MCBK Infrastructure

MCBK Infrastructure WG 2018-2020

	**Leslie McIntosh** Research Data Alliance	Co-Chair
	**Chris Shaffer** University of California San Francisco	Co-Chair
	**Peter Boisvert** University of Michigan	MCBK Liaison

MCBK Infrastructure: Charge

- Identify the landscape of **infrastructure stakeholders**
- Describe the **framework components** necessary to move computable biomedical knowledge from generation into practice by facilitating the testing, versioning, use, evaluation, scalability, interoperability, and dissemination of MCBK
- Develop **use cases** connecting stakeholders to framework components
- Act as a **clearinghouse** for news and events of interest to infrastructure stakeholders and the overall MCBK community

MCBK Standards & Infrastructure WG 2021-

	**Bruce Bray** University of Utah	Co-Chair
	**Jamie McCusker** Rensselaer Polytechnic Institute	Co-Chair

MCBK Standards & Infrastructure: Purpose

The Standards and Infrastructure workgroup seeks to mobilize diverse stakeholders in an ongoing and active engagement around the detailed scientific description of computable biomedical knowledge (CBK). We envision the creation and perpetuation of a robust CBK ecosystem that encourages public-private partnerships; supports open standards; generates value for users by making CBK more findable, accessible, interoperable, and reusable; highlights the limits of CBK and CBK biases; and engenders equity in the generation and application of CBK for health.

MCBK Standards & Infrastructure: Charge

- The one charge of the Standards and Infrastructure workgroup is to identify and describe the landscape of infrastructure stakeholders; the framework components necessary to move computable biomedical knowledge (CBK) from generation into practice by facilitating the testing, versioning, use, evaluation, scalability, interoperability, and dissemination of CBK; and the use cases that connect stakeholders to framework components.
- The Standards and Infrastructure workgroup will serve as a clearinghouse for news and events of interest to infrastructure stakeholders and the overall MCBK community.
- We will engage with complementary efforts within MCBK and externally with various standards development organizations and open science initiatives (e.g. RDA, GA4GH, Chan Zuckerberg Biohub) to identify what makes it difficult for people to implement CBK right now, and to ask, “How can we make it easier?”

White Papers

- Categorizing metadata to help mobilize computable biomedical knowledge, Alper BS, et al., DOI: 10.1002/lrh2.10271
- Guiding principles for technical infrastructure to support computable biomedical knowledge, McIntosh LD, et al., unpublished preprint


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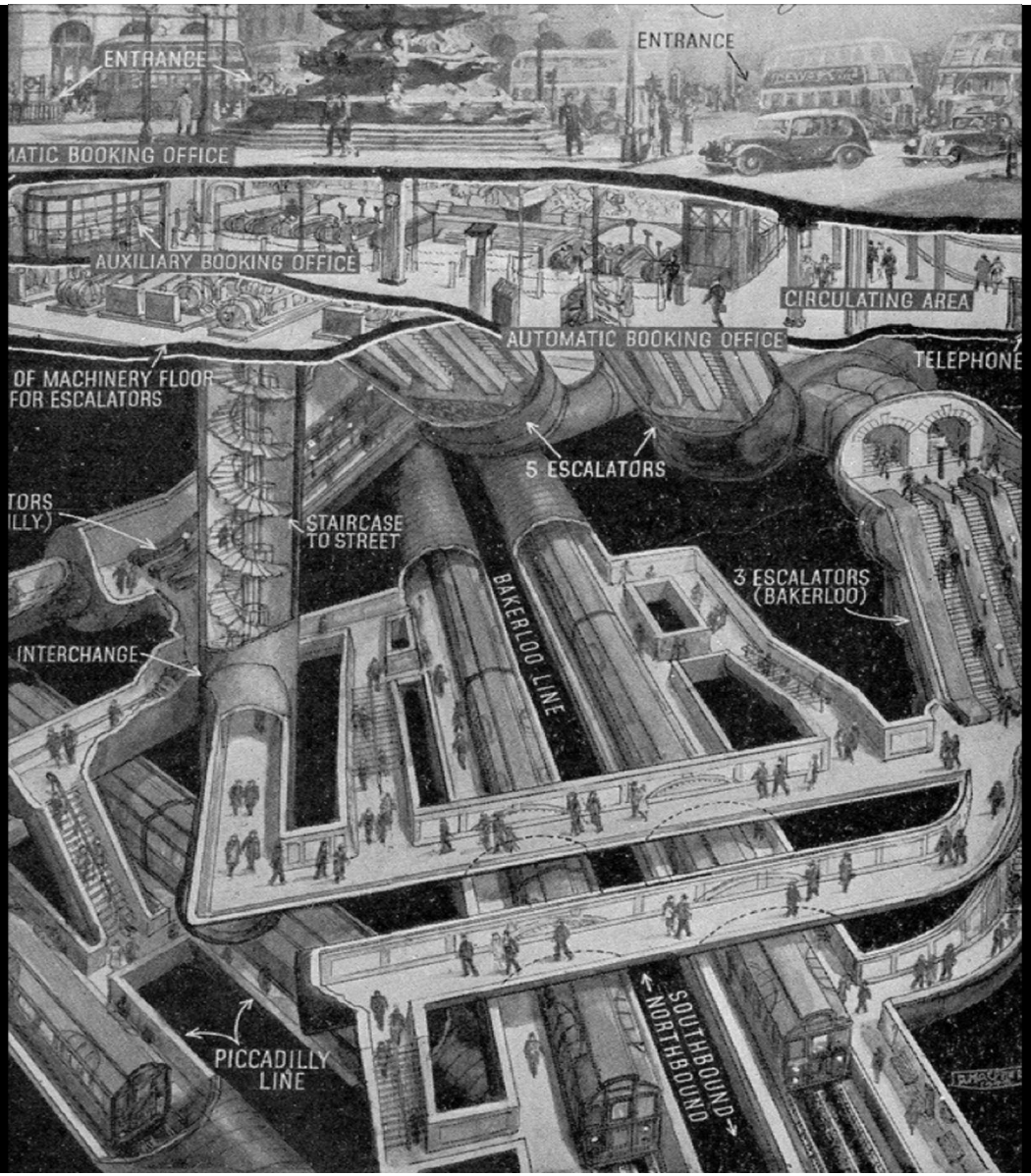
Northwick Park
South Kenton
North Wembley
Wembley Central
Stonebridge Park
Harlesden
Willesden Junction
Kensal Green
Queen's Park
Kilburn Park
Maida Vale
Warwick Avenue
Royal Oak
Westbourne Park
Ladbroke Grove
Latimer Road
White City
East Acton
Acton Central
Shepherd's Bush
Goldhawk Road
Hammersmith
Ravenscourt Park
Stamford Brook
Barons Court
Kensington (Olympia)
West Kensington
Earl's Court
West Brompton
Fulham Broadway
Parsons Green
Putney Bridge
East Putney
Southfields
Wimbledon Park
Wimbledon
Preston Road
Wembley Park
Neasden
Dollis Hill
Willesden Green
Kilburn
Brondesbury Park
Kensal Rise
Brondesbury
Harrow-on-the-Hill
Golders Green
Hampstead
Hampstead Heath
Gospel Oak
Finchley Road & Frognal
Belsize Park
Chalk Farm
West Hampstead
Finchley Road
Swiss Cottage
St. John's Wood
Camden Town
Mornington Crescent
Kentish Town West
Kentish Town
Archway
Tufnell Park
Camden Road
Caledonian Road
Holloway Road
Arsenal
Caledonian Road & Barnsbury
Manor House
Tottenham Hale
Walthamstow Central
Finsbury Park
Canonbury
Highbury & Islington
Hackney Central
Hackney Wick
Dalston Kingsland
Homerton
King's Cross St. Pancras
Great Portland Street
Euston
Angel
Farringdon
Barbican
Old Street
Liverpool Street
Bethnal Green
Mile End
Bow Road
Bow Church
Devons Road
Stepney Green
Whitechapel
Shoreditch
Aldgate East
Aldgate
All Saints
Westferry
Poplar
Blackwall
Limehouse
Shadwell
Wapping
West India Quay
Canary Wharf
Heron Quays
South Quay
Crossharbour & London Arena
Mudchute
Island Gardens
Cutty Sark for Maritime Greenwich
Greenwich
Deptford Bridge
Elverson Road
Lewisham
Surrey Quays
New Cross
New Cross Gate
Canada Water
Rotherhithe
Bermondsey
London Bridge
Tower Gateway
Tower Hill
Monument
Bank
Cannon Street
Mansion House
Blackfriars
Temple
Embankment
Westminster
Victoria
St. James's Park
Sloane Square
South Kensington
Gloucester Road
Knightsbridge
Hyde Park Corner
Green Park
Piccadilly Circus
Charing Cross
Leicester Square
Covent Garden
Holborn
Chancery Lane
St. Paul's
Tottenham Court Road
Oxford Circus
Bond Street
Lancaster Gate
Queensway
Notting Hill Gate
Marble Arch
Bayswater
Paddington
Edgware Road
Marylebone
Warren Street
Regent's Park
Euston Square
Goodge Street
Russell Square
Moorgate
Pimlico
Vauxhall
Waterloo
Southwark
Borough
Lambeth North
Elephant & Castle
Kennington
Oval
Stockwell
Clapham North
Clapham Common
Clapham South
Brixton
Balham
River Thames
Interchange stations
Connections with National Rail
Connections with riverboat services
Airport interchange
Explanation of zones
Zone D
Zone C
Zone B
Zone A
Zone 6
Zone 5
Bakerloo
Central
Circle
District
Points


WAY OUT


ENTRANCE
ENTRANCE
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AUXILIARY BOOKING OFFICE
CIRCULATING AREA
AUTOMATIC BOOKING OFFICE
TELEPHONE
OF MACHINERY FLOOR
FOR ESCALATORS
5 ESCALATORS
TORS
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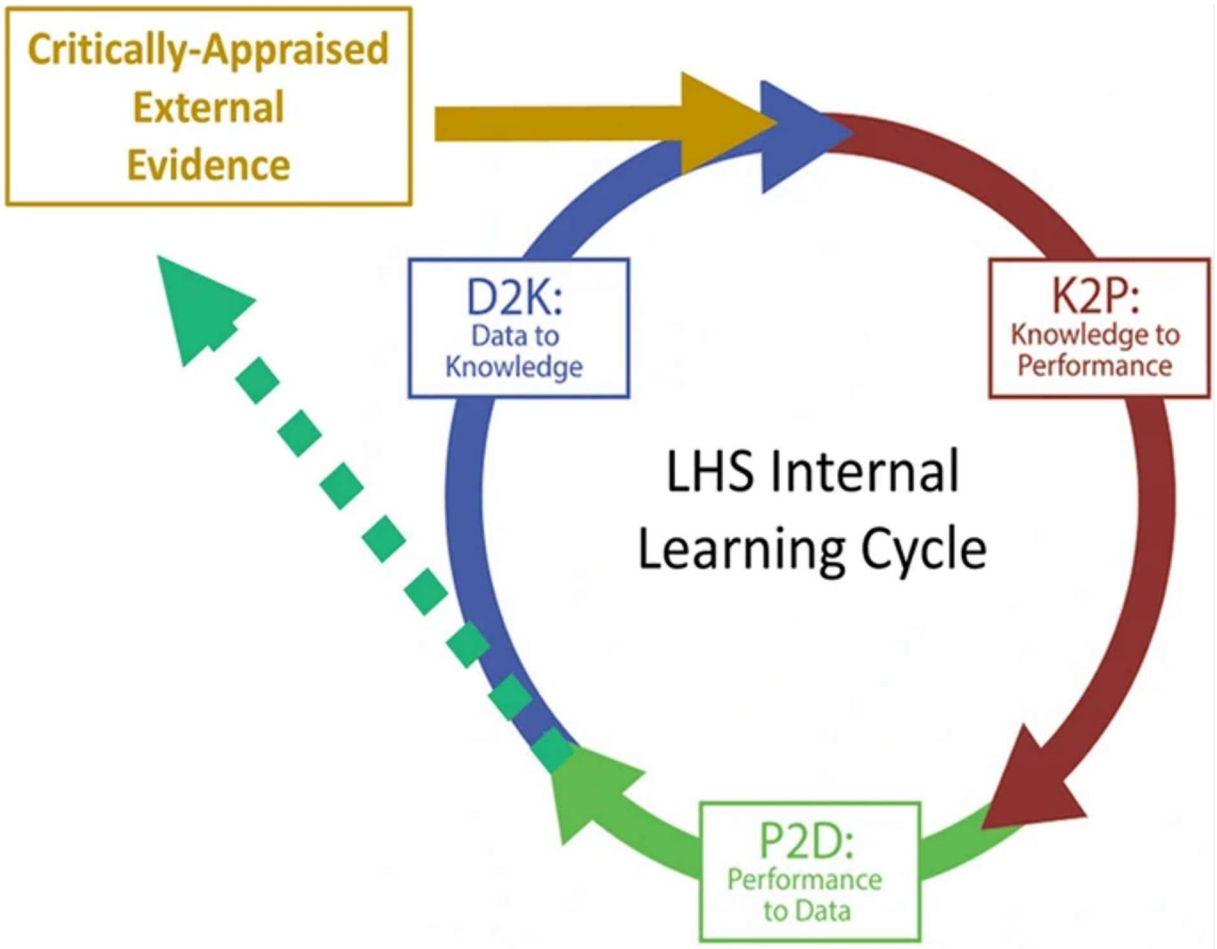
STAIRCASE
TO STREET
BAKERLOO LINE
3 ESCALATORS
(BAKERLOO)
INTERCHANGE
SOUTHBOUND
NORTHBOUND
PICCADILLY
LINE


Critically-Appraised External Evidence
D2K: Data to Knowledge
K2P: Knowledge to Performance
LHS Internal Learning Cycle
P2D: Performance to Data

Infrastructure Principles

1. Promote interoperable systems for data and knowledge
2. Encapsulate knowledge objects and systems in an environment of accessibility and openness
3. Enable stable, trustworthy knowledge representations that are human and machine readable

Knowledge Infrastructure Requirements

for Computable Biomedical Knowledge (CBK)

Bob Greenes

ASU and Mayo Clinic

Carl Lagoze

University of Michigan

What do we mean by CBK?

Based on evolution of the goals of clinical decision support (CDS), this includes:

- Some traditional kinds of knowledge artifacts
- Some newer notions that rely on views or analyses of data to support cognitive processes

Raises the question of distinctions among data, information, and knowledge…

Traditional CBK resources types

- ECA rules
  - ON **event** IF **condition** THEN **action**
  - Alerts and reminders
- Order sets
- Documentation templates
  - Structured forms
  - Structured reports
- Infobutton manager requests
- Care process models
  - Guidelines
  - Protocols

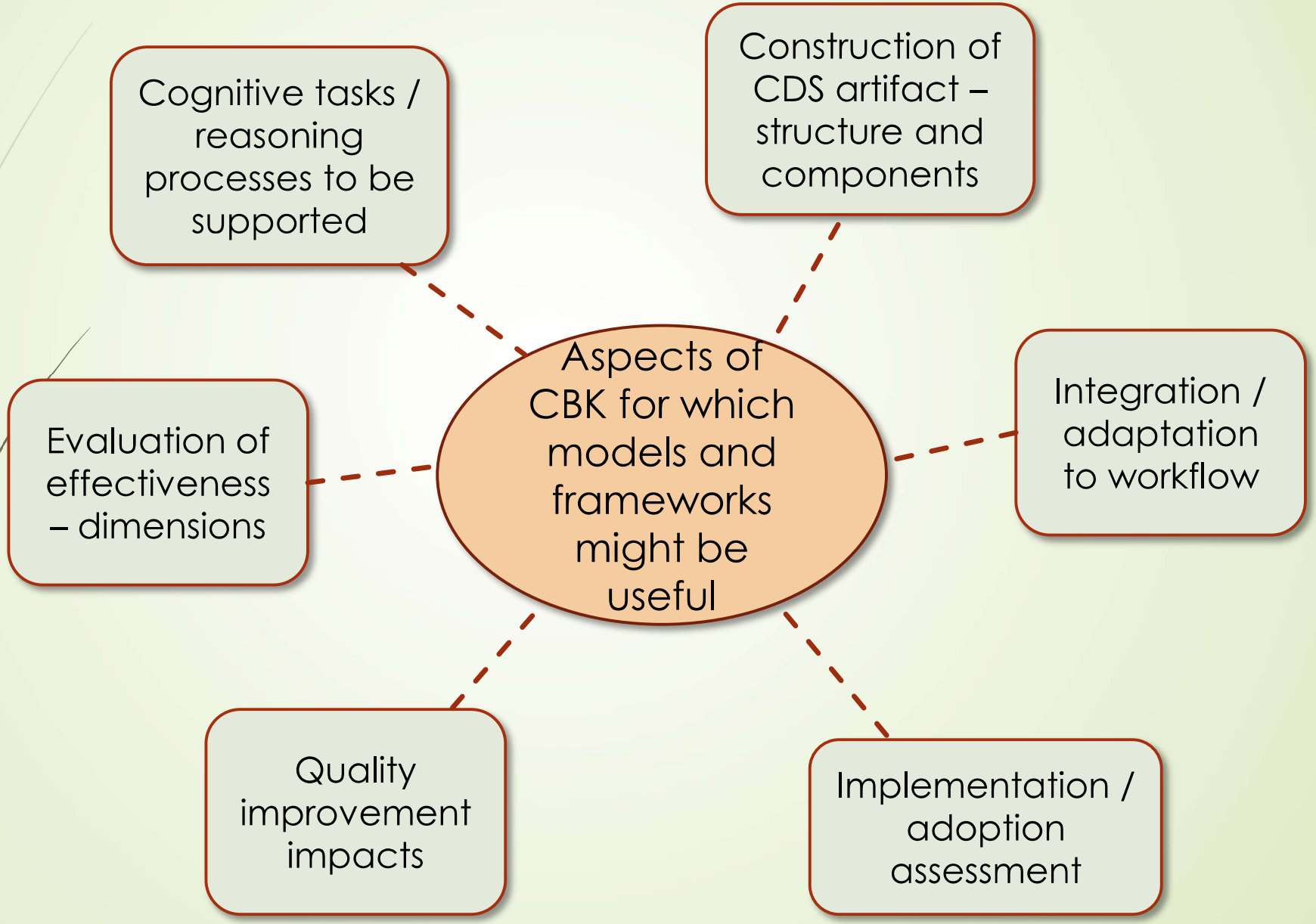
Some non-traditional CBK types

- Quality measures
  - As reports
  - As dashboards showing outliers
  - As indicators for attention re: current patient
- Process models, expanded
  - Business process models
  - Workflow models
    - BPMN, CMMN, DMN
- Projections
  - Predictive models
  - "Patients like mine" analyses

Some non-traditional CBK types - 2

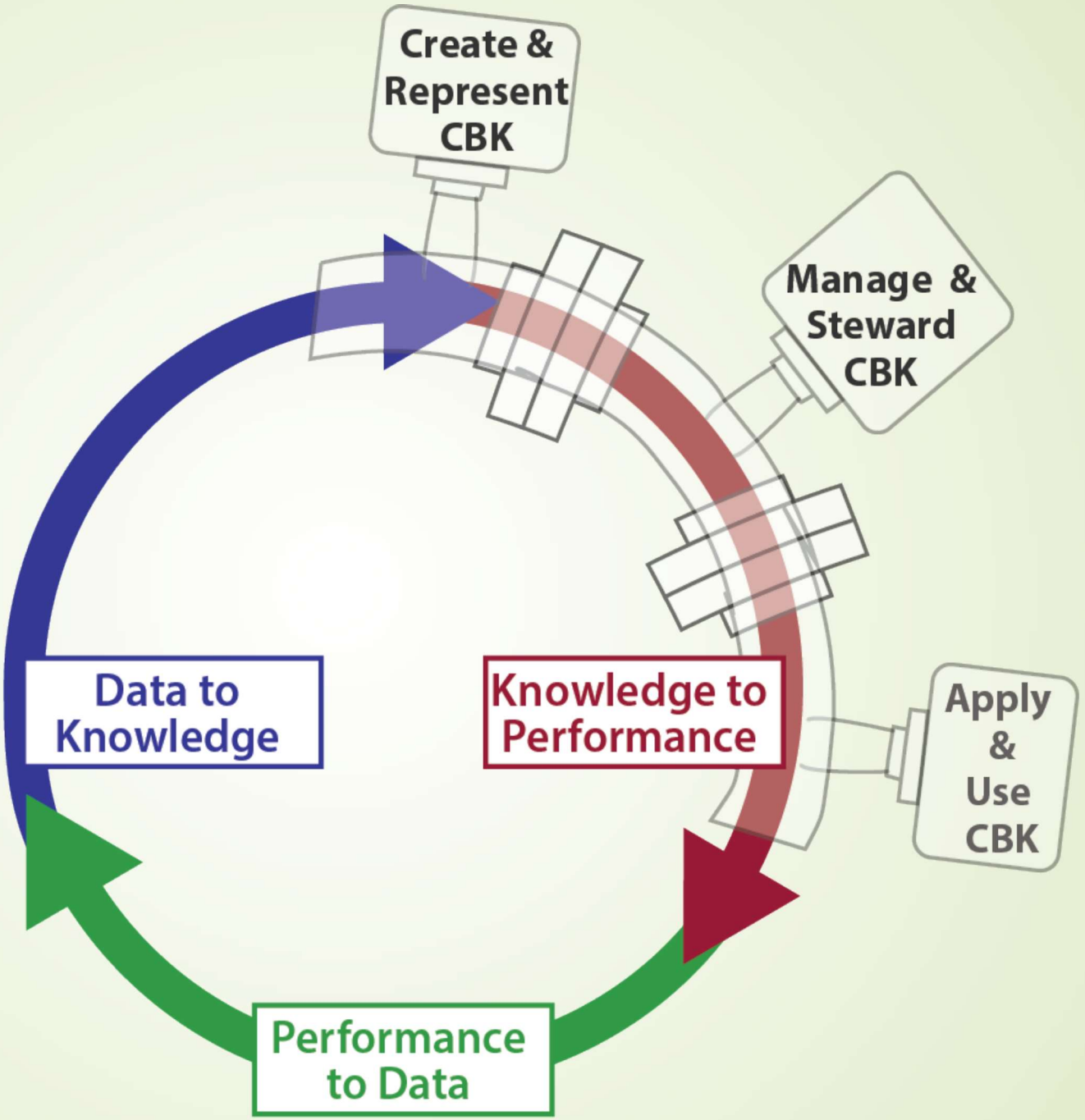
- Context-based focusing
  - Analogous to GPS navigation
    - Situation, setting, workflow activity, patient problems, provider skills/expertise
    - Activity within app
- Semantic relations among data
  - conditions ⇔ observations ⇔ actions
    - In any direction
  - Trends of associated data over time
    - e.g., lab findings varying as med choices and doses are altered
  - Suggesting associations to consider for assessments/plans

Some perspectives that may need to be accommodated



What do we mean by infrastructure?

- Recognizing the huge variety of CBK and its potential use, we are seeking to define a set of general capabilities common to all:
  - to support the various stages of:
    - creating and representing knowledge
    - managing and stewarding knowledge
    - applying and using
    - capturing experience
- Why?
  - To make it easier to archive, update, share
  - By individual organizations with much CBK
  - Across organizations, nationally, internationally


Create & Represent CBK
Manage & Steward CBK
Apply & Use CBK
Knowledge to Performance
Performance to Data
Data to Knowledge

STAGE 1: CBK Creation & Representation

- Creation
  - The generation of the knowledge
    - human-intensive sources
    - EBM/literature-based approaches
    - data analytics
- Representation
  - Use of formal methods to encode concepts, attributes, relations
    - Individual to the type of knowledge
  - Many standards exist in this space
    - Terminologies/taxonomies
    - Ontologies
    - KNART models
    - Work flow models
  - Not clear whether they exist yet for predictive models and analytics

STAGE 2: CBK Management & Stewardship

- This includes several functions
  - Curation
  - Assigning metadata
  - Updating, versioning, purging
- Principles of knowledge FAIRness seem to apply primarily to this stage

Knowledge FAIRness

- Findable
  - relies on metadata adequately capturing
    - the content domains
    - type of artifact
    - appropriate settings for use
    - provenance and derivatives
- Accessible
  - authentication, authorization, rights management
  - availability for retrieval
- Interoperable
  - using standards for representing, searching, and accessing
- Reusable
  - separation of generic vs. localization components
  - conditions for adaptation and use

STAGE 3: CBK Adaptation and Use

- Localization is needed to insert into workflows or to trigger by specific events
- Even incorporating in a service via an API requires such localization
- The knowledge thus modified is often quite different from what started out
  - Doing the adaption may be 50-80% of the work
- Execution
  - Interpreters
  - Service models

STAGE 3: CBK Adaptation and Use - 2

- What happens then when the underlying knowledge changes?
  - Need system of separating localizations from core knowledge
  - Need subscription/notification service to be aware of changes
- Usage provides data also for the continuous feedback loop of the cycle
  - How did the knowledge affect process and outcome?
  - How effective was the implementation?

Some other considerations

- This topic is heavily dependent on the other themes being discussed
  - Metadata, indexing, context-based search
  - Validation and trust
  - Intellectual property, access, and adaption rights

Seamless Bay Area

Discussion Points

- What are the **framework components** necessary to move computable biomedical knowledge from generation into practice by facilitating the testing, versioning, use, evaluation, scalability, interoperability, and dissemination of MCBK?
- How do we build and share a conceptual infrastructure model that supports MCBK?
- How can our work support the infrastructure? What does the developer community need from us?