A National Web Conference on Using Health IT to Support Improvements in Clinical Workflow

Presented By:
Keith Butler, Ph.D., M.S.
Amy Franklin, Ph.D.

Moderated By:
Teresa Zayas Cabán, Ph.D.
Agency for Healthcare Research and Quality

July 29, 2015
Agenda

• Welcome and Introductions
• Presentations
• Q&A Session with Presenters
• Instructions for Obtaining CME Credits

Note: After today’s Webinar, a copy of the slides will be emailed to all participants.
The following presenters and moderator have no financial interest to disclose:

- Keith Butler, Ph.D., M.S.
- Amy Franklin, Ph.D.
- Teresa Zayas Cabán, Ph.D.

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- Please address your questions to “All Panelists” in the dropdown menu.
- Select “Send” to submit your question to the moderator.
- Questions will be read aloud by the moderator.
Learning Objectives

At the conclusion of this activity, the participant will be able to:

1. Discuss the ability of clinical workflow analysis to increase the likelihood of a successful health IT intervention that improves efficiency and quality of care in three clinical settings.

2. Describe the relationship between cognitive burden and workflow in an emergency department setting and the potential for health IT to support effective decision making.
Workflow for Evidence-based Health IT

Keith A. Butler
University of Washington
Our Multidisciplinary Team

University of Washington
- Keith Butler, Ph.D.
  PI for AHRQ
- Mark Haselkorn, Ph.D.
  Co-I for AHRQ user research
- Mark Oberle, M.D.
  AHRQ project doctor
- Amy Walker, R.N., Ph.D.
  AHRQ project nurse
- Brian Theodore, Ph.D.
  Co-I for UW Pain Clinic
- GRAs Andrew Berry, Trevor Johnson

Puget Sound VA
- Paul Nichol, M.D.
  Assoc. Dir., National Health Informatics
- Jodie Haselkorn, M.D., M.P.H.
  Director, M.S. CoE

Baylor Scott & White Health
- Brett Stauffer, M.D.
  Co-I, VP Care Improvement
- John Garrett, M.D.
  Co-I, Medical Dir., Emergency Dept.
- Yan Xiao, Ph.D.
  Co-I, Dir., Patient Safety Science
- Adam Probst, Ph.D.
  Senior Human Factors Specialist

Medico Systems
- Ali Bahrami, Ph.D.

Univ. of TX, School of Biomedical Informatics
- Cui Tao, Ph.D.
  Co-I for knowledge modeling
- Mohcine Madkour, Ph.D., Post-Doc
Today’s Agenda

• Need: Predictably beneficial health IT
• Basics of Business Process Modeling Notation (BPMN) standard for workflow diagrams
• Common disruption patterns of health IT
• Some examples and design fixes
Great Potential of Health IT is yet to be Realized

Inherent complexity of health care + Technical complexity of health IT = Risk of unpredictable impact
Challenge
How can we represent the work of clinical care to analyze how it should be improved with health IT?

Background
People have been modeling human work since the industrial revolution, so there are many ways.
Recent Standard for Workflow Diagrams

- BPMN\(^1\) is a standard of the Object Management Group.
- Purpose is to understand IT requirements for groups of people doing work that is supported by computing.
- Good match to clinical care
- Widely accepted and supported by more than 35 commercial modeling systems
- A good tutorial at
  
“All models are wrong ... but some are useful.”

– George Box, distinguished statistician
BPMN connects workflow to the use and change of information.
BPMN Can Distinguish Value-Added Activity and Overhead

Computer overhead is more than just extra work.
It can disrupt cognition and disguise the true nature of care tasks.
## Common Patterns of Disruption

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Compensation Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Info has different values in multiple systems or pages.</td>
<td>Check to determine authoritative source. Manually maintain consistency.</td>
</tr>
<tr>
<td>Info is in single source but doesn’t match workflow.</td>
<td>Transcribe onto paper.</td>
</tr>
<tr>
<td>Needed pieces of info are spread across pages or multiple systems.</td>
<td>Transcribe onto paper, then integrate by hand onto notes.</td>
</tr>
<tr>
<td>All info is there all the time.</td>
<td>Ignoring cluttered pages. Alert fatigue.</td>
</tr>
<tr>
<td>Right content in wrong format.</td>
<td>Sketch a graph for a list of test results to detect trends. Mentally transform, estimate.</td>
</tr>
<tr>
<td>New info expected but time is unknown.</td>
<td>Checking, and re-checking. Post-It Note reminders.</td>
</tr>
<tr>
<td>Information is there but may be out of date.</td>
<td>Checking other sources. Calling. Guessing.</td>
</tr>
<tr>
<td>Partial automation</td>
<td>Re-do some tasks manually to overcome fractured awareness.</td>
</tr>
</tbody>
</table>
Example Workflow Problems and Design Fixes
Multiple Sclerosis (MS) Outpatient Clinic

• Sees over 300 advanced patients every 3 months
• Providers issue 1-10 orders from most exams.
• Different workflows to complete 11 distinct types of orders
Case complexity mandates a senior nurse coordinator (NC) for case manager to:

• Monitor and manage all treatment plans between exams.

• Review plan status and make appointment reminder calls.

• Primary focal point for any new problems for all MS patients.
Multiple Overlapping Information Resources of MS Case Management

Spreadsheet of all active patients

Treatment plan

Clinic schedule
Information usage patterns establish a connection to software design for needed health IT.

<table>
<thead>
<tr>
<th>User tasks</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>...</th>
<th>N</th>
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<td>1</td>
<td>0</td>
<td>1</td>
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<td>0</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
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</table>

1 = used
0 = not used
<table>
<thead>
<tr>
<th>Name</th>
<th>MRN#</th>
<th>DOB</th>
<th>Age</th>
<th>Next MS Visit Date</th>
<th>Last MS Visit Date</th>
<th>Order.Task</th>
<th>Action</th>
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<tr>
<td>Amberly Delong</td>
<td>901000011</td>
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<td>Dana Phelps</td>
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<td>2015-02-08</td>
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<td>2014-11-20</td>
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<td>Henry Alexander</td>
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<td>2015-02-03</td>
<td>2014-11-05</td>
<td>N/A N/A</td>
<td></td>
</tr>
</tbody>
</table>

New: New patients added to the system.
Usability Test Results for Use Cases

GOMS\textsuperscript{3} Estimate for Expert User

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Find patient info</th>
<th>Find patients with new orders</th>
<th>Review orders for appts coming due</th>
<th>Find and annotate patient record</th>
<th>Find all incomplete orders that are coming due</th>
<th>View orders by age and annotate a record</th>
<th>View orders by age and suspend notifications on one</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>18.0</td>
<td>25.9</td>
<td>31.8</td>
<td>84.0</td>
<td>33.0</td>
<td>66.7</td>
<td>62.5</td>
</tr>
</tbody>
</table>

Empirical Task Times of 7 Sr. Nurses

GOMS - Goals, Operators, Methods, and Selection rules
Reduced Overhead Tasks: Managing Treatment Plans

As-is vs. P-CMS
Time-Savings Simulation: Hours per 80 Patients

As-is

P-CMS

15.6%
Additional Expected Benefits

- Improved situational awareness for case-managers, providers, patients and their families
- More timely completion of orders
- Increased quality of information
- Clinicians can work at/near the top of their skill level
Workflow Conclusions

Workflow helps understand existing care before you try to improve it!

• Should be a part of IT design to avoid common disruption patterns

• BPMN offers a widely practiced standard for workflow diagrams

• Makes a connection between health IT and care benefits
Great systems are not supposed to be easy to design - they’re supposed to be easy to use.


Contact Information

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Opportunistic Decision Making, Information Needs, and Workflow in Emergency Care

Amy Franklin, Ph.D.
University of Texas Health Science Center - Houston
Goals for Today

• Describe the relationship between cognitive burden and workflow in an emergency department (ED) setting.

• Discuss potential for health IT to influence opportunistic decision making.

• Discuss challenges in real-world solutions.

• Describe ongoing and future efforts.
Emergency Departments

• Complex, non-deterministic environment
  ► You never know *who* is coming through the door.
  ► You don’t know *when* patients are coming in.
  ► You may not know *what* resources you have at any moment, including staff, beds, supplies, etc.
Opportunistic Decision Making

Proportion of each type of decision made over the entire shift

Finding: Local Rules Govern Action

Published: JBI 2011
Opportunistic Decision Making (cont.)

• Observable impact of ED complexity on work
  ▶ Interruption intensive environment
  ▶ Verbal exchange of information
  ▶ Opportunistic decision making

• Potential impact of opportunistic decisions on care
  ▶ Potential risk of adverse events
  ▶ Decreased quality of care/increased length of stay
  ▶ Decreased satisfaction
Opportunistic Decision Making (cont.)

• We believe opportunistic decision making is triggered by environmental factors.

• Its impact on patient care is reflected by a decrease of productivity and increase of potential adverse events.

• Hypothesis: Improved situational awareness through visualizations will decrease opportunistic decision making and lead to increases in productivity, such as shorter lengths in stay.
Understanding the Work to Support Visualization

• To support decision making through visualizations, we need to understand the work of the clinical providers.

• We represent the work of the ED using a Work Domain Ontology (WDO).

• The WDO is a representation of clinical goals, information (as objects), clinical operations (i.e., activities) required for the care of patients and the constraints in this system.
**Goal** is an objective that needs to be achieved for the work domain
- Answer the essential question of why the work domain exists
- Attributes: hasID, hasName

**Object** is an entity towards which an operation is directed
- Indicate the resources required for the work domain
- Attributes: hasID, hasName

**Operation** is a necessary activity towards the goal
- Identify the major activities in the work domain
- Attributes: hasID, hasName, hasStartState, hasEndState

**Constraint** is a relation between two components and defines an explicit condition the work domain must satisfy
- Identify connections among the components
- Attributes: hasID, hasName, hasSubject, hasObject
WDO Example: Medical Screening Exam

**Goal: Patient Care**

requires

**Operation:** Completion of Medical Screen Exam (MSE)

requires

**Object(s):** Information required to determine outcome of MSE/Outcome decision

Constraints: MSE must be appropriate to individuals’ presenting signs and symptoms, requires continued monitoring, completed prior to any move to transfer or relocate patients, prior to collection of insurance information/ability to pay

Constraints: initial triage information (demographics, chief complaint, vitals), clinician exam of patient by qualified medical personnel, information derived from actions as appropriate to determine emergency medical condition
Visualizations

• We believe human-centered visualizations can be systematically created by using the WDO to improve the ED’s situational awareness.
Goal of Visualizations

• Improve situational awareness
  ▶ Through the presentation of information as needed to support workflow

• Decrease cognitive burden on clinicians
  ▶ Improve understanding
  ▶ Support communication

• Alter patterns of opportunistic decision making.

All lead to improved outcomes.
Understanding Needs

• Observations, interviews, and input from different types of hospitals and providers
  ▶ Trauma 1 to community centers
  ▶ Teaching facilities, midlevel practice, rapid treatment area
  ▶ High volume EDs/smaller attached hospitals
• Ethnographic Observations
  ▶ Attending physicians, residents, midlevel providers, nurses

• Interviews with medical directors, emergency department directors, clinical coordinators, charge nurses…

• Surveys across clinical roles

• Input from collaborative Team (5 ED physicians, 1 Physician Assistant, nurses)

• Working in conjunction with the ED collaborative for a hospital system

• Collaborative efforts with a hospital to deploy at 11 sites
Total In Department: 54

- Critical: 1 / 4 (44%)
- Blue: 12 / 31 (134%)
- Flex: 5 / 10 (66%)
- Gold: 4 / 6 (24%)
- Start: 0 / 4 (33%)

Care Area: Over KPI / Total
- Transfer: 0 / 0
- Boarding: 14 / 24
- Discharge: 0 / 1
- In Process: 8 / 29
- Waiting: 13 / 46

- Orange: Needs MDE over 4 hrs
- Blue: Has MDE or less than 4 hrs
- Under KPI

Now: 12/19/2018 11:00:00 PM
### NEDOCS DASHBOARD

**National Emergency Department Overcrowding Scale**

As of July 20, 2015, 7:35 PM

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients Here Now</td>
<td>113</td>
</tr>
<tr>
<td>Patients without MSE</td>
<td>48</td>
</tr>
<tr>
<td>Patients in a Care Area</td>
<td>52</td>
</tr>
<tr>
<td>Patients with Admit Disposition</td>
<td>16</td>
</tr>
</tbody>
</table>

**NEDOCS Interpretation**

- **0 - 50 Normal**
- **51 - 100 Busy**
- **101 - 140 Overcrowded**
- **141 - 180 Severe**
- **181 - 200 Disaster**

**NEDOCS Components**

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Patients in the ED</td>
<td>103</td>
</tr>
<tr>
<td>Number of Staffed ED Beds</td>
<td>75</td>
</tr>
<tr>
<td>Last Door to Bed Time (min)</td>
<td>2</td>
</tr>
<tr>
<td>Number of 1:1 Patients</td>
<td>1</td>
</tr>
<tr>
<td>Total Admits in the ED</td>
<td>16</td>
</tr>
<tr>
<td>Longest Admit Boarding Time (min)</td>
<td>492</td>
</tr>
<tr>
<td>Number of Inpatient Beds</td>
<td>332</td>
</tr>
</tbody>
</table>

**Percent Contribution to NEDOCS Score**

- **ED Pt. Count**: 72%
- **Last Door-Bed**: 1%
- **1:1**: 7%
- **Total Admits**: 15%
- **Longest Admit**: 4%
Evaluation and Experimentation
Evaluation

- Surveys
- Interviews
- Log data
- Performance data over time
Challenges in Implementation

• Expectation and prior experience
  ► Color scales (The reasons why we use red and green on our slides.)
  ► Displays (But I like bar graphs)
  ► Historical Views (Shifting the focus to real time)
Challenges in Implementation (cont.)

- Integration with workflow
  - Static versus dynamic displays (Can we have this on a big screen?)
  - Pocket displays (How about a little one?)
Challenges in Implementation (cont.)

- Trust and Process (We do it by hand.)
Challenges in Implementation (cont.)

• Training
• Culture
• Policy
• Administrative changes
Ongoing Efforts

- Site 3
- Phase 2 of dashboards
- Training of more/different user types
- Observation of systems in use
- Evaluation of impact on systems post adoption phase
ED WORKLOAD DASHBOARD

As of June 23, 2015 6:35 PM

58 Patients Here Now
13 Patients without MSE
48 Patients in a Care Area
6 Patients Boarding

ATTENDINGS

RESOURCES

<table>
<thead>
<tr>
<th>Status</th>
<th>Consult</th>
<th>Imaging</th>
<th>Labs</th>
<th>Pharmacy</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td>2/2</td>
<td>5/5</td>
<td></td>
</tr>
<tr>
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<td></td>
<td></td>
<td>0/1</td>
<td>3/5</td>
<td>0/1</td>
</tr>
</tbody>
</table>

Totals

Resource counts are represented as:

"Number Completed / Total Number Ordered"
ED THROUGHPUT DASHBOARD
As of June 24, 2015 7:35 PM

59 Patients Here Now
9 Patients without MSE
43 Patients in a Care Area
10 Patients with Admit Disposition

CURRENT LENGTH OF STAY

Admit
Discharged
Transfer
In Process

0 100 200 300 400 500 600 700 800 900 1000 1100 1200 minutes

STATISTICAL PROCESS CONTROL CHART

UCL 186
Median 111
LCL 35

Filters
Affect all graphs

Select Facility
Hospital A

Select Care Area
(All)

Select ESI
(All)

Select Age
(All)

Special Cause Variation
Common Cause Variation

Legends
- Over Threshold
- Below Threshold

AMIA 2015 accepted poster
Thank you

- AHRQ
- Our local hospitals and all the wonderful clinicians!

Our Team

- Juliana Brixey, Ph.D., M.P.H., R.N.
- Tina Chacko, P.A.
- Swaroop Gantela, M.D.
- Todd Johnson, Ph.D.
- Brent King, M.D.
- Charles Maddow, M.D.
- Amit Metha, M.D.
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- Nnaemeka Okafor, M.D., M.S.
- David Robinson, M.D.
- Salsawit Shifarraw, BBA
- Debora Simmons, Ph.D., R.N., C.C.N.S.
- Adriana Stanley, M.S.
- Cui Tao, Ph.D.
- Eric Thomas, M.D., M.P.H.
- Jiajie Zhang, Ph.D.

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• Please address your questions to “All Panelists” in the dropdown menu.
• Select “Send” to submit your question to the moderator.
• Questions will be read aloud by the moderator.
Appendix
Intermediate states to check elapsed days to determine acceptable order progress