Phd Project Proposal: Longitudinal analysis of Heterogeneous Treatment Effects in Danish Register Data

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PhD proposal

- Funding hope: Pioneer center
- Costs: $\sim$ 1.9 million DKK
- Period: 2025-2028
- Place: Section of Biostatistics, University of Copenhagen
- Keywords: Complex diseases, Causal prediction, Danish register data, Pharmacoepidemiology, Heterogeneous treatment effects, Longitudinal causal inference, Targeted minimum loss-based estimation
- Subject matter collaborators:
  - Pioneer center: XX
  - Lars Vedel Kessing (Department of Clincal Medicine, Psychiatry, Copenhagen Affective Disorder research Center)
  - Christian Torp-Pedersen (Department of Cardiology, Nordsjællands Hospital)

Example applications

Example 1

- Data (readily available): Patients with monopolar and bipolar depression are identified via Danish nation-wide population-based longitudinal register linkage
- We analyse study the comparative effectiveness of antidepressants and anticonvulsants.

Example 2

- Data (readily available): Patients with diabetes are identified in the Danish nation-wide population-based longitudinal register data.
- We analyse the effects of polypharmacy on a multivariate outcome.

Methods

Trial emulation and cluster randomized trials are relatively new concepts which have received a lot of attention in the epidemiological literature recently.

In Danish register data they allows us to

- estimate treatment effects beyond intention-to-treat
- study populations that would normally not be enrolled in clinical trials
- estimate treatment heterogeneity (causal prediction)

The longitudinal causal inference for electronic health records can be used to analyse the data, but is

- not fully developed (lack of methods)
- not implemented (lack of software)
- not broadly accessible (lack of know-how and experience)

Aims

We will develop new architectures for semiparametric causal inference of emulated target trials.

We will:

- study block randomization designs and enroll patients into series emulated trials.
- design estimands and predictimands in collaboration with subject matter partners
- derive methods for propensity scores that acknowledge the multivariate treatment options
- develop new super learner algorithms for the longitudinal structure of the data
- work out graphical representations of treatment effects that ease patients decision making with personalized predictions of multivariate outcomes