Clinical Decision Support

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Overview

- Why do we need clinical decision support?
- Types of Clinical Decision Support
- ARRA, the HIT Stimulus, and Clinical Decision Support
- Select current CDS R&D Topics at Partners
- Discussion/Q&A
“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.”
Medical literature doubling every 19 years
  ➢ Doubles every 22 months for AIDS care
2 Million facts needed to practice
Covell study of LA Internists:
  ➢ 2 unanswered clinical questions for every 3 pts
    • 40% were described as questions of fact,
    • 44% were questions of medical opinion,
    • 16% were questions of non-medical information.

Kassirer J, Pauker S. NEJM 1973
Covell DG, Uman GC, Manning PR.
Generally, with direct observation, or interview immediately after clinical encounters, physicians have approximately one question for every 1-2 patients

- Independent estimates: 0.6, and 0.62 Q/pt
- Holds across PCP and specialty care
- Holds across urban and rural

Gorman, 1995
Gorman and Helfand 1995
Factors Positively Influencing Information Seeking Behavior

- Factors correlating best with pursuit of an answer
  - Urgency – the question had to be answered soon
  - Answerability – the physician felt an answer was likely to exist
  - Generalizability – an answer would help manage other patients

Gorman & Helfand, 1995
Factors that did Not Correlate with Information Seeking Behavior

- Knowledge – how much was previously known about the problem
- Uneasiness – how uneasy the physician felt about the problem
- Potential help – an answer could help the patient
- Potential harm – not having an answer could hurt the patient
- Edification – an answer would benefit the practitioner’s general knowledge
- Liability – the problem involved liability risk
- Knowledge of peers – peers of the practitioner know the answer
- Difficulty – how difficult would it be to find the answer

Gorman & Helfand, 1995
Paper-based Medicine

- Prone to error
- Lots of information but no data
- Limited decision support, or quality measurement
- Does not integrate with eHealthcare
- Will not transform healthcare
HITECH Act: HIT Adoption
Stimulus $34B

- Medicare/Medicaid support for provider and hospital adoption of HIT
  - Hospitals $2M (+/- depending on case mix and Medicare Part A inpatient bed days)
  - Physicians potentially > $60K (+/- depending on case mix)
  - Certified HIT (Certification Commission for HIT)
  - “meaningful use”: eRx, healthcare information exchange, quality reporting
  - Meaningful use must be achieved by 2012 to realize full incentives
  - Penalties for non-use after 2015
CDS Applications by Category

- Alerting/Reminding
  - Drug-drug interaction, allergy, drug-lab, drug-symptom
- Formatting
  - Results review, “pocket rounds” reports
- Interpreting
  - EKG, PFTs, Pap, ABG
- Consulting
  - QMR, DxPlain, Iliad, Meditel, Abd Pain, MI risk
- Monitoring
  - Alerts: Critical labs, ABx/Surgery, ADEs
- Critiquing
  - Vent mgmt, anesthesia mgmt, HTN Rx, Radiology test selection, Blood products ordering

Kuperman GJ et al. J Hlth Info Mgmt (13)2, pg 81-96
The Evidence for CDS

- CDS yields increased adherence to guideline-based care, enhanced surveillance and monitoring, and decreased medication errors
  - (Chaudhry et al., 2006)

- CDS, at the time of order entry in a computerized provider order entry system can help eliminate overuse, underuse, and misuse.
  - (Bates et al., 2003; Austin et al., 1994; Linder, Bates and Lee, 2005; Tierney et al., 2003)

- For expensive radiologic tests and procedures this guidance at the point of ordering can guide physicians toward ordering the most appropriate and cost effective, radiologic tests.
  - (Bates et al., 2003; Khorasani et al., 2003)

- Showing the cumulative charge display for all tests ordered, reminding about redundant tests ordered, providing counter-detailing during order entry, and reminding about consequent or corollary orders may also impact resource utilization
  - (Bates and Gawande, 2003; Bates, 2004; McDonald et al., 2004).
The Value of Ambulatory CDS

- CITL model projects annual savings of approximately $44 billion from reduced medication, radiology, laboratory, and ADE-related expenses
- The value of ambulatory CPOE occurs with advanced CDS
- Advanced CDS systems cost five times as much as basic CDS, but were projected to generate 12 times greater financial return
- A potential reduction of more than 2 million adverse drug events (ADEs) annually with nationwide implementation of ambulatory CPOE

Johnston et al., 2003
Problems with CDS

22 Categories of Increased Medication Risk

- **Information Errors**
  - Assumed dose
  - Med d/c failure
  - Procedure-linked med error
  - Give now, and prn d/c error
  - Antibiotic renewal
  - Diluent option error
  - Allergy display
  - Conflict or duplicate med

- **User Interface/Workflow Errors**
  - Patient selection
  - Med selection
  - Unclear log on/off
  - Meds after surgery
  - Post surgery suspended meds
  - Time/data loss when CPOE down
  - Med delivery error
  - Timing errors
  - Delayed nursing documentation
  - Rigid system design

*Koppel R et al. JAMA 293:10, Mar 2005*
Problems with CDS

- Han YY (Pediatrics 116:6, Dec 2005)
  - Analyzed data 13 prior, and 5 months post, implementation of CPOE in critical care
  - Pre CPOE mortality rate 2.8%, Post 6.57%
  - 3.28 Odds ratio after multivariate analysis adjusting for covariates

- Conclusions
  - Order delay due to lack of pre-register
  - Up front time cost to enter orders
  - Nurses away from bedside, at computer
  - Altered interactions between ICU team members
  - Delayed pharmacy administration
  - Problems with order timing (subsequent doses)

- Comment: Implementation flawed in many ways
<table>
<thead>
<tr>
<th>Types of Unintended consequences</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>new work for clinicians</td>
<td>19.8</td>
</tr>
<tr>
<td>unfavorable workflow issues</td>
<td>17.6</td>
</tr>
<tr>
<td>never ending system demands</td>
<td>14.8</td>
</tr>
<tr>
<td>problems related to paper persistence</td>
<td>10.8</td>
</tr>
<tr>
<td>untoward changes in communication patterns</td>
<td>10.1</td>
</tr>
<tr>
<td>negative emotions</td>
<td>7.7</td>
</tr>
<tr>
<td>generation of new kinds of errors</td>
<td>7.1</td>
</tr>
<tr>
<td>unexpected changes in the power structure</td>
<td>6.8</td>
</tr>
<tr>
<td>overdependence on the technology</td>
<td>5.2</td>
</tr>
</tbody>
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*Ash J, et al. JAMIA 2007*
Rates of Positive Survey Responses on the Effect of Adoption of EMRs, 2008

4% of physicians use fully functional electronic health records
13% use some form of basic electronic records

yet, 89% of the benefit of HIT goes to others,
Current adoption of advanced clinical decision support is limited due to a variety of reasons, including:

- Limited implementation of EMR, CPOE, PHR, etc.
- Difficulty developing clinical practice guidelines.
- A lack of standards
- Absence of a central repository or knowledge resource.
- Limited CDS functionality in commercial EHRs.
- Challenges in integrating CDS into the clinical workflow.
- A limited understanding of organizational, and cultural issues relating to clinical decision support.
“A knowledge-based system is an AI program whose performance depends more on the explicit presence of a large body of knowledge than on the presence of ingenious computational procedures...”

Inference Methods Used in Knowledge-based Systems

- Algorithmic
- Statistical
- Pattern Matching
- Rule-based (Heuristic)
- Fuzzy sets
- Neural nets
- Bayesian
Assessment and recommendations generated from rules engine

- Lipids
- Anti-platelet therapy
- Blood pressure
- Glucose control
- Microalbuminuria
- Immunizations
- Smoking
- Weight
- Eye and foot examinations

- Blood Pressure is above goal (avg. over last 2 visits 130/80, goal < 130/80)
- Patient is on anti-platelet therapy
- Patient is due for Pneumovax (older than 65, no record of prior vaccination)
- Patient is due for Influenza Vaccine (high risk medical condition)
- Patient may be Current Smoker, not thinking of quitting. Last counseled on 10/10/06.
- Patient is overweight or obese (BMI 27.1 on 10/31/06, goal < 25)
CAD/DM Smart Form

**Medication Orders**

75 yo man with CAD, DM, and elevated CK. He is not take any of his medications. I last saw him 3 months ago.

**Review of Systems**
ROS: No F, C, N, V, SOB, cough, CP, palpitations, abdominal pain, bowel changes, vision changes, hearing changes, MS problems, headache, dizziness in limbs increased moisture, decreased

**Lab Orders**

**CAD-related**
- Diabetes mellitus type 1
- Coronary artery disease

**DM-related**
- Diabetes mellitus type 1

**Referrals**
- Onychomycosis
- Elevated creatine phosphokinase

**Procedures**
None listed

**Handouts/Education**

- Adjust Qutec 25 MG (25MG TABLET take 1) PO QD
- Adjust Lisinopril 20 MG (20MG TABLET take 1) PO QD
- Adjust Acetabutolol HCL 200 MG (200MG CAPSULE take 1) PO QD

**Blood Pressure Management**

Blood Pressure is above goal (avg. over last 2 visits 130/80, goal < 130/80)

- Start an Other Anti-Hypertensives (Help Me Choose)
  - Adjust Qutec 25 MG (25MG TABLET take 1) PO QD
  - Adjust Lisinopril 20 MG (20MG TABLET take 1) PO QD
  - Adjust Acetabutolol HCL 200 MG (200MG CAPSULE take 1) PO QD

- Order Chem 7 now
- Order Chem 7 in [Weeks]
- Referral to Nutritionist
- Referral to Cardiac Rehab (Help Me Choose)
- Referral to Blood Pressure Specialist (Help Me Choose)
- Print "Control High Blood Pressure"
- Print DASH diet instructions
- Print exercise "prescription"
Converting evidence to care

Original research

Negative results

18%
Dickersin, 1987

Submission

46%
0.5 year
Kumar, 1992

17 years to apply 14% of research knowledge to patient care!

Bibliographic databases

6.0 - 13.0 years
Antman, 1992

Reviews, guidelines, textbook

9.3 years

Patient Care

Lack of numbers

50%
Poynard, 1985

Inconsistent indexing

Dickersin, 1987

Koren, 1989

Balas, 1995

Kumar, 1992

Poyer, 1982

Antman, 1992

Balas Yearbook Medical Informatics 2000gtre4, courtesy M Overhage
The Knowledge Management Portal Filter-Based Search page:

This screen shot illustrates the filter search selections that facilitate knowledge sharing across Partners HealthCare System. Filter selections include: Clinical disciplines, entity, venue, application, content type, disease management and patient safety.
AHRQ’s Goals for Advancing Clinical Decision Support

- To facilitate the development, adoption, implementation and evaluation of best practices using CDS.

- To further enhance the nation's efforts to make evidence-based clinical knowledge more readily available to health care providers.

- [http://www.partners.org/cird/cdsc/](http://www.partners.org/cird/cdsc/)
CDS Consortium Specific Research Objectives

- Knowledge management lifecycle
- Knowledge specification
- Knowledge Portal and Repository
- CDS Knowledge Content and Public Web Services
- Evaluation
- Dissemination

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<thead>
<tr>
<th>1. Knowledge Management Life Cycle</th>
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<tr>
<td>5. Evaluation Process for each CDS Assessment and Research Area</td>
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<tr>
<td>6. Dissemination Process for each Assessment and Research Area</td>
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Knowledge Artifacts by Layer

- Published Guideline
- Semi-structured Recommendation
- Abstract Rule
- Abstract Order Set
- Executable Rules
- Order Sets in CPOE system
Discussion, Q&A

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