Effective use of IT and decision support in guideline implementation

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Readings


- See also AHRQ CDS Consortium: [www.partners.org/cird/cdsc](http://www.partners.org/cird/cdsc) (HHSA290200810010)
- See also ONC Advancing CDS: [www.rand.org/health/projects/clinical-decision-support.html](http://www.rand.org/health/projects/clinical-decision-support.html) (HHSP23320095649WC)
Overview

- Motivation for CDS
- Approaches to Knowledge Sharing
- Experiences with the CDS Consortium
Figure 1 Schematic contrasting human cognitive capacity (e.g., the number of sets of facts the brain can correlate in a decision) with the explosion of new biomedical data types. SNP indicates single nucleotide polymorphism. The authors adapted this figure with permission from Stead.5
## The Quality of Health Care Delivered to Adults in the United States

Elizabeth A. McGlynn, Ph.D., Steven M. Asch, M.D., M.P.H., John Adams, Ph.D., Joan Keesey, B.A., Jennifer Hicks, M.P.H., Ph.D., Alison DeCristofaro, M.P.H., and Eve A. Kerr, M.D., M.P.H.

<table>
<thead>
<tr>
<th>ADA Guideline</th>
<th>Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test for lipid disorders at least annually and more often if needed to achieve goals.</td>
<td>57.86%</td>
</tr>
<tr>
<td>Visual foot exam at every routine visit, comprehensive foot examination annually.</td>
<td>44.92%</td>
</tr>
<tr>
<td>Test for microalbuminuria in all type 2 diabetic patients at least annually and during pregnancy.</td>
<td>23.62%</td>
</tr>
<tr>
<td>Dilated and comprehensive <strong>eye exam</strong> at diagnosis of Type 2 and annually.</td>
<td>14.21%</td>
</tr>
</tbody>
</table>

On average, Patients receive 54.9% of recommended care

“What information consumes is rather obvious: it consumes the attention of its recipients.

Hence a wealth of information creates a poverty of attention, and a need to allocate that attention efficiently among the overabundance of information sources that might consume it.”

Changing clinician roles:

- From Omniscient Oracle... to Knowledge Broker.
CITL HIT Value Assessments

- Net US could save $150B with HIT adoption, or approximately 7.5% or US Healthcare Expenditure
  - The Value of Ambulatory Computerized Order Entry (ACPOE)
    - $44B US nationally; $29K per provider, per year
  - The Value of HealthCare Information Exchange and Interoperability (HIEI)
    - $78B/yr
  - The Value of IT-enabled Chronic Diabetes Management (ITDM)
    - $8.3B Disease Registries; Advanced EHR $17B
  - The Value of Physician-Physician Tele-healthcare
    - >$20B*
  - The Value of Personal Health Records
    - Approx. $20B
Iran’s agony
The mystery of Mrs Merkel
Asia’s consumers to the rescue?
The Greeks and those marbles
Evolution and depression

Reforming health care
This is going to hurt
A perfect storm for CDS?

- Lots of clinical data going online
  - Increasing standardization, health information exchange
  - Lots of genetic data coming
  - Lots of personal/social data coming
  - Lots of geospatial data coming

- Inexorable rise of Healthcare costs...
  - Healthcare Reform
CDS Grand Challenges

- Summarize patient-level information
- Prioritize recommendations to users
- Combine recommendations for patients with co-morbidities
- Improve the human-computer interface
- Use free text information in clinical decision support
- Manage large clinical knowledge databases
- Create a internet-accessible, clinical decision support repository
- Prioritize CDS content development and implementation
- Disseminate best practices
- Create an architecture for sharing executable CDS modules
- Mine large clinical databases to create new CDS

Sittig et al., J Bio Inf 2008
Inference Methods Used in Expert Systems

- Algorithmic
- Statistical
- Pattern Matching
- Rule-based (Heuristic)
- Fuzzy sets
- Neural nets
- Bayesian
- TBD...
Knowledge Translation and Specification

Evidence

Experience

Guideline(s)

K Repres’n

Shareable K

Executable

Decision Tables

GEM

Arden

ONCOCIN

EON(T-Helper)

GLIF2

GLIF3

GEODE-CM

MBTA

EON2

Asbru

PRODIGY

PRODIGY3

DILEMMA

PROforma

PRESTIGE

Oxford System of Medicine

1980


2000
The Unified Theory for CDS

Clinical Guidelines → GEM → Structured Knowledge → CDSC “L2” → Implementable/Executable Knowledge → Service → CDSC “L3” → OpenCDS/HL7 CDSC “L4” → VMR → CDSC “CCD+” → EHR
Goal: To assess, define, demonstrate, and evaluate best practices for knowledge management and clinical decision support in healthcare information technology at scale – across multiple ambulatory care settings and EHR technology platforms.

Significance: The CDS Consortium will carry out a variety of activities to improve knowledge about decision support, with the ultimate goal of supporting and enabling widespread sharing and adoption of clinical decision support.

1. Knowledge Management Life Cycle
2. Knowledge Specification
3. Knowledge Portal and Repository
4. CDS Public Services and Content
5. Evaluation Process for each CDS Assessment and Research Area
6. Dissemination Process for each Assessment and Research Area
Knowledge is Like a Cake-Stack

Enterprise or Standard App Rules

Enterprise or Standard App Templates, Flowsheets, Forms, Order Sets, etc

Enterprise Order Catalogues and Classes

Enterprise Meds (Dictionaries, Classes, Contraindications, Indications, Adverse Effects, Allergies)

Intermediate Concept Classes

Enterprise Problem Lists

Enterprise Terminologies Svss

Collections of Concepts – Braden Assessment Full Nursing Assessment
Collections of Orders – Order Sets

Med Orders, Special Beds, Topicals
Consults - Neurology or Vascular

If Braden Score < 11: Low Air Loss Bed, etc
If Abn Vasc Exam: Vascular Consult

Dorsalis Pedis Pulse: Present or Absent
Posterior Tibial Pulse: Present or Absent
Color Pink, Pale, or Rubor on Dependency
Ankle Brachial Index range 0.7–1.0

Taxonomies of Problems such as CAD, Diabetes, Peripheral Vascular DZ

Taxonomies of Terms such as Skin Exam, Decub Ulcer, Pulse, Skin Turgor
# Building Blocks For Rule Modularity and Reusability

## Assessment Rules
- Indication State Rules
- Observation State rules
- Classes of Observations LOINC or SNOMED
- Observation Dictionaries LOINC or SNOMED

## Screening Rules
- Goal State Rules
- Problem Class State Rules
- SNOMED Problem Subsets
- Problem List Dictionaries SNOMED

## Management Rules
- Contraindication State Rules
- Drug Class State Rules
- NDF-RT Drug Classes
- Drug Dictionaries RX Norm

## Disease State Rules
- Disease State Rules
- Order Class State Rules
- Other Order Classes
- Order Catalogues
Three Models to Accelerate Knowledge -> Practice

• Current paper-based approach

• Knowledge artifact import into EMR

• Cloud-based clinical decision support services


**Knowledge Translation and Specification: Four-Layer Model**

**Level 1**
Unstructured Format: .jpeg, .html, .doc, .xl
+ metadata

**Level 2**
Semi-structured Format: xml
+ metadata

**Level 3**
Structured Format: xml
+ metadata

**Level 4**
Machine Execution Format: any
+ metadata

**Initial evaluation results:** Structured recommendation (L3) was considered *more implementable* than the semi-structured recommendation (L2).

An external repository of clinical content with web-based viewer

http://cdsportal.partners.org
CDS Consortium Demonstrations

Toward a National Knowledge Sharing Service

Mid-Valley IPA (NextGen)
Salem, Oregon

Kaiser Roseville
UC Davis
Kaiser Sacramento
Kaiser San Rafael
Kaiser San Francisco
California

Wishard Hospital
Indianapolis, IN

Children’s Hospital
Colorado

Cincinnati Children’s
Nationwide Children’s
Ohio

NYP
NY

UMDNJ (GE)
Newark, NJ

PECARN TBI CDS
Screenshot of CDSC Reminders, in Regenstrief G3 EMR: “Prevention/Recommendations”
Traumatic Brain Injury Risk: Child less than 2 years

**RECOMMENDATION:** Clinical observation in the ED is an acceptable strategy for many patients such as this, whose only risk factor from the [PECARN prediction rule](https://www.pecarn.com) is presence of a temporal, parietal, or occipital scalp hematoma.

**Risk Estimate:** The risk of clinically-important traumatic brain injury for this patient is approximately 0.5% (4/821) based on the PECARN head injury study.

*Importantly, the PECARN data were based on initial attending evaluations (not based on subsequent evaluations over time).*

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Traumatic Brain Injury Risk: Child less than 2 years

**RECOMMENDATION:** A head CT is not recommended for this patient based on the absence of any of the [PECARN prediction rule](https://www.pecarn.com) variables.

**Risk Estimate:** The risk of *clinically-important traumatic brain injury* for patients less than 2 years is < 1/5000

*Importantly, the PECARN rules were based on attending initial evaluations (not based on subsequent evaluations over time).*

The age-specific PECARN rule findings documented are:

- Loss of consciousness?: No
- Acting normally per caregiver?: Yes
- Mechanism of injury?: Mild
- Total Glasgow Coma Scale score: 15
- Other signs of altered mental status?: No
- Scalp hematoma?: None
- Palpable skull fracture or unclear on the basis of swelling or distortion of the scalp?: No
- If the above clinical findings are incorrect, please revise.

*Note: The PECARN prediction rules do not apply to patients with bleeding diatheses, ventricular (e.g., “VP”) shunts, known brain tumors, or pre-existing neurological disorders complicating your clinical assessment.*

[Click here to view the PECARN prediction rule manuscript (Lancet)](https://www.pecarn.com)
# PHS Immunizations SMArt App

## Immunization Record SMART Application

### Amy Shaw (female, DOB: 2007-03-20)

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Due</th>
<th>Doses</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROTAVIRUS</td>
<td>5/1/12</td>
<td>5/24/07</td>
</tr>
<tr>
<td>DTAP</td>
<td>3/1/12</td>
<td>9/27/07</td>
</tr>
<tr>
<td>HepB</td>
<td>1/2/12 - 2/1/12</td>
<td>9/27/07</td>
</tr>
<tr>
<td>POLIO</td>
<td>3/1/12</td>
<td>9/27/07 1/27/11 5/27/11</td>
</tr>
<tr>
<td>HPV</td>
<td>1/1/23 - 1/1/24</td>
<td></td>
</tr>
<tr>
<td>MENING</td>
<td>1/1/23 - 1/1/24</td>
<td></td>
</tr>
<tr>
<td>HepA</td>
<td>1/1/13 - 7/1/13</td>
<td></td>
</tr>
<tr>
<td>ZOSTER</td>
<td>Not indicated Patient not yet indicated for ZOSTER vaccine</td>
<td></td>
</tr>
<tr>
<td>VARICELLA</td>
<td>1/1/13 - 4/1/13</td>
<td></td>
</tr>
<tr>
<td>HBV</td>
<td>3/1/12</td>
<td></td>
</tr>
<tr>
<td>MMR</td>
<td>1/1/13 - 4/1/13</td>
<td></td>
</tr>
<tr>
<td>PneumoPCV</td>
<td>3/1/12 - 4/1/12</td>
<td></td>
</tr>
<tr>
<td>FLU</td>
<td>Not indicated - Current date is not within influenza season</td>
<td></td>
</tr>
</tbody>
</table>
The Nationwide Health Information Network

Mobilizing Health Information Nationwide

And knowledge!
Acknowledgements

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KM Portal Team: Tonya Hongsermeier, MD, MBA
CDS Services Team: Howard Goldberg, MD
CDS Demonstrations Team: Adam Wright, PhD
CDS Dashboards Team: Jonathan Einbinder, MD
CDS Evaluation Team: David Bates, MD, MSc
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