

Decision Support for the LHS: The LHS Needs a “Brain”

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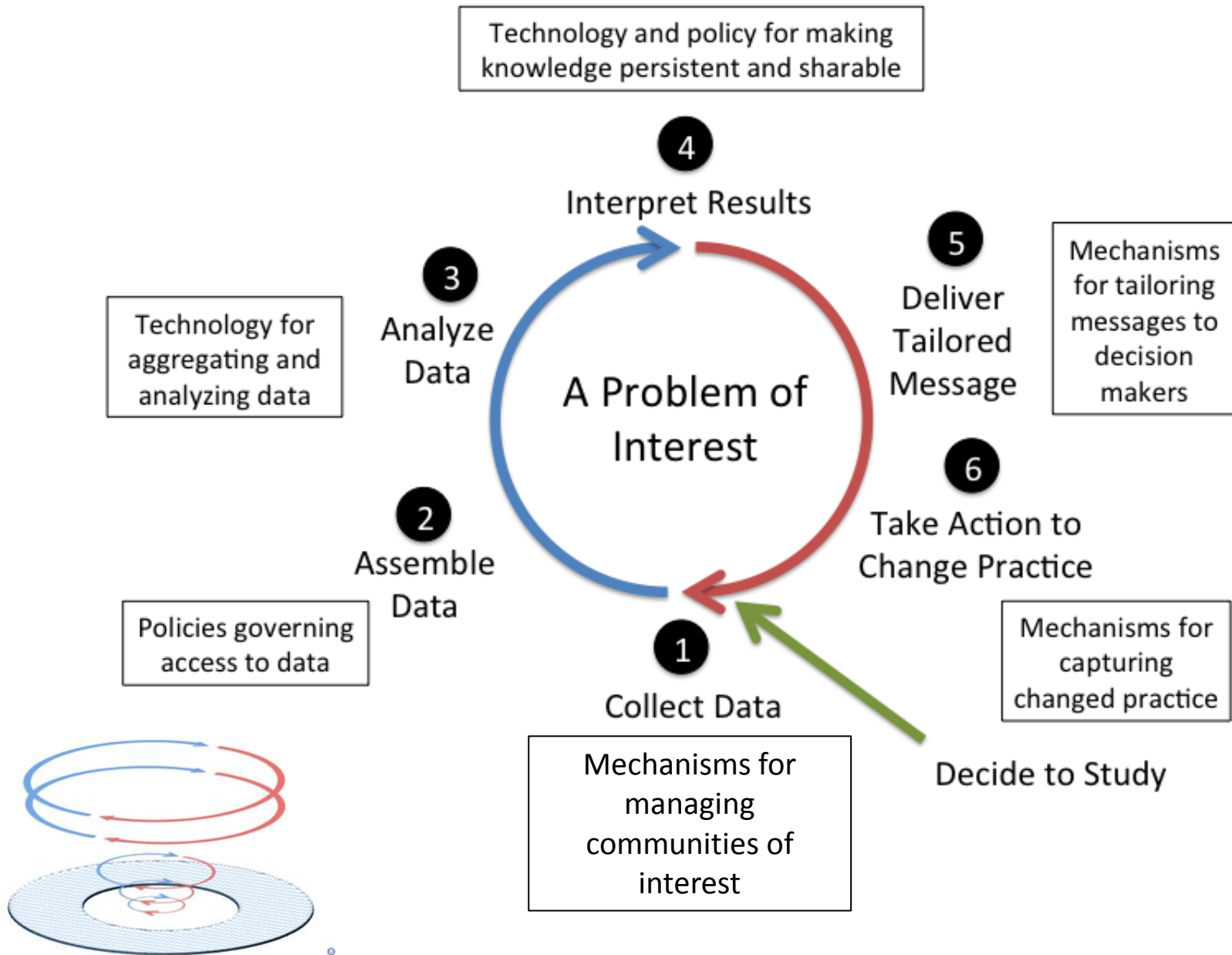
Creating a “Brain” for a Learning Health System

- I could learn if only I had a brain



The Health Care System stands tall, makes a difference, and yet is propped up and unresponsive, as is a scarecrow

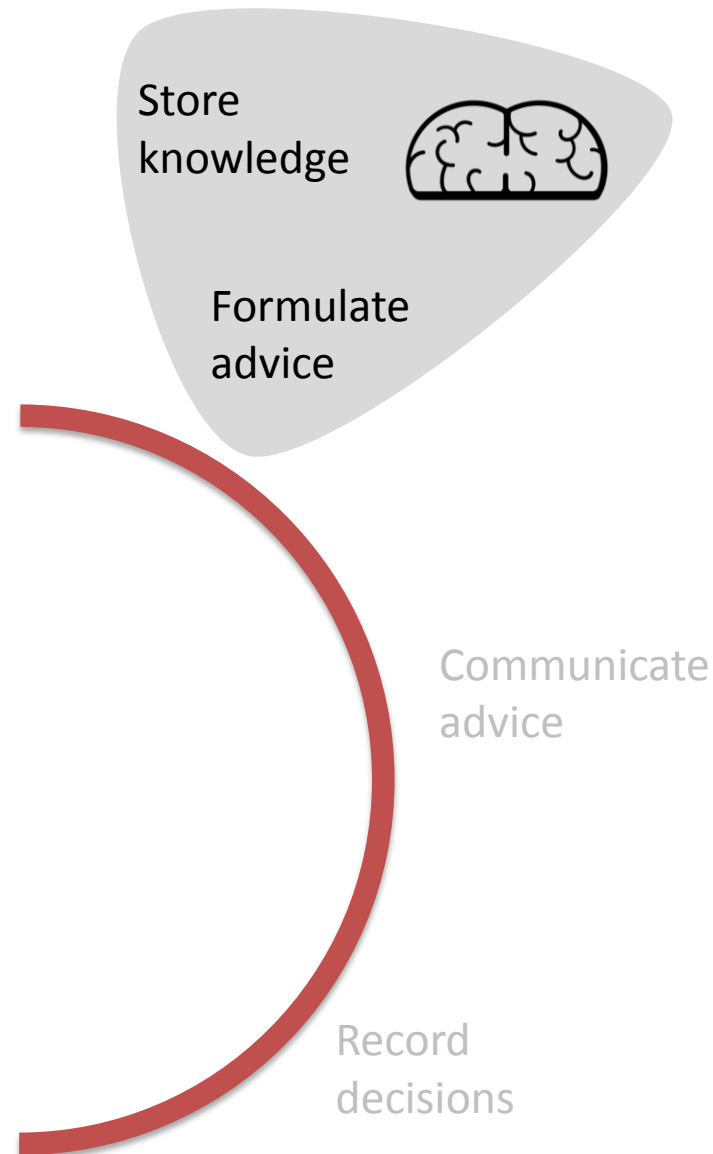
So What's in a Complete Platform?



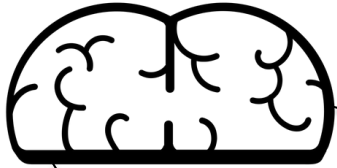
The LHS Needs a *Brain* to Drive the Efferent Side

LHS components to organize, manage and provide access to what is learned, i.e., to knowledge.

At scale, the Brain is a Digital Library of Learning. There can be one such library, or many.



A Brain Contains Knowledge



Examples of knowledge are...

Regression Equation*

Clinical Calculation*

Checklist

Template

Guideline

Predictive Model

Decision Model

* The demo in this presentation uses these two types of knowledge – the demo is of a clinical risk calculation based on a regression equation.

Specific Functions of a Brain



Basic Brain Functions

Organize knowledge to know what is known

Manage knowledge to know *about* what is known

Represent and provide knowledge for use

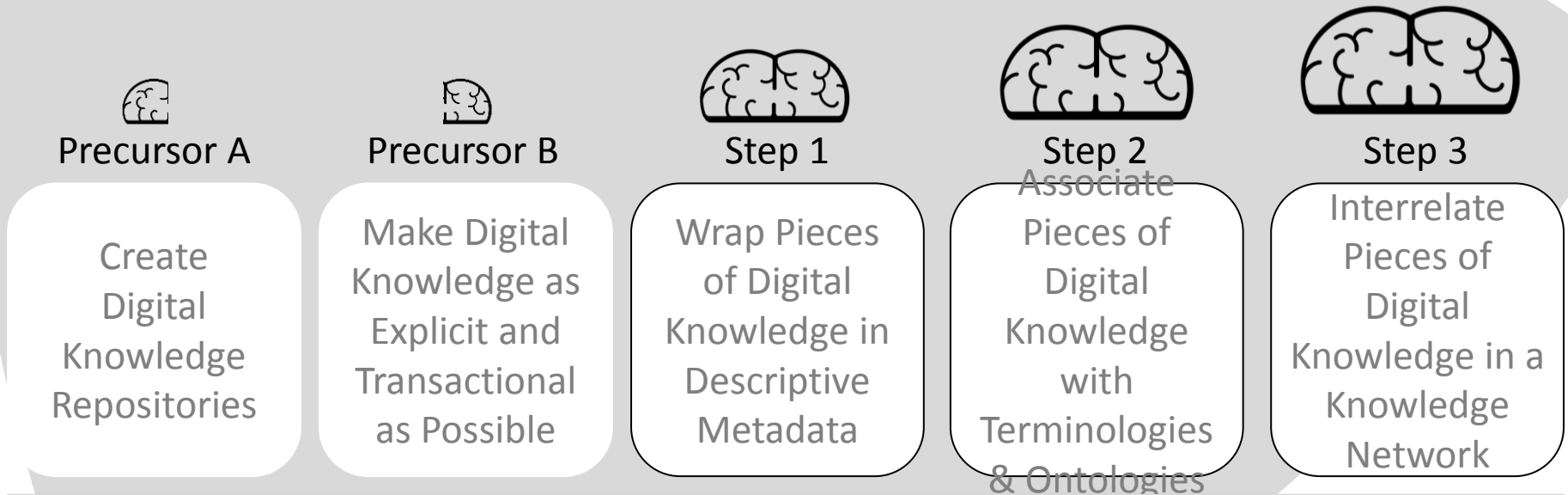
Advanced Brain Functions

Formulate tailored advice

Infer what is NOT YET known

Predict an individual's immediate knowledge needs

Creating a “Brain” for an LHS



Organize knowledge to know what is known

Manage knowledge to know *about* what is known

Represent and provide knowledge for use

Formulate Tailored Advice

Infer what is NOT YET known

Predict Knowledge Needs

Use the Fedora Commons Digital Knowledge Repository

- An open source management system for digital content
- Scalable knowledge engineering and management system
- Ready solution that speeds up LHS “brain” development
- Proven system already in use by libraries worldwide

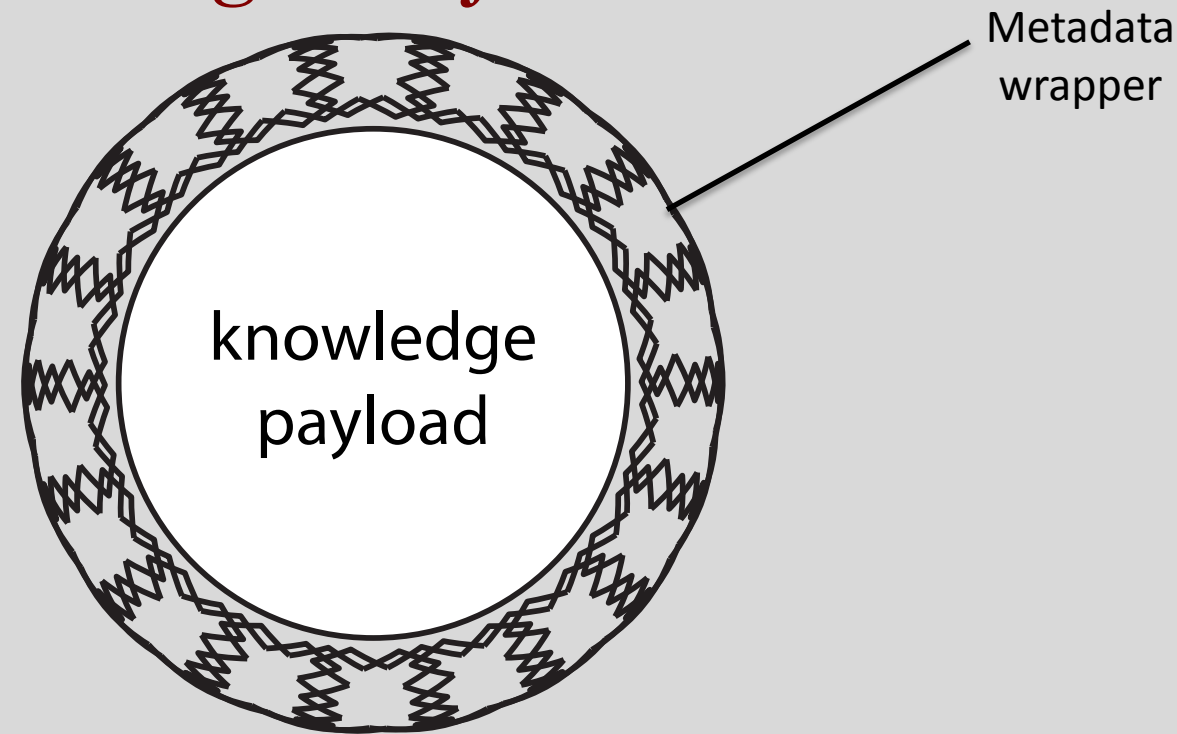


Precursor A

Create
Digital
Knowledge
Repositories

No need to start from scratch.

The Brain is Composed of Digital Knowledge Objects



Digital Knowledge Object
(DKO)

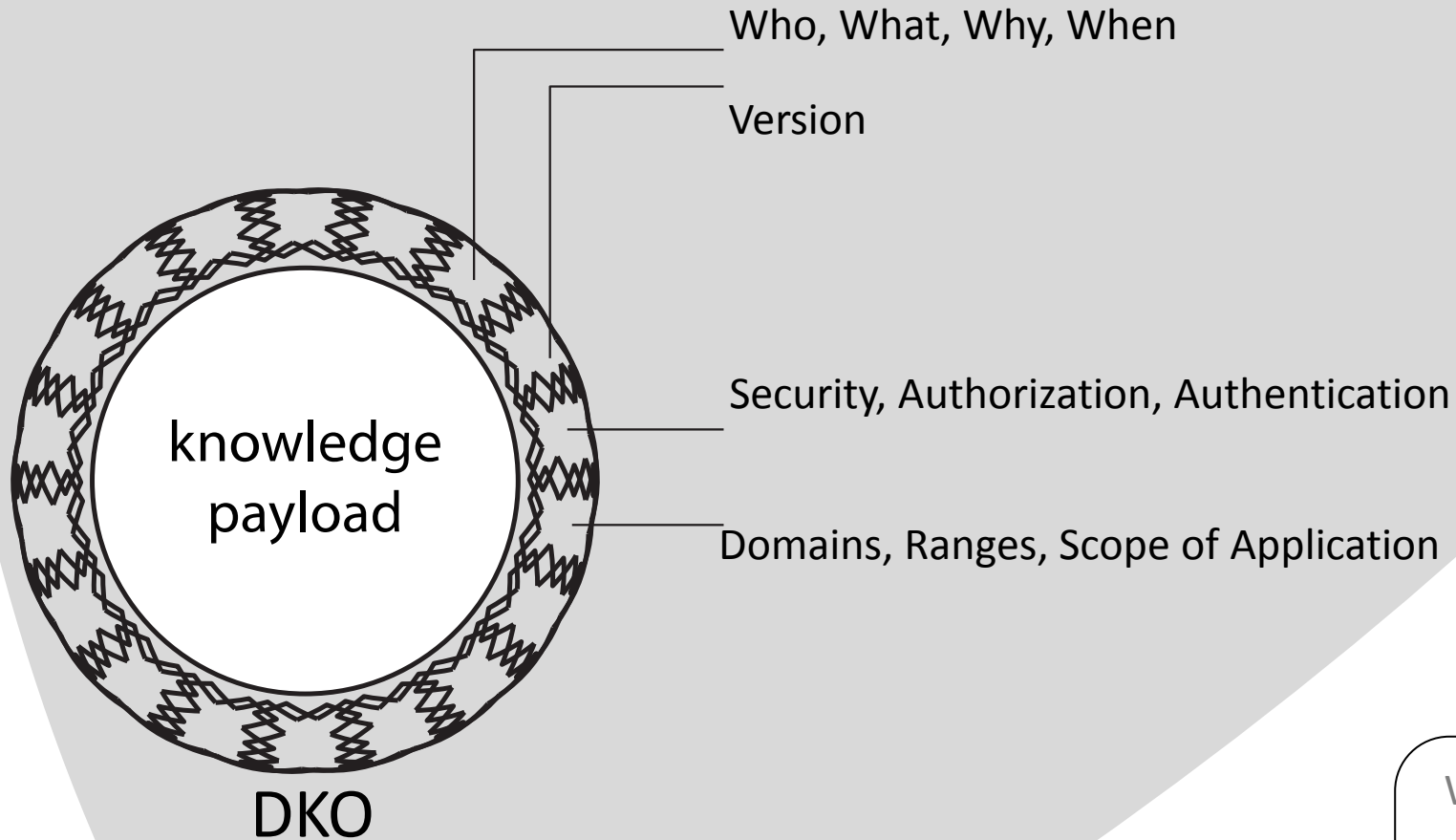
Fedora is for storing and managing DKOs.



Step 1

Wrap Pieces
of Digital
Knowledge in
Descriptive
Metadata

DKO Metadata Types Can Be Many

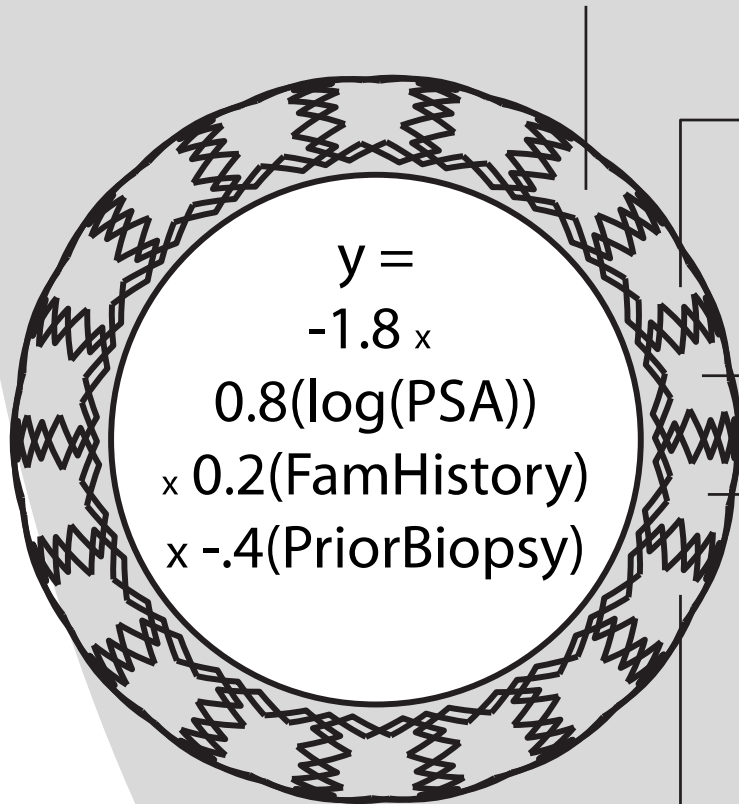


Step 1

Wrap Pieces
of Digital
Knowledge in
Descriptive
Metadata

Example Prostate Cancer Risk DKO

University of Michigan, Prostate Cancer Risk Model, Predict Risk Prior to Biopsy, November 3, 2015



Version 1

Creative Commons License, Editing Restricted

Cancer, Prostate Cancer, Men 55 years and older

SNOMED-CT: PSA(102687007)

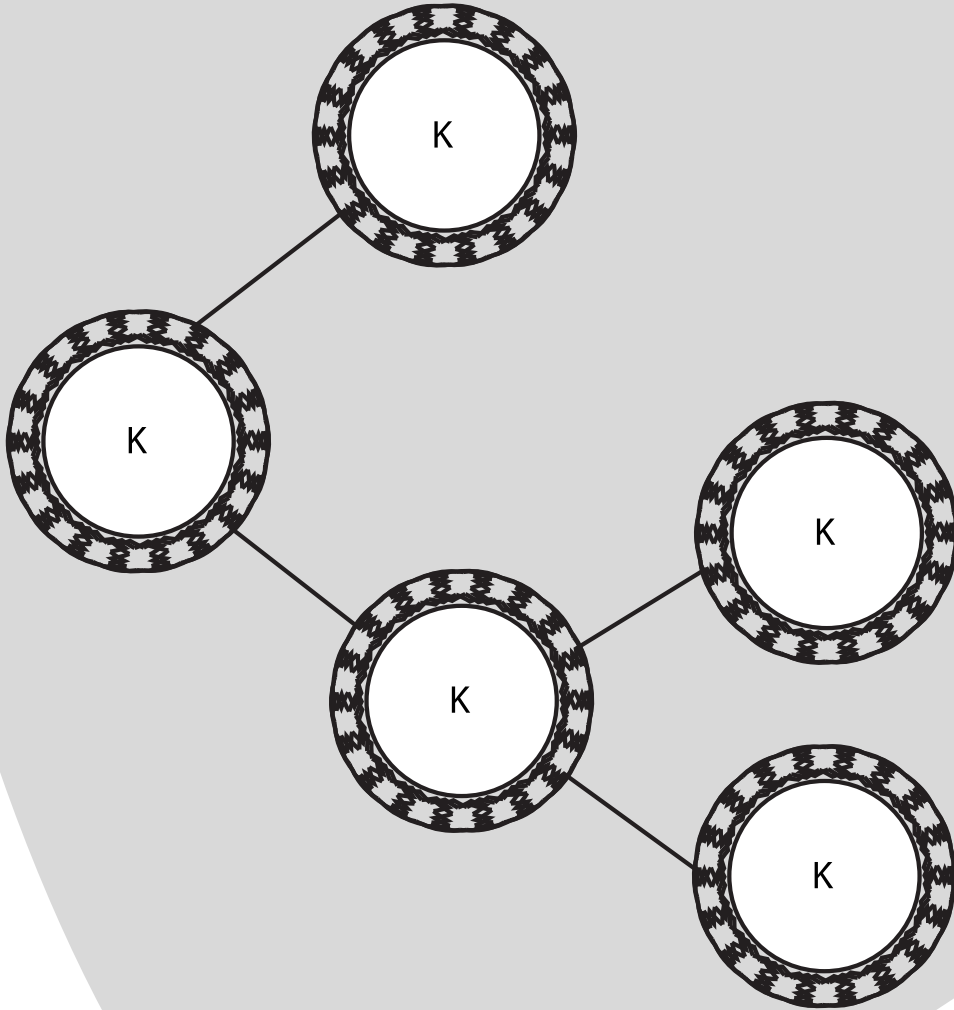
ICD-9 CM (NEOPLASM OF UNCERTAIN BEHAVIOR OF PROSTATE(236.5)



Step 2
Associate

Pieces of
Digital
Knowledge
with
Terminologies
& Ontologies

DKOs can be Explicitly Linked



DKO networks afford new capabilities.



Step 3

Interrelate
Pieces of
Digital
Knowledge in a
Knowledge
Network

Analogous Functions and Capabilities

Necessary “Brain” Function	Knowledge Repository Capability
Know what is known	Semantically-aware information retrieval
Know what is NOT YET known	Inference-making to identify knowledge gaps automatically
Manage what is known	Digital library for versioning, governance, & curation
Represent knowledge for use	Transactional, coded, computable knowledge via APIs
Formulate advice	Quick development & rapid deployment of advice-giving systems
Predict immediate knowledge needs	Relate “pieces” of knowledge to each other in a knowledge network

We're Building the Brain (Collaborators Welcome!)

- We have developed a prototype design based on the Fedora Commons platform
- An open “brain service” usable at many levels of scale
- We have assembled a technical team
- We are applying for funding to create a mature version, but expect to have a working, open source prototype in 6-8 months
- For technical details:

Flynn, AJ et al. Digital Knowledge Objects and Digital Knowledge Object Clusters: Unit Holdings in a Learning Health System Knowledge Repository. Hawaii International Conference on System Science, 2016.