

Studies of Pharmaceutical Sciences in Switzerland

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Academic training in pharmaceutical sciences in Switzerland is oriented towards the interdisciplinary character of the different facets of the profession of a pharmacist as a public health expert as well as a scientist. As highly skilled experts, graduates have a major impact on health care, and the scientific and economic landscape in Switzerland and beyond. Academic curricula in pharmaceutical sciences are supported by excellence in research and are constantly adapted to face the challenges of modern society. Switzerland and her pharmacists are well-prepared for these challenges – now and in the future.

The landscape of pharmaceutical sciences in Switzerland

It is no secret that pharmaceutical sciences play a big role in the Swiss research, economic, and health care sectors. Switzerland offers several regional clusters of academic institutions and pharma/biotech industries from the Basel Area for Life Sciences (1) in the North, the Greater Zurich Area (2), to the Greater Geneva Berne Area (3), together with BioAlps (4) merging clusters in the center and West into Switzerland's Health Valley (5). The success of clustering of academic institutions, start-up companies with the necessary supporting network, and established companies is also positively impacting innovation: the European Patent Office received almost 1'000 Swiss patent applications per million inhabitants in 2019, which is significantly higher than for Switzerland's neighbors Germany (334) and France (150), as well as for the USA (140). In 2020, Switzerland was ranked on top of the Global Innovation Index (6) again, and Swiss pharmaceutical research and development activities did contribute significantly to this success.

In 2018, the workforce of Swiss pharma and biotech companies was 135'000 employees (7), 15'000 of which in privately held and publicly traded biotech companies (8). In 2018, Swiss pharma and biotech companies were producing pharmaceuticals, diagnostics, and vitamins worth CHF 90 billion annually (9). More than one third of Swiss exports are being produced by the pharmaceutical industry.

Nevertheless, the Swiss health care system has to cope with severe drug shortages, which affected almost 1000 drugs (originator and generics alike) in December 2019 (10). In 2020, shortages mostly concerned essential antibiotics, analgesics, anticancer drugs and vaccines (11). Drug shortages may be the result of an unexpected increase in demand in Switzerland or in other countries, problems in the manufacture or procurement of the active ingredients or an excipient, or delays in the regulatory process (inspections of the manufacturing site or the drug). Not only in a global pandemic this signifies the importance of maintaining production facilities for essential drugs and skilled personnel to satisfy demand.

On the drug distribution end, there are 1819 public pharmacies in Switzerland, employing 22'212 persons serving 314'533 patients every day, amounting to 94 million patient contacts per year (11). Compared to the rest of Europe, the density of pharmacies is relatively low with 21 pharmacies per 100'000 inhabitants, as the European mean is 32 pharmacies per 100'000 population. At the same time, in 2018 merely 6.8% of all health care costs and only 3.2% of costs reimbursed by health insurances were incurred by public pharmacies. This is due to the fact that the majority of drugs is applied in hospitals, and about the same number of drugs is dispensed in the cabinets of general practitioners in some cantons as are in all Swiss pharmacies (11).

Of the 5'800 pharmacists currently registered in Switzerland and active in public pharmacies, many obtained their diploma abroad. As an example, in 2020, the number of Swiss federal pharmacy diplomas (184) attributed to graduates of Swiss universities was lower than foreign diplomas were recognized (217) (12), which shows that Switzerland relies on the import of skilled labor also in this part of the health care sector.

Studies in pharmaceutical sciences in Switzerland

According to recent surveys, Swiss universities and especially their Schools of Pharmaceutical Sciences are very competitive and rank among the top 50 worldwide (2020: Basel 38, Zürich 15, Geneva 30, www.topuniversities.com). This position is based on the understanding of Pharmaceutical Sciences as the dichotomy of research and training in fundamental and clinical sciences, as only excellence in research does bode for excellence in training of students.

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Academic training in pharmacy and pharmaceutical sciences in Switzerland has been offered until recently at the cantonal universities of Basel and Geneva, and the Swiss Federal Institute of Technology (ETH) in Zürich. The Universities of Neuchâtel and Lausanne, in cooperation with the Geneva school, are offering the first Bachelor year, as well. Responding to the rising demand of qualified pharmacists as has been outlined above, the School of Pharmacy at the University of Berne has extended its curriculum from the first two Bachelor years to a full 5-year curriculum and has become the 4th academic institution for the training of pharmacists in Switzerland.

All four academic institutions are unique: while the Department of Pharmaceutical Sciences at Basel is part of a cantonal university, the Institute of Pharmaceutical Sciences of ETH Zürich is a federal institution. Geneva's Institute of Pharmaceutical Sciences of Western Switzerland (ISPSO) is based in a cantonal university, however, covers the entire area of French-speaking Switzerland. The School of Pharmacy at the University of Berne is no exception, as its program is organized by two faculties. As a consequence of the interdisciplinary character of the pharmacist's profession, cooperation between pharmaceutical and medical sciences at all universities have been strong in both training and research. However, due to the strong presence of medical sciences at Berne, while the Bachelor program in pharmaceutical sciences is organized by the Department of Chemistry, Biochemistry and Pharmacy, the Master phase is under the auspices of the Faculty of Medicine.

The program consists of a 3-years Bachelor and a 2-years Master phase, which includes a Master's thesis project. Curricula in pharmacy have to undergo a process of accreditation by an independent organisation (Swiss Agency of Accreditation and Quality Assurance, AAQ) every seven years. Students graduate with a Master of Science degree (MSc) from their alma mater. To become a licensed pharmacist, graduates have to pass in addition the Swiss federal exam in pharmacy, which is organized at the national level.

Through a change of the federal Medical Professions Act (13) in January 2019 following the report of a federal commission to explore the role of pharmacists and pharmacies in the Swiss health care system (14), pharmacists were given more competencies, including the dispensing of prescription drugs and drugs for common diseases without prior consultation of a medical doctor. In addition, vaccination in Swiss public pharmacies by specifically trained pharmacists was already introduced in 2015. Today, vaccinations are applied in 60% of all pharmacies in 23 out of 26 cantons, and one third of all pharmacists has received training in injection techniques (subcutaneous, intramuscular), blood sampling, and basic resuscitation skills. Needless to mention that under the current pandemic conditions, pharmacists are well placed to contribute to antigen testing and will be involved in COVID-19 vaccination campaigns. Obviously, the traditional as well as these new activities of pharmacists require a close cooperation and coordination with other professionals such as general practitioners, specialists, hospitals and nurses as partners in the health care system.

The contents of the pharmacy curriculum offered at all Swiss universities is formally based on the common «Catalogue of learning objectives» (15). However, within the general framework given by the catalogue, each school organizes the structure and contents of their programs individually. The teaching philosophy in pharmaceutical sciences is based on the dichotomy of fundamental and clinical pharmaceutical sciences, and the conviction that excellence in teaching is determined by excellence in scientific research. Therefore, the respective research activities of the different Schools influence to some extent the contents of their respective curricula.

The catalogue lists the general topics to be taught to pharmacy students and defines the required level of theoretical and practi-

cal knowledge for each subject. A commentary to the catalogue is currently drafted by the APhWS («Ausbildung Pharmazeutische Wissenschaften Schweiz») (16) committee under the auspices of the Swiss Academy of Pharmaceutical Sciences (SAPhS). This commentary further specifies the subjects to be integrated into the curricula and will become mandatory for the academic institutions. The Bachelor phase of the first three years of study provides a solid education in basic sciences, medical sciences and pharmaceutical sciences. Teaching methods include traditional *ex cathedra* courses, seminars and practical lab courses, but also increasingly advanced problem-oriented methods such as e-learning, inversed classrooms and simulations. The Master's phase includes one year of specialization in pharmaceutical sciences, and a second year is dedicated to at least 20 weeks of research work for the Master's thesis, and additionally internships in a public pharmacy and possibly in a hospital. It is completed by specific courses necessary to acquire the many skills of the profession of a pharmacist.

1. Training of undergraduates in pharmaceutical sciences is facing three challenges, which shall be illustrated by the example of the Section of Pharmaceutical Sciences at the University of Geneva, however, is generally applicable to the other Swiss Schools of Pharmacy. The pharmacist profession is very attractive, especially for female students (e.g., 78.5% female, 21.5% male students in Geneva). Student numbers at Geneva's School have constantly and very significantly increased by 41% over the last ten years, from 321 in 2011 to 550 in 2020. At the same time, the number of students in the other Sections of the Faculty of Sciences, of which the School is an integral part, has risen by about 15% (2331 to 2864).
2. At Geneva, the curriculum consists of 2349 hours of lectures and seminars, and 1098 hours of practical courses, which makes it a rather «crowded» program. In addition, several internships and the Master's thesis project complete the student training. Adding on new subjects like injection techniques into this already crowded curriculum is very challenging. Rational decisions must be taken which subjects should remain in the basic training, and which may be taught in postgraduate continuing education.
3. The profession of a pharmacist in all its facets is based on a rigorous scientific training in fundamental sciences, which is constantly updated according to the scientific progress. On the other hand, skills and expertise in clinical sciences, including interprofessional training and patient contacts are needed likewise to fulfill the role society is expecting from pharmacists. To strike the right balance for time spent between fundamental and clinical sciences is a constant point of discussion in the reform of curricula in pharmaceutical sciences.

In Switzerland, unemployment among pharmacists is virtually absent. According to internal statistics (2019), about 60% of Geneva pharmacy graduates (78.5% female, 21.5% male) work (77% full-time) in public pharmacies, 13% in hospitals, about 8% in the pharmaceutical industry, 7% in academic institutions (43% PhD students, 38% staff, 19% faculty), 1% in federal and cantonal administration, 0.3% in humanitarian organizations, and 10% in other sectors. In addition, over the next few years there will be an increased demand for licensed pharmacists to cushion a wave of retirements and to cope with extended opening hours introduced recently. Furthermore, service offers such as more competences and, for example, extended opening hours are an important reason why more pharmacists should be trained.

In addition to the «classical» curriculum in pharmaceutical sciences, the Schools in Basel, Zürich and Geneva have created courses that are more targeted toward the research and industrial aspects of pharmaceutical sciences.

The School of Pharmacy at the University of Basel, in cooperation with the Department of Biomedicine, the local life science industry, the Swiss Centre for Applied Human Toxicology (SCAHT) and regulatory authorities created the 2-year Master course in Drug Sciences, which prepares its students for a future career in industrial or academic research, product development or in a regulatory agency.

Already in 2007, the Institute of Pharmaceutical Sciences at ETH Zürich introduced the Master's program in Medicinal and Industrial Pharmaceutical Sciences (MIPS). After being revised and renamed MSc in Pharmaceutical Sciences in 2017, the program prepares students for a career in industry and for PhD studies in pharmaceutical or (bio)medical research.

The Section of Pharmaceutical Sciences at the University of Geneva, in coordination with the university's faculty of medicine is offering a Master in Biomedical Sciences, which is building upon the Bachelor program in the same discipline managed by the faculty of medicine. The aim of the program is to prepare students for a career in industrial drug and medical device development. It also opens up opportunities in the biotechnology or food industry as well as in today's genetics and human genomics.

Graduates of all programs presented here are not licensed pharmacists and may complete their training by a successive PhD thesis.

In addition to cantonal universities and federal institutes of technology in Zürich (ETHZ) and Lausanne (EPFL), universities of applied sciences (UAS) enrich the academic landscape in Switzerland. They are «equivalent to but different from» (fhschweiz.ch) other types of higher-education institutions, preparing their students through practice-oriented programs as well as through application-oriented research and development activities. UAS training is aimed at a high level of employability in the Swiss workplace and beyond, and is completed by either a Bachelor's or highly specialized Master's degree. Research in the UAS area is aimed at delivering solutions to practical issues in industry. Thus, teaching at UAS is guided by the principle «Gained in practice, for use in practice» (fhschweiz.ch).

The UAS in Northwestern Switzerland close to Basel offers an 18-months Master's program in Pharmatechnology. The program can be followed also part-time, extending the duration to a maximum of 3 years. Its aim is to enable students to contribute to R&D and manufacturing in the pharmaceutical and biotech industry. A Master's thesis project of eight months, usually carried out on the site of a pharmaceutical company, completes the training. Graduates are qualified to pursue a PhD thesis successively.

Postgraduate studies in pharmaceutical sciences in Switzerland

Public pharmacies are regarded as a low threshold entry into the Swiss health care system, with pharmacists having a crucial role not only in the dispensing of medicines and in giving professional advice, but increasingly in accompanying patients with chronic diseases in an aging society. In order to responsibly direct an existing or open a new pharmacy, a postgraduate title in addition to the federal diploma is mandatory since 2018. This title can be obtained through a two-year extra-occupational education while working at least for 80% in a pharmacy. In accordance with the CanMEDs framework (17), the curriculum offers advanced training in the different roles of a pharmacist: pharmaceutical expert, communicator, partner to other health care professionals, scholar (scientist/educator), health advocate, responsible leader and manager, and professional role model. While the role of pharmaceutical expert is confirmed by a final Board exam, the remaining roles are assessment

of the candidate's practical assignments by the candidate's mentor (18). In 2019, 276 postgraduate diplomas in public pharmacy were attributed in Switzerland.

Postgraduate specializations in both hospital and clinical pharmacy are offered in Switzerland as well (19). The postgraduate title in hospital pharmacy requires extra-occupational training lasting between three and six years and is completed under the supervision of a recognized instructor at one or more recognized institutions.

Postgraduate training clinical pharmacy takes place in a recognized training center under the supervision of a recognized instructor, is conducted on a part-time basis and lasts at least 18 months. For part-time candidates, the training must not last longer than four years.

All of these postgraduate programs need to be certified by a federal accreditation body, the Swiss Foederatio Pharmaceutica Helvetica (FPH).

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