Impact of providing evidence-based answers to a broad base of clinical questions at the point of care

Technical Expert Panel on Clinical Decision Support
Denise Basow, MD
President, Editor-in-Chief
UpToDate
# AMIA Taxonomy of Clinical Decision Support Tools

- **Medication dosing support**
  - Medication dose adjustment
  - Formulary checking
  - Single dose range checking
  - Maximum daily dose checking
  - Maximum lifetime dose checking
  - Default doses/pick lists
  - Indication-based dosing

- **Order facilitators**
  - Medication order sentences
  - Subsequent or corollary orders
  - Indication-based ordering
  - Service-specific order sets
  - Condition-specific order sets
  - Procedure-specific order sets
  - Condition-specific treatment protocol
  - Transfer order set
  - Non-medications order sentences

- **Point of care alerts/reminders**
  - Drug-condition interaction checking
  - Drug-drug interaction checking
  - Drug-allergy checking
  - Plan of care alerts
  - Clinical laboratory value checking
  - Duplicate order checking
  - Care reminders
  - Look-alike/sound alike medication warnings
  - Ticklers
  - Problem list management
  - Radiology ordering support
  - Intravenous (IV)/per os (PO) conversion
  - High-risk state monitoring
  - Polypharmacy alerts

- **Workflow support**
  - Order Routing
  - Registry functions
  - Medication reconciliation
  - Automatic order termination
  - Order approvals
  - Free-text order parsing
  - Documentation aids

- **Expert Systems**
  - Antibiotic ordering support
  - Ventilator support
  - Diagnostic support
  - Risk assessment tools
  - Prognostic tools
  - Transfusion support
  - Nutrition ordering
  - Laboratory test interpretation
  - Treatment planning
  - Triage tools
  - Syndromic surveillance

- **Relevant Information display**
  - Context-sensitive information retrieval
  - Patient-specific relevant data display
  - Medication/test cost display
  - Tall man lettering
  - Context-sensitive user interface
What I am talking about today doesn’t fit into any of these categories

But it does fit many of the features of CDS systems that are correlated with improving patient care*

- Integrated into the workflow
- Electronic based
- Provide decision support at the time and location of care rather than prior to or after the patient encounter
- Provides recommendations for care, not just assessments

Contents of today’s discussion

0 Need for answering a broad base of clinical questions at the point of care
0 Impact of answering questions on decision making and outcomes
0 How/where to deliver these answers
Need for answering a broad base of clinical questions at the point of care
Unanswered clinical questions impact patient management decisions

- Approximately 2 out of 3 clinical encounters generate a question
- Physicians have approximately 11 clinical questions per day
- Only 40% of questions are answered

Answering all clinical questions could change 5 to 8 management decisions each day

Diffusion of knowledge is slow

**Thrombolytic Therapy for AMI**

- Year: 1960, Cumulative RCTs: 1, Pts: 23
- Year: 1965, Cumulative RCTs: 3, Pts: 149
- Year: 1970, Cumulative RCTs: 4, Pts: 316
- Year: 1975, Cumulative RCTs: 15, Pts: 3311
- Year: 1985, Cumulative RCTs: 30, Pts: 6346
- Year: 1990, Cumulative RCTs: 70, Pts: 48154

**Odds Ratio (Log Scale)**

- Year: 1960, Odds Ratio: 0.5
- Year: 1965, Odds Ratio: 1
- Year: 1970, Odds Ratio: 2
- Year: 1975, Odds Ratio: p < 0.01
- Year: 1980, Odds Ratio: p < 0.001
- Year: 1985, Odds Ratio: p < 0.00001

**Textbook/Review Recommendations**

<table>
<thead>
<tr>
<th>Routine</th>
<th>Specific</th>
<th>Rare/Never</th>
<th>Experimental</th>
<th>Not Mentioned</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>21</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td></td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>7</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>15</td>
<td>8</td>
<td></td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Clinical judgment in discretionary settings leads to variability in healthcare

Reducing annual growth in per capita spending from 3.5% (the national average) to 2.4% (the rate in San Francisco) would lead to a cumulative savings of $1.42 trillion by 2023.

Impact of answering questions on decision making and outcomes
Use of preappraised EBM resources changes decisions

- Study of the use of a knowledge resource for answering questions during patient rounds on medicine and respiratory wards and in the medical intensive care unit of a tertiary teaching hospital in Singapore
- 157 searches conducted from junior doctors and consultants
- Each search took a median of three minutes
- The information led to a change in investigations, diagnosis, or management 37% of the time

Better decisions improve quality and efficiency

- Random sample of 146 inpatients cared for by 33 internal medicine physicians
- Critical decisions assessed before and after providing knowledge support
- Main findings
  - Treatment changed in 18% of patients
  - Most changed decisions considered to have improved care of patient
  - Some of these decisions may have prevented an adverse event

<table>
<thead>
<tr>
<th>Problem</th>
<th>Original decision</th>
<th>New decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonfunctioning AV graft</td>
<td>Place temporary vascular access</td>
<td>Fibrinolytic therapy</td>
</tr>
<tr>
<td>Severe labile HTN</td>
<td>Diltiazem</td>
<td>Stop diltiazem add atenolol</td>
</tr>
<tr>
<td>Community acquired pneumonia</td>
<td>IV antibiotics</td>
<td>Oral antibiotics</td>
</tr>
<tr>
<td>Diastolic heart failure</td>
<td>Furosemide, isosorbide, hydralazine</td>
<td>Stop hydralazine, add atenolol</td>
</tr>
<tr>
<td>Inoperable hepatocellular cancer</td>
<td>Transarterial chemo-embolization</td>
<td>Palliative care only</td>
</tr>
</tbody>
</table>

Changing decisions is associated with better outcomes

- Investigators at Solucient\(^1\) studied the impact of UpToDate on length of stay, complications, and patient safety\(^2\)

- Compared hospitals with and without access to UpToDate

- The study adjusted for hospital size, hospital type (teaching vs. non) and geographic location

  \[\text{Impact}\]

- Hospitals that used UpToDate had significantly lower risk-adjusted length of stay, on average .167 days/discharge \((p<.0001)\)

- UpToDate hospitals also had statistically significantly lower complication rates \((p<.0476)\) and better patient safety outcomes \((p<.0001)\)

\(^1\) Solucient maintains the nation's largest healthcare database, comprised of more than 26 million discharges per year from 2,900 hospitals

“Dose-response” effect

More complications prevented with increasing use

More hospital days saved with increasing use

Average topic reviews viewed per week
Similar results noted in a second study, including mortality benefit

Use of UpToDate and Outcomes in US Hospitals

Thomas Isaac, MD, MBA, MPH¹, Jie Zheng, PhD², Ashish Jha, MD, MPH²,³,⁴

¹Division of General Internal Medicine and Primary Care, Beth Israel Deaconess Medical Center, Boston, Massachusetts; ²Department of Health Policy and Management, Harvard School of Public Health, Boston, Massachusetts; ³Division of General Medicine, Brigham and Women’s Hospital, Boston, Massachusetts; ⁴VA Boston Healthcare System, Boston, Massachusetts

BACKGROUND: Computerized clinical knowledge management systems hold enormous potential for improving quality and efficiency. However, their impact on clinical practice is not well known.

OBJECTIVE: To examine the impact of UpToDate on outcomes of care.

DESIGN: Retrospective study.


PATIENTS: Fee-for-service Medicare beneficiaries.

INTERVENTION: Adoption of UpToDate in US hospitals.


RESULTS: We found that patients admitted to hospitals using UpToDate had shorter lengths of stay than patients admitted to non-UpToDate hospitals overall (5.6 days vs 5.7 days; P < 0.001) and among 6 prespecified conditions (range, −0.1 to −0.3 days; P < 0.001 for each). Further, patients admitted to UpToDate hospitals had lower risk-adjusted mortality rate for 3 of the 6 conditions (range, −0.1% to −0.6% mortality reduction; P < 0.05). Finally, hospitals with UpToDate had better quality performance for every condition on the Hospital Quality Alliance metrics. In subgroup analyses, we found that it was the smaller hospitals and the non-teaching hospitals where the benefits of the UpToDate seemed most pronounced, compared to the larger, teaching institutions where the benefits of UpToDate seemed small or nonexistent.

CONCLUSIONS: We found a very small but consistent association between use of UpToDate and reduced length of stay, lower risk-adjusted mortality rates, and better quality performance, at least in the smaller, non-teaching institutions. These findings may suggest that computerized tools such as UpToDate could be helpful in improving care. Journal of Hospital Medicine 2011;000:000–000 © 2011 Society of Hospital Medicine.
Four major databases consolidated

- **AHA data**
  - Hospital structural characteristics

- **MIIF**
  - Medicare Inpatient Impact Files (more hospital characteristics)

- **MEDPAR**
  - Medicare Provider Analysis review (patient-level discharge info)

- **HQA**
  - Hospital Quality Alliance (publicly available data for inpatient quality measures)

Adoption of UTD was associated with shorter LOS

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Using UptoDate (Days)</th>
<th>Not Using UptoDate (Days)</th>
<th>Difference (CI) (Days)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>5.6</td>
<td>5.7</td>
<td>-0.1 (-0.2 to -0.0)</td>
<td>0.001</td>
</tr>
<tr>
<td>AMI</td>
<td>5.3</td>
<td>5.5</td>
<td>-0.2 (-0.3 to -0.2)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>CHF</td>
<td>5.6</td>
<td>5.7</td>
<td>-0.2 (-0.2 to -0.1)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>PN</td>
<td>6.3</td>
<td>6.5</td>
<td>-0.2 (-0.2 to -0.1)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Stroke</td>
<td>5.9</td>
<td>6.0</td>
<td>-0.1 (-0.2 to -0.1)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>GIH</td>
<td>5.3</td>
<td>5.4</td>
<td>-0.2 (-0.3 to -0.2)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hip fracture</td>
<td>6.7</td>
<td>6.8</td>
<td>-0.1 (-0.2 to -0.1)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

NOTE: Quarterly data from 2004 through 2006. All analyses are adjusted for hospital characteristics including size, census region, urban vs rural location, ownership (for-profit, not-for-profit private, not-for-profit public), teaching status (member of the Council of Teaching Hospital vs not), and the presence or absence of a medical intensive care unit (ICU). Analyses were also adjusted for patient-level factors and co-variables using methodology developed by Elixhauser.

Abbreviations: AMI, acute myocardial infarction; CHF, congestive heart failure; CI, confidence interval; GIH, gastrointestinal hemorrhage; PN, pneumonia.
Adoption of UTD was associated with lower mortality.

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Using UpToDate (%)</th>
<th>Not Using UpToDate (%)</th>
<th>% Difference (CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>9.0</td>
<td>9.1</td>
<td>-0.1 (-0.2 to 0.0)</td>
<td>0.04</td>
</tr>
<tr>
<td>AMI</td>
<td>18.4</td>
<td>19.0</td>
<td>-0.7 (-1.2 to -0.2)</td>
<td>0.03</td>
</tr>
<tr>
<td>CHF</td>
<td>11.1</td>
<td>11.3</td>
<td>-0.2 (-0.4 to -0.1)</td>
<td>0.21</td>
</tr>
<tr>
<td>PN</td>
<td>12.1</td>
<td>12.6</td>
<td>-0.5 (-0.7 to -0.2)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Stroke</td>
<td>19.9</td>
<td>19.9</td>
<td>-0.02 (-0.5 to 0.5)</td>
<td>0.91</td>
</tr>
<tr>
<td>GIH</td>
<td>6.9</td>
<td>7.3</td>
<td>-0.4 (-0.7 to -0.2)</td>
<td>0.001</td>
</tr>
<tr>
<td>Hip fracture</td>
<td>8.8</td>
<td>8.6</td>
<td>0.2 (-0.2 to 0.5)</td>
<td>0.41</td>
</tr>
</tbody>
</table>

**NOTE:** Rates from 2004 through 2006. All analyses are adjusted for hospital characteristics and patient characteristics.

**Abbreviations:** AMI, acute myocardial infarction; CHF, congestive heart failure; CI, confidence interval; GIH, gastrointestinal hemorrhage; PN, pneumonia.
Adoption of UTD was associated with better hospital quality

These measures are publicly reported and represent 4 of the 6 measures that will be used in Medicare’s Value Based Purchasing Program (beginning October 2012)

**TABLE 4. UpToDate Use and Performance on the Standard Quality Indicators**

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Using UpToDate (%)</th>
<th>Not Using UpToDate (%)</th>
<th>% Difference (CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMI summary score</td>
<td>93.4</td>
<td>90.2</td>
<td>3.2 (2.6, 3.6)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>CHF summary score</td>
<td>81.0</td>
<td>75.1</td>
<td>5.9 (5.0, 6.8)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>PN summary score</td>
<td>83.7</td>
<td>83.1</td>
<td>0.6 (0.3, 0.9)</td>
<td>0.003</td>
</tr>
<tr>
<td>SIP summary score</td>
<td>80.0</td>
<td>78.1</td>
<td>1.9 (1.0, 2.9)</td>
<td>0.002</td>
</tr>
</tbody>
</table>

NOTE: All analyses are adjusted for hospital characteristics and patient characteristics. Data are based on performance on the Hospital Quality Alliance (HQA) indicators; UpToDate use and HQA scores among all hospitals, 2004 through 2007.

Abbreviations: AMI, acute myocardial infarction; CHF, congestive heart failure; CI, confidence interval; PN, pneumonia; SIP, surgical infection prevention.
How/where to deliver these answers
Physicians adopt and use UpToDate without integration.
Keys to driving usage/acceptance

- Simple and quick to use at point of care
  - Average time spent under 3 minutes
  - One answer to a question
- Answers found around 90% of the time
- Available on multiple platforms – can be used anywhere
- Clinicians trust the answer
“Integration” points for UpToDate

- EMR API (search box)
- HL7 infobutton (search results)
- Order sets (recommendations)
- Practice changing updates (order sets, R&D)
- Laboratory results
So far, when given a choice, most use is through IP authentication.
Summary

0 A relatively simple technology is accepted by physicians and used widely at the point of care
0 Providing answers to clinical questions changes decision making for a broad range of important decisions that goes beyond quality measures and available decision rules
0 Changing these decisions is associated with improvements in the quality and efficiency of care
0 “Pushing” information into the workflow has the promise of a much larger impact on clinical outcomes – this remains largely in an R&D phase