The Journey of OHDSI: Where can we go together?

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Janssen Research and Development

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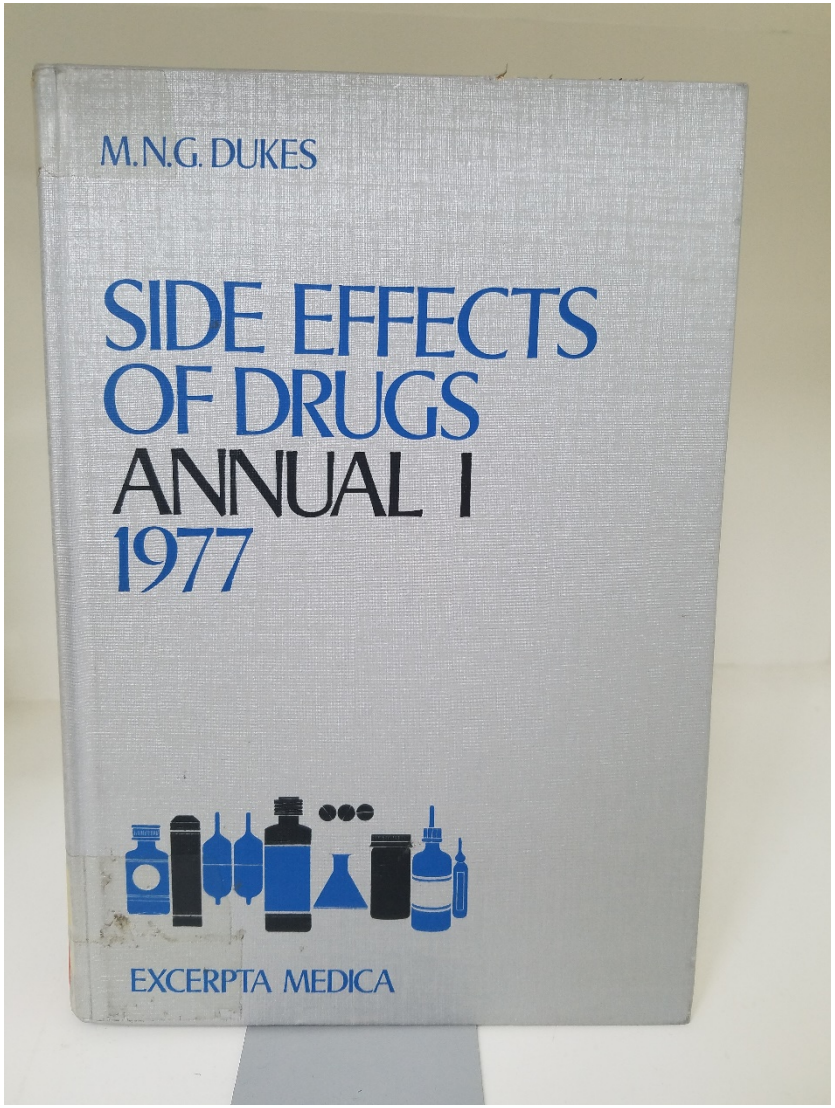
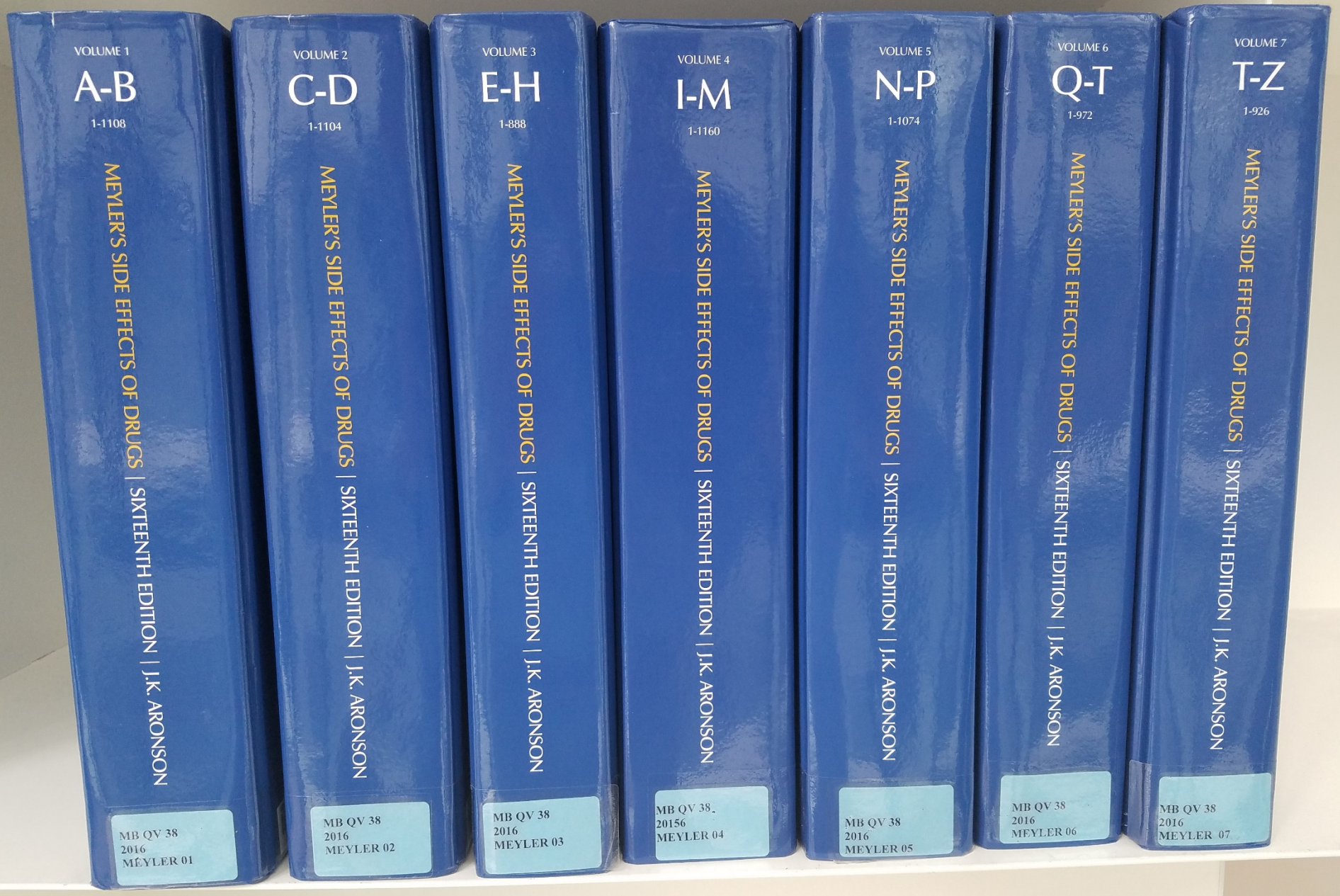


"No one could reasonably maintain that there has, up to the present, been a shortage of printed material on the adverse reactions to drugs; the problem, and the justification of this Annual, is just the reverse…

Leo Meyler's first 'Side Effects of Drugs', a valiant effort to tame the rising flood, was a readable little book of 128 pages; the latest edition of the encyclopaedic work which it has become runs more than 1100 pages of small print.

At this rate, one would by the end of the century need a treatise of ten volumes to supply the physician with even a summary view of what is known, or supposed to be known, about adverse drug reactions. "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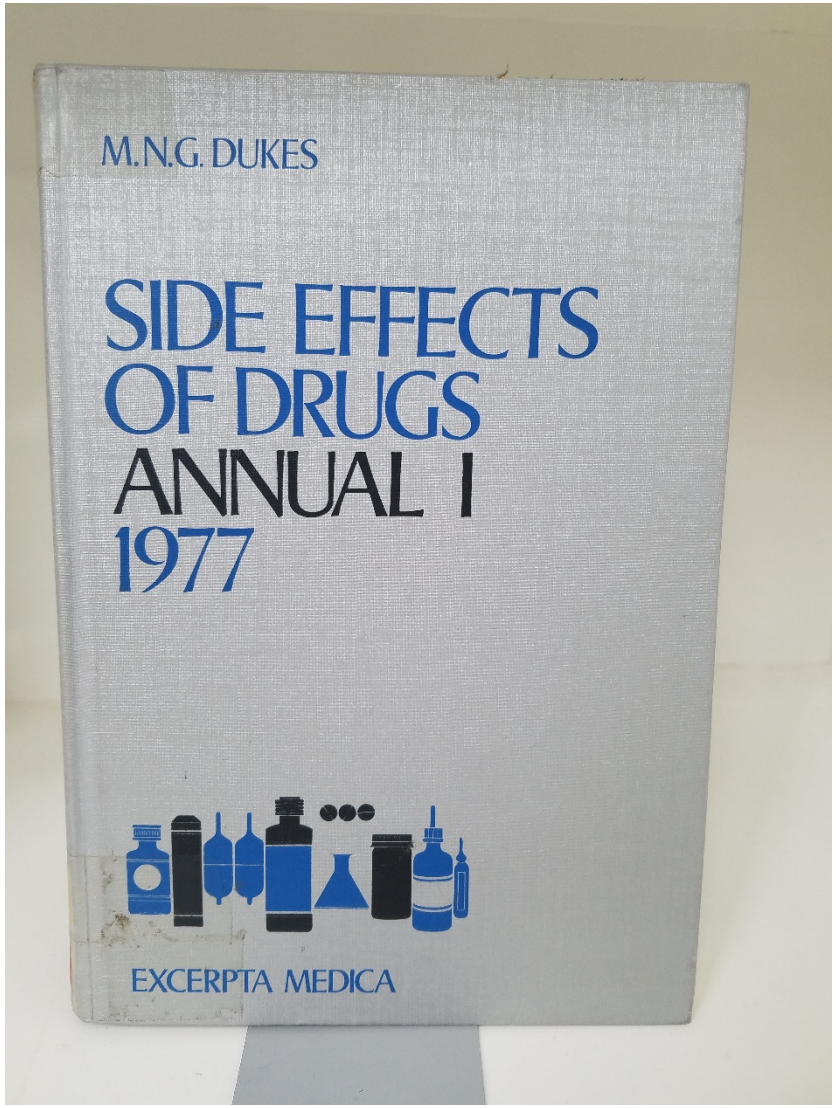
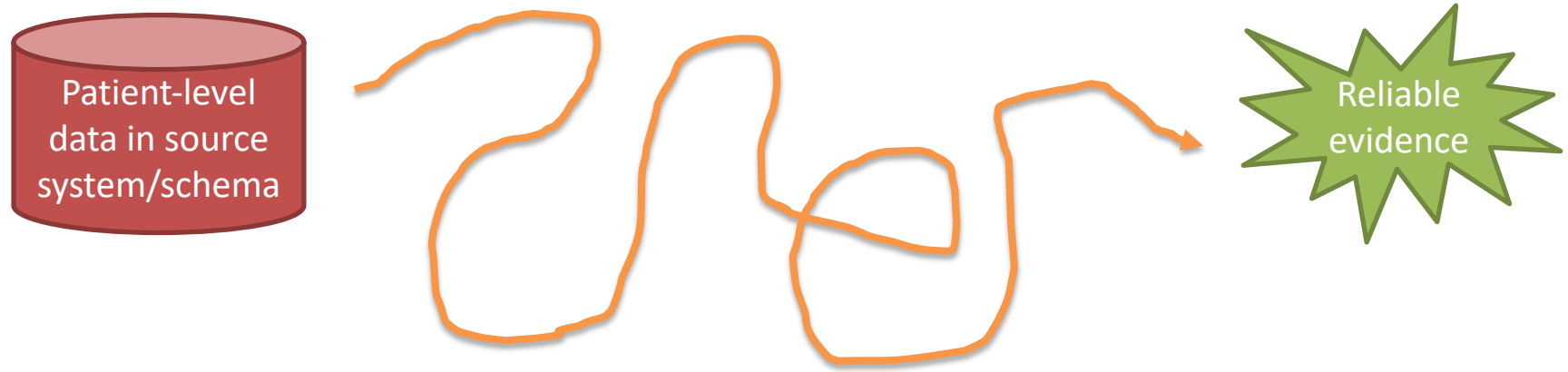


"But the exponential growth of 'Meyler' is merely symptomatic of the underlying problem. The number of published papers on drugs and their wanted or unwanted effects has become staggering and virtually indigestible.

Truth, ever evasive, has now become embedded in a vast haystack of repetitions, assertions, denials, arguments, and irrelevancies. Are there any answers to such a problem?"

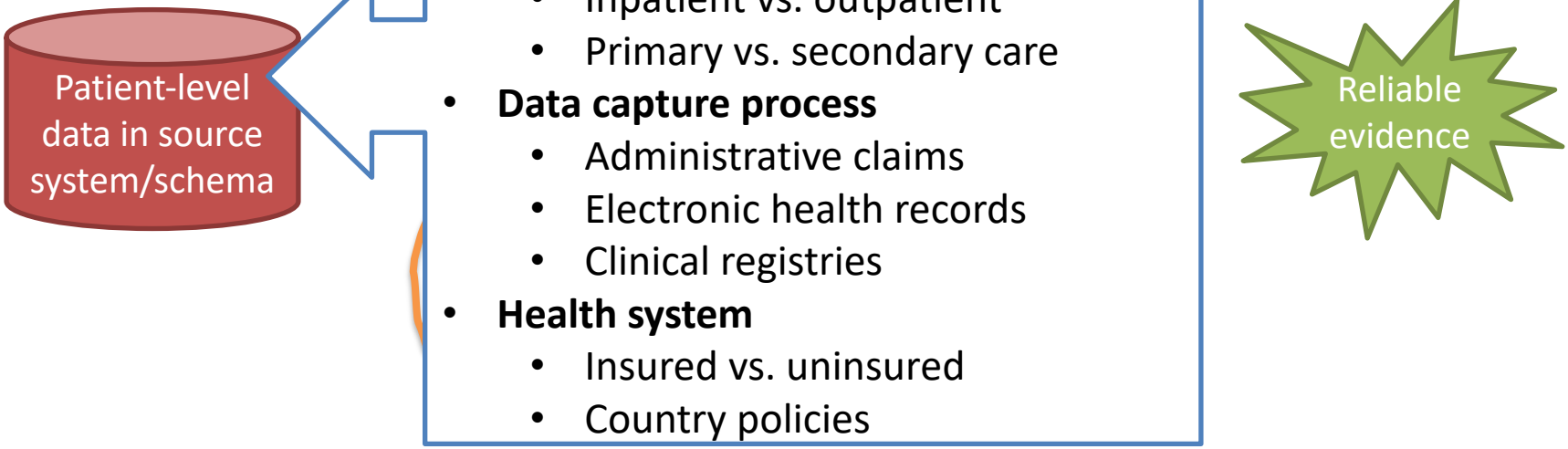
The journey to real-world evidence



One-time

Repeated

The journey to real-world evidence



One-time Repeated

The journey to real-world evidence

Patient-level data in source system/schema

Types of evidence desired:

- **Cohort identification**
  - Clinical trial feasibility and recruitment
- **Clinical characterization**
  - Treatment utilization
  - Disease natural history
  - Quality improvement
- **Population-level effect estimation**
  - Safety surveillance
  - Comparative effectiveness
- **Patient-level prediction**
  - Precision medicine
  - Disease interception

Reliable evidence

One-time

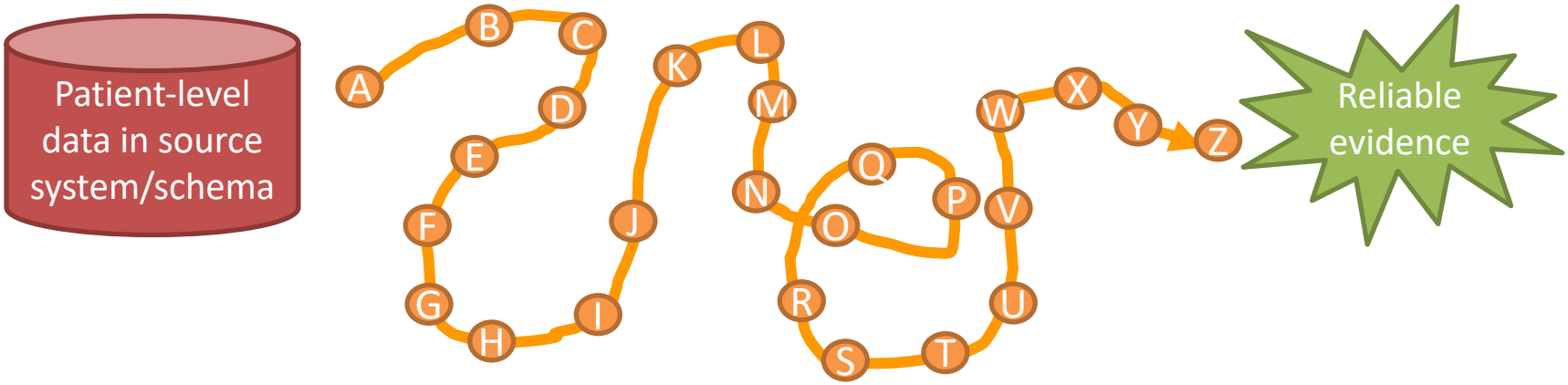
Repeated

Desired attributes for reliable evidence

Desired attribute	Question	Researcher	Data	Analysis		Result
Repeatable	Identical	Identical	Identical	Identical	=	Identical
Reproducible	Identical	Different	Identical	Identical	=	Identical
Replicable	Identical	Same or different	Similar	Identical	=	Similar
Generalizable	Identical	Same or different	Different	Identical	=	Similar
Robust	Identical	Same or different	Same or different	Different	=	Similar
Calibrated	Similar (controls)	Identical	Identical	Identical	=	Statistically consistent

Minimum requirements to achieve reproducibility

Desired attribute	Question	Researcher	Data	Analysis		Result
Reproducible	Identical	Different	Identical	Identical	=	Identical

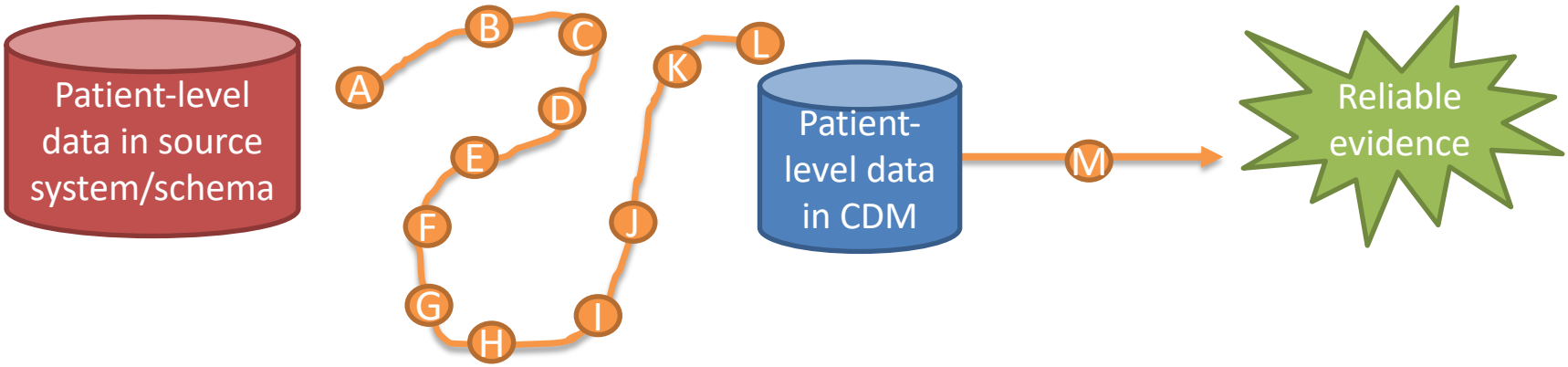


- Complete documented specification that fully describes all data manipulations and statistical procedures
- Original source data, no staged intermediaries
- Full analysis code that executes end-to-end (from source to results) without manual intervention

One-time | Repeated

How a common data model + common analytics can support reproducibility

Desired attribute	Question	Researcher	Data	Analysis		Result
Reproducible	Identical	Different	Identical	Identical	=	Identical

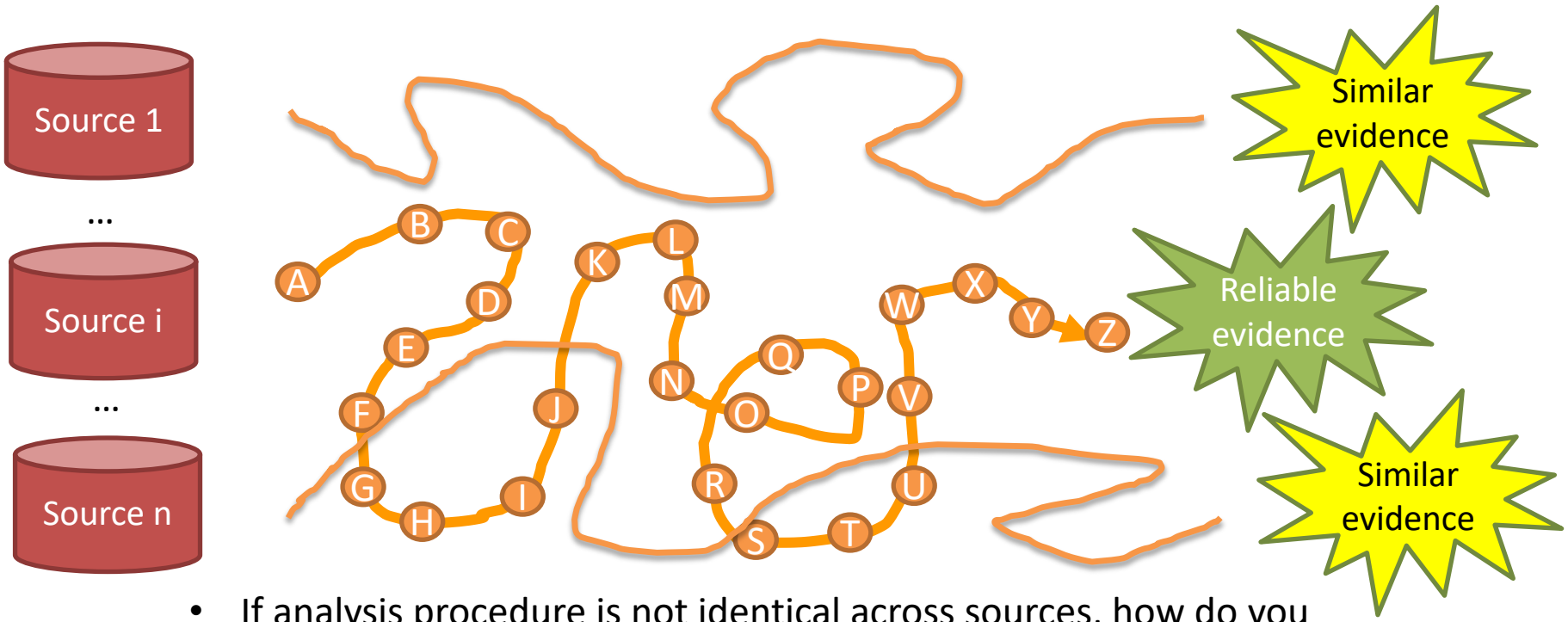


- Use of common data model splits the journey into two segments: 1) data standardization, 2) analysis execution
- ETL specification and source code can be developed and evaluated separately from analysis design
- CDM creates opportunity for re-use of data step and analysis step

One-time | Repeated

Challenges to achieve replication

Desired attribute	Question	Researcher	Data	Analysis		Result
Replicable	Identical	Same or different	Similar	Identical	=	Similar

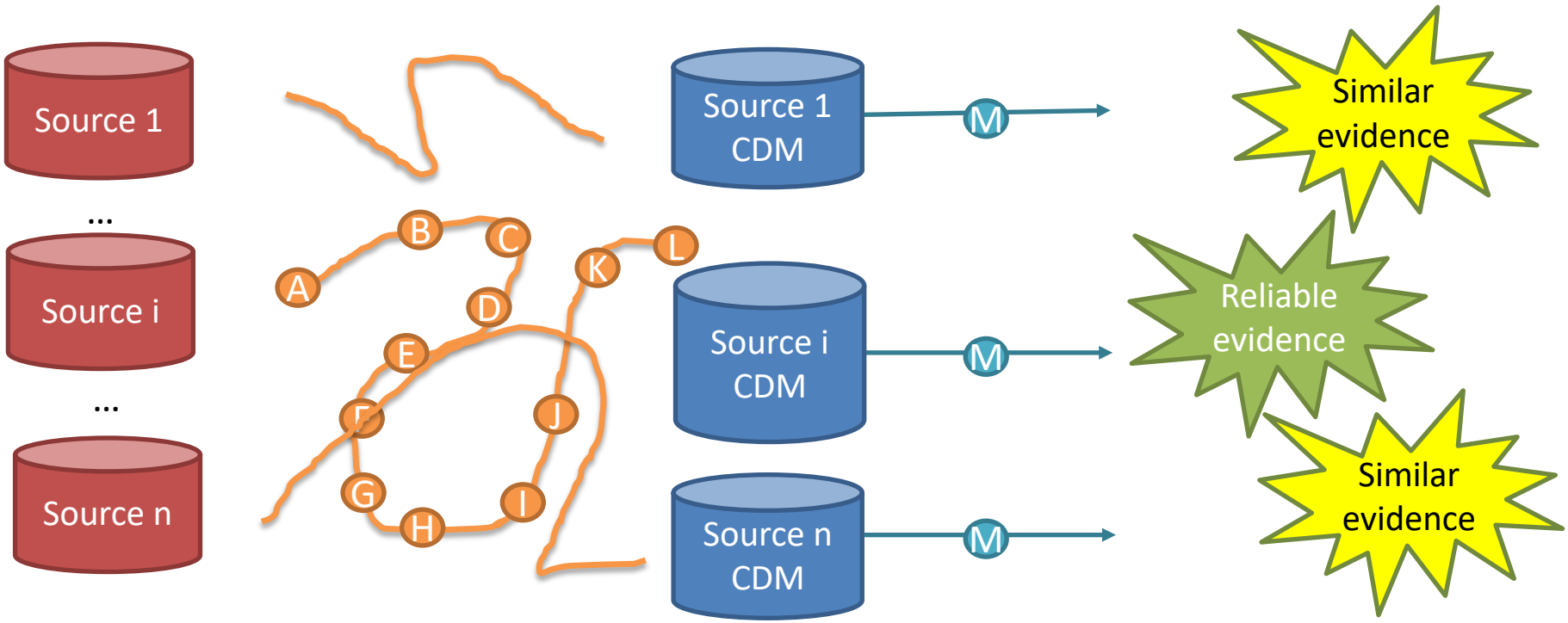


- If analysis procedure is not identical across sources, how do you determine if any differences observed are due to data vs. analysis?

One-time | Repeated

How a common data model + common analytics can support replication

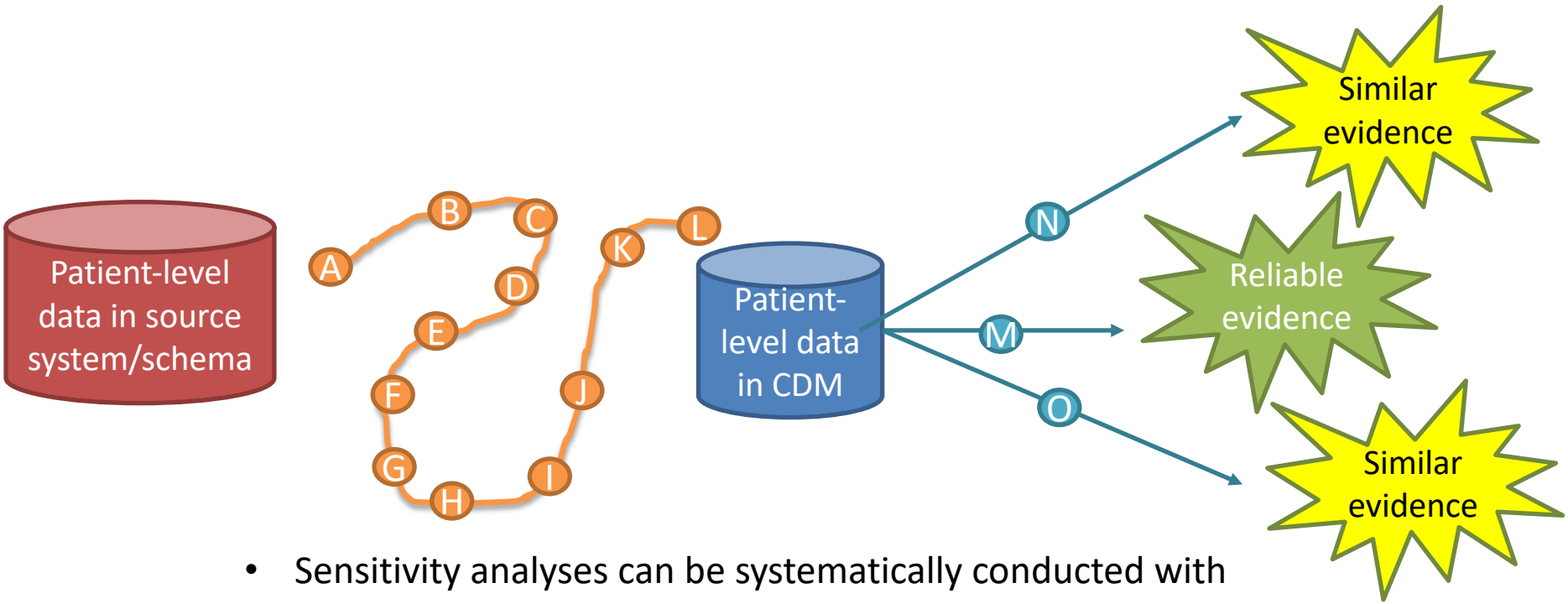
Desired attribute	Question	Researcher	Data	Analysis		Result
Replicable	Identical	Same or different	Similar	Identical	=	Similar



One-time | Repeated

How a common data model + common analytics can support robustness

Desired attribute	Question	Researcher	Data	Analysis		Result
Robust	Identical	Same or different	Same or different	Different	=	Similar

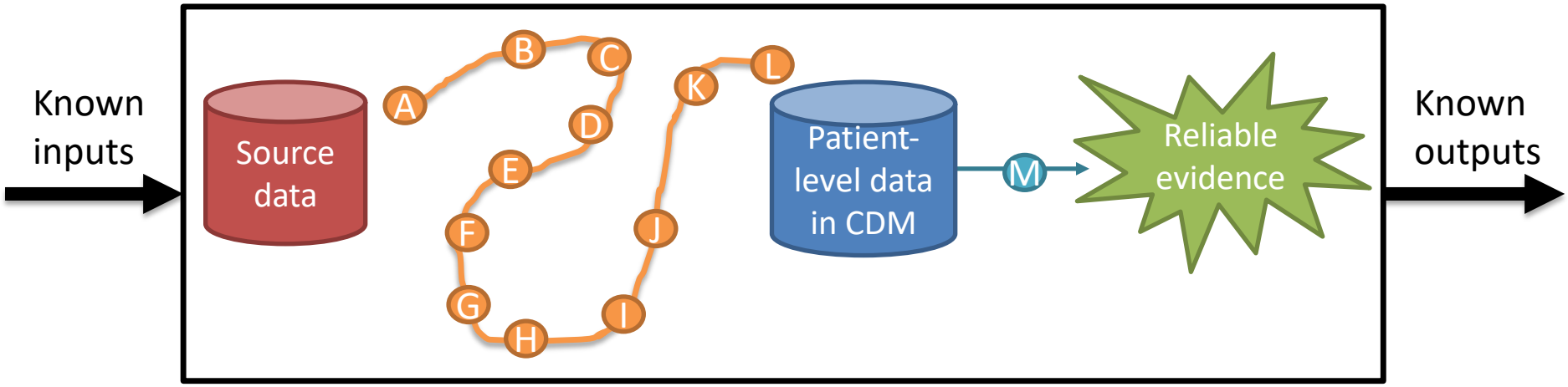


- Sensitivity analyses can be systematically conducted with parameterized analysis procedures using a common input

One-time | Repeated

How a common data model + common analytics can support calibration

Desired attribute	Question	Researcher	Data	Analysis		Result
Calibrated	Similar (controls)	Identical	Identical	Identical	=	Statistically consistent



- With a defined reproducible process, you can measure a system's performance and learn how to properly interpret the system's outputs

One-time | Repeated

Why reliable evidence requires a community effort

Desired attribute	Question	Researcher	Data	Analysis		Result
	Identical	Identical	Identical	Identical	=	Identical
	Identical	Different	Identical			Identical
	Identical	Same or	Similar			Similar
Generalizable	Ide		Different	Identical	=	Similar
Robust	Ide	different	Same or	Different	=	Similar
Calibrated	Similar (controls)	Iden		Identical	=	

Community of researchers with important public health questions

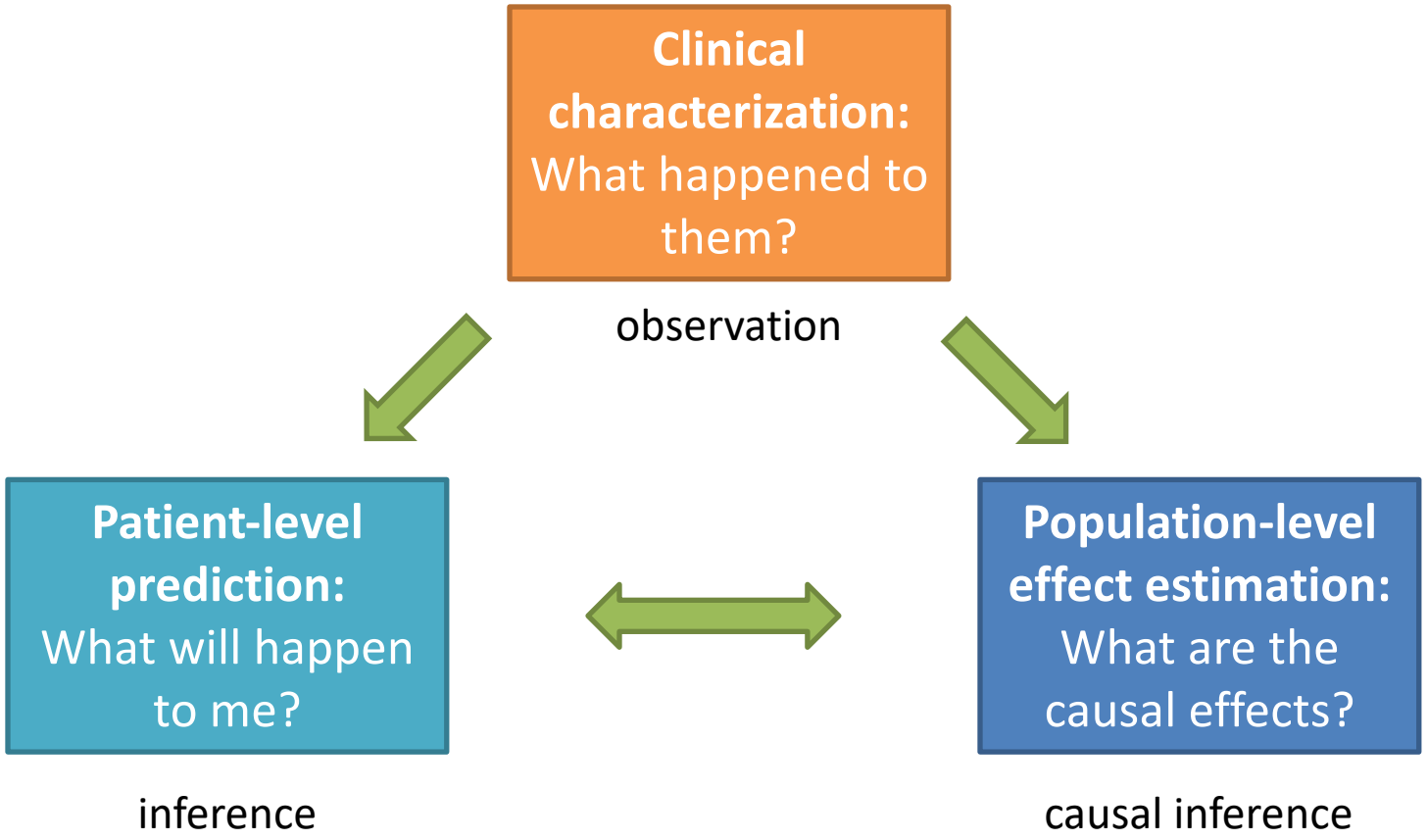
Analyses sharing community open-source tools

Data network using community standards

Application of community best practices for evaluation

Evidence sharing across community

Complementary evidence to inform the patient journey



How *should* patients with major depressive disorder be treated?

Treating Major Depressive Disorder

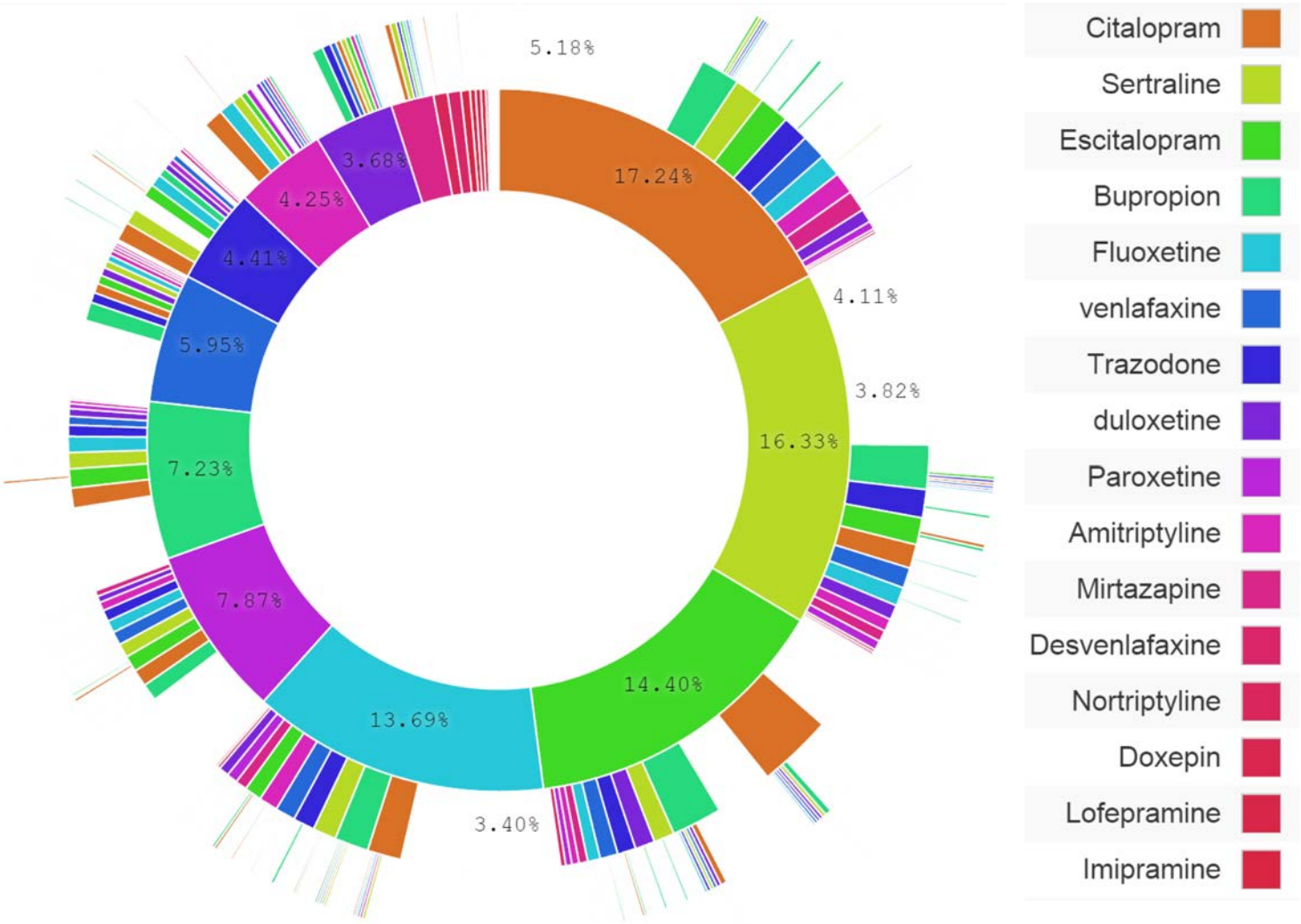
A Quick Reference Guide

Based on *Practice Guideline for the Treatment of Patients With Major Depressive Disorder,* Third Edition, originally published in October 2010. A guideline watch, summarizing significant developments in the scientific literature since publication of this guideline, may be available.

Pharmacotherapy

- The effectiveness of antidepressant medications is generally comparable between and within classes of medications, including selective serotonin reuptake inhibitors (SSRIs), serotonin norepinephrine reuptake inhibitors (SNRIs), bupropion, tricyclic antidepressants (TCAs), and monoamine oxidase inhibitors (MAOIs). Therefore, choose a medication largely based on the following:
  - Patient preference
  - Nature of prior response to medication
  - Safety, tolerability, and anticipated side effects
  - Co-occurring psychiatric or general medical conditions
  - Pharmacological properties of the medication (e.g., half-life, actions on cytochrome P450 enzymes, other drug interactions; consult the full guideline or a current drug database)
  - Cost
- For most patients, a SSRI, a SNRI, mirtazapine, or bupropion is optimal.
- In general, the use of MAOIs should be restricted to patients who do not respond to other treatments.

How are patients with major depressive disorder *ACTUALLY* treated?



Hripcsak et al, PNAS, 2016

How are patients with major depressive disorder ACTUALLY treated?

- Substantial variation in treatment practice across data sources, health systems, geographies, and over time
- Consistent heterogeneity in treatment choice as no source showed one preferred first-line treatment
- 11% of depressed patients followed a treatment pathway that was shared with no one else in any of the databases

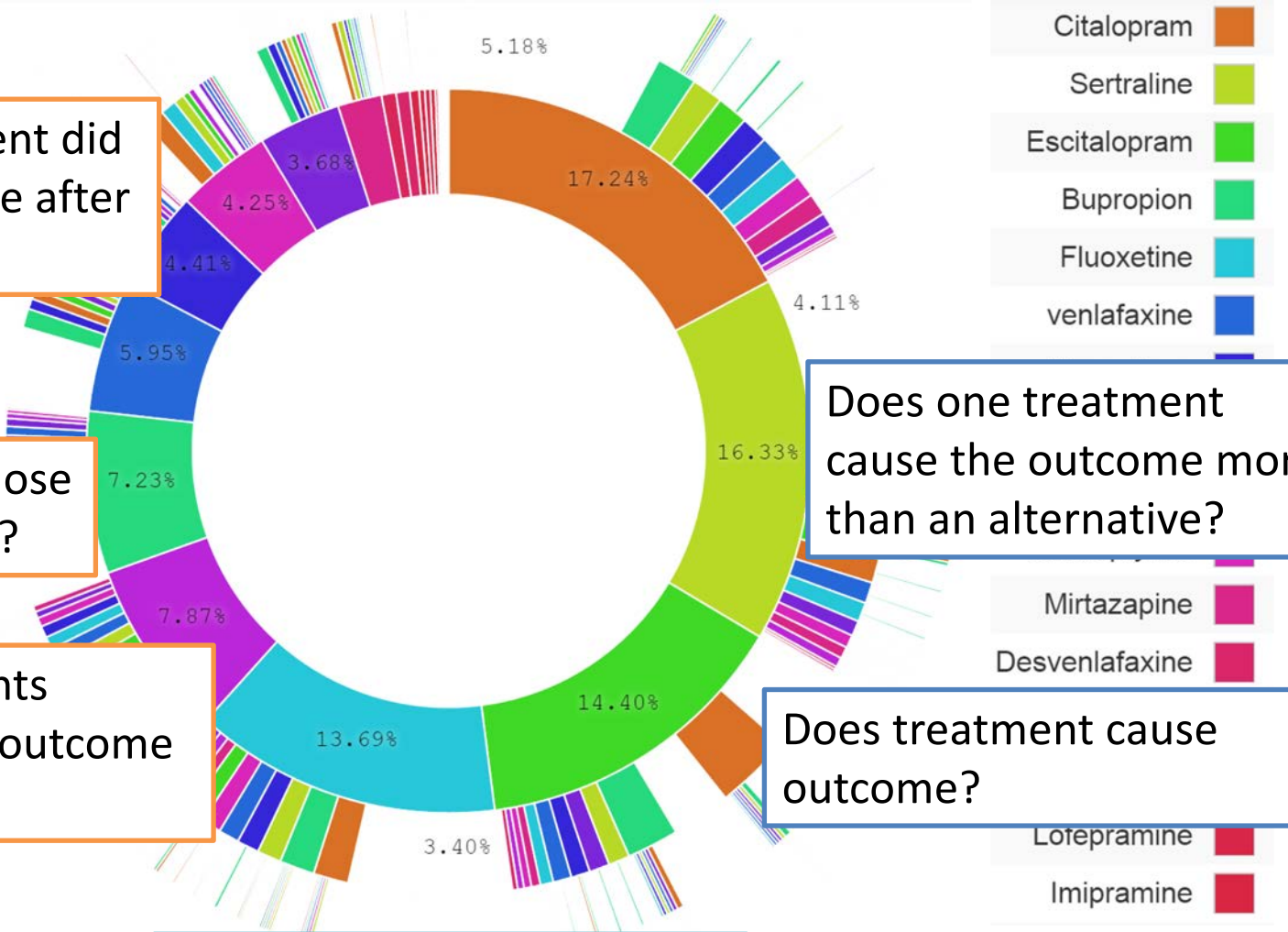
Hripcsak et al, PNAS, 2016

What questions does this answer? What question does it prompt to ask?

Which treatment did patients choose after diagnosis?

Which patients chose which treatments?

How many patients experienced the outcome after treatment?



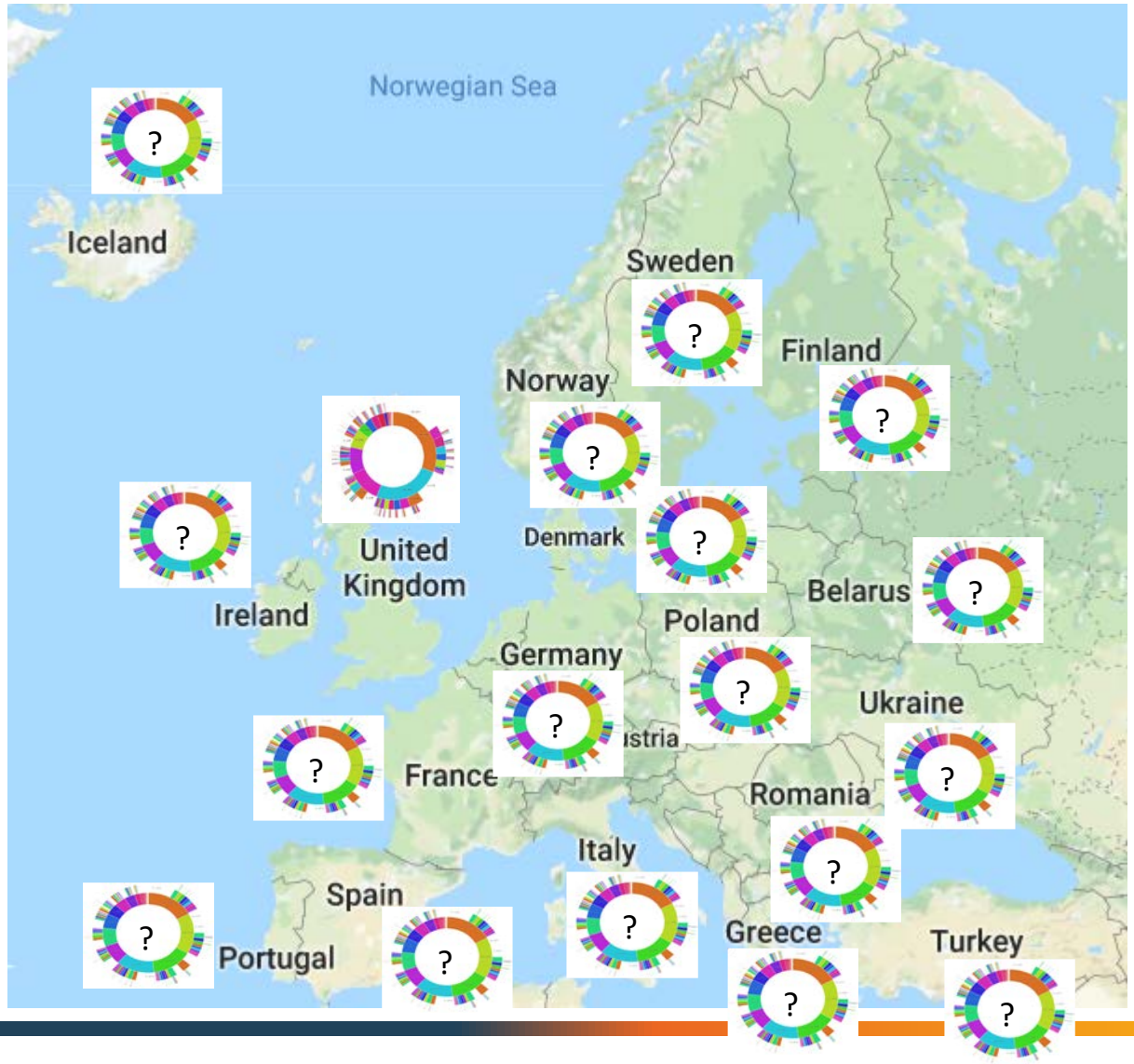
Does one treatment cause the outcome more than an alternative?

Does treatment cause outcome?

What is the probability I will experience the outcome?

Hripcsak et al, PNAS, 2016

What do the treatment pathways look like across Europe?



What do the treatment pathways look like across the world?

Questions we can answer with reliable evidence

- **Clinical characterization:** What happened to them?
  - What treatment did they choose after diagnosis?
  - Which patients chose which treatments?
  - How many patients experienced the outcome after treatment?

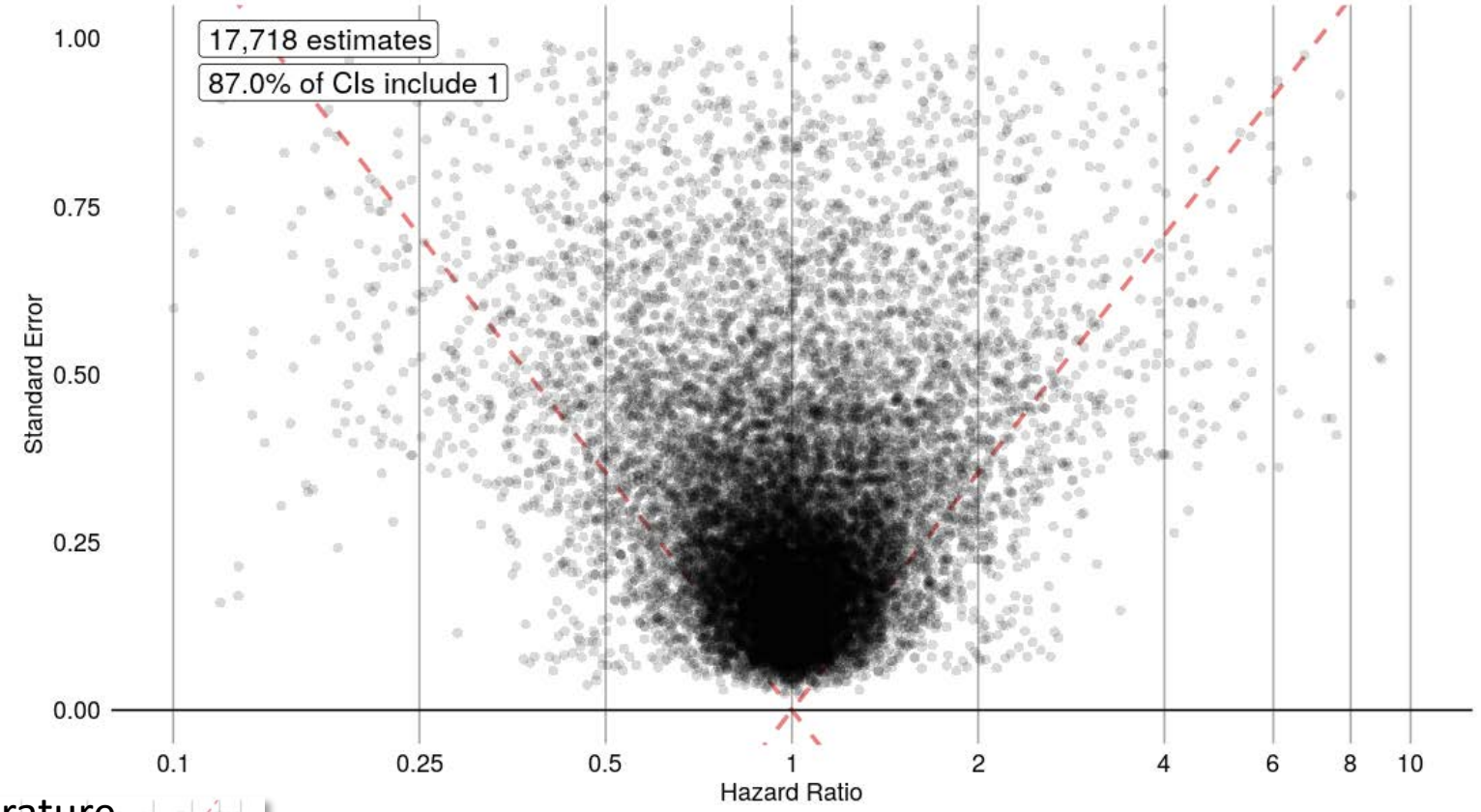
- **Patient-level prediction:** What will happen to me?
  - What is the probability that I will develop the disease?
  - What is the probability that I will experience the outcome?

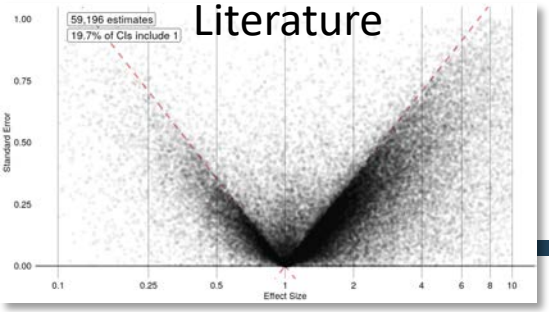
- **Population-level effect estimation:** What are the causal effects?
  - Does treatment cause outcome?
  - Does one treatment cause the outcome more than an alternative?

Journey toward reliable evidence

- How to produce evidence from the data?
- How do we know the evidence is reliable?
- How do we share evidence to inform decision making?

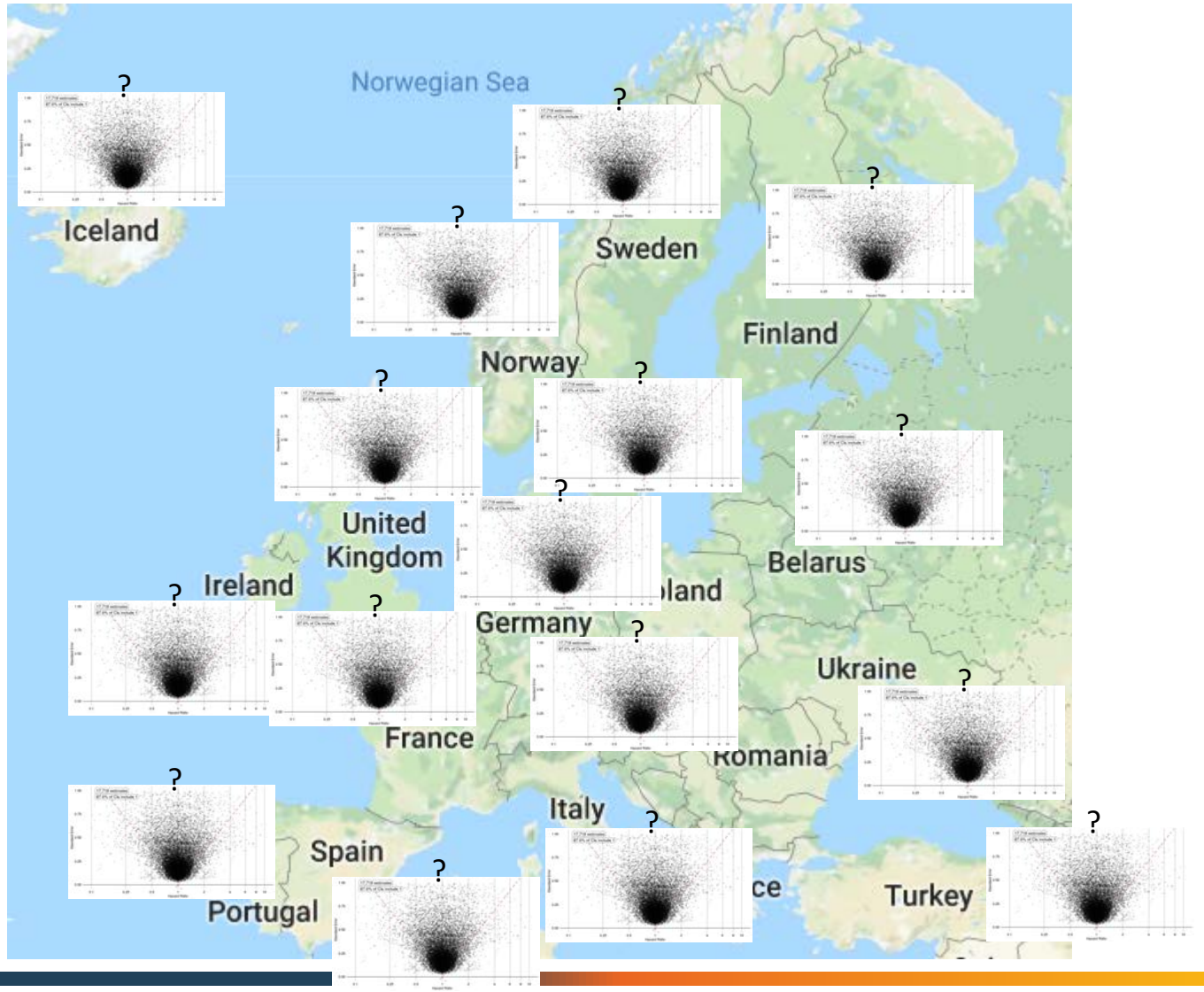
Large-scale Evidence Generation and Evaluation in a Network of Databases



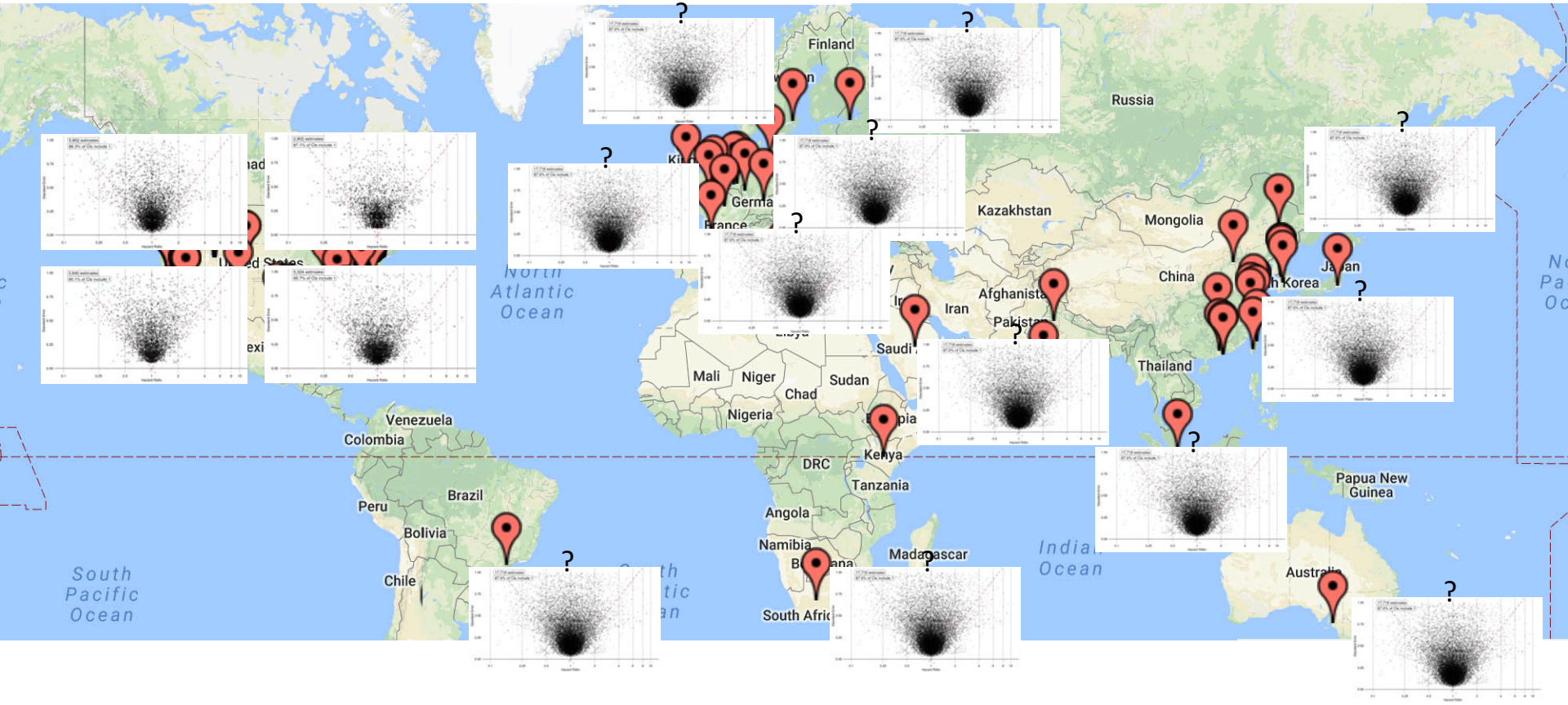


Literature

What do the population-level effect estimates look like across Europe?



What do the population-level effect estimates look like across the world?



Building the LHC of observational research?

OHDSI community

We're all in this journey together…

Coffee Break

First Annual

EUROPEAN OHDSI SYMPOSIUM

March 23th 2018

Tutorials March 24th

Bridging Europe

Erasmus MC Rotterdam The Netherlands

Photography: Tom Roeleveld