Integration of N-of-1 trials with electronic health records for personalized clinical care
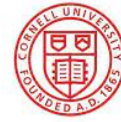
Project partners:

Project aims

The goal of this Bachelor project is to develop and set-up a digital platform integrated with patients' electronic health records to perform personalized trials at Mount Sinai Hospital and at Weill-Cornell Medicine in New York. This platform will allow to evaluate medical treatments for each single patient with the potential to be identify optimal treatments and change standard clinical care.

Why are personalized trials needed?

What can you do if you want to know which medical treatment (and in which intensity or dosis) helps you best to decrease your back pain? Or if you want to know which dose of drug xyz helps you best to control your high blood pressure? Your treating physician might look at medical guidelines that are based on population-level research studies. But they typically do not tell you whether it will work for you, they will tell you at best that a drug works in maybe 60% of the population. You could just try out whether a particular exercise helps you or which dose is best? Sure! And if you want to do this systematically to avoid biases, you can perform an experiment called N-of-1 trial to evaluate it scientifically with valid statistical inference.

What are N-of-1 trials?

In N-of-1 trials, one or more health interventions are applied sequentially in one person over time. This is illustrated below, where two interventions A and B are administered in blocks, and the outcome is measured at all time points.
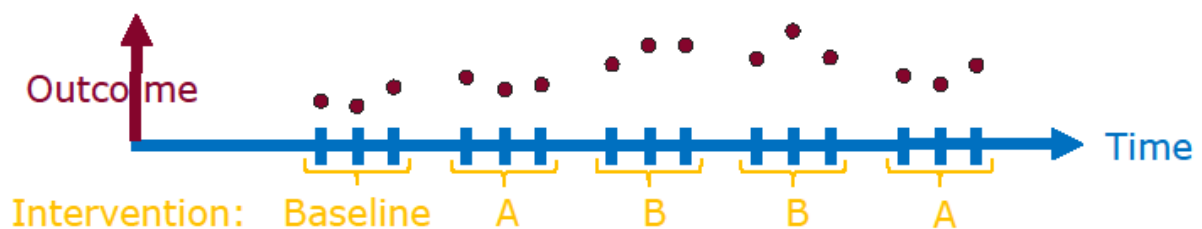
Existing work

In recent work, we have developed the StudyU platform (https://www.doi.org/10.2196/35884), which consists of a study designer web app (https://designer.studyu.health/) that allows researchers to design and implement N-of-1 trials, and a study app that allows study participants and patients to take part in these studies (https://app.studyu.health/). StudyU is open source (https://github.com/HIAlab/studyu) and free and the participant app is available in Android and Apple app stores. The current tech stack of StudyU is Flutter/Dart, PostgreSQL/Supabase, Git/Gitlab, Jupyter Notebooks.
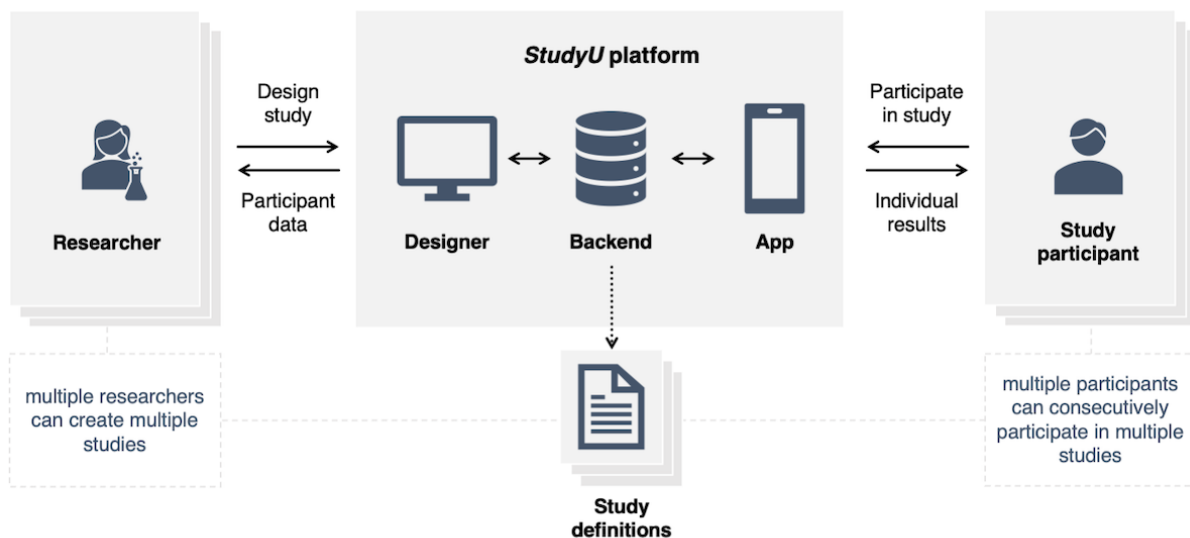
Project objectives and work packages

1. Adapt the StudyU platform and set it up on-premise at Mount Sinai and Weill-Cornell Medicine
   a. Literature review and scoping of existing work and of existing software infrastructure at the partner institutions
   b. Get to know clinical work flows
   c. Learn and go through about all necessary processes for setting up a digital trial platform at each institute
2. Ensure data privacy, secure data processing and adherence to all local institutional standards
3. Develop an integration of the platform with patients' electronic health records (EHR)
   a. Co-develop requirements with collaboration partners, physicians, and local IT team
   b. Design the integration and workflows, e.g. together with AIR-MS team at Mount Sinai
   c. Implement and test the set-up in iterative design processes
4. Develop and integrate predictive capabilities in the platform based on machine learning/deep learning models to fully use and integrate EHR data in N-of-1 trials

a. Use EHR data in prediction models of treatment success
b. Use EHR data for finding patients that might benefit from specific trials

Learning outcomes

- Gain hands-on experience with cross-platform full-stack application development.
- Learn about the ethical and regulatory aspects of handling patient data
- Learn about the structure and challenges of setting up new software within the software infrastructure of large hospital systems
- Learn to model and integrate complex electronic health records
- Develop and implement AI algorithms for medical applications
- Work closely with medical professionals from various disciplines
- Interdisciplinary team of supervisors from multiple institutions
- Develop project management skills through real-world project timelines and deliverables
- Enhance teamwork and collaboration skills by working in a diverse team environment

Supervisors

Come and meet us in person in the office at HPI or contact us via email if you have any questions:

- Christoph Lippert (Christoph.lippert@hpi.de)
- Stefan Konigorski (Stefan.konigorski@hpi.de)
- Ipek Ensari (ipek.ensari@mssm.edu)
- Kyra Gan (kyragan@cornell.edu)