Blueprints for Learning:
How does Healthcare System advance the science of its data?

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Abstract

In this poster we present a framework for planning and implementing research projects that rely on skills and techniques of "data science" to generate actionable knowledge from linked, full-cross-continuum health data in the context of learning healthcare system.

First, we lay out the elements of the general framework for applied health data science (AHDS), exemplifying a generic workflow process. Then we delineate critical features of the environments for data access and data analysis that are critical to ensuring *practical reproducibility* - a paramount consideration for building a healthcare system that *learns*.

Using an ongoing research program at the Stroke Rapid Assessment Unit at VIHA, we proceed to demonstrate how a specific implementation of this framework transmutes into the research/analytical core of the Cognitive Health Initiative (CHI), which pursues a combination of computerized cognitive assessments and provider-generated clinical records to advance the accuracy of diagnosing and to improve patient care. Data visualizations of person-level and cohort-level are provided.

We conclude by demonstrating how this framework could be instantiated to support two projects of the current HSI fellow. The first project, explores the predictive capacity of clinical transactions (i.e. how healthcare system was engaged by the patient) to anticipate catastrophic medical events, such as opioid overdose (OO) or a death from an OO. The second project aims to leverage directly off of transactional records generated at a full continuum of services to enhance the surveillance of MHSU conditions, which are notoriously prone to be misrepresented by administrative sources of data.

Workflow

lays out the elements and processes involved in generating clinically useful discoveries in the patient-oriented research while adhering to standards of reproducible software design.
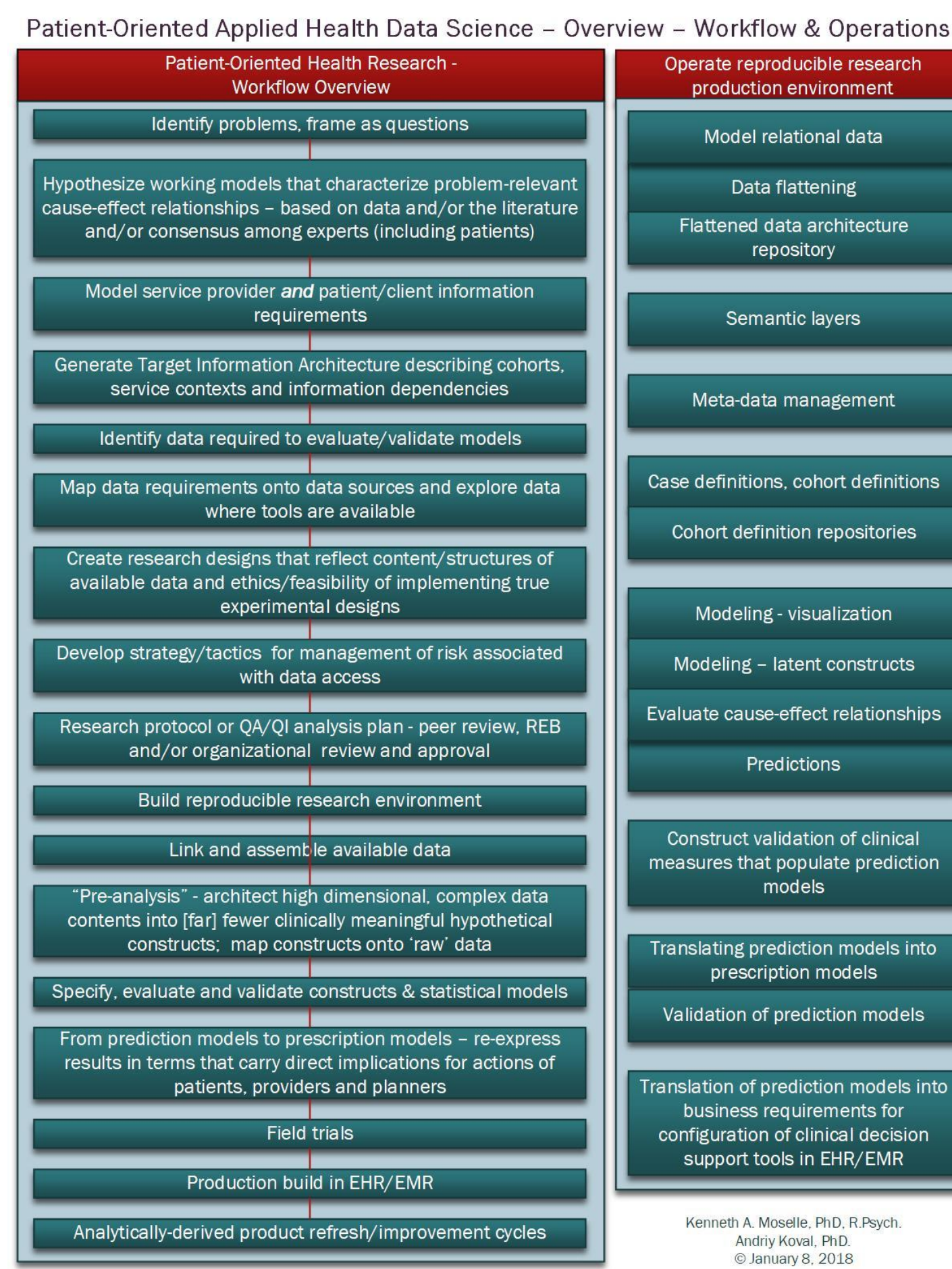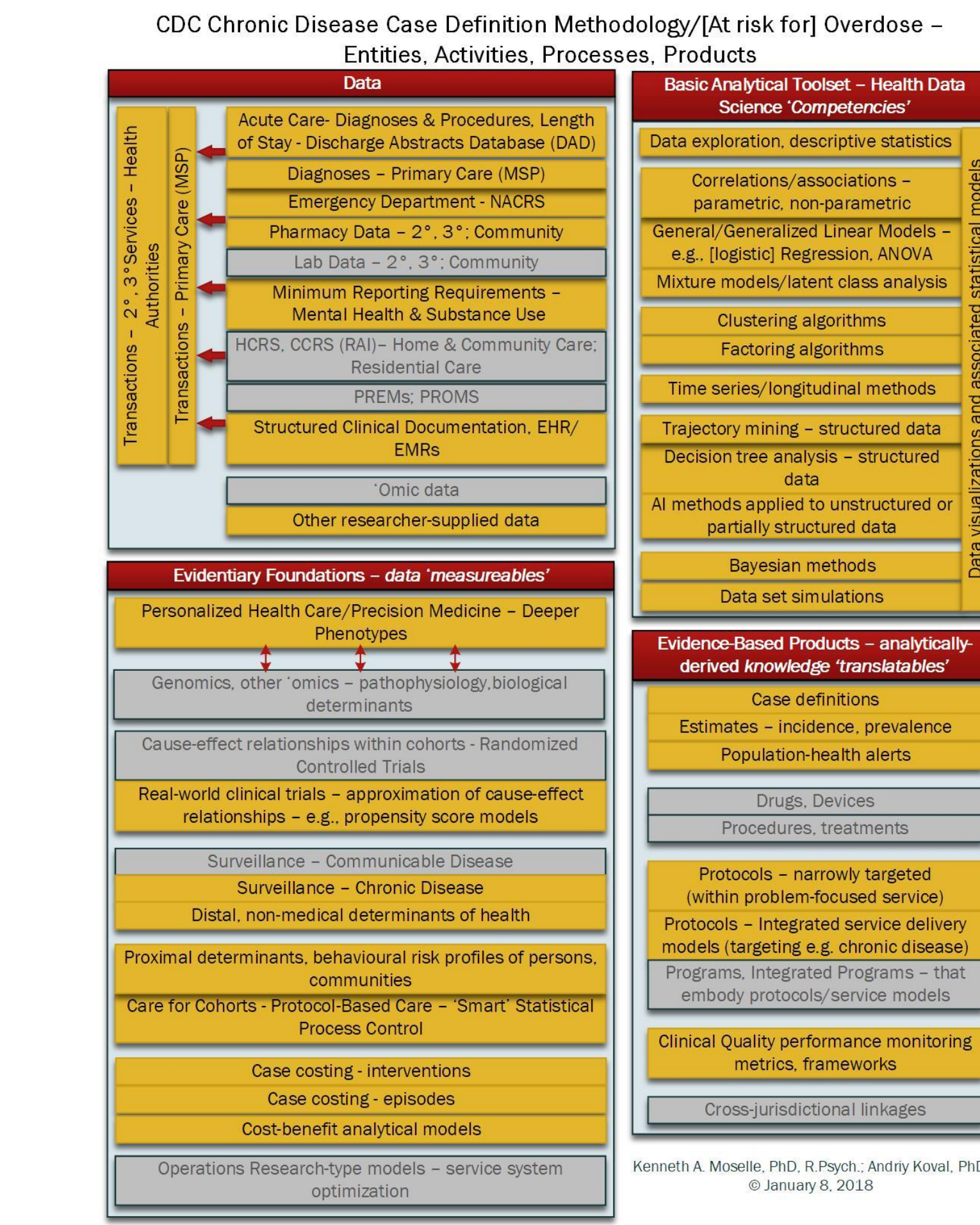

TIA space

invites to assemble concrete research initiatives by describing relationships among data sources, analytic methods, and products.
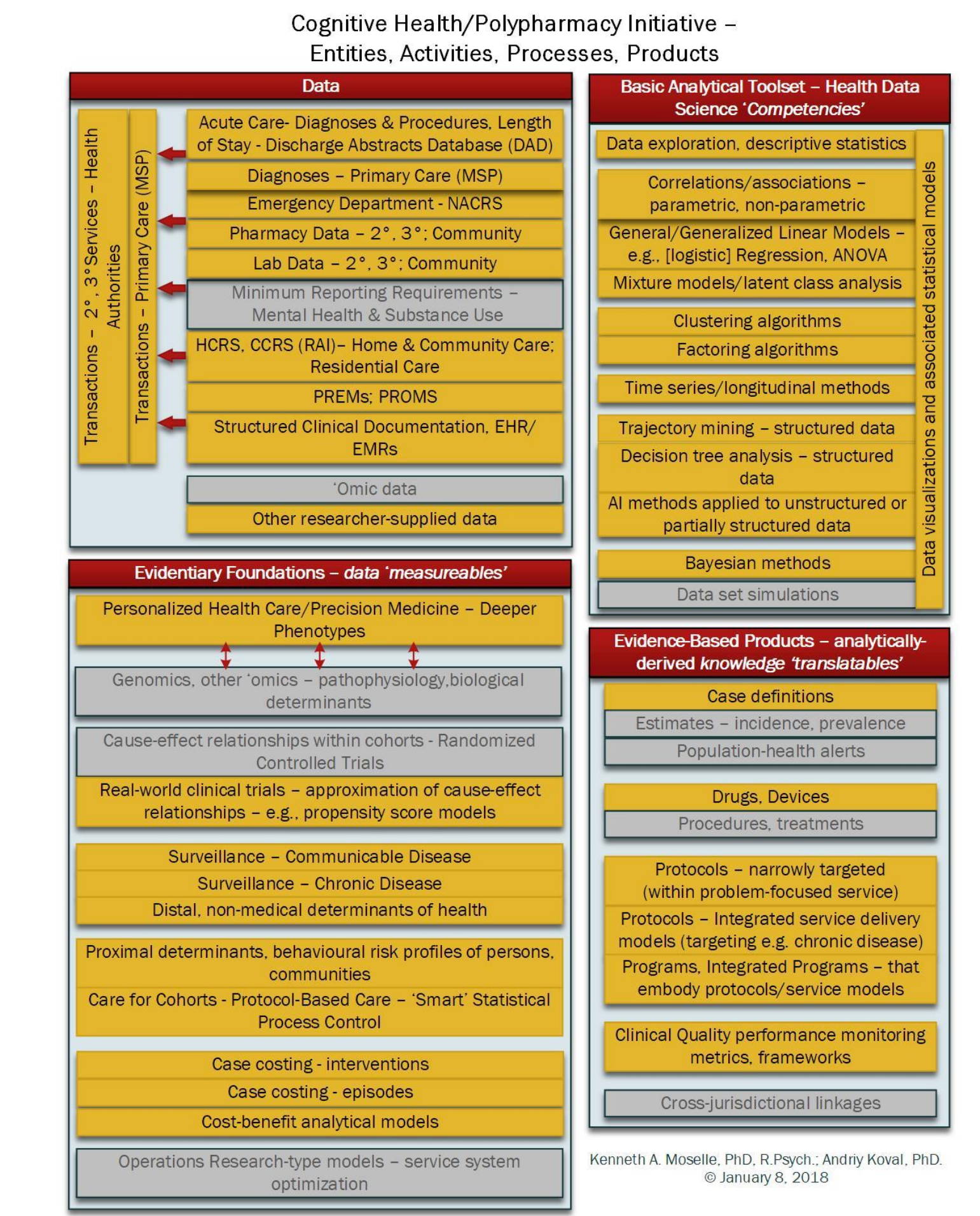

TIA₁

Target Information Architecture for enhancing case definitions of chronic mental health conditions and improving detection accuracy of opioid overdose events.

TIA₂

Target Information Architecture for engaging transactional data from Island Health to pursue research goals of Cognitive Health Initiative, aimed at studying cognitive aging in the context of clinically rich data.

Cohort description tools

Psychotic Illness

General MHSU Cohort

Substance Use

Number of unique patients and encounters per each value of *service location* and *population age*, two of the components in the Clinical Context Coding Scheme (CCCS) that reduced ~1700 unique VIHA locations into ~150 *location classes*

Number of unique patients and encounters per each *location class*, a category of service locations that were judged to be homogeneous with respect to the nature of services they provide. The product of applying Clinical Context Coding Scheme (CCCS) of Island Health.

Person description tools

Case Study: Addiction

This is a fictional composite visualization based on data from several patients, cut and reassembled (Photoshop) to create an image that is representative of a single individual patient 'journey' through the array of secondary and tertiary services, but not actually reflecting at a row level the data of any patient.

Case Study: Stroke Mimic

This is a 53 year old male with extensive history of ischemic events, and who scored moderately low on both MoCA time points. Patients' slope of cumulative number of encounters with the system maintains a steady pattern of service utilization which may indicate that he retains unresolved health issues
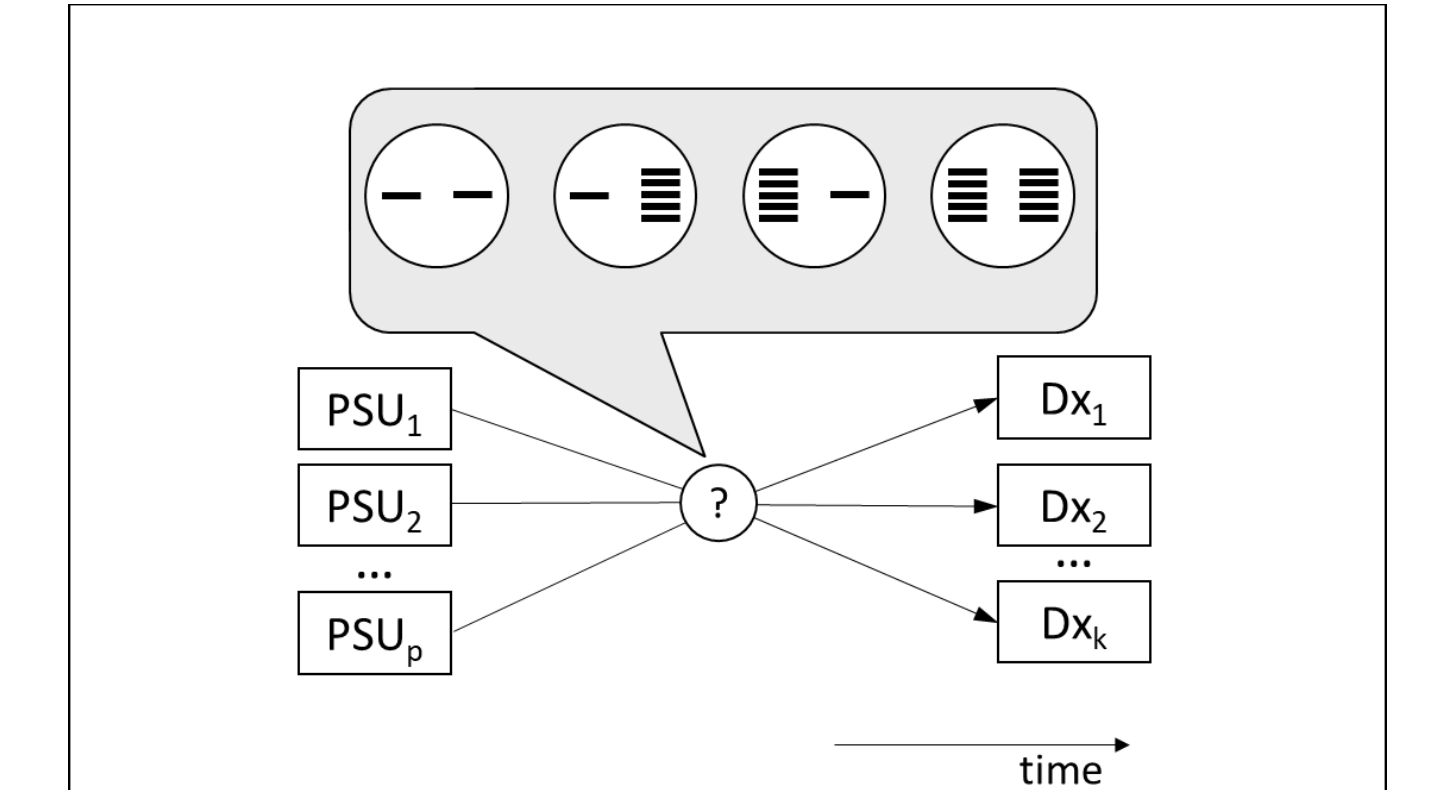
Stratifications of Clinical Histories
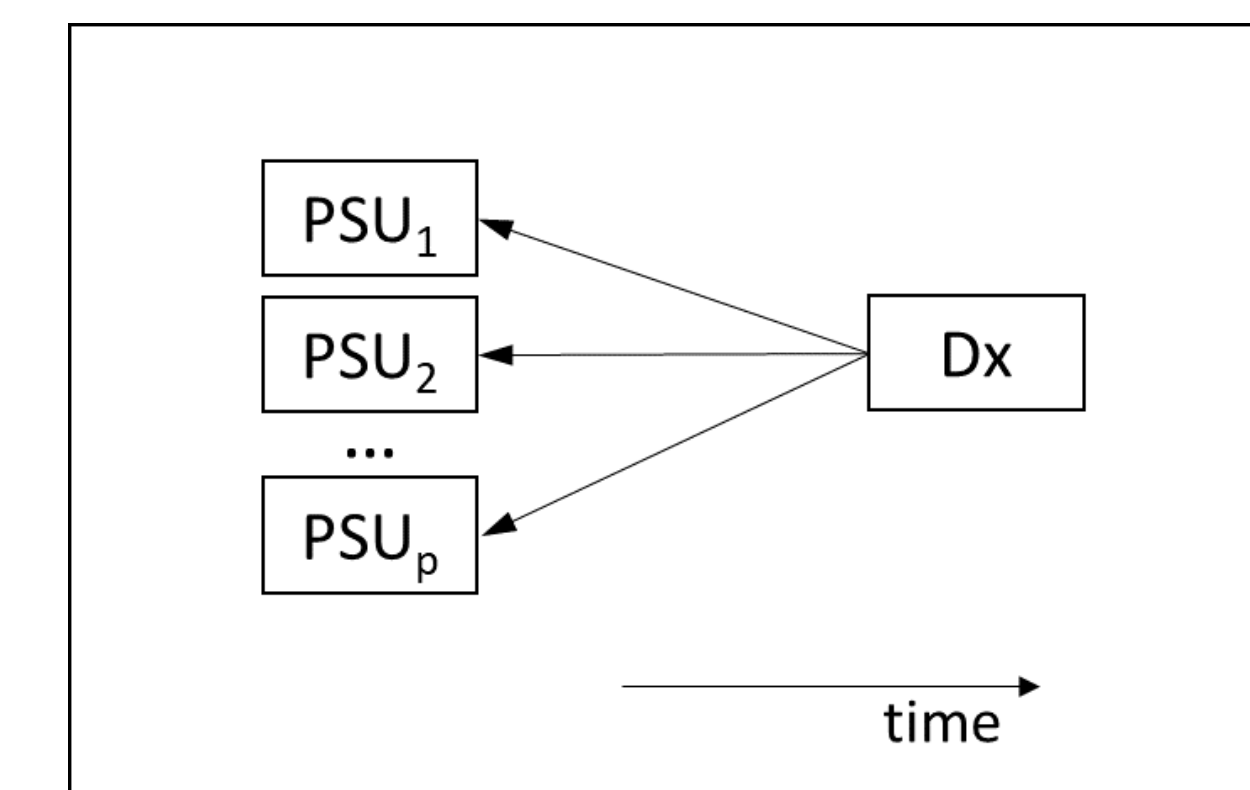
Question: Do individuals with certain diagnoses/event tend to have similar patterns of service utilization?

Premise: Transactional records of secondary and tertiary health services of Island Health are linked with substance use profile from MHSU-MRR profile, emergency room, and acute care records to assemble a data frame for estimating and training statistical models for identifying patterns of service use (PSU) related to specific health outcomes.

Applied Objective: Demonstrate *clinical heterogeneity of diagnostically homogeneous cohorts* by describing the variability in their clinical histories.

Methodological Question: How can we stratify patients on severity of condition and burden of disease based on their clinical history?

Predictive Utility of Service Use

Question: What patterns of service utilization can help identify individuals at risk for an overdose event?

Premise: Using mathematical operationalizations of PSUs generated in Part 1 ("Models of Clinical Histories") we establish statistical relationship between exhibiting a particular PSU and subsequently experiencing an overdose event(s).

Applied Objective: Identify the features of service use that differentiate individuals who go on to experience an opioid overdose event.

Methodological Question: A conceptualized and operationalized PSU may not have a strong predictive relationship with the outcome, so how do we screen for PSU that would be useful in predicting a particular health outcome?