Toward a Learning Health System: Enabling the National Knowledge Ecosystem at Scale

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Disclosure Summary:
Blackford Middleton, MD -- Nature of Relationship:

Employee: Apervita, Inc

- Stockholder: Apervita, Inc.

Consultant

- CMS Alliance to Modernize Healthcare (CAMH) at MITRE
- C19 Health Care Consortium (C19HCC.org) Digital Guidelines Working Group
- AHRQ ACTS Roadmap Working Group
- AHRQ Patient-centered Outcomes Research Clinical Decision Support Learning Network
  - Chair, Steering Committee
- Mobilizing Computable Biomedical Knowledge, Member Steering Committee,
  - Co-Chair, Trust and Policy Sub-committee
- AHRQ Solicitation 18-233-SOL-00276, "Quantifying efficiencies gained through shareable clinical decision support (CDS) resources". PI Kristen Miller, Medstar Health, Technical Consultant
- TEP (Technical Expert Panel) Member, AHRQ/NIDDK project to establish an e-care Plan for Kidney disease
- TEP (Technical Expert Panel) Member, CDC MEDMORPH project to establish an common clinical research data model
- HL7 Advisory Council
- Advisory Committee and Stockholder, Veravas, Inc.

Does not intend to discuss off-label/investigative use.

What are the new clinical information needs (and skills)?

- What is the precise phenotype of this patient?
- What are the genomic, proteomic, metabolomic, microbiomic, exposomic clinical correlates?
- What is the summarized and tailored clinical evidence?
- What is the aggregated experience – real world evidence - under various scenarios for similar patients?
- What are the pivot points or pivot patterns for Dx? For Rx?
- What is the most effective method of patient engagement? Behavior change? Chronic Care Management? Care team coordination?
- Beyond this patient, how can I impact the population health?
- How do I answer these questions? In real time? In reflection?

Where will AI / Cognitive aides apply?

1. Higher Level Clinical Functions

- Differential Diagnosis
- Therapy Planning
- Care Coordination
- Examination
- Communication

2. Sub-clinical Functions (Procedural / Transactional)

- Intelligent summarization
- Automatic Clinical Documentation
- Care Management (order entry, corollary orders, patient handouts, referrals)

3. Automatic / Operational

- Surveillance / monitoring
- Automatic phenotyping
- Case detection / public health reporting
- Prior authorization
- Billing / coding
- Quality measurement and reporting
- Patient safety / adverse event detection

Leaping the Computable Knowledge Chasm: Toward Smart Healthcare

"Dumb" Healthcare

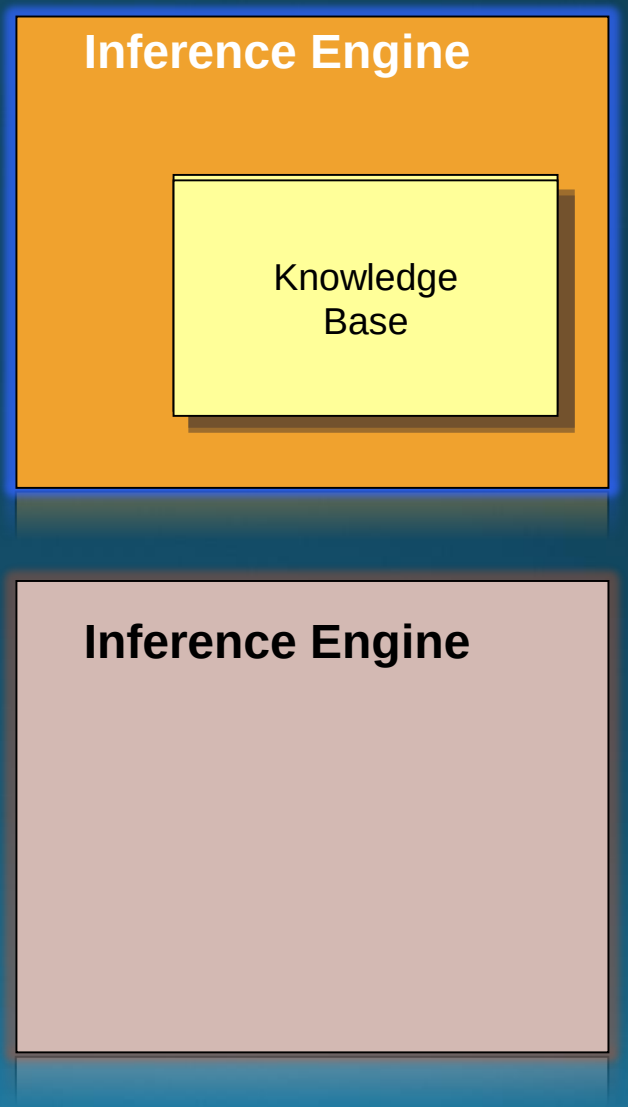
- EMR
- Patient Portal
- EDW / Data Lake
- Revenue Cycle Mgmt
- Call Center / CRM

"Smart" Healthcare

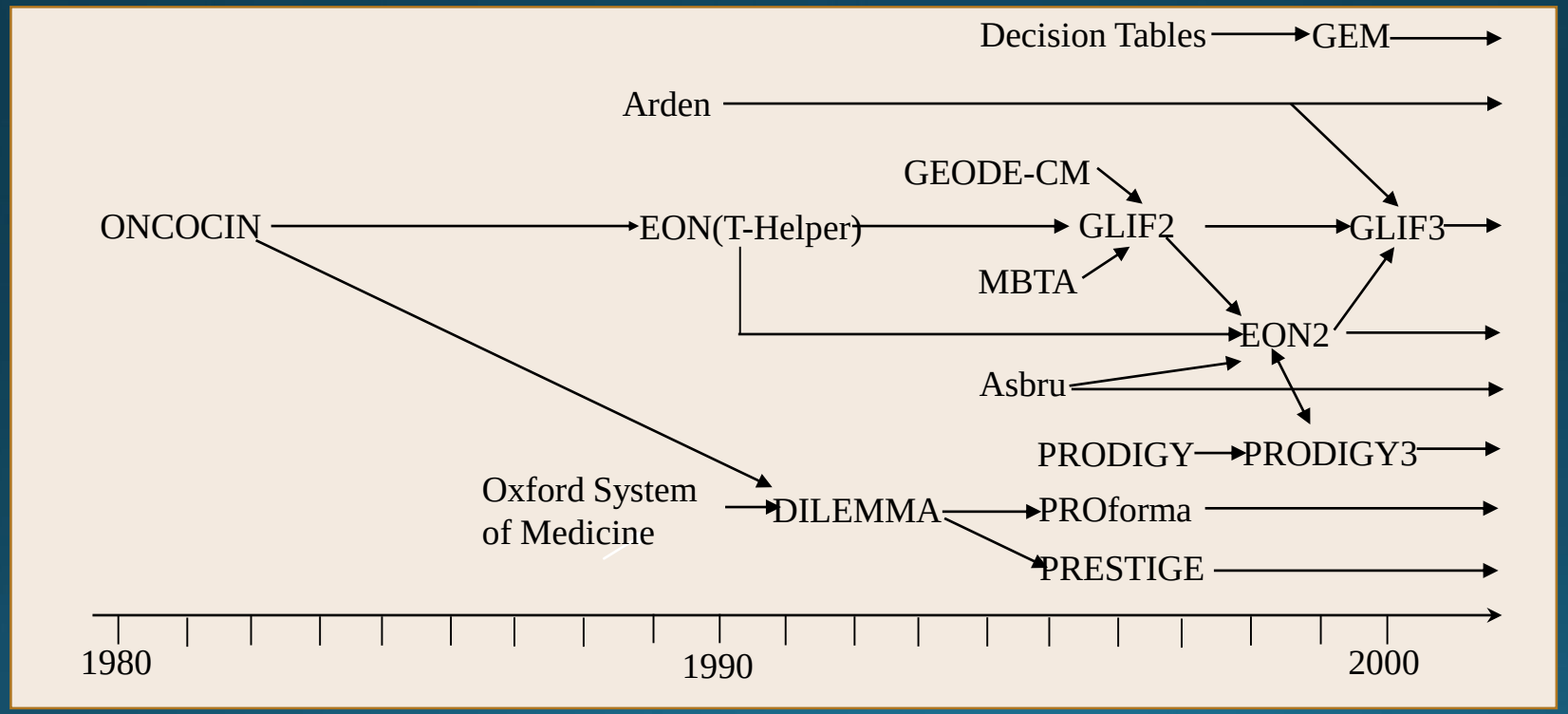
- Surveillance
- Prevention
- Prediction
- Anticipation
- Guidance
- Monitoring
- Feedback
- Learning
- Discovery

Inference Methods Used in Expert Systems and Portability

- Algorithmic
- Statistical
- Pattern Matching
- Rule-based (Heuristic)
- Fuzzy sets
- Neural nets
- Bayesian
- TBD…



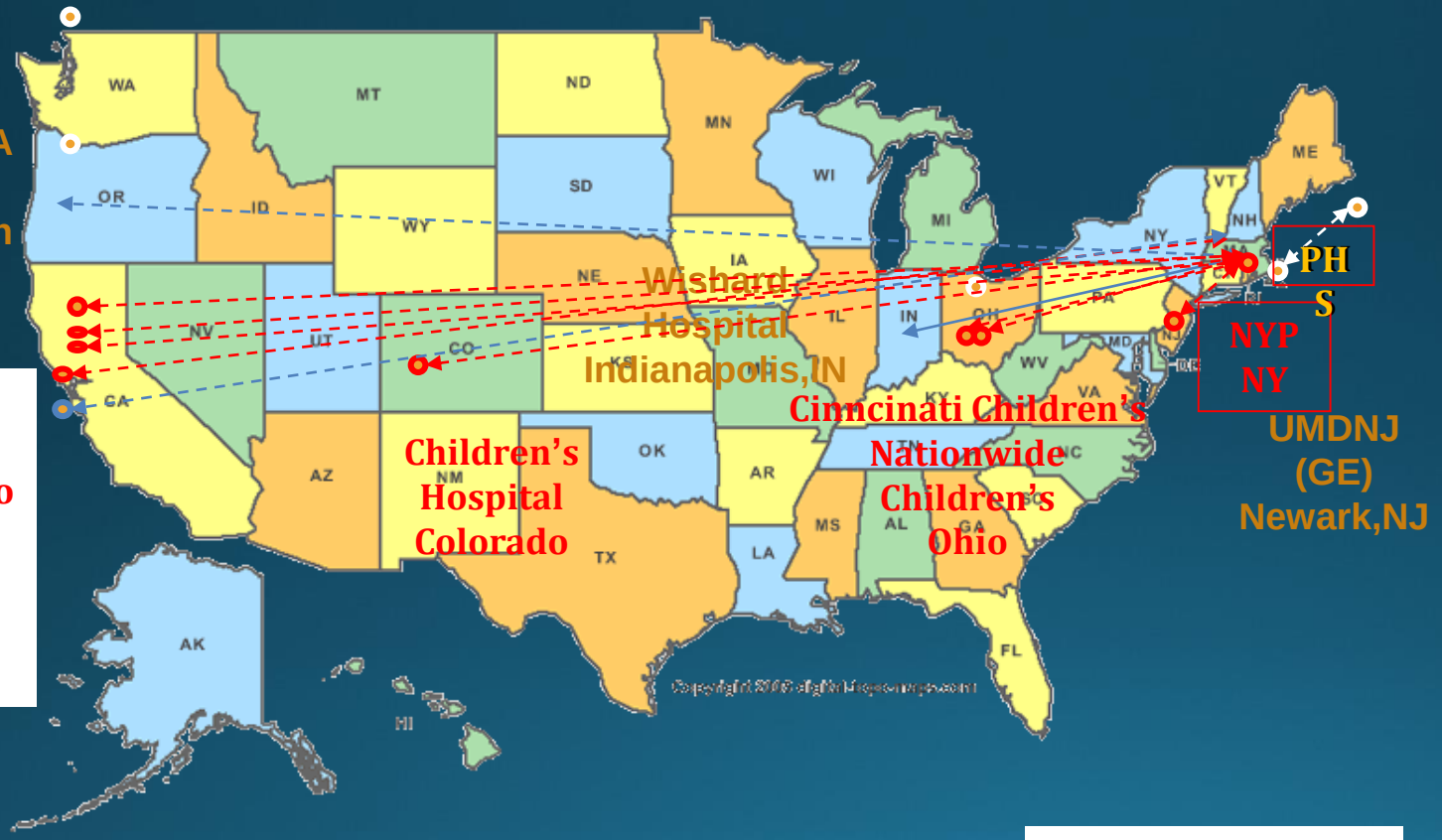
Toward generalized knowledge sharing for augmented clinical reasoning and operations



P. L. Elkin, M. Peleg, R. Lacson, E. Bernstam, S. Tu, A. Boxwala, R. Greenes, & E. H. Shortliffe. Toward Standardization of Electronic Guidelines. *MD Computing* 17(6):39-44, 2000

CDS Consortium Demonstrations

Toward a National Knowledge Sharing Service



Clinical Decision Support Consortium

Middleton B, PI: 2008-13, AHRQ –funded: HHSA290200810010

Major accomplishments:

Knowledge artifacts published: 11 clinical rules, 50+ classification rules and 375 immunization schedule rules

Eight clinical sites implemented using five different EHRs

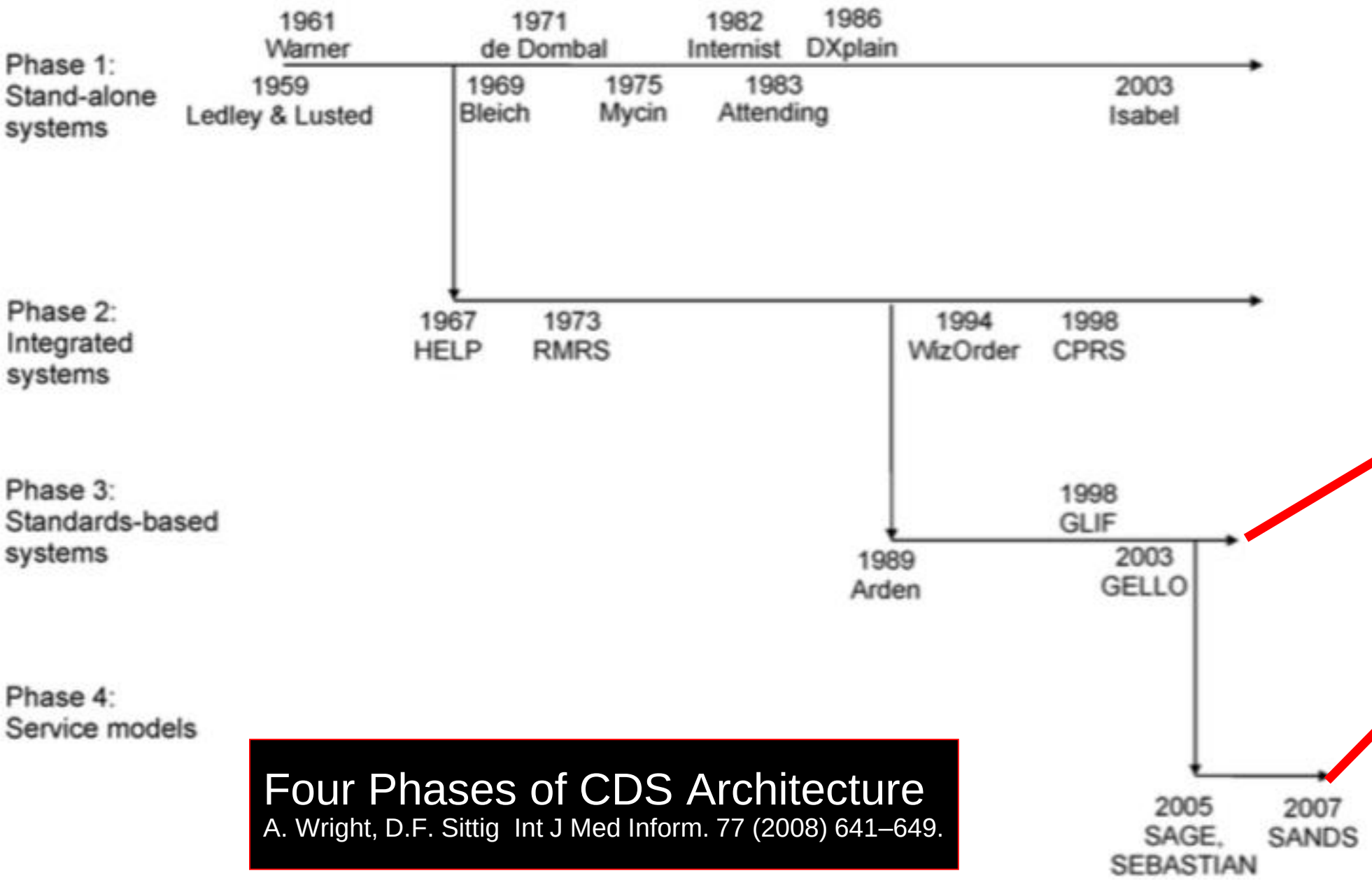
More than 240 users utilize CDS services

Established legal framework for collaboration

Since 2010, more than 1.7M CCD transactions were processed

31 entities (companies and academics) in a pre-competitive environment

Contributed to ONC-sponsored Health-e-Decisions efforts: KAS 1 and KAS 2



Four Phases of CDS Architecture

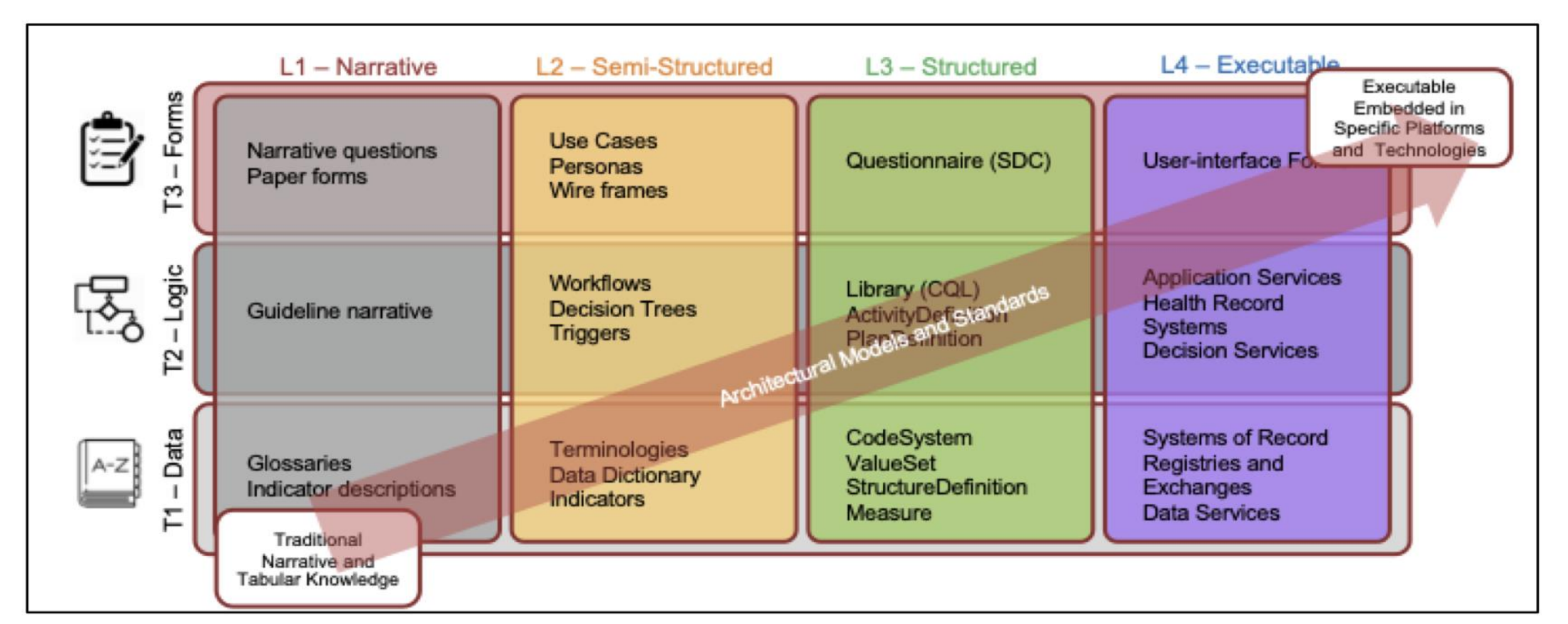
A. Wright, D.F. Sittig Int J Med Inform. 77 (2008) 641–649.

Fig. 1 – A schematic drawing of the four-phase model for clinical decision support.

HeD KAS 1
FHIR
ELM/CQL
SMArt

HeD KAS 2
CDS
Consortium,
HSPC,
Apervita…

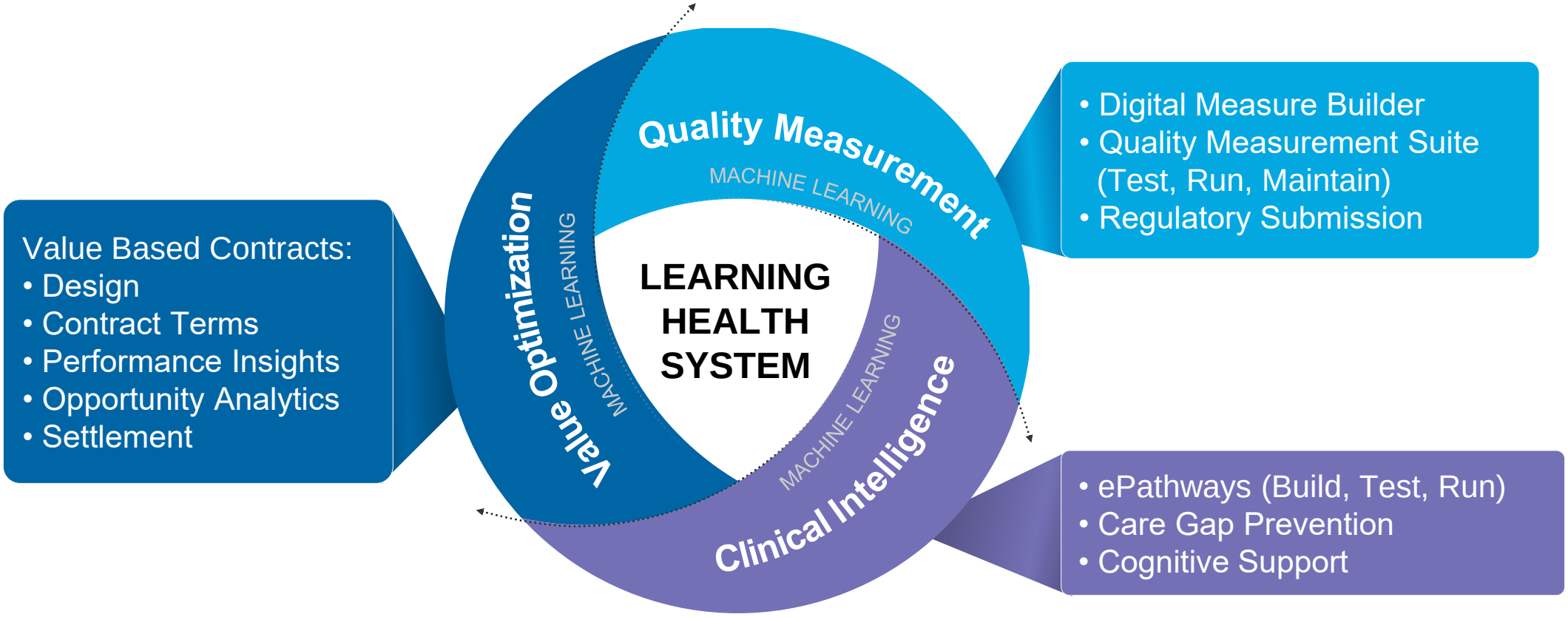
Emerging Model: HL-7 Computable Practice Guideline on FHIR Layers of Abstraction and Tiers of Implementation



Middleton B, Burton M, Rhodes B. (pre-publication) Adapted from:
http://build.fhir.org/ig/HL7/cqf-recommendations/documentation-approach.html

Apervita | Purpose: To Power the Learning Health System

Making continuous learning in healthcare a reality



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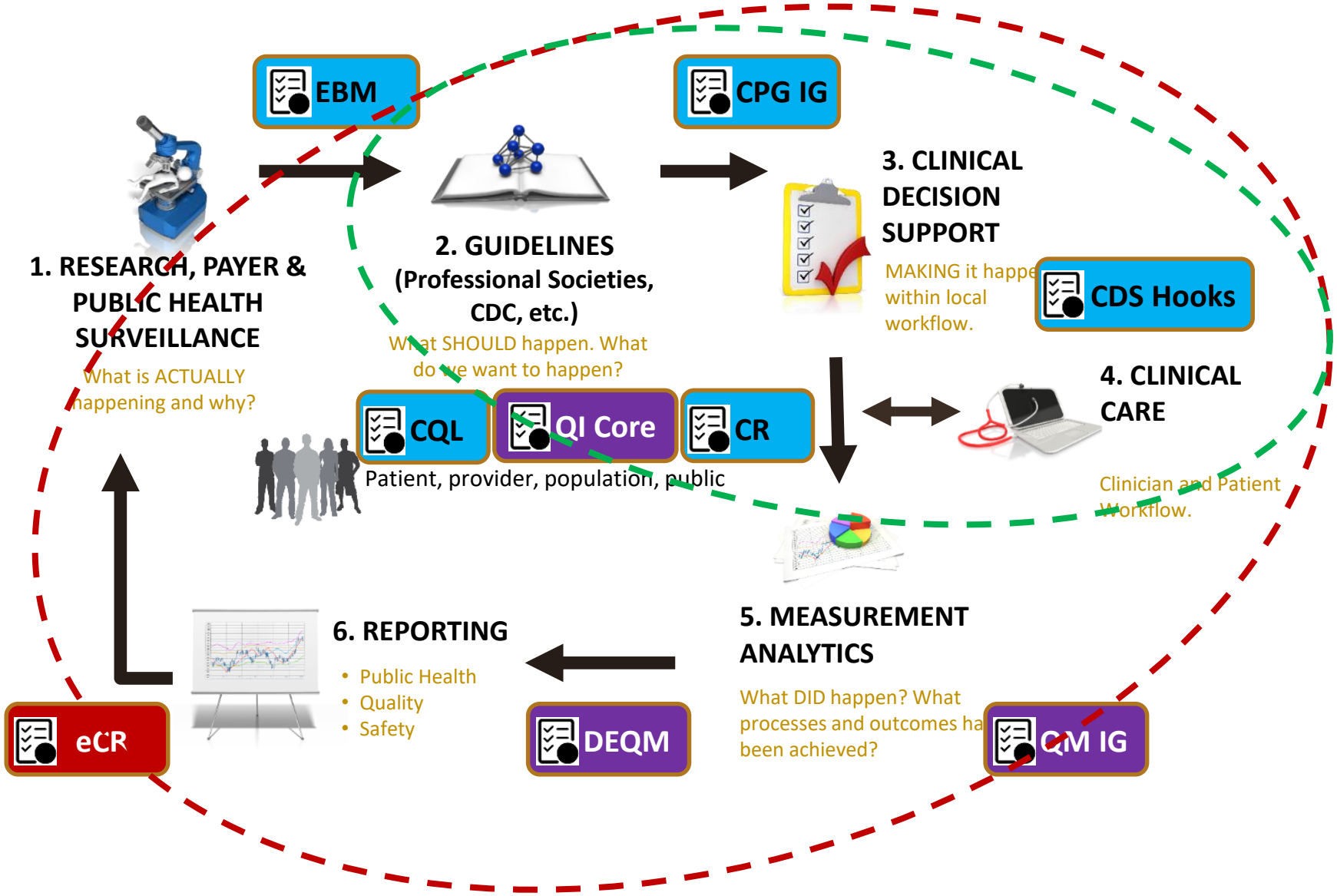
Computable Clinical Practice Guidelines (CPGs) and Pathways

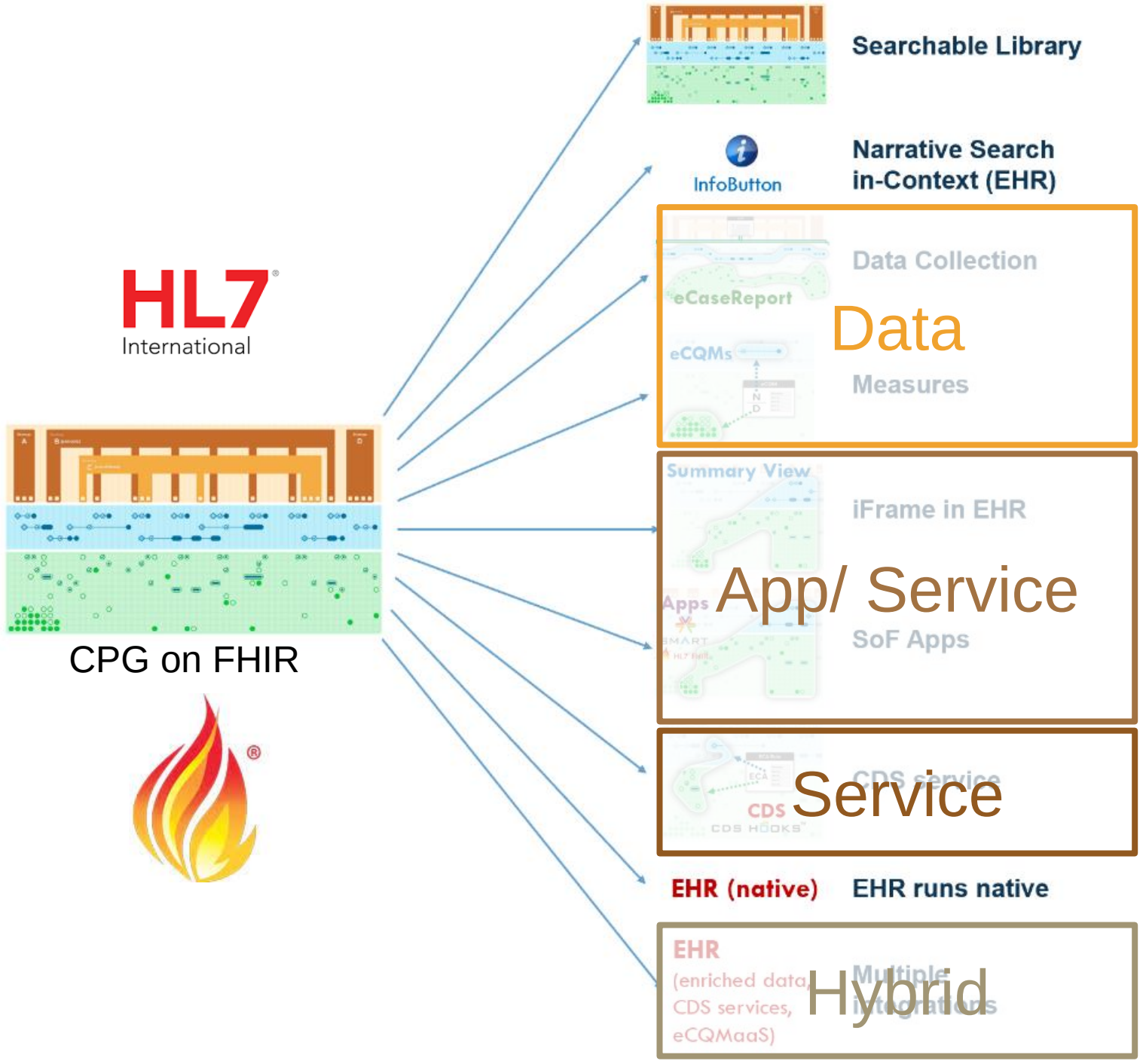
The Keystone an Interoperable Learning Health System



Apervita | Standards-based Knowledge Representation and Implementation

One Translation

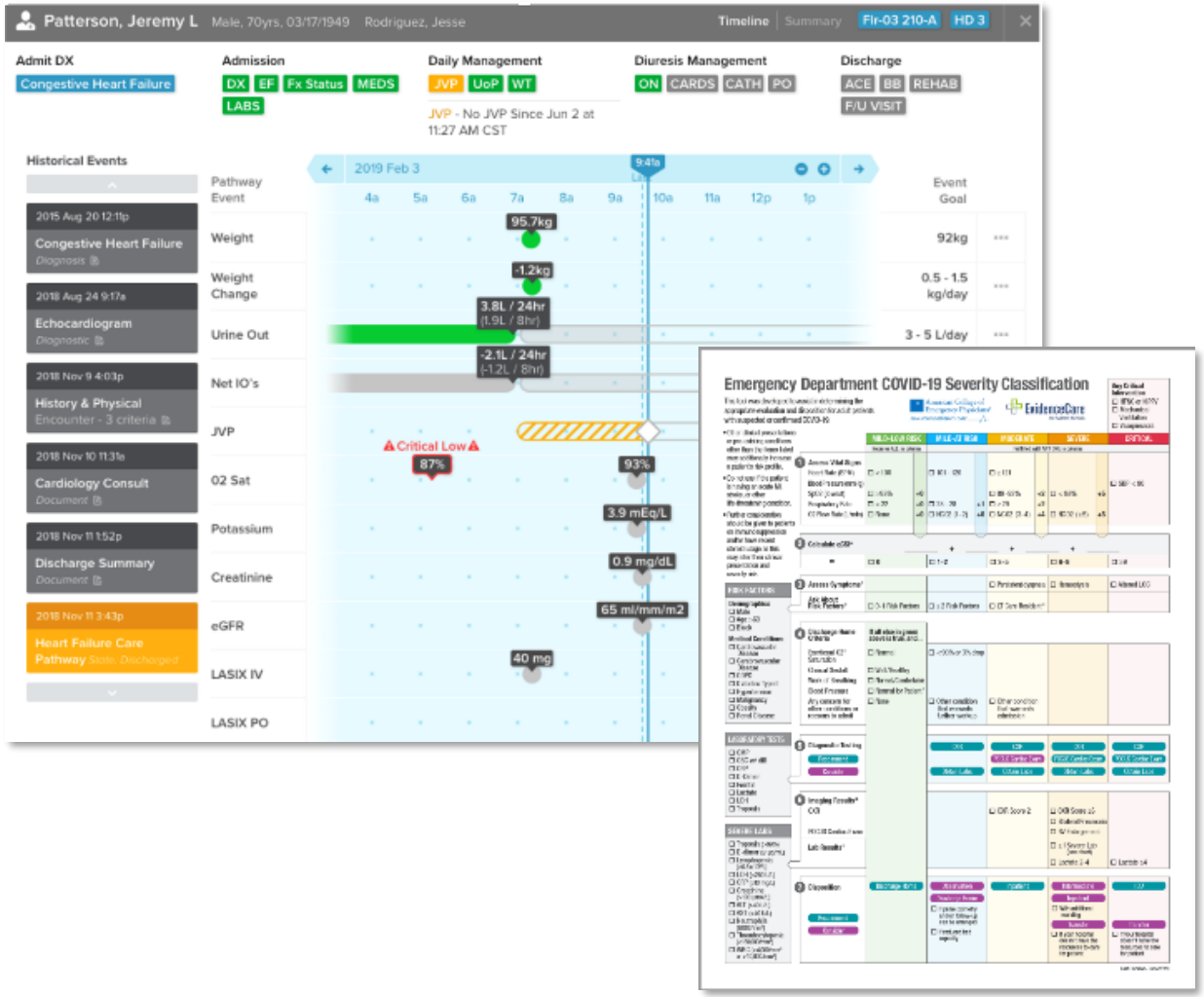
Many Ways to Implement It



Supporting Next Generation Computable CPGs

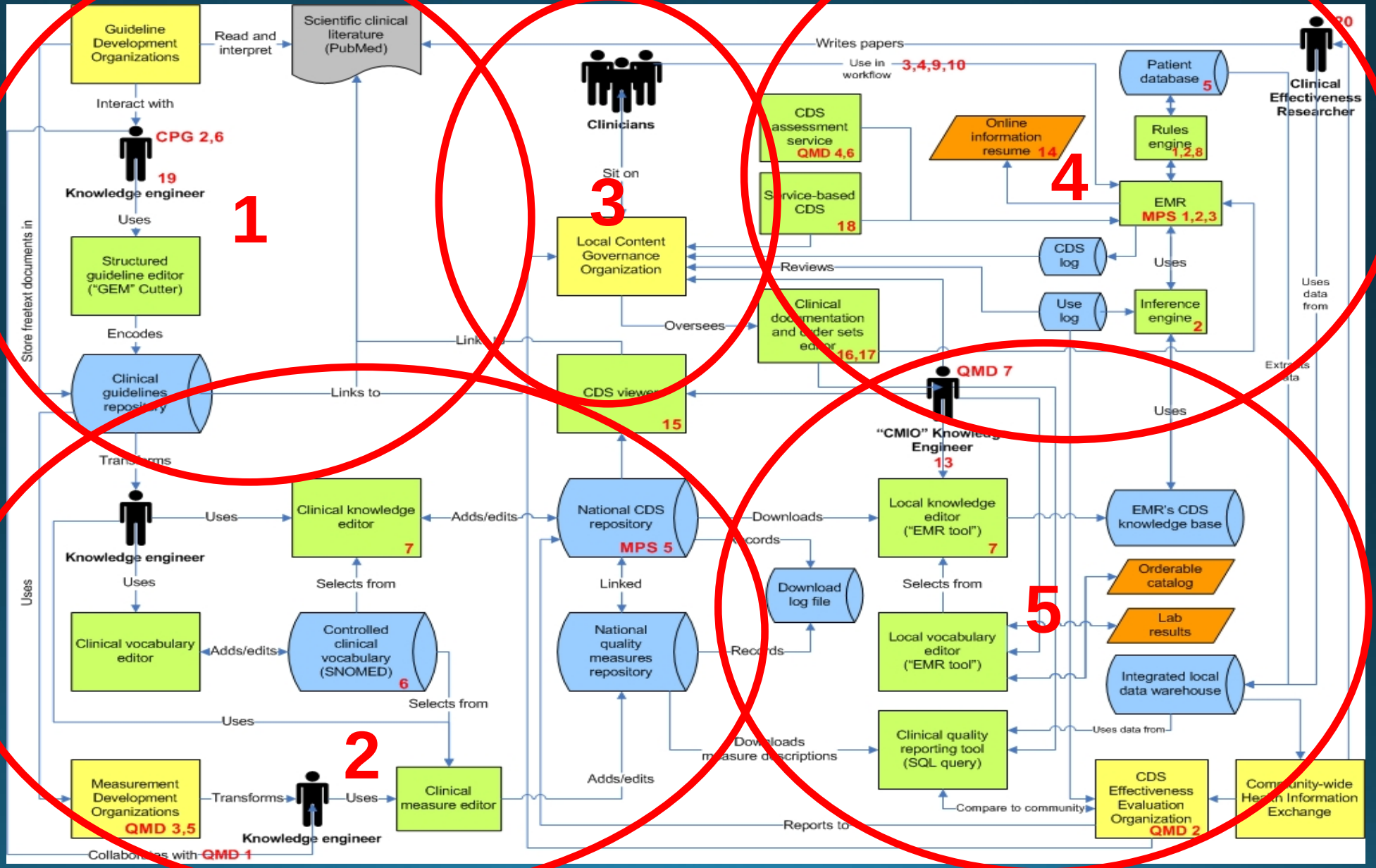
Rapidly build and deployment of Best Practices; leverage Standards & Knowledge-driven systems

- Critical to *enabling* and *empowering* a truly **Learning Health System**
- **Stateful Reasoning** (Adaptive/ Probabilistic)
  - State of Patient- and with respect to Best Practice
- **Reactive** to Native execution of CPG-on-FHIR
  - Care Processes expressed via Cognitive Support
- **Metrics**- Compliance and Adherence Measurement
  - Dozens of patterns for high value patient-specific, practice-level metrics that are
- **eCaseReports**- Registries
  - Pt-specific Case Features, Proposals, Metrics, and more captured as part of execution/ workflow
- Use HL7 Clinical Reasoning (**CQL, Definitions**) & **BPM+** as well as standard **APIs**/ services & K-Rep



Toward a National Knowledge Ecosystem

1. Guideline Development
2. Knowledge Translation, Specification
3. Content Governance
4. Knowledge Implementation
5. Knowledge Use, Evaluation, and Feedback

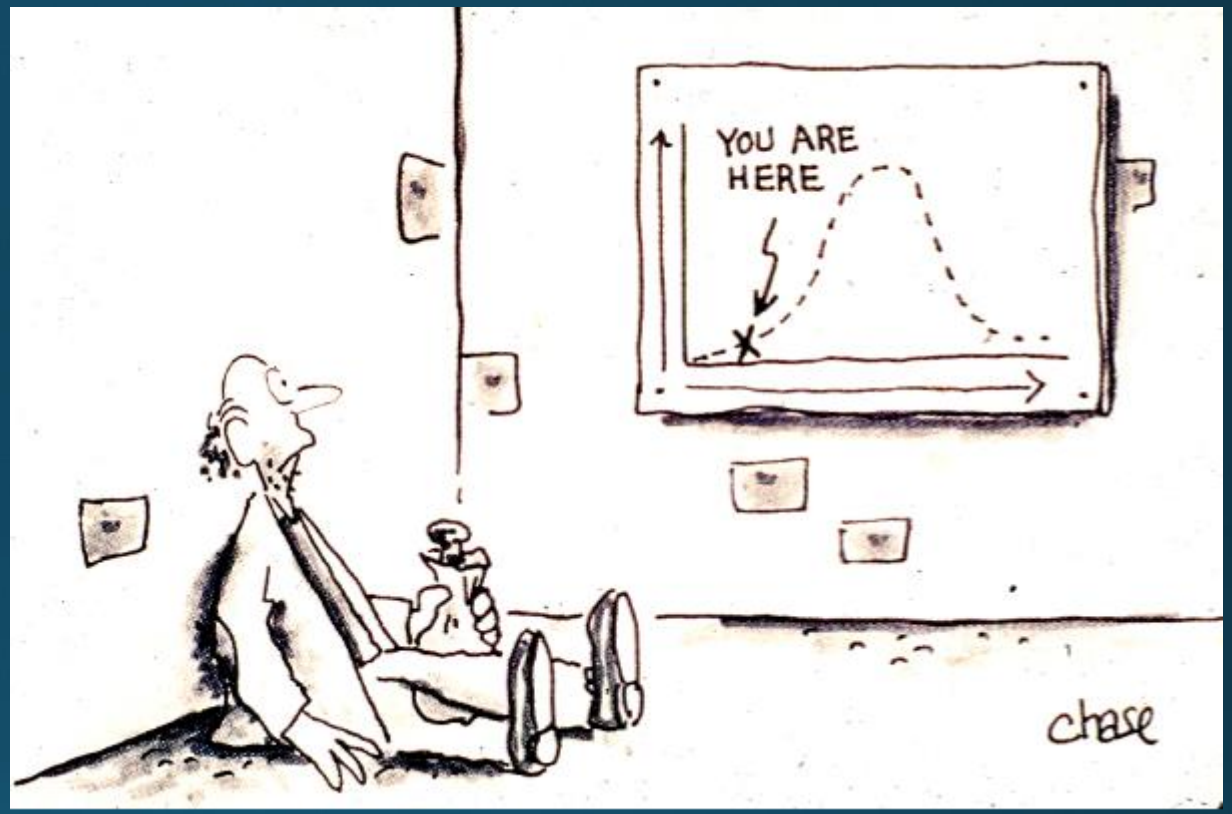


Sittig DF, Wright A, Ash J, Turechek ZD, Middleton B. A Conceptual Architecture for National Standards-based Clinical Decision Support Integration and Syndication. Manuscript in preparation.

Where are we?

"Knowing is not enough; we must apply. Willing is not enough; we must do."

—Goethe



Thank you!

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