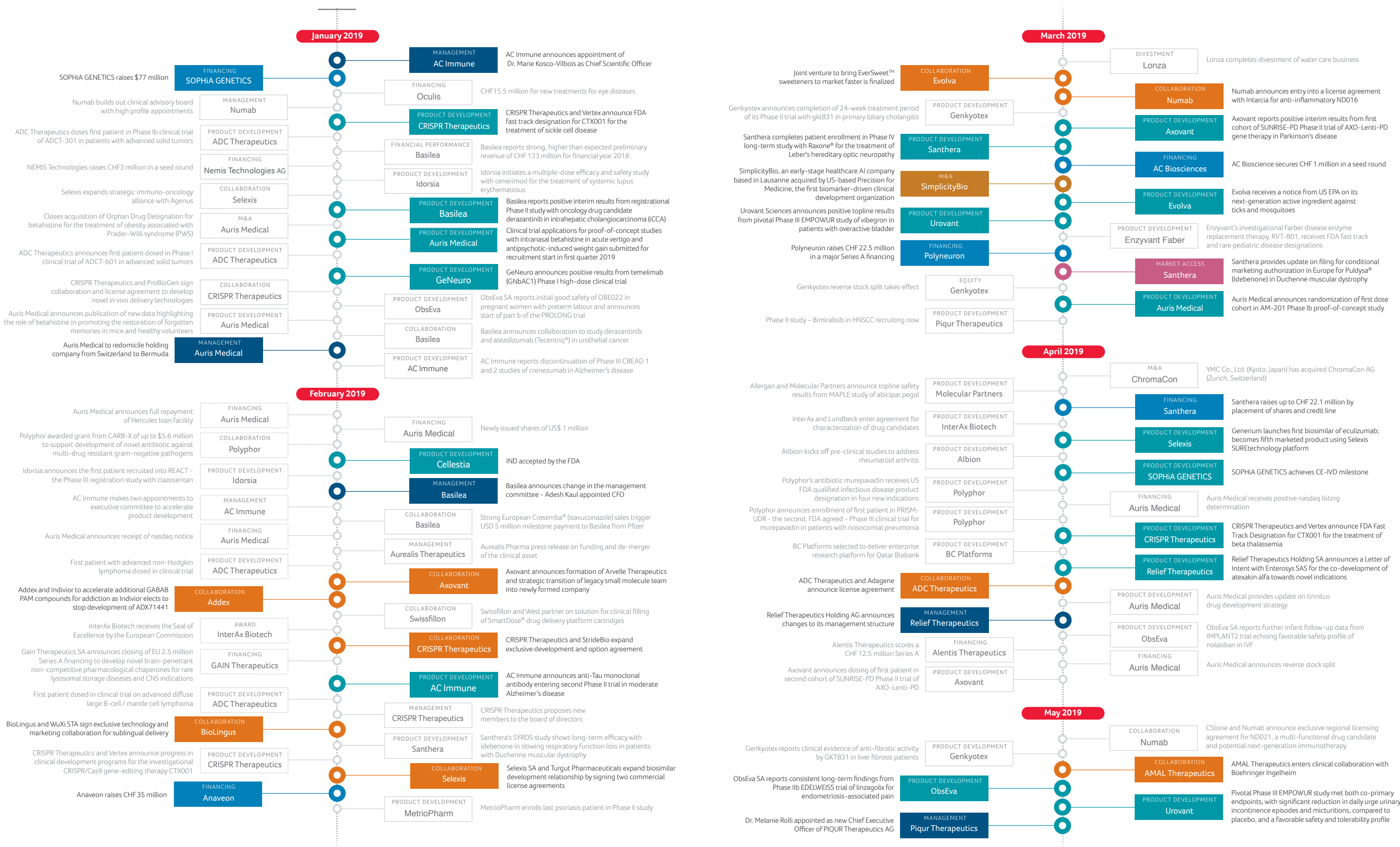
Credited with a long list of accomplishments within the biotechnology sector, Arber enjoys notable recognition for his research in the mechanisms of biological evolution and bacterial restriction and modification.

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.

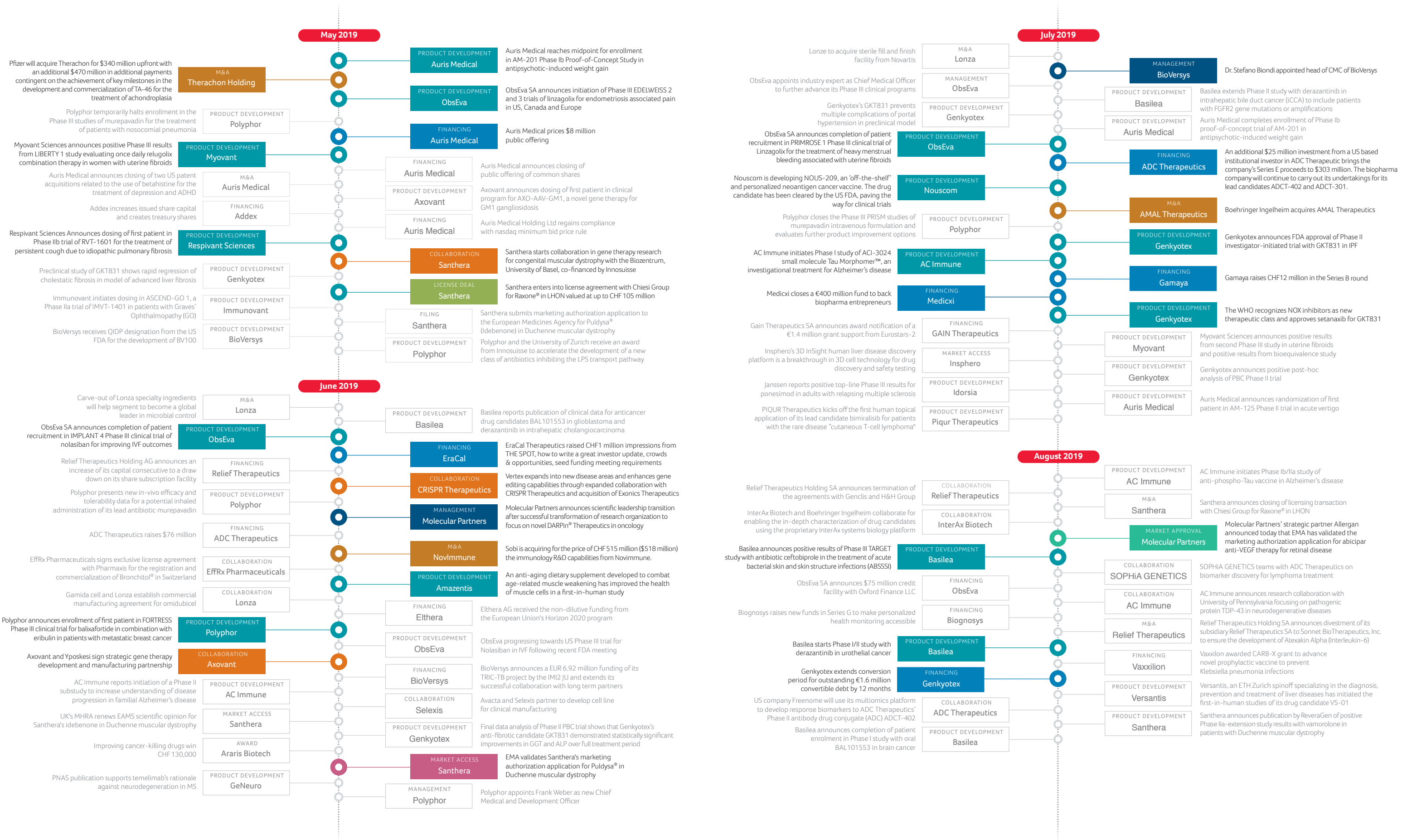


Swiss Biotech Events of 2019



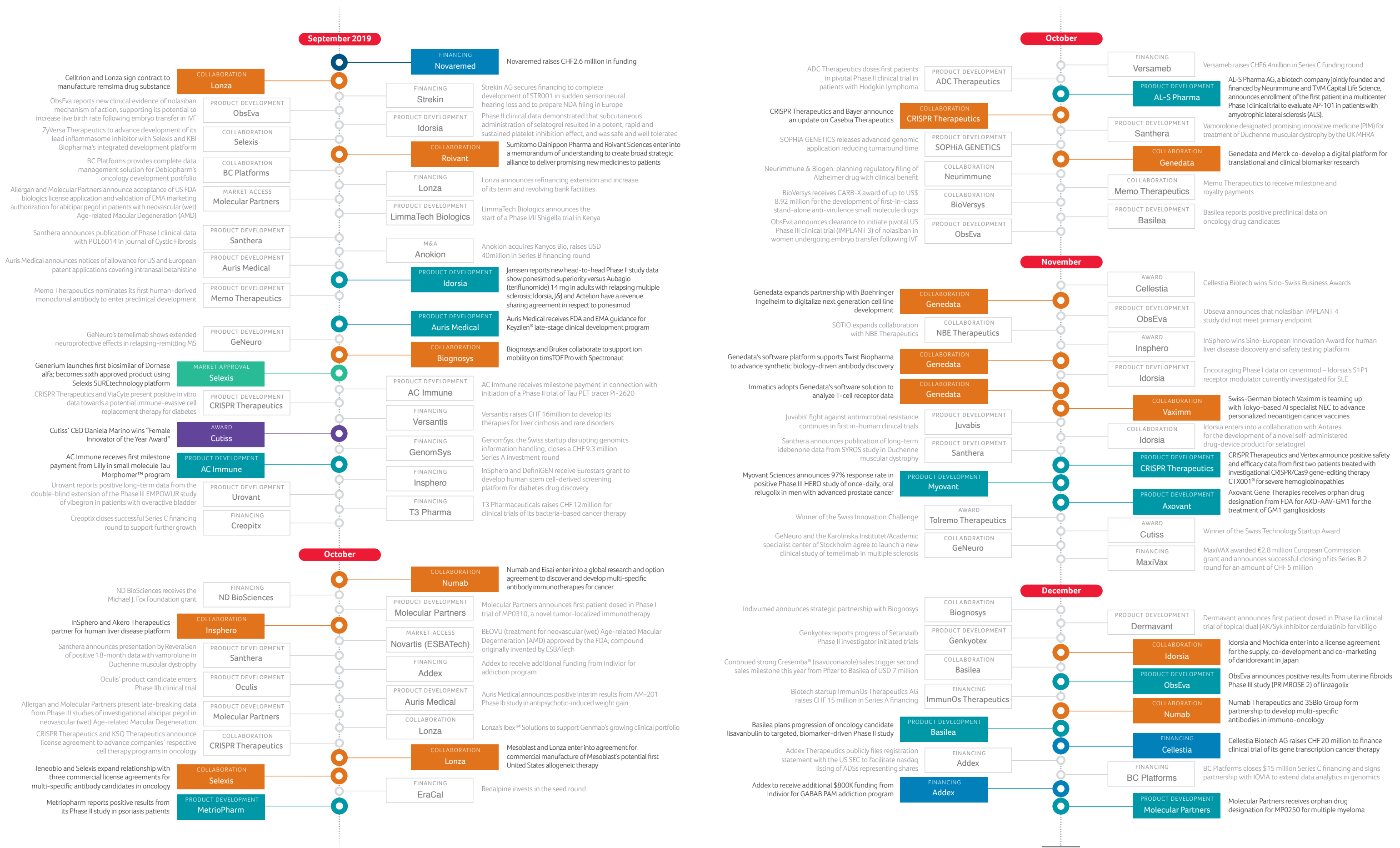
Swiss Biotech Events of 2019

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Swiss Biotech Events of 2019

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Swiss Biotech Report: Contributors' Profiles

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

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www.ey.com/lifesciences

scienceindustries

scienceindustries is the Swiss business association of chemistry, pharma 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

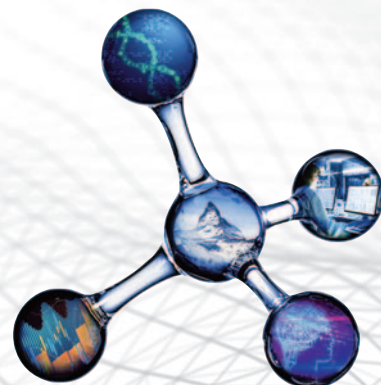
Innosuisse is the Swiss Innovation Agency. Its mission is to promote science-based innovation for the benefit of the economy and society. It offers funding for up to half the cost of clearly defined innovation projects involving partners from industry and research. It also provides mentors, coaching 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

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