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Digitalization in healthcare:

Efficient treatment of stroke with AI and federated learning

A research team of Inselspital, University Hospital Bern, the University of Bern and the «Centre hospitalier universitaire vaudois» (CHUV) uses AI to improve efficiency of treatment after stroke. The project Advanced Stroke Analysis Platform (ASAP) applies federated learning that links the database of each hospital center without exchange of raw data. Innosuisse, the Swiss innovation agency, promotes the project.

The most important areas of application are currently in the interpretation of image and analysis data to support diagnosis and prognosis. At present, a crucial hurdle is the limited amount of data available for training the algorithms. It is often the case that the only available data are from individual centers and cannot be transferred. Furthermore, issues concerning anonymization stand in the way of an effective use of AI.

Federated learning – a breakthrough for AI in medicine
The new technology enables federated learning, the learning process of an algorithm across different, decentralized devices, locations and platforms. The research group SCAN (Support Center for Advanced Neuroimaging) led by Prof. Roland Wiest at the Institute of Diagnostic and Interventional Neuroradiology at Inselspital, Bern University Hospital, and by Dr. Jonas Richiardi at CHUV in Lausanne, are developing a new methodology to ensure data heterogeneity and data security in the project. In simplified terms, the approach functions in such a manner that a large part of data acquisition and analysis is decentralized – and only pre-processed, anonymized and normalized data is used centrally for the learning process. **Richard McKinley**, an AI expert and IT specialist explains the methodology as follows*: "Previous approaches were based on centralized access to the data. To overcome this limitation, we propose to learn between-site mappings using image translation with distributed Generative Adversarial Networks (GANs). While each site trains its own discriminator, the raw data is not seen by the server or other sites."*

Advanced Stroke Analysis Platform (ASAP), federated learning pilot project
ASAP is the pilot project for the new technology to be applied in a clinical real world setting in the hospital centers in Bern (Inselspital, University Hospital) and Lausanne (CHUV) with the implementation partner Siemens Healthineers located at EPFL. As of yet, there has been no clinically established AI application of a prognosis for stroke patients. Prognoses are made based on

relatively inaccurate data on the basis of so-called volume diffusion or perfusion maps. The inaccuracy results from the extremely high time pressure during stroke and from the error-proneness of automated image interpretation methods. The ASAP project strives to now derive predictions directly from deep learning based on MRI images. For this, sufficient data must be available from the acute phase as well as from medium- and long-term outcomes. Prof. **Roland Wiest and Dr. Richard McKinley** expound on this*: "We propose to build deep learning models that predict the imaging outcome and the final lesion extent after stroke and the clinical outcome (mRS score) of a patient by using federated learning. In particular, our models will include all available imaging sources and precise clinical timings that are routinely recorded and that could dramatically alter the assessment of prognosis and recovery after a stroke."* The ASAP will be launched during the first quarter of 2021. Results are expected by the end of 2023. The implementation partner of the project is Siemens Healthineers Switzerland with its MRI innovation hub at the EPFL, Lausanne, the "Advanced Clinical Imaging Technology" group.

Bern's contributions to AI in medicine
The use of federated learning in AI in medicine is by no means limited to cardiovascular diseases: for example, in neurology for the complex diagnosis of Covid-19 induced brain complications; or wide fields are opening up for the methodology and its further development in oncology.
The medical location of Bern offers an ideal environment for the development and application of federated collaborative learning. On the one hand, researchers at Insel Gruppe can rely on a large center where the highest level of expertise is available and where the networks among personnel at other leading centers worldwide are already well established. In addition, AI research can now rely on the **Center for Artificial Intelligence in Medicine (CAIM), which is scheduled to officially open on March 19, 2021.**

Experts:
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- Dr. Jonas Richiardi PhD, Principal Investigator and Senior Lecturer, Department of Radiology, CHUV, Lausanne Switzerland
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Insel Gruppe

Insel Gruppe is Switzerland's leading group of hospitals for university and integrated medicine. It offers comprehensive health care based on groundbreaking quality, research, innovation and education. The six hospitals comprising Insel Gruppe (Inselspital, Aarberg, Belp, Münsingen, Riggisberg and Tiefenau) carry out over 800 000 outpatient consultations and treats about 60 000 in-patients. Insel Gruppe employs almost 11 000 members of staff from 100 nations. It provides training for a large number of professions and is the most important institution for the further training of young physicians.

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