Observational Health Data Sciences and Informatics

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1. Tools
2. Methods
3. Data network
**Cohort definition:** A cohort is defined as the set of persons satisfying one or more inclusion criteria for a duration of time. One person may qualify for one cohort multiple times during non-overlapping time intervals. Cohorts are constructed in ATLAS by specifying cohort entry criteria and cohort exit criteria. Cohort entry criteria involve selecting one or more initial events, which determine the start date for cohort entry, and optionally specifying additional inclusion criteria which filter to the qualifying events. Cohort exit criteria are applied to each cohort entry record to determine the end date when the person’s episode no longer qualifies for the cohort.

**Initial event cohort:** Events are recorded time-stamped observations for the persons, such as drug exposures, conditions, procedures, measurements and visits. All events have a start date and end date, though some events may have a start date and end date with the same value (such as procedures or measurements). The event index date is set to be equal to the event start date.

- People having any of the following: [Add Initial Event...]

  - a condition occurrence of [Ischemic stroke (replication of Lee et al., J Clin Psychiatry 2016)]
  - for the first time in the person’s history
  - occurrence start is [Between 2005-01-01 and 2010-12-31]
  - with a Visit occurrence of [Inpatient Visit]

  with continuous observation of at least [0] days before and [0] days after event index date

  Limit initial events to [earliest event] per person.

**Initial event inclusion criteria:** From among the initial events, include:

- People having all [of the following criteria: [Add New Criteria...]]

  - with at least [1] using all occurrences of:
    - a procedure occurrence of [Computed tomography (CT) or magnetic resonance imaging (MRI)]
    - with a Visit occurrence of [Inpatient Visit]

  starting between [7] days before and [7] days after event index date and ending any time.

  Limit cohort of initial events to [earliest event] per person.
Complementary evidence to inform the patient journey

Clinical characterization: What happened to them?

Patient-level prediction: What will happen to me?

Population-level effect estimation: What are the causal effects?

Observation

Inference

Causal inference
Efficacy of monotherapy (Stanford data only)

Hripcsak et al, PNAS 2016

250 million patients
Effective treatment pathways

Metformin → Glipizide vs. Pioglitazone

Metformin → Sitagliptin vs. Glipizide

Metformin → Sitagliptin vs. Pioglitazone
Propensity models for all comparisons

<table>
<thead>
<tr>
<th>Amitriptyline</th>
<th>Bupropion</th>
<th>Citalopram</th>
<th>Desvenlafaxine</th>
<th>Doxepin</th>
<th>duloxetine</th>
<th>omeprazole</th>
<th>Escitalopram</th>
<th>Fluoxetine</th>
<th>Mirtazapine</th>
<th>Nortriptyline</th>
<th>Paroxetine</th>
<th>Psychotherapy</th>
<th>Sertraline</th>
<th>Venlafaxine</th>
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Calibration using negative controls

We would expect 5% of negative controls to have $p < 0.05$. Instead, 68% has $p < 0.05$!

Statistically significant

Not statistically significant
Calibration using negative controls

When using the propensity score, 16% have \( p < 0.05 \)

After calibration, 4% have \( p < 0.05 \) (was 16%)

Calibrated \( p < 0.05 \)
OHDSI recommendations (and tool support) for evidence generation

✓ Produce standard diagnostics
  • E.g. for cohort studies diagnose the propensity score distribution, covariate balance, etc.

✓ Include negative controls
  • Estimate the error when the null is true

✓ Create positive controls
  • Estimate the error when RR > 1

✓ Calibrate p-value and confidence intervals
  • Restoring nominal characteristics
Results from all x all comparison

11% of exposure-outcome pairs have calibrated $p < 0.05$
Observational research in literature (done one at a time)

85% of exposure-outcome pairs have $p < 0.05$

29,982 estimates
11,758 papers
Clinical situation

Guideline available?

Yes
Use level A guideline

No

Queue / Consider for randomization at point of care

Point of care randomization / large simple trial

High priority
Priority list of clinical situations

Useful byproduct

Increment priority

Large cohort of similar patients present?

Yes
Use practice-based evidence

No
Use professional judgment