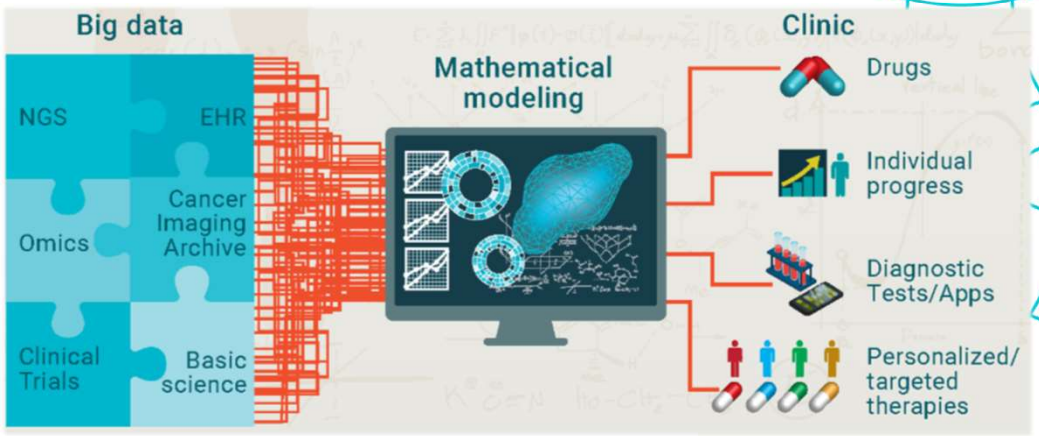
OMOP-tietomallin käyttöönotto HUS-tietoaltaalla



Kimmo Porkka

Ylilääkäri, kehityspäällikkö
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HUS-tietohallinto

Professori
Hematology Research Unit Helsinki
Helsingin yliopisto

eCare for Me
CleverHealth Network

HUS Helsinki University Hospital

eCare for Me
CleverHealth Network

tieto EVRY

aiforia

BC Platforms

productivity leap

BUSINESS FINLAND

HYKS-INSTITUUTTI

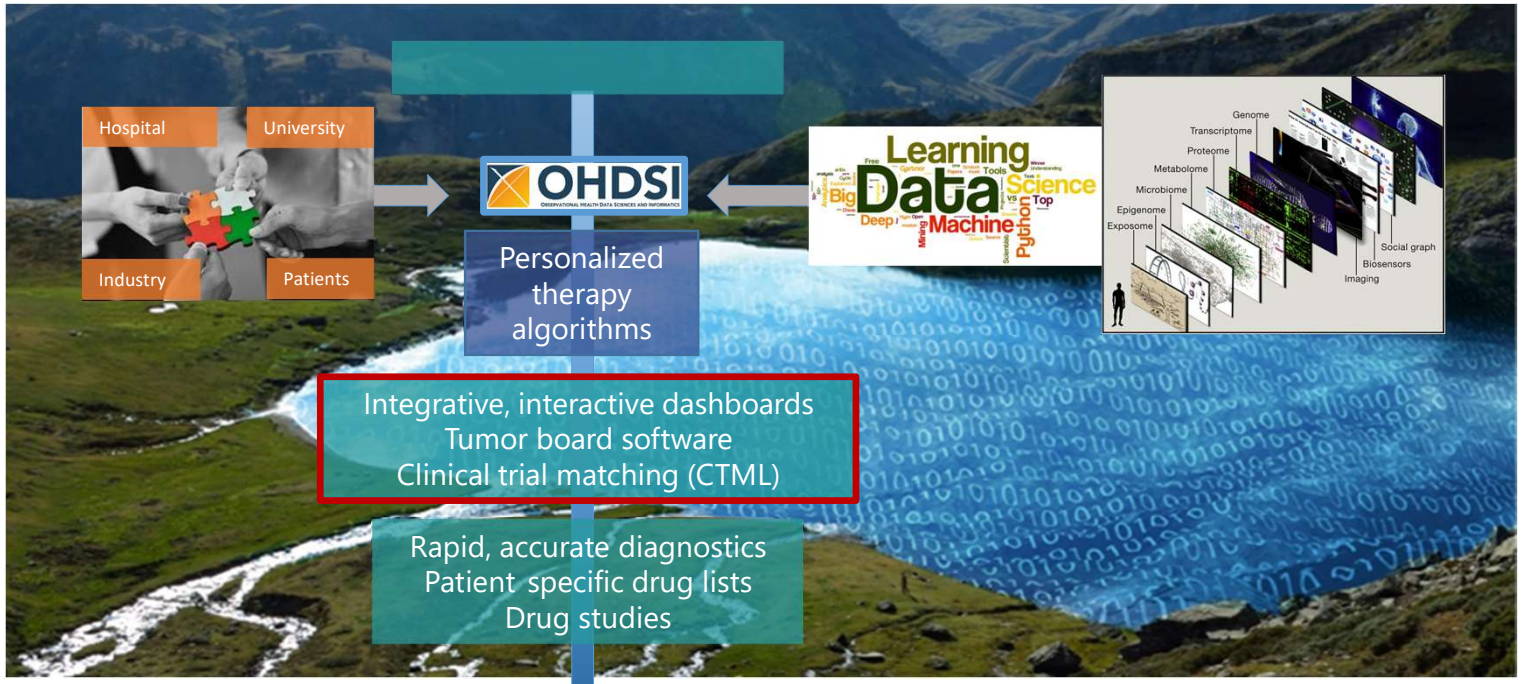
Use case: eCare for Me project

- Part of the CleverHealth ecosystem (Helsinki University Hospital - HUS)
  - Data-driven solutions to improve early diagnostics, automated treatment selection and home-based care
- A public-private partnership model
- Main funding from Business Finland
  - Finnish government organization for innovation funding and trade, travel and investment promotion
- Several SMEs, medium- and large-size companies as partners

eCare for Me
CleverHealth Network

Block 2: automated diagnostics, treatment selection (POC: acute leukemia)

PI: prof. Kimmo Porkka



General aims

- Provide robust, reliable, reproducible evidence for research and decision-making using extended, harmonized RWD

- Implement precision medicine for cancer
  - Deep tumor profiling: genomics, transcriptomics
  - Novel data sources: image analysis, epigenetics (early diagnosis), functional assays (e.g. ex vivo drug testing), immunoprofiling, pharmacogenomics
  - Utilize public datasets (genomics, transcriptomics) for *in silico* discovery and validation
  - Collaborate/integrate with standardized EHR datasets (OHDSI OMOP, HL7 FHIR, Flatiron)

- Data integration and modeling for scalable clinical applications

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HUS datalake 2018: no common data model

- Data structuring ad hoc, project-based; not into a common standard
- Overlap of data parsing efforts – not an optimal use of scarce resources
- Commercial registries (e.g. BCB) suboptimally implemented, require manual data entry
- Merging Uranus and Apotti datasets a big unknown

- National, international projects: most of the time used for data structuring, conversion, not analytical work (high costs, long duration)
- Applications/algorithms built on HUS datalake poorly scalable
- No standard analytical tools

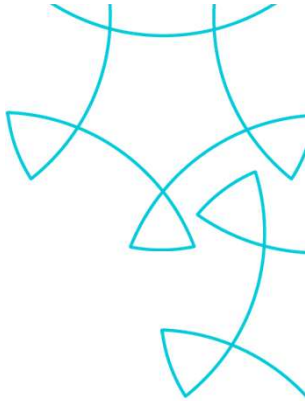
HUS datalake 2019=>

- Query of CDM standards for observational research on EHR data
  - HL7 FHIR
  - OHDSI OMOP
  - Interoperable

- OMOP selected as a pilot (BCPlatforms BCRQuest; eCare4Me B2)

- eCare4Me/B2
  - Comprehensive mapping and ETL work at the main datalake
  - Close collaboration between clinical domain experts, HUS IT and ETL experts
  - Uranus, Apotti

Observational Health Data Sciences and Informatics (OHDSI, as “Odyssey”)



- Mission: To improve health by empowering a community to collaboratively generate the evidence that promotes better health decisions and better care

- An academic, multi-stakeholder, interdisciplinary, international collaborative with a coordinating center at Columbia University, NY

http://ohdsi.org

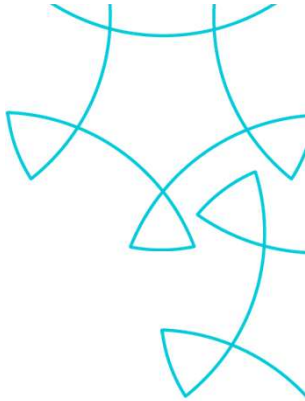
OMOP: Observational Medical Outcomes Partnership common data model implemented by the OHDSI community

OHDSI's global research community

- >300 collaborators from 30 different countries
- Experts in informatics, statistics, epidemiology, clinical sciences
- Active participation from academia, government, industry, providers
- Records on about 600 million unique patients in >100 databases

http://ohdsi.org/who-we-are/collaborators

Evidence OHDSI seeks to generate from observational data

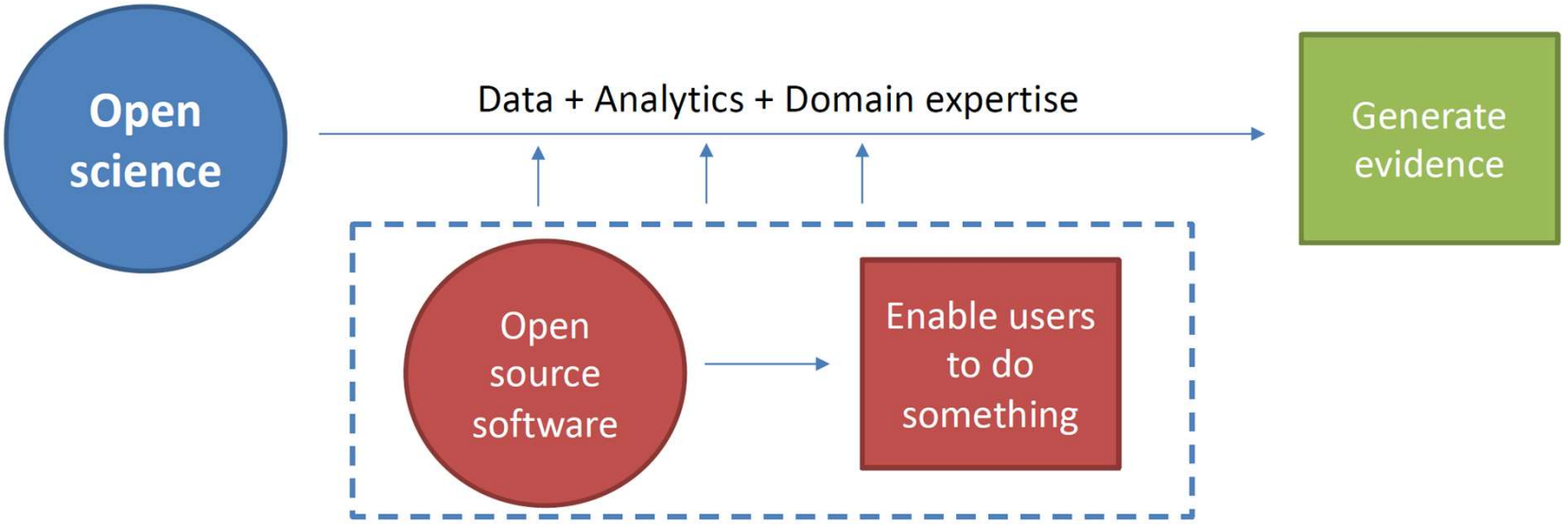


- **Clinical characterization – tally**
  - Natural history: Who has diabetes, and who takes metformin?
  - Quality improvement: What proportion of patients with diabetes experience complications?

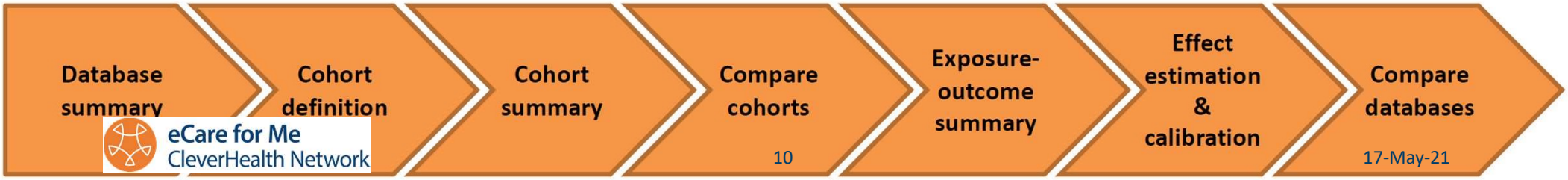
- **Population-level estimation – cause**
  - Safety surveillance: Does metformin cause lactic acidosis?
  - Comparative effectiveness: Does metformin cause lactic acidosis more than glyburide?

- **Patient-level prediction – predict**
  - Precision medicine: Given everything you know about me, if I take metformin, what is the chance I will get lactic acidosis?
  - Disease interception: Given everything you know about me, what is the chance I will develop diabetes?

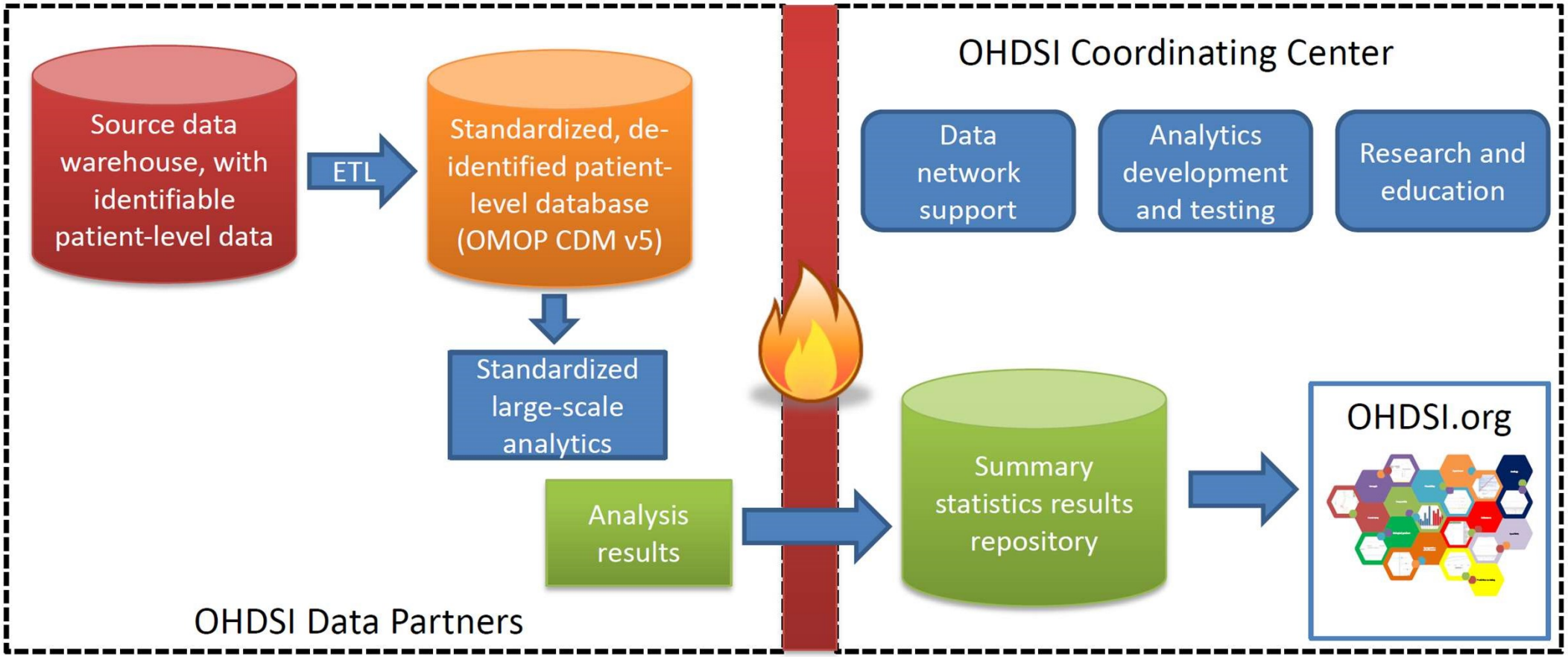
Open Science



Standardized, transparent, reproducible workflows

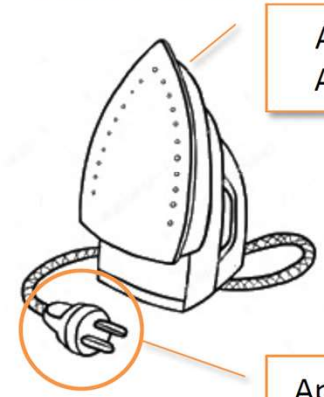


How OHDSI Works



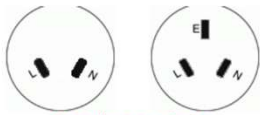
Current Approach: “One Study – One Script“

"What's the adherence to my drug in the data assets I own?"

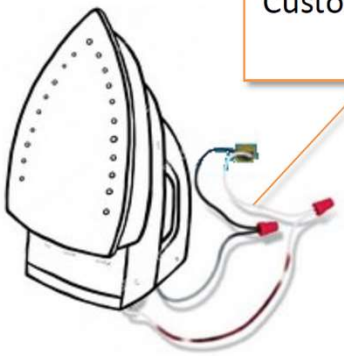


Analytical method: Adherence to Drug

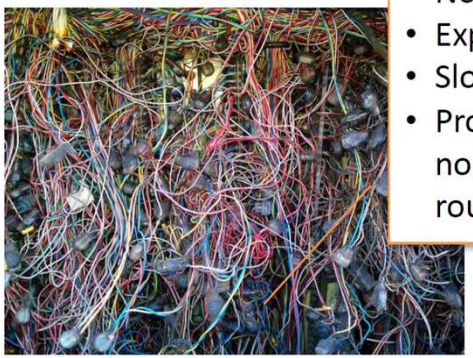
Application to data



Current solution:

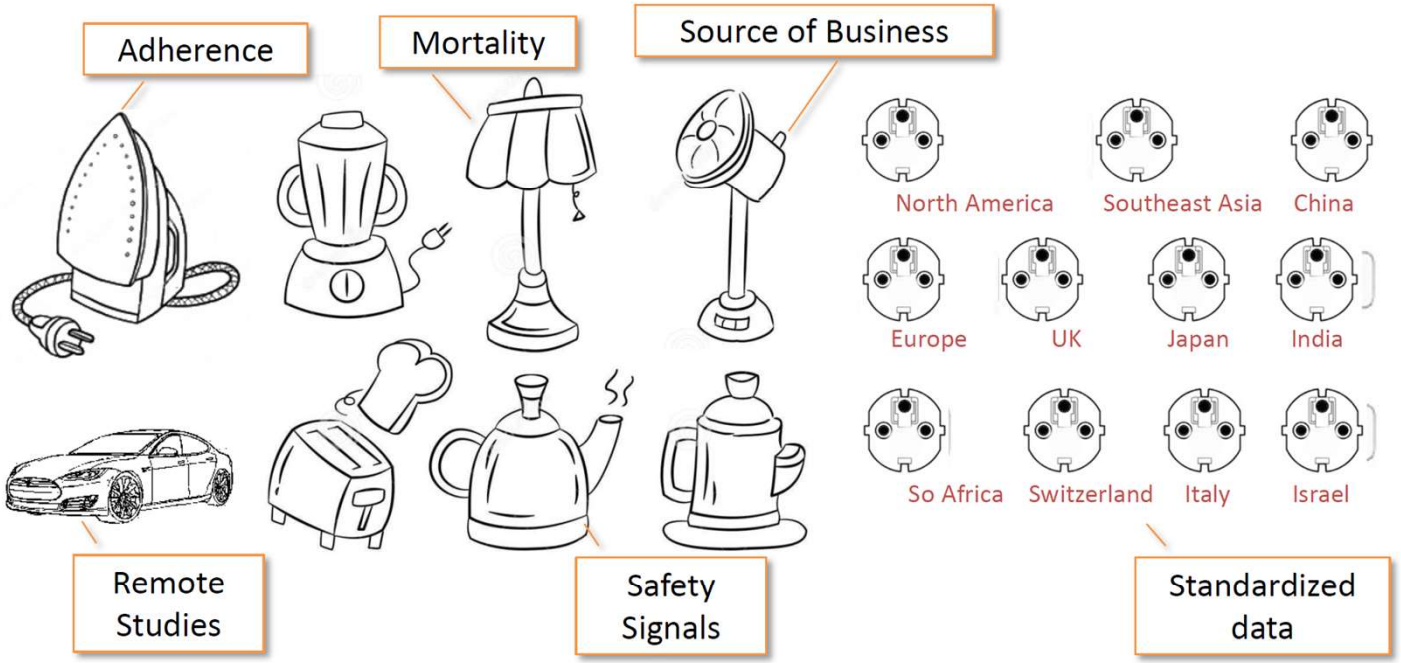


Custom script for each study



- Not scalable
- Expensive
- Slow
- Prohibitive to non-expert routine use

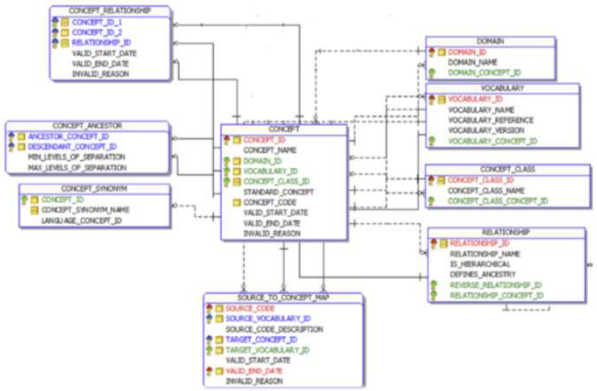
Solution: Standardized Data and Analytics



1. ATLAS, Remote Studies
   - Standard Cohorts
   - Standardized Analytics
2. OMOP CDM
   - Standardized Format
   - Standardized Coding

OMOP-CDM: core structure

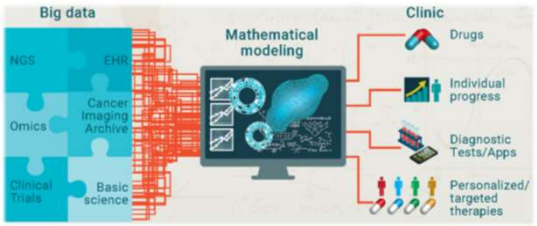
syntactic operability:
common underlying data structure
(standard grammar)



semantic operability:
common understanding required to
exchange interchange information
(standard vocabulary)

1 SNOMED	Systematic Nomenclature of Medicine - Clinical Terms (IHDSTO)
2 ICD9CM	International Classification of Diseases, Ninth Revision, Clinical Modification, Volume 1 and 2 (NCHS)
3 ICD9Proc	International Classification of Diseases, Ninth Revision, Clinical Modification, Volume 3 (NCHS)
4 CPT4	Current Procedural Terminology version 4 (AMA)
5 HCPCS	Healthcare Common Procedure Coding System (CMS)
6 LOINC	Logical Observation Identifiers Names and Codes (Regenstrief Institute)
7 NDFRT	National Drug File - Reference Terminology (VA)
8 RxNorm	RxNorm (NLM)
9 NDC	National Drug Code (FDA and manufacturers)
10 GPI	Medi-Span Generic Product Identifier (Wolters Kluwer Health)
11 UCUM	Unified Code for Units of Measure (Regenstrief Institute)
12 Gender	OMOP Gender
13 Race	Race and Ethnicity Code Set (USBC)
14 Place of Service	Place of Service Codes for Professional Claims (CMS)
15 MedDRA	Medical Dictionary for Regulatory Activities (MSSO)
16 Multum	Cerner Multum (Cerner)
17 Read	NHS UK Read Codes Version 2 (HSCIC)
18 OXMIS	Oxford Medical Information System (OCHP)
19 Indication	Indications and Contraindications (FDB)
20 ETC	Enhanced Therapeutic Classification (FDB)
21 ATC	WHO Anatomic Therapeutic Chemical Classification
22 Multilex	Multilex (FDB)
28 VA Product	VA National Drug File Product (VA)
31 SMQ	Standardised MedDRA Queries (MSSO)
32 VA Class	VA National Drug File Class (VA)
33 Cohort	Legacy OMOP HOI or DOI cohort
34 ICD10	International Classification of Diseases, 10th Revision, (WHO)

analytical operability:
robust evidence generation
(standard analytics)



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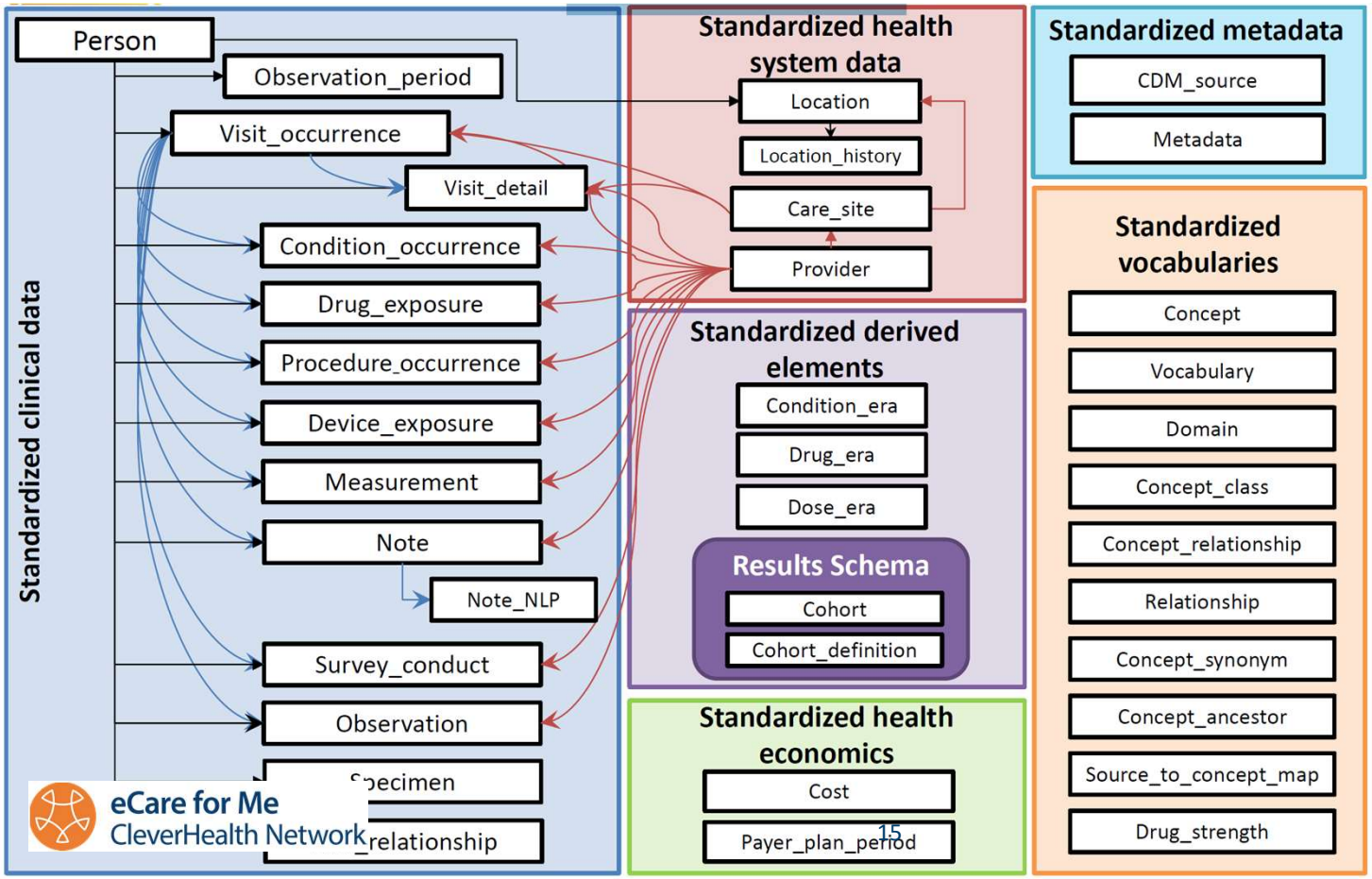
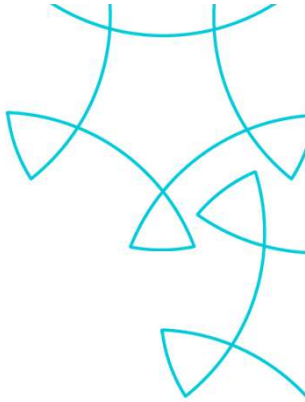
Deep information model: OMOP CDM



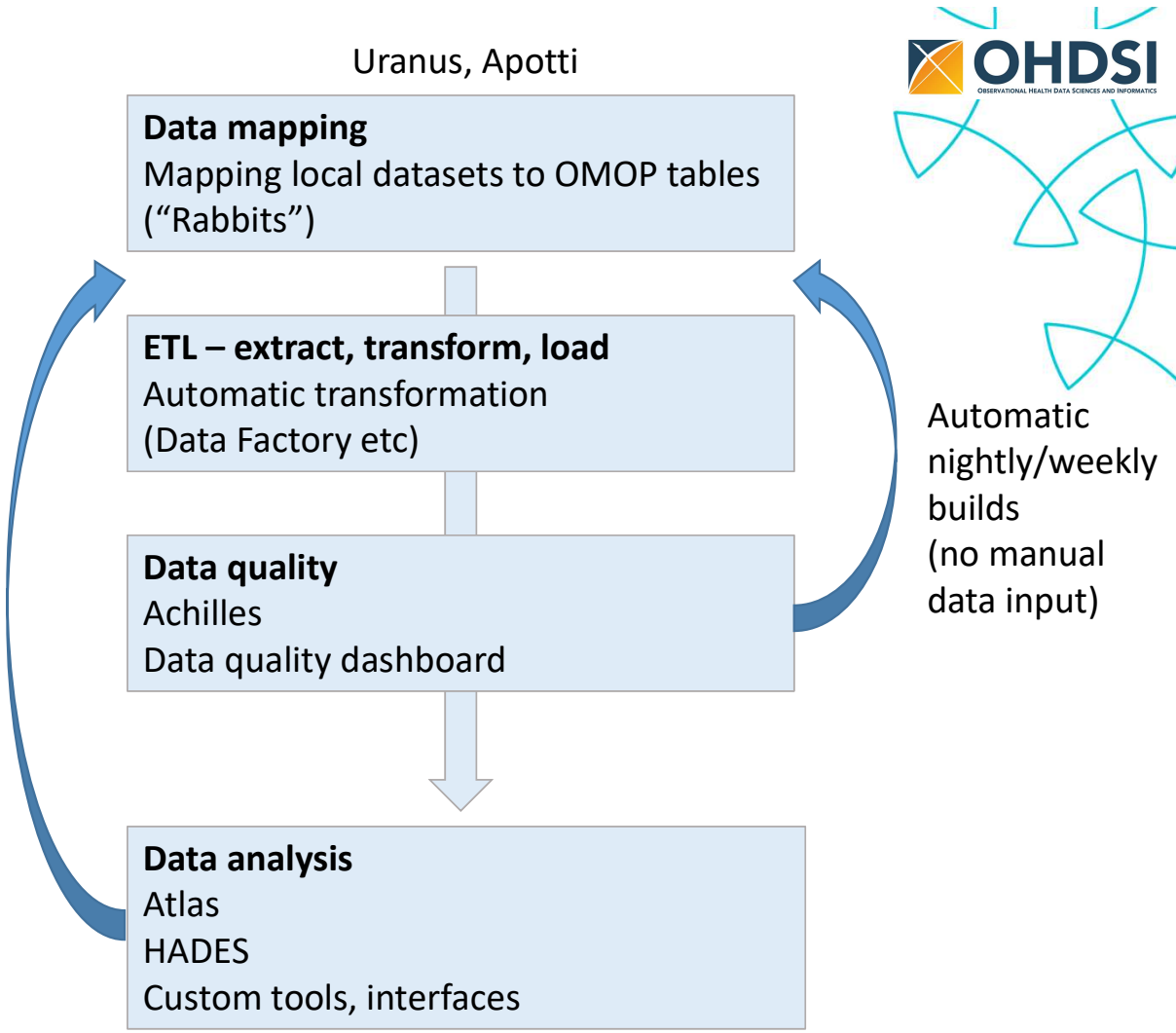
OMOP's standardized vocabularies



- 153 Vocabularies across 41 domains
  - MU3 standards: SNOMED, RxNorm, LOINC
  - Disparate sources: ICD9CM, ICD10(CM), Read, NDC, Gemscript, CPT4, HCPCS…
- >9 million concepts
  - >3.3 million standard concepts
  - >5.1 million source codes
  - >629,000 classification concepts
- >55 million concept relationships
- >84 million ancestral relationships

Publicly available for download at: http://athena.ohdsi.org/

OMOP-CDM: implementation



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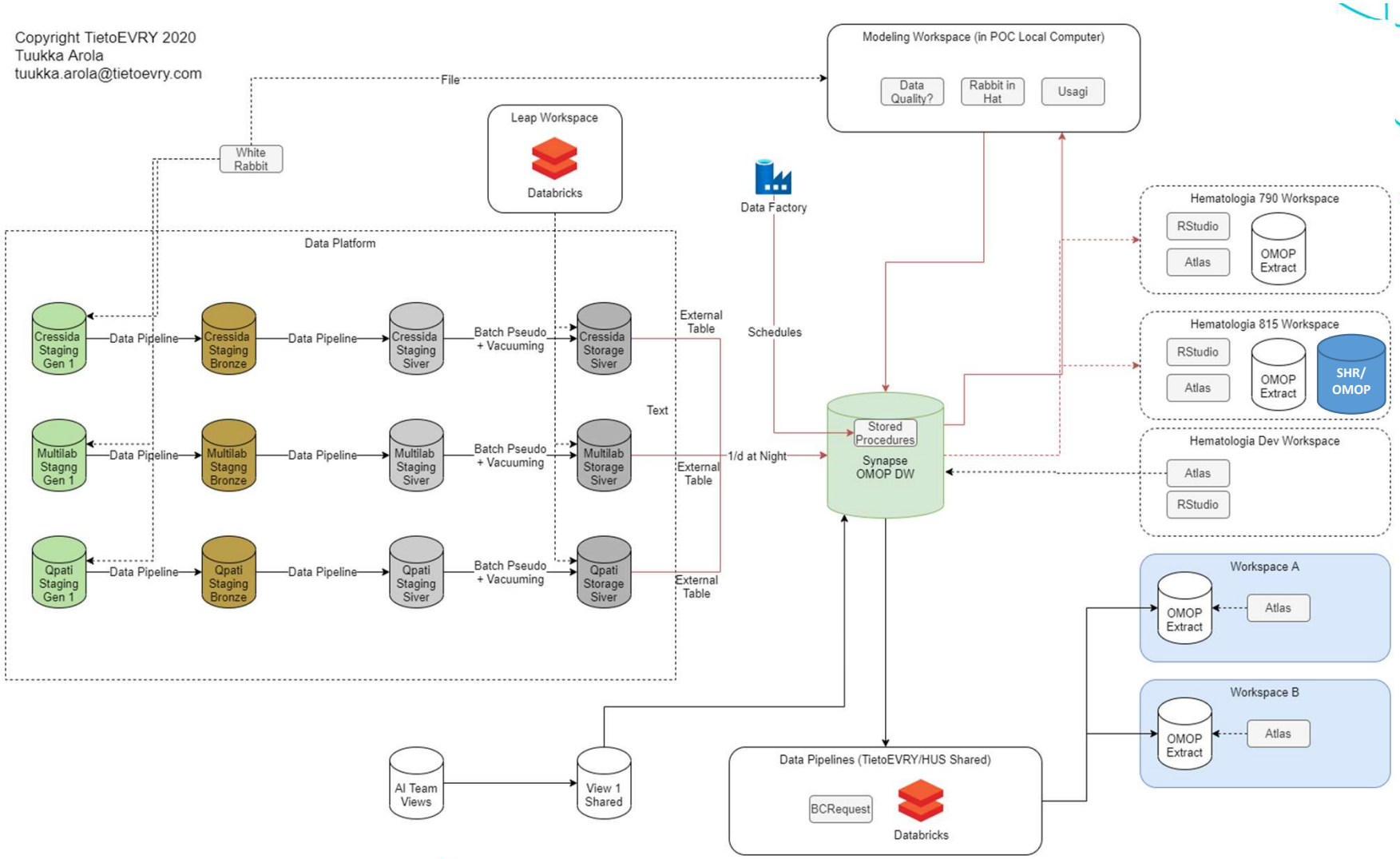

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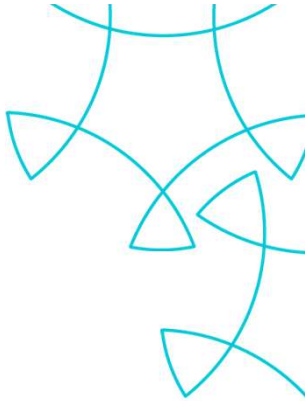
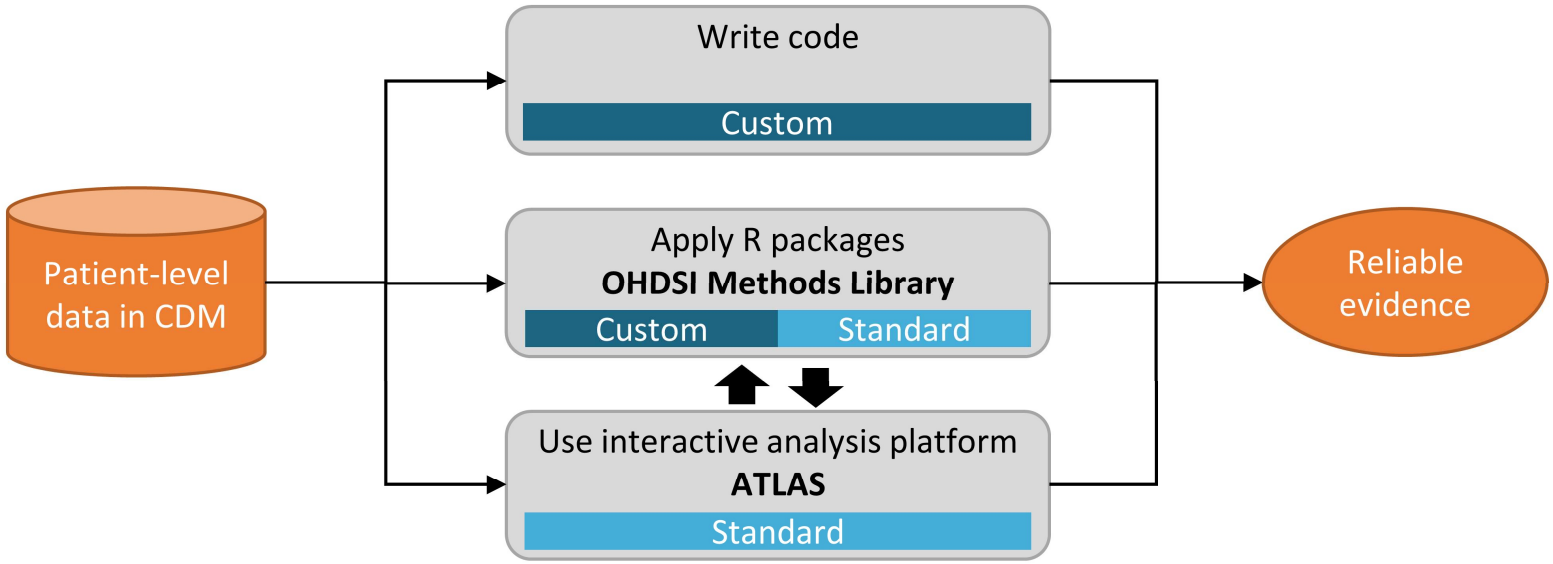
Data Analytics Use Cases

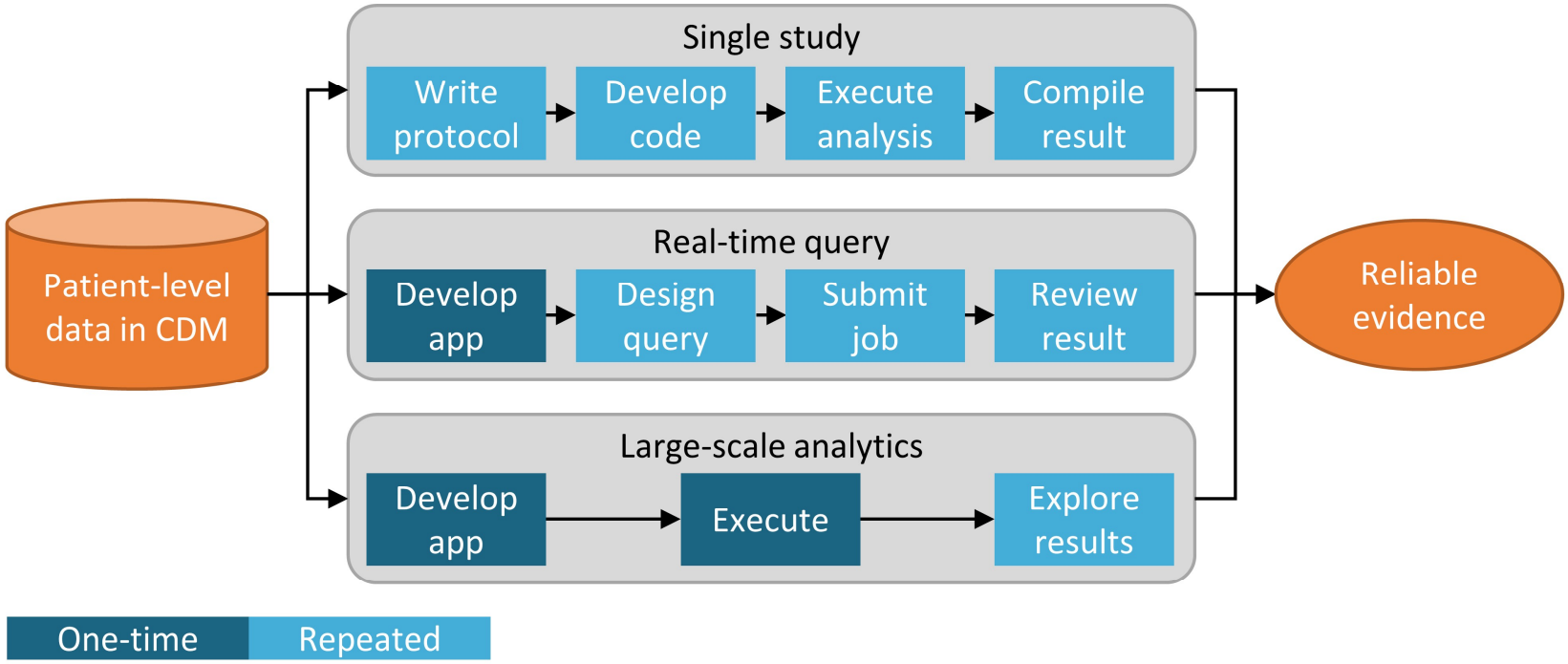


- Characterization
  - "What happened to them?"
  - Count or percentage, Averages, Descriptive statistics, Incidence, Prevalence, Phenotype
- Population-level estimation
  - "What are the causal effects?"
  - Relative risk, Hazards/Odds ratio, Average treatment effect, Causal effect, Correlation
- Patient-level prediction
  - "What will happen to me?"
  - Probability for an individual, Prediction model, High/low risk groups, Probabilistic phenotype

OMOP Analysis Implementation: reproducible research



Some Analysis Strategies



HADES Health Analytics Data-to-Evidence Suite

nature COMMUNICATIONS

ARTICLE

https://doi.org/10.1038/s41467-020-18849-z OPEN

Deep phenotyping of 34,128 adult patients hospitalised with COVID-19 in an international network study

Edward Burn et al.#

Comorbid conditions appear to be common among individuals hospitalised with coronavirus disease 2019 (COVID-19) but estimates of prevalence vary and little is known about the prior medication use of patients. Here, we describe the characteristics of adults hospitalised with COVID-19 and compare them with influenza patients. We include 34,128 (US: 8362, South Korea: 7341, Spain: 18,425) COVID-19 patients, summarising between 4811 and 11,643 unique aggregate characteristics. COVID-19 patients have been majority male in the US and Spain, but predominantly female in South Korea. Age profiles vary across data sources. Compared to 84,585 individuals hospitalised with influenza in 2014-19, COVID-19 patients have more typically been male, younger, and with fewer comorbidities and lower medication use. While protecting groups vulnerable to influenza is likely a useful starting point in the response to COVID-19, strategies will likely need to be broadened to reflect the particular characteristics of individuals being hospitalised with COVID-19.

Comprehensive comparative effectiveness and safety of first-line antihypertensive drug classes: a systematic, multinational, large-scale analysis

Marc A Suchard, Martijn J Schuemie, Harlan M Krumholz, Seng Chan You, RuiJun Chen, Nicole Pratt, Christian G Reich, Jon Duke, David Madigan, George Hripcsak, Patrick B Ryan

Summary

Background Uncertainty remains about the optimal monotherapy for hypertension, with current guidelines recommending any primary agent among the first-line drug classes thiazide or thiazide-like diuretics, angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, dihydropyridine calcium channel blockers, and non-dihydropyridine calcium channel blockers, in the absence of comorbid indications. Randomised trials have not further refined this choice.

Methods We developed a comprehensive framework for real-world evidence that enables comparative effectiveness and safety evaluation across many drugs and outcomes from observational data encompassing millions of patients, while minimising inherent bias. Using this framework, we did a systematic, large-scale study under a new-user cohort design to estimate the relative risks of three primary (acute myocardial infarction, hospitalisation for heart failure, and stroke) and six secondary effectiveness and 46 safety outcomes comparing all first-line classes across a global network of six administrative claims and three electronic health record databases. The framework addressed residual confounding, publication bias, and p-hacking using large-scale propensity adjustment, a large set of control outcomes, and full disclosure of hypotheses tested.

Findings Using 4·9 million patients, we generated 22 000 calibrated, propensity-score-adjusted hazard ratios (HRs) comparing all classes and outcomes across databases. Most estimates revealed no effectiveness differences between classes; however, thiazide or thiazide-like diuretics showed better primary effectiveness than angiotensin-converting enzyme inhibitors: acute myocardial infarction (HR 0·84, 95% CI 0·75–0·95), hospitalisation for heart failure (0·83, 0·74–0·95), and stroke (0·83, 0·74–0·95) risk while on initial treatment. Safety profiles also favoured thiazide or thiazide-like diuretics over angiotensin-converting enzyme inhibitors. The non-dihydropyridine calcium channel blockers were significantly inferior to the other four classes.

Interpretation This comprehensive framework introduces a new way of doing observational health-care science at scale. The approach supports equivalence between drug classes for initiating monotherapy for hypertension—in keeping with current guidelines, with the exception of thiazide or thiazide-like diuretics superiority to angiotensin-converting enzyme inhibitors and the inferiority of non-dihydropyridine calcium channel blockers.

Funding US National Science Foundation, US National Institutes of Health, Janssen Research & Development, IQVIA, South Korean Ministry of Health & Welfare, Australian National Health and Medical Research Council.

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See Online/Comment https://doi.org/10.1016/S0140-6736(19)32461-4

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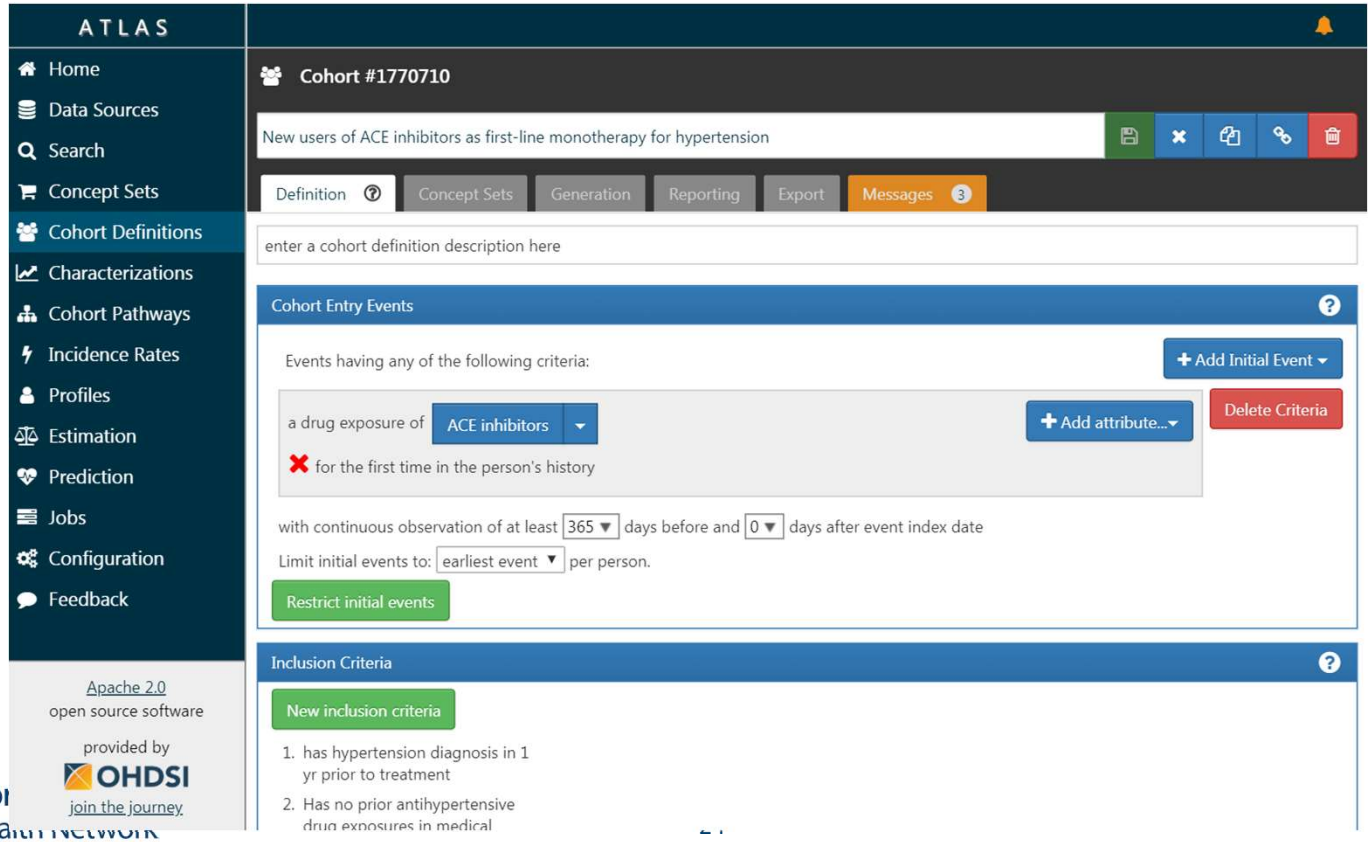
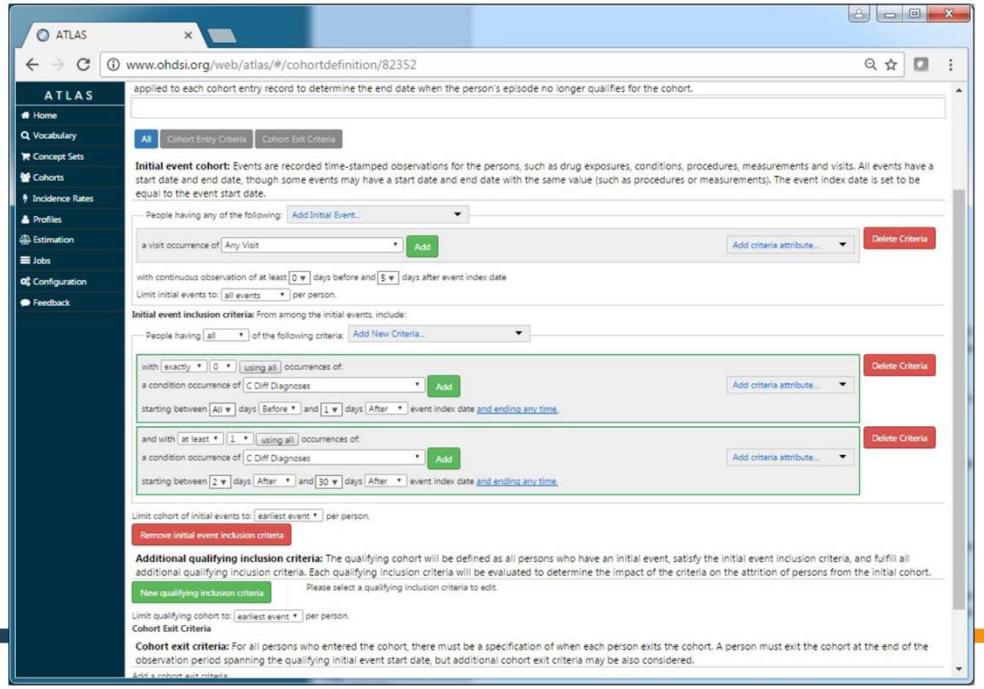
Atlas

ATLAS is a free, publicly available, web-based tool developed by the OHDSI community that facilitates the design and execution of analyses on standardized, patient-level, observational data in the CDM format.



ATLAS: Cohort building

- Optimized for observational research
  - Time series: who and *when* (vs classification)
    - Observation period, event timing
  - Assume a complex definition – Linearized AND-OR group

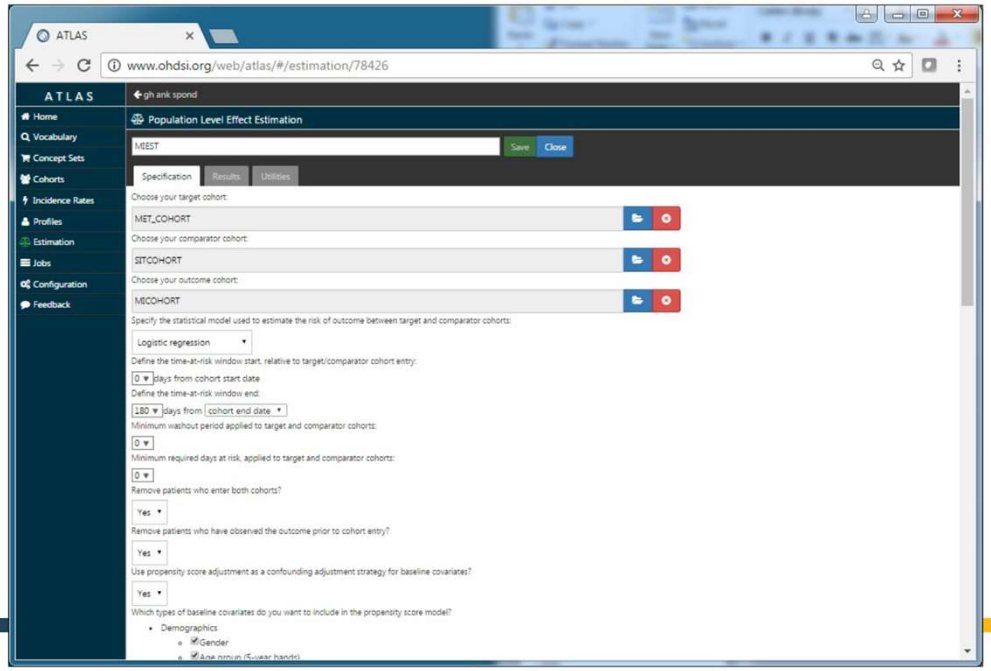


ATLAS: Visualization

- Tables
- Graphs

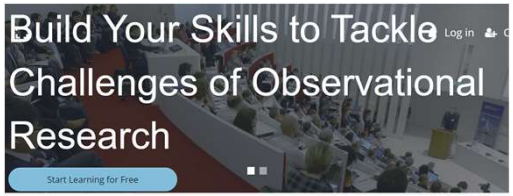
ATLAS: Analysis (observational)

- Approach: log regression, Poisson regression, survival
- Confounder: regularized-regression propensity score
- Residual confounding: calibration
- Diagnostics



OHDSI standardized analytical tools: training

- Book of OHDSI: https://ohdsi.github.io/TheBookOfOhdsi/
- EHDEN academy: https://academy.ehden.eu/

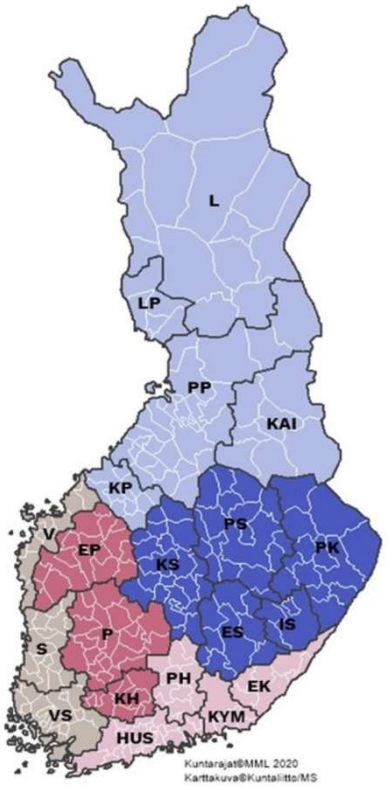


- Training videos: https://www.youtube.com/user/OHDSIJoinTheJourney
- Study-a-thons:

- Local seminars

FIN-OMOP: national, population-based OMOP CDM database of EHR and registry data

- Started 2019, project lead prof Tarja Laitinen, TAYS
- 5 university hospital districts, currently 3 actively mapping
- Inclusion of national governmental registries discussed (THL; e.g. drug prescriptions and reimbursement, cancer registry)
- Federated and centralized analysis
- First versions in production Q3 2021
- Funded by Business Finland, hospital districts, EU (EHDEN)



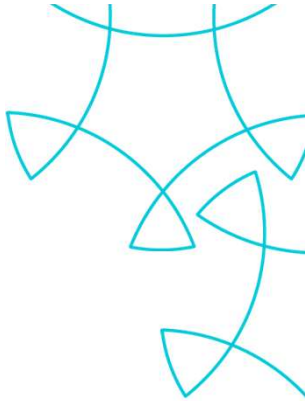
BUSINESS FINLAND

EHDEN EUROPEAN HEALTH DATA & EVIDENCE NETWORK

Big Data for Better Outcomes

imi innovative medicines initiative

Vision for Finland:
all key observational datasets under a CDM



- All hospital datalakes
- THL registries
- Other high-quality, disease-specific registries

- A unique, population-based data resource for observational research and generating reliable evidence for decision making
- A highly desirable partner for international collaboration