Faculty of Science and Engineering

Profile report: Pharmaceutical Data Science & Statistics

- Discipline: Pharmaceutical data science, statistics
- Level: Tenure-track assistant professor with education profile
- Fte: 1,0 fte

1. Scientific discipline

The discipline Pharmaceutical Data Science & Statistics aims to retrieve, store, combine and analyse big health care data as well as smaller data sets from laboratory experiments from various resources. In Pharmaceutical sciences both causal and predictive analytical modelling is applied in an unstructured hypothesis-free way by using machine learning techniques, as well as in using pharmaceutically informed hypothesis testing and risk estimation. Examples of data science applications in pharmacy include the construction of dynamic drug treatment pathways and its relation to drug intended and unintended effects; reconstruction of genomic and metabolic data in the causal pathway to disease and modification of drug effects as well as machine learning approaches supporting diagnosis and prognosis estimations. Challenges concern the definition of data privacy rules, the set-up of an effective infrastructure to capture and utilize unstructured datasets into smart readable datasets as well as the derivation of insights from clinical trial, patient cohort and smaller laboratory experiment rich datasets combining theoretical concepts from the computer and information sciences, mathematics and statistics.

With this position we aim to re-align and develop the Data Science and Statistics course learning line within the bachelor and master pharmacy as well as the research master Medical Pharmaceutical Sciences taught in the educational cluster Pharmacy. The candidate will join existing research lines within the unit GRIP-PTEE with a strong emphasis on causal and predictive research with large linked datasets.

2. Vacancy

This position is opened by the Board of the Faculty (PT/gl/22/00302) and will be embedded in the Groningen Research Institute of Pharmacy, research groups PharmacoTherapy, -Epidemiology & -Economics (PTEE). The criteria and conditions pertaining to the position are described in the document 'Assistant professor with an education profile'.

3. Selection committee (BAC)

- Prof dr Gerrit Poelarends (Director GRIP, chair BAC)
- Prof dr Eelko Hak (Director Education Cluster Pharmacy)
- Prof dr Talitha Feenstra, professor of pharmaco-economics, GRIP
- Dr Herman Woerdenbag, associate professor of pharmaceutical technology (Program Director bachelor Pharmacy)
- Prof dr Martina Schmidt, professor molecular pharmacology, GRIP
- Prof dr Rolf Groenwold, professor of clinical epidemiology, LUMC
- Student Kevin Keijzer

Advisors:
Friso Salverda (HR)

Prof dr Gerton Lunter, professor of medical statistics, dept. Epidemiology, UMCG

4. Area of expertise

Data analysis in drug studies, using large routine health care datasets, clinical trials or cohort data as well as rich small laboratory datasets, and applying innovative methods from data science and biostatistics are an expanding area of research and applications. The need for scientific experts in this field is high not only in academia, but also in industry as well as drug registration agencies, like the European Medicines Agency. Real-world data analytics has become a growing scientific discipline in the pharmaceutical sciences because of the growing availability of huge amounts of health care data from routine administrations and/or personal data from sources like wearables or social media. Major challenges exist, both regarding methods of analysis and regarding study design and data-infrastructure. For instance, the development of a legal and effective infrastructure to combine datasets, the cleaning and structuring of data as well as the application of newly developed methods from various disciplines regarding causal inference and predictive analytics. The overarching aim is to derive scientific knowledge to support the personalization of pharmaceutical therapy. Research in this area is inherently interdisciplinary and collaborative, and requires familiarity with state-of-the-art quantitative methods, as well as a solid understanding of pharmaceutical principles, and the nature of clinical and pharmaceutical data.

Within GRIP, Data Science is applied in various groups such as the Drug Design unit (to map potential targets for drugs), the Analytical Biochemistry unit (analysis of mass spectrometric data from laboratory experiments) and the unit PharmacoTherapy, -Epidemiology and –Economics (analysis of a large variety of observational datasets from routine care, the Lifelines cohort, and linked datasets combining these with national data infrastructure on population characteristics at statistics Netherlands). While sufficient expertise within specific statistical and data science specialisations is certainly available across scientific staff within the cluster Pharmacy, a more overarching perspective on the data analysis skills required for future bachelors and masters with a pharmacy degree or pharmaceutical scientists is lacking. This requires dedicated attention from a scientist with a solid background in mathematics and statistics as well as in-depth familiarity with the needs, abilities and interests of the typical pharmaceutical sciences student. Education should be geared towards the requirements of future employers and research areas. In order to prepare our students for the increasing volume and complexity of pharmaceutical and clinical data available to pharmaceutical scientists, a solid and up-to-date basis in statistics, mathematics and information science is required. The involvement of pharmaceutical data science combined with subject-matter expertise in the teaching programmes is required to realize these ambitions, and to create coherence between data science elements in introductory courses and field-specific applications across different pharmaceutical specializations.

In addition, expertise is needed to provide advanced-level education in medical and pharmaceutical data science for students who decide to specialize in this discipline. All of these initiatives require a high commitment to education, educational innovation and didactic skill development, since teaching data science and statistics to pharmacy students, as well as training of PhD candidates within GRIP depends on a deliberate strategy for promoting cross-disciplinary learning, starting from the development of elementary quantitative skills in students who do not necessarily have an outspoken quantitative profile.

5. Embedding: institute (and expertise group)

The GRIP in Groningen is positioned within the FSE and physically located within the University Medical Centre Groningen (UMCG) of the Faculty of Medical Sciences (FMS); hence, in an ideal position to benefit from co-operations between both faculties. Together with Medical Sciences, GRIP participates in the Research Institute GUIDE (Groningen University Institute for Drug Exploration), and apart from its scientific relevance within GRIP, the research associated with this position would also find multiple collaborative partners within GUIDE.

Research at the GRIP is multidisciplinary. It bridges clinical, health economy and biomedical sciences on the one side and chemistry, biology, physics and mathematics (statistics) on the other side. The interaction between the pharmaceutical sciences with these fundamental and clinical sciences offers excellent opportunities for cutting-edge research.

GRIP consists of the following research groups (with their chairpersons):

- Analytical Biochemistry (Prof dr. P. Horvatovich)
- Drug Design (Prof dr. A. Dömling)
- Molecular Pharmacology (Prof dr. M. Schmidt)
- Pharmaceutical Analysis (Prof dr. E.M.J. Verpoorte)
- Chemical and Pharmaceutical Biology (Prof dr. W.J. Quax)
- Pharmaceutical Technology & Biopharmacy (Prof dr. H.W. Frijlink)
- Nanomedicine & Drug targeting (Prof dr. K. Poelstra)
- PharmacoTherapy, -Epidemiology & -Economics (Prof dr. E. Hak)

With this vacancy GRIPs ambition is to further build on the scientific knowledge generated by the preclinical research groups (e.g. Molecular Pharmacology, Analytical Biochemistry) coordinated by a new center of Precision Drug Therapy which will be based on this life-cycle approach, and to expand the biomarker discovery, trial and real-world validation with data form large clinical and pharmacy networks to gain insights into the impact of drugs in vulnerable patient groups in real-life settings.

The candidate will be embedded in the GRIP research group PharmacoTherapy, -Epidemiology & -Economics (PTEE). PTEE also participates in GUIDE within the programme of Real World Studies in PharmacoEpidemiology, -Genetics, -Economics and -Therapy (PEGET) and the departments of Epidemiology, Clinical Pharmacy and Pharmacology from the UMCG.

The unit strives to innovate by deriving scientific evidence on personalization of medications, which can only be advanced by the application of valid interdisciplinary epidemiologic and economic studies on large amounts of data and biological samples from various patient populations. To this aim health care Big Data stored in large locally available databases are available in-house such as the prescription database IADB.nl covering >1,5 million inhabitants and 120 million prescriptions and which can be linked under the PharmLines Initiative to Lifelines cohort data. Other specific databases are also available via existing collaborations including GIANTT, the Lareb

pharmacovigilance report database, NIVEL General Practitioner database, mental healthcare datasets (IMPROVE), and various other cohorts and trials.

6. Local and (inter)national position

In The Netherlands, education and research in the area of Pharmaceutical Data Science and Statistics is mainly carried out at the Leiden University Medical Center (LUMC), Utrecht Institute of Pharmaceutical Sciences associated with the department of Pharmacy of the University Utrecht (UU) and the Groningen Research Institute of Pharmacy (GRIP) of the University Groningen. At the LUMC, research into epidemiological methods for valid real-world data analysis is central. At the UU, research into personalized medicine mainly focuses on asthma in children and preventive cardiovascular drug treatment. In Groningen, Precision Drug Therapy is addressed by the disciplines Pharmacogenetics, Clinical Pharmacoepidemiology, Pharmacoeconomics, Molecular Pharmacology, Analytical Biochemistry and Clinical Pharmacy. The research is thus embedded in a life-cycle drug approach combining scientific knowledge from bench to bedside and vice versa. Areas of specific attention are Diabetes, Cardiovascular, Respiratory and Psychiatric diseases.

Research collaborations exist with Lifelines, the inter-university Dutch Biomarker Development Center, the Groningen Data Science and Systems Complexity Center, the Department of Genetics (UMCG) and RGOC (regional specialized mental healthcare (UMCG). Specific collaborations exist with the Dutch pharmacovigilance center (LAREB) and NIVEL through appointments of professors at the unit PTEE. In addition, PTEE has strong (inter)national collaborations with amongst others the Central EUROCAT-network (birth defect registries covering one-third of all births in Europe), the Health Protection Agency (London), and the universities of Ghent, Oxford and Boston.

This vacancy is foreseen to be part of a new Center of Precision Drug Therapy. The tenure track position in Data science and statistics will be instrumental in co-developing this center and integrating education and research from various angles. Internationally, only few Western countries (e.g. USA, UK, Canada) have started integrating novel diagnostic tools and clinical predictions into actual pharmaceutical practice. The strong networks with health professionals in the region, such as the academic network of pharmacies (ANNA) allow to test innovations in pharmacy practice. Internationally, the European Drug Utilization Research Group (EuroDURG), Pharmaceutical Care Network Europe (PCNE) and the European Society of Clinical Pharmacy (ESCP) are other relevant large professional networks enabling the conduct of innovative research. Another opportunity is the EMA, which is setting up large European networks to move forward data science and analytics in the regulatory field, but pharmaceutical data science and statistics is still at its infancy.

7. Expected contributions to teaching
The candidate is expected to contribute to the bachelor program pharmacy, specifically to the compulsory courses mathematics and statistics (WBFA054-05, 5 EC, approx. 190 first-year students), biostatistics (WBFA011-05, 5 EC, approx. 160 second year students) and pharmacoepidemiology (WBFA028-05, 5 EC, 160 second year students). There will be interaction with other basic courses, such as pharmaceutical technology and biopharmacy, and pharmacokinetics. In the research master Medical Pharmaceutical Sciences, data science and statistical skills are trained as part of the Academic skills course (WMMP012-05, approximately 40 students) and this research master participates in the

new learning line coordinated by the research master Biomedical Sciences on Data Sciences. In the master pharmacy, there is currently no further cursory training in these skills, however, statistical skills are an important part of individual Pharmacy and MPS master projects (approx. 80 per year), notably when rich data from laboratory experiments or big data need to be analysed. Apart from major contributions to the MPS regular courses, the candidate will be expected to have a coordinating, consultancy and supervisory role for bachelor and master projects.

In addition, the candidate will develop a coherent introduction of data science elements in the existing courses across the curriculum, ranging from introductory elements in existing BSc courses, to field-specific applications in elective bachelor and master courses (e.g. bachelor course from clinical trials to big data, advanced bioanalysis). The candidate is also expected to develop innovations in teaching in general making use of internet-based tools such as SOWISO, interactive visualizations and instruction videos. This contribution to the curricular development will be supported by successful applications for grants for educational innovation.

8. Expected contributions to research

The assistant professor is expected to join and contribute to existing research within PTEE applied to a relevant field of personalized medicine and pharmacotherapy such as pharmacogenetics, metabolomics and/or clinical data analysis (depending on the candidate's background). Furthermore, the candidate is expected to support efforts in the field of data science and statistics within GRIP by establishing research collaborations with existing groups. Finally, the candidate is expected to contribute to the supervision of PhD students and the acquisition of external funding.

9. Expected contributions to the organization

The candidate is expected to have an active interest and to provide a positive contribution to the management and organizational tasks of the institute. At the level of FSE, the candidate will contribute to the organization of the faculty, for example by participating in working groups and committees in the area of education. The candidate will participate in relevant national and international organizations.