Use of Clinical Decision Support and the Impact of Clinical Decision Support on Workflow

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Presenters:

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Moderator:

Jonathan White
Agency for Healthcare Research and Quality
Clinical Decision Support (CDS) and Workflow

Ben-Tzion Karsh, PhD
Associate Professor
Industrial and Systems Engineering
UW-Madison
Agenda

• Very brief review of the effectiveness of CDS
• Interpretation of the mixed evidence from a workflow perspective
• Understanding workflow and workflow integration
State of the Evidence

“Nonetheless, there are few CDS implementations to date in routine clinical use that have substantially delivered on the promise to improve healthcare processes and outcomes, though there have been an array of successes at specific sites … Yet even these successes have generally not been widely replicated. There are many reasons for the lack of diffusion of these systems.”¹
State of the Evidence
The Good

• Computerized Provider Order Entry (CPOE) with CDS can reduce medication error rates and increase the quality and efficiency of medication use\(^2\)

• Using order sets as basic CDS within CPOE systems can, potentially, improve clinician efficiency\(^3\)
State of the Evidence
The Good

• CDS integrated into CPOE can improve the use of the order sets\textsuperscript{4}

• Computerized clinical reminders can increase compliance with guidelines and even save time \textsuperscript{5}
State of the Evidence

The Good

• Well-designed interruptive alerts can increase alert acceptance to 67%\textsuperscript{6}
• CDS can lead to faster diagnosis\textsuperscript{7}
State of the Evidence

The Less Good

- Systems did a poor job of identifying severe clinically significant drug-drug interactions\textsuperscript{8}
- Drug safety alerts are overridden 49\%-96\% of the time\textsuperscript{9}
State of the Evidence

The Less Good

• Even allowing primary care physicians to customize drug alerts still resulted in 88% of alerts being ignored\textsuperscript{10}

• Ambulatory CDS automation is criticized for being time consuming and unusable\textsuperscript{11}

• Primary care physicians working for the Veteran’s Health Administration (VHA) rated their CDS as average\textsuperscript{12}
State of the Evidence
The Less Good

• Reviews that have demonstrated CDS can improve physician outcomes have not been able to demonstrate improvements to patient outcomes\(^7\)
Why are the Results Mixed?

Workflow integration problems

“Rather, the CDS should unobtrusively, but effectively, remind clinicians of things they have truly overlooked and support corrections, or better yet, put key pieces of data and knowledge seamlessly into the context...”

“Systems that alter clinician workflow by not integrating all relevant information for informed decision making into one place run the risk of distracting already busy clinicians. …”

A systematic review of CDS effectiveness found that CDS can improve clinical practice if there was workflow integration.
Clearly workflow integration is key. But what do we mean by workflow and workflow integration?
Workflow

• Workflow can be defined as the flow of work through space and time, where work is comprised of three components: inputs are transformed into outputs.
What is Workflow?

• **Inter-organizational workflow:**
  – workflow between a primary care physician and a community pharmacy or
  – between an emergency department physician and a primary care physician to share information about a patient

• **Clinic-level workflow:**
  – flow of a physician, nurse or patient through physical space
  – and the flow of information, in paper or electronic formats, among people at a practice or clinic
What is Workflow?

• Intra-visit workflow:
  – workflow during a patient visit, which involves the workflow of the visit (e.g. start by asking for a problem list, then do history and physical, then prescribe treatment)

• Cognitive workflow – the workflow in the head:
  – Sensation, perception, decision making, response execution
  – A clinician might be thinking “listen for any significant acute problems and deal with those first. Also, investigate my concern about spousal abuse. If I don’t hear any, focus on the chronic problems.”
  – This is unlikely to be observable
What is Workflow?

• People flow through space and time.
• Information flows through space and time in paper and electronic formats.
• Objects, such as medications, flow through space and time.
• The flow of all of those, information, people, and products and the different levels of workflow are necessary to consider when designing CDS to support workflow.
What does it mean to integrate CDS into workflow?

- Making sure CDS supports the flow of work desired at the multiple levels
HIT-workflow integration

THE WORK SYSTEM

- Clinician-HIT System
  - User factors (needs/attitudes/abilities)
  - Usability of HIT features/capabilities
  - Flexibility/adjustability
  - Voluntary/mandatory?

- Work group/unit
  - Unit factors (Patient factors)
  - Group norms (Communication)
  - Task demands/complexity/goals
  - Time constraints
  - Physical environment

- Organization
  - Organizational policy
  - Organizational priorities
  - Organizational structure
  - Financial resources
  - Available expertise
  - Training provided
  - Organizational climate
  - Social influence

- Industry
  - Industry standards
  - Industry regulations
  - Enforcement of regulations
  - Applicable legislation
  - Industry social influence
  - Industry workforce characteristics

DETERMINES FIT

- User-Technology-Unit-Task fit
- Organization-User-Technology-Unit-Task fit
- Whole System Fit

DETERMINES BEHAVIOUR

IF YES, then...
- APPROPRIATE USE
  - Motivation to use technology
  - Intention/decision to use technology
  - Technology acceptance

IF NO, then...
- NO OR LOW USE (OR MISUSE)

Feedback
References


Thank you!

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Clinical Decision Support (CDS)

Ross Koppel, Ph.D.
University of Pennsylvania
From EBM to CDS: *Salto Mortale*?

**Salto Mortale:**
- deadly jump
- full somersault
- dangerous or crucial undertaking
From EBM to CDS: 
Underlying Logic of Alerts

The Decision Tree
Alerts, Underlying Logic

The Decision Tree

Correct direction?
Reality: A Simple Decision Tree
More Reality: Decision Trees
Data bases on which CDS are created

• Evidence on the Evidence

• Evidenced-Based Medicine: Promise and potential
Decision Trees: Still Simplified
Some Data

• 80-90% of alerts overridden
  Fewer if tiered (i.e., increasing levels)

In study of 300 Overrides, 300 were medically correct.
Types of CDS

Range of types and intensities: Linkage to CPOE and EMRs

1. Requesting help (e.g., click to see more)

2. Alerts/Alarms

3. Order sets
Requesting Help

1. Hide n’ go seek
2. More monitors?
3. Link to....
   other documents

Abbreviated or not
Alerts: For Rx and/or for Dosages

1. Regular:
   OR

2. Tiered:
   • Flash on screen
   • Must Acknowledge
   • Must justify override

Pt. X. Tried Rx previously. Pt allergic
Alerts Just for You

- Service-specific
- Provider-specific
Alerts:
Other (unintended) Function

Bumpers
Order Sets

- Acknowledge order sets as not-so-hidden CDS

- Order set wars
Competing Order Sets

• Danger of differing order sets when residents or others circulate across institutions and/or services.
Trajectories of installation:

1. Off the shelf (or off someone’s shelf)
2. Withdrawn
   • (Real story of Cedar-Sinai)
3. Re-introduced stepwise
4. Role of departments and power
5. CDS and order-set wars
6. Time and input and utility
Evaluations: What the data show

1. Implementation rates
2. Success rates
3. Factors influencing achievement
4. The bases of decision support: building on CPOE and EMRs
5. Concerns of experienced providers
The Future of CDS

- Learning from our mistakes
- Improved technology
- Concern about future clinicians who never practiced without them

- Don’t leave home without them?
Thank you!

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Use of Clinical Decision Support in Clinical Practice

David F. Lobach
Duke University Medical Center
Disclosure

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  – The Agency for Healthcare Research and Quality
  – The Dept. of Commerce Technology Opportunities Program
  – The Health Resources and Services Administration
  – The National Cancer Institute
  – The National Eye Institute
  – The Pfizer Health Literacy Foundation
  – The Small Business Technology Transfer Grant program through the National Library of Medicine

• Dr. David Lobach and Dr. Kensaku Kawamoto have a pending patent application for the intellectual property related to SEBASTIAN, which represents one approach for instantiating the HL7 Decision Support Service described in this presentation. Drs. Lobach and Kawamoto and Duke University may benefit financially if products using SEBASTIAN are commercially successful.
Presentation Overview

• Success Factors for CDS
• CDS Engine - SEBASTIAN
• CDS Examples in Practice
  – Chronic Disease Management
  – Diagnosis and Management
  – Population Health Management
  – Medication Management
  – Care Transitions for Complex Patients
• Lessons Learned
Success Factors for CDS

- Systematic review to identify features of CDS systems important for improving clinical practice
- >10,000 manuscripts screened, 70 RCTs included
- 68% → significant improvement in clinical practice
- Most common system types and content:
  - 34%: Computer systems providing patient-specific advice on printed encounter forms or printouts attached to charts
  - 26%: Non-electronic systems that attached patient-specific advice on appropriate charts
  - 16%: CPOE systems with CDS capabilities
  - 81% chronic conditions, 23% acute conditions
  - 53% pharmacotherapy, 46% lab test ordering

Principle Findings-1

Multi-variate regression analysis identified 4 features as independent predictors of success:

<table>
<thead>
<tr>
<th>CDS Intervention Feature</th>
<th>Adjusted OR</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automatic provision of decision support as part of clinician workflow</td>
<td>112.1</td>
<td>&lt; 0.00001</td>
</tr>
<tr>
<td>Provision of decision support at time and location of decision making</td>
<td>15.4</td>
<td>0.0263</td>
</tr>
<tr>
<td>Provision of a recommendation rather than just an assessment</td>
<td>7.1</td>
<td>0.0187</td>
</tr>
<tr>
<td>Computer generation of decision support</td>
<td>6.3</td>
<td>0.0294</td>
</tr>
</tbody>
</table>
Principle Findings-2

• % of CDS interventions leading to significant improvements in clinical practice
  - CDS interventions lacking any of the 4 features → 46%
  - CDS interventions with all 4 features → 94% (n = 32)
Sebastian
System for Evidence-Based Advice through Simultaneous Transaction with an Intelligent Agent across a Network
SEBASTIAN Overview

Independent, centralized, scalable, portable CDS resource

DATA SOURCES
- Claims Databases
- Clinical Databases
- Practice Management Systems
- Real Time Data Entry

DATA OUTPUT FORMATS
- Point-of-Care Reminders
- Feedback Reports
- Patient Reminder Letters
- Alerts (eMail, Pager, Phone)
- Real Time Notification

KNOWLEDGE SOURCES
- Clinical Practice Guidelines
- HEDIS Measures
- Eligibility Criteria
- Formularies
- Drug-Drug Interaction Rules
- Pay for Performance Metrics
- Cost Containment Guidelines

Duke University Medical Center

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CDS for Chronic Disease Mgt

• Setting: Duke University Health System
• Goal: To provide guideline-based care recommendations for chronic diseases at the point of care
Duke University Health System

- Academic medical center and hospital with 2 associated community hospitals
- >100 academic and community-based clinics
- 10,765 full-time employees
  - 1,653 clinical faculty
  - 850 house staff physicians in training
- Inpatient admissions: 61,197 (FY07)
- Outpatient visits: 1.4 M (FY07)
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<th>Date/Time</th>
<th>Status</th>
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<td>03/22/2007 15:01</td>
<td>DUNI</td>
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<td>CHOLESTEROL TOTAL</td>
<td>03/22/2007 15:01</td>
<td>DUNI</td>
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<tr>
<td>LDL CHOLESTEROL (DIRECT)</td>
<td>03/22/2007 15:00</td>
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<td>FAM Endocrinology Follow Up</td>
<td>03/22/2007 00:00</td>
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<td>MICROALBUMIN/CREATININE RATIO</td>
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<tr>
<td>LIPID PANEL (CALCULATED LDL)</td>
<td>07/13/2006 16:49</td>
<td>DUNI</td>
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<tr>
<td>OP4 (BILLAST ALKPHOS ALT)</td>
<td>07/13/2006 16:49</td>
<td>DUNI</td>
</tr>
<tr>
<td>OP7 (CO2,CLK,NA,BUN,GLU,CR)</td>
<td>07/13/2006 16:49</td>
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<td>DUNI</td>
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<td>OP7 (CO2,CLK,NA,BUN,GLU,CR)</td>
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<td>DUNI</td>
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<tr>
<td>OP4 (BILLAST ALKPHOS ALT)</td>
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<td>ECG (ELECTROCARDIOGRAM STANDARD)</td>
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<td>DUNI</td>
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<td>CT DUAL ABDOMEN W/WO ENHANCEMENT</td>
<td>10/01/2003 08:52</td>
<td>DUNI</td>
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Patient is diagnosed with Diabetes. Last evaluated at 7:18 PM on 08/15/2007.

<table>
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<th>Focus</th>
<th>Status</th>
<th>Relevant Data</th>
<th>Guidelines</th>
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<tbody>
<tr>
<td>B.P.</td>
<td>DUE NOW</td>
<td>Last Done: 03/22/07 (4m 24d ago)</td>
<td>q visit, goal &lt; 130/80 [ ]</td>
</tr>
<tr>
<td>Weight</td>
<td>DUE NOW</td>
<td>Last Done: 03/22/07 (4m 24d ago)</td>
<td>q visit, goal BMI &lt; 25 [ ]</td>
</tr>
<tr>
<td>Visual Foot Exam</td>
<td>DUE NOW</td>
<td>Last Done: 07/13/06 (1y 1m 2d ago)</td>
<td>q visit [ ]</td>
</tr>
<tr>
<td>Foot Monofilament</td>
<td>DUE NOW</td>
<td>Last Done: 07/13/06 (1y 1m 2d ago)</td>
<td>annual [ ]</td>
</tr>
<tr>
<td>HgbA1C</td>
<td>DUE NOW</td>
<td>Last Done: 02/22/07 (4m 24d ago)</td>
<td>q6mo if &lt; 7%, q3mo if &gt;= 7% [ ]</td>
</tr>
<tr>
<td>Urine Microlab/cr</td>
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<td>Last Done: 07/13/06 (1y 1m 2d ago)</td>
<td>annual [ ]</td>
</tr>
<tr>
<td>Total Chol.</td>
<td>Not due</td>
<td>Last Done: 03/22/07 (4m 24d ago)</td>
<td>annual, goal &lt; 200 [ ]</td>
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<tr>
<td>LDL Chol.</td>
<td>Not due</td>
<td>Last Done: 03/22/07 (4m 24d ago)</td>
<td>annual, goal &lt; 100 [ ]</td>
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<tr>
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<td>Not due - already scheduled</td>
<td>last Done: 08/09/09 (6d ago)</td>
<td>annual [ ]</td>
</tr>
<tr>
<td>Flu Vacc.</td>
<td>Not flu season</td>
<td>Last Done: &gt; 2 years ago</td>
<td>annual, unless egg allergic [ ]</td>
</tr>
<tr>
<td>Pneum. Vacc.</td>
<td>Not due</td>
<td>Last Done: 01/03/07 (7m 12d ago)</td>
<td>once; revacc. if &gt;= 65, last 5+ yrs ago when &lt; 65 [ ]</td>
</tr>
<tr>
<td>ASA (81 mg)</td>
<td>CONSIDER Rx</td>
<td>Not known to be allergic to aspirin</td>
<td>age &gt;= 40, no contraindications [ ]</td>
</tr>
<tr>
<td>Education</td>
<td>DUE NOW</td>
<td>Last Done: Not on record</td>
<td>once; repeat annually if hgbA1c &gt; 7% [ ]</td>
</tr>
<tr>
<td>Care Metric</td>
<td>Care Guideline</td>
<td>Help Information on Care Metric</td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>--------------------------------------------------------------------------------</td>
<td>---------------------------------</td>
<td></td>
</tr>
<tr>
<td>Diabetes – Hgb(_{A1C}) test</td>
<td>Conduct every 6 months if meeting goal, every 3 months if not meeting goal. Goal: &lt; 7.0%</td>
<td><strong>Guideline:</strong>&lt;br&gt;- Monitor Hgb(<em>{A1C}) level every 6 months if meeting goal (Hgb(</em>{A1C}) level &lt; 7.0%), every 3 months if not meeting goal. (EADA)&lt;br&gt;- Manage patient as appropriate to achieve Hgb(<em>{A1C}) level &lt; 7.0%. (EADA)&lt;br&gt;&lt;br&gt;<strong>Rationale:</strong>&lt;br&gt;- The hemoglobin A1C test measures a patient’s average glycemia over the preceding 2–3 months.&lt;br&gt;- Prospective randomized clinical trials have shown that improved glycemic control is associated with sustained decreased rates of retinopathy, nephropathy, and neuropathy.&lt;br&gt;- In these trials, treatment regimens that reduced average A1C to ~7% (~1% above the upper limits of normal) were associated with fewer long-term microvascular complications.&lt;br&gt;&lt;br&gt;<strong>What this rule does:</strong>&lt;br&gt;- This rule prompts for a Hgb(</em>{A1C}) test if it has been ≥ 5 months since the last test, if that test showed a Hgb(<em>{A1C}) level under 7.0%. Otherwise, this rule prompts for a Hgb(</em>{A1C}) test if it has been ≥ 2 months since the last test.&lt;br&gt;&lt;br&gt;<strong>Data entry notes:</strong>&lt;br&gt;- Rule inactivation: this rule can be turned off for a specific patient and later turned back on if appropriate.&lt;br&gt;- Documentation of reason for not delivering intervention: a clinician may document a reason for not delivering the recommended intervention. This reason will be displayed on future reminder screens until the intervention is completed.&lt;br&gt;&lt;br&gt;<strong>References:</strong>&lt;br&gt;(1) American Diabetes Association. Standards of Medical Care in Diabetes – 2006. <em>Diabetes Care</em>. 2006;29 (Supplement 1): S4-S42. <a href="#">Link to guideline as PDF</a> [note: Hgb(_{A1C}) monitoring guidelines are on pp. S10-S11]</td>
<td></td>
</tr>
</tbody>
</table>
## Duke Health Disease Management System – Diabetes

Patient is diagnosed with Diabetes. Last evaluated at 7:18 PM on 08/15/2007.

### Focus

<table>
<thead>
<tr>
<th>Name</th>
<th>Status</th>
<th>Relevant Data</th>
<th>Guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>B.P.</td>
<td>DUE NOW</td>
<td>Last Done: 03/22/07 (4m 24d ago)</td>
<td>q visit, goal &lt; 130/80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Last Value: 132/82 mmHg</td>
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<tr>
<td>Weight</td>
<td>DUE NOW</td>
<td>Last Done: 03/22/07 (4m 24d ago)</td>
<td>q visit, goal BMI &lt; 25</td>
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<tr>
<td></td>
<td></td>
<td>Last Value: 75.7 kg</td>
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<tr>
<td>Visual Foot Exam</td>
<td>DUE NOW</td>
<td>Last Done: 07/13/06 (1y 1m 2d ago)</td>
<td>q visit</td>
</tr>
<tr>
<td>Foot Monofilament</td>
<td>DUE NOW</td>
<td>Last Done: 07/13/06 (1y 1m 2d ago)</td>
<td>annual</td>
</tr>
<tr>
<td>HgbA1C</td>
<td>DUE NOW</td>
<td>Last Done: 02/22/07 (4m 24d ago)</td>
<td>q6mo if &lt; 7%, q3mo if &gt;= 7%</td>
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<tr>
<td></td>
<td></td>
<td>Last Value: 8.3%</td>
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<tr>
<td>Urine Micro alb/cr Ratio</td>
<td>DUE NOW</td>
<td>Last Done: 07/13/06 (1y 1m 2d ago)</td>
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<tr>
<td></td>
<td></td>
<td>Last Value: 2.4 mg/g</td>
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</tr>
<tr>
<td>Total Chol.</td>
<td>Not due</td>
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<td>annual, goal &lt; 200</td>
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<tr>
<td></td>
<td></td>
<td>Last Value: 187 mg/dL</td>
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<tr>
<td>LDL Chol.</td>
<td>Not due</td>
<td>Last Done: 03/22/07 (4m 24d ago)</td>
<td>annual, goal &lt; 100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Last Value: 110 mg/dL</td>
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</tr>
<tr>
<td>Eye Exam</td>
<td>Not due - already scheduled</td>
<td>Last Done: 08/09/07 (6d ago)</td>
<td>annual</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Appt scheduled: 09/13/07</td>
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</tr>
<tr>
<td>Flu Vacc.</td>
<td>Not flu season</td>
<td>Last Done: &gt; 2 years ago</td>
<td>annual, unless egg allergic</td>
</tr>
<tr>
<td>Pneum. Vacc.</td>
<td>Not due</td>
<td>Last Done: 01/03/07 (7m 12d ago)</td>
<td>once; revacc. if &gt;= 65, last 5+ yrs ago when &lt; 65</td>
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<td>CONSIDER Rx</td>
<td>Not known to be allergic to aspirin</td>
<td>age &gt;= 40, no contraindications</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aspirin not listed as prescribed</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>DUE NOW</td>
<td>Last Done: Not on record</td>
<td>once; repeat annually if hgbA1c &gt;= 7%</td>
</tr>
</tbody>
</table>
CDS for Diagnosis and Mgt

• Setting: Private practice ophthalmology and optometrist offices

• Goal: To overcome challenges to collecting complex clinical data at the point of care in order to provide diagnostic decision support and improve care documentation, staging and quality
Point-of-Care Data Collection and Decision Support for Eye Care Professionals

Principle Investigator: Paul Lee, MD, JD

Joint Project of
Division of Clinical Informatics, Dept. of Community and Family Medicine and Department of Ophthalmology, Duke University Medical Center, Durham, NC

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Sample Note – Color Diagrams

DILATED EXAM
- dilation and anesthetic
- warning discussed

OD OS GXL
ClinX 10/30

C/D CD

ON

- 90 D
- CL
- Indirect

previous photos reviewed

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Capturing Detailed Diagrams
Eye Care Decision Support
CDS for Population Management

• Setting: Urban and rural safety net providers for Medicaid beneficiaries in a 6-county region of north central NC

• Goal: To improve appropriate utilization and quality of care
COACH HIE Context

- Receives and displays external billing/claims/clinical data from 5 hospitals, 8 clinics and NC State Medicaid
- Supports care management activities (documentation, communication, referrals, care plans, etc.) for 2 care management teams
- 5 Hospitals, 34 Primary Care Clinics, 3 Urgent Care Facilities, & 8 Government Agencies
- >40,000 Medicaid Beneficiaries
**COACH Sample Screen**

![Sample Screen](image)

### Addresses
<table>
<thead>
<tr>
<th>Address 1</th>
<th>Address 2</th>
<th>Mailing Address 1</th>
<th>Mailing Address 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Durham</td>
<td>Durham</td>
<td>Durham</td>
<td>Durham</td>
</tr>
<tr>
<td>Durham</td>
<td>Durham</td>
<td>Durham</td>
<td>Durham</td>
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<td>Durham</td>
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<tr>
<td>Durham</td>
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<td>Durham</td>
<td>Durham</td>
</tr>
<tr>
<td>Durham</td>
<td>Durham</td>
<td>Durham</td>
<td>Durham</td>
</tr>
</tbody>
</table>

### Phone Numbers
- 919 919 919
- 919 919 919

### Active Providers
- Andrea Leach, RD (Home)
- Sharita Lee, HEd (Not Assigned)

### Status Date
- 09/13/2004
- 07/16/2004

### Comments & Other Information
- Author: Sharita L Lee/Dept_CFM/mc/Duke
- Comments: Diabetes Disparities Collaborative

### Guardian Name
- Relationship

### School
- School Phone

### DCHN Case Code
- Case Manager

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Population Mgt Intervention

Data from Community Partners

Patient Entered Data via Kiosk System

Data from Community Partners

COACH HIE Community Network Clinical Database

SEBASTIAN CDSS

Query Database

Interventions

Email Alerts

Patient Reminders

Feedback Reports

Care Providers

Clinic Managers

Patients

Patients

Clinic Managers

Care Providers

Feedback Reports

Patient Reminders

Email Alerts

Interventions

Query Database

SEBASTIAN CDSS

COACH HIE Community Network Clinical Database

Data from Community Partners

Patient Entered Data via Kiosk System

Duke University Medical Center

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Sample Provider Alert

COACH Alerts for Ms. Jenny Rawlings
Document ID: 24
08/08/05 (Mon)

If you have any questions or concerns, please contact Ken Kawamoto, M.D.-Ph.D. candidate, Duke University (kawam001@mc.duke.edu; 919-684-2340).

Patients requiring attention (highest priority patients listed first):

1. Norris, [redacted] (COACH link). 23 yr. old Caucasian female, DOB [redacted]/82.
Medicaid #: [redacted] Duke MRN: [redacted]
Durham, NC 27[redacted] Home #: 919-[redacted]

Priority: 23.0

ED visits that may require follow-up:

☐ 3+ ED visits in 90 days, most recent in past month: The patient was seen at Duke Hospital ED (listed as 'Emergency Room-duke' in COACH) on 07/09/05. This visit was at least the 3rd ED visit in 90 days. Including this visit, the patient has had 13 such repetitive (3+ in 90 days) ED visit(s) in the past 6 months.

General preventive care needs:

☐ DUE NOW - Chlamydia test: Women between the ages of 16 and 26 should be tested for Chlamydia once every year. We have no record of the patient having received a Chlamydia test in the past 2 years.

☐ DUE NOW - Pap smear: Women between the ages of 21 and 64 should have a Pap smear at least once every 3 years to screen for cervical cancer. We have no record of the patient having received a Pap smear in the past 3 years.

2. Weaver, [redacted] (COACH link). 8 mo. old Caucasian male, DOB [redacted]04.
Sample Feedback Report

Feedback Report - Duke Family Medicine
Active CAI Patients: 2,339
April 25, 2005

Sorted by: Highest priority patients

<table>
<thead>
<tr>
<th>Name</th>
<th>Medicaid #</th>
<th>DOB</th>
<th>Priority</th>
<th>MRN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Williams, Jacob</td>
<td>0000000000</td>
<td>5/17/89</td>
<td>1001 Main Street, Durham, NC 27000-1001</td>
<td>919-123-4567</td>
</tr>
</tbody>
</table>

**Events requiring follow-up:**

- ED visit for diabetes: 1/20/05, Duke Hospital; Encounter diagnosis - diabetes
- Multiple missed appointments by patient w/ diabetes: 2/18/05, Missed appointment at Duke CFM; (4th missed appointment in 90 days)

**Health maintenance needs:**

- DUE NOW – Well-child visit: Patients aged 12-16 should have a well-child visit once every year. (CPT billing procedure code 99210). Last known well-child visit: 8/12/03 at Duke CFM.

**Diabetes care needs:**


**Other issues requiring follow-up:**

- NEED PHYSICIAN FOLLOW-UP – Risk factors for TB exposure: Patient reported information at health information kiosk visit on 1/25/05.

**Other relevant information:**

- CAI status: Active
- CAI home clinic: Duke CFM
- High Medicaid cost: Medicaid costs over last 6 months: $5200. $1000 (20%) on outpatient encounters, $1550 (30%) on ED visits, $2550 (50%) on inpatient encounters
- Meets DCHN priority contact criteria: Patient has diabetes and < 80% of diabetes care standards are met.

<table>
<thead>
<tr>
<th>Doe, Jane</th>
<th>Medicaid #</th>
<th>DOB</th>
<th>Priority</th>
<th>MRN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doe, Jane</td>
<td>0000000000</td>
<td>3/28/46</td>
<td>200 Cedar Lane, Durham NC 27000-0200</td>
<td>919-345-6789</td>
</tr>
</tbody>
</table>

**Events requiring follow-up:**

- ED visit for asthma: 2/14/05, ED visit at Duke; Encounter diagnosis - diabetes
- Multiple missed appointments by patient w/ asthma: 2/25/05, Missed appointment at LCHC; (2nd missed appointment in 63 days)

**Asthma care needs:**

- Asthma Action Plan: Patients with asthma should have a written asthma action plan.
  None documented. Patient reported information at health information kiosk visit on 2/10/05.
Sample Patient Letter

August 9, 2005

To the parents of [Name],

We are sending you this letter to address your child's health care needs. Based on our records, it appears your child may be due for the following services:

**Diabetes services that may be due:**
- [ ] Hemoglobin A1c test: This test is recommended every 6 months for patients with diabetes.
- [ ] Cholesterol test: This test is recommended every 12 months for patients with diabetes.
- [ ] Urine protein test: This test is recommended every 12 months for patients with diabetes.

Please call our office at (919) 477-2202 to schedule an appointment, so that the doctor can check to see if your child is in need of these services. Also, please bring this letter with you to the appointment and show it to the doctor. We look forward to seeing you soon!

Sincerely,

*Your Care Team*

Your Care Team
Regional Pediatric Associates
A Member of the Durham Community Health Network

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CDS for Medication Management

• Setting: 14 primary care practices and their affiliated care managers serving Medicaid beneficiaries

• Goal: To improve adherence to evidence-based pharmacotherapy for IOM priority conditions
Med. Mgt. Project Overview

• Point-of-care information about filled prescriptions
• Evidence based pharmacotherapy recommendations about 7 priority conditions (IHD, CHF, Htn, Stroke, Asthma, COPD, Diabetes)
• 14 clinic sites and notifications to care managers
• Report delivery beginning March 2009
Intervention Overview

Data from Community Partners – Pending Appointments and NC Medicaid Claims

Community Network Clinical Database

SEBASTIAN CDSS

Query Database

Intervention

Med. Mgt. Reports

Clinicians

Patients

Email Alerts

Care Managers

Duke University Medical Center

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Sample Medication Mgt. Report

<table>
<thead>
<tr>
<th>IOM Priority Conditions Detected From Billing Data For This Patient:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Diabetes mellitus</td>
</tr>
<tr>
<td>2. Hypertension</td>
</tr>
<tr>
<td>3. Ischemic heart disease (post-MI)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Prescriptions Filled in the 12 Months Prior to 6/28/07 (Excluding Antibiotics) POS, A, B, C</th>
</tr>
</thead>
<tbody>
<tr>
<td>% coverage</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Cardiovascular</td>
</tr>
<tr>
<td>Beta Blockers</td>
</tr>
<tr>
<td>Carvedilol 25 mg tab (30 d Rx) (MD: Smith, John)</td>
</tr>
<tr>
<td>Metoprolol 100 mg tab (30 d Rx) (MD: Smith, John)</td>
</tr>
<tr>
<td>ACE Inhibitors</td>
</tr>
<tr>
<td>Statins</td>
</tr>
<tr>
<td>Simvastatin 25 mg tab (30 d Rx) (MD: Smith, John)</td>
</tr>
<tr>
<td>Diuretics</td>
</tr>
<tr>
<td>Torsemide 10 mg tab (30 d Rx) (MD: Smith, John)</td>
</tr>
<tr>
<td>Torsemide 20 mg tab (30 d Rx) (MD: Smith, John)</td>
</tr>
<tr>
<td>Diabetes Drugs</td>
</tr>
<tr>
<td>Insulin</td>
</tr>
<tr>
<td>Humulin N 100 units/mL vial (30 d Rx) (MD: Lee, David)</td>
</tr>
<tr>
<td>Humulin R 100 units/mL vial (30 d Rx) (MD: Lee, David)</td>
</tr>
<tr>
<td>Oral Agents</td>
</tr>
<tr>
<td>Metformin 500 mg tab (30 d Rx) (MD: Lee, David)</td>
</tr>
<tr>
<td>Other Drugs</td>
</tr>
<tr>
<td>Colchicine 0.5 mg tab (30 d Rx) (MD: Benson, Carol)</td>
</tr>
<tr>
<td>Loratadine 10 mg tab (30 d Rx) (MD: Smith, John)</td>
</tr>
</tbody>
</table>

Patient-Specific, Evidence-Based Medication Suggestions for IOM Priority Conditions:
1. Consider prescribing ACE inhibitor or angiotensin II receptor blocker (ARB), unless contraindicated.

Indications that apply specifically for this patient: (1) diabetes in context of hypertension (ADA Diabetes guidelines, 2007); and (2) ischemic heart disease in context of diabetes and hypertension (ACC/AHA ACS guidelines, 2002). Some contraindications include pregnancy, renal artery stenosis, and allergy.
CDS for Care Transitions

• Setting: A 6-county regional health information exchange network serving Medicaid beneficiaries

• Goal: To increase awareness about care transitions and to augment information availability across these transitions
Project Description

• Identification of Care Transitions
  – Hospitalizations
  – ED visits
  – Specialty care consults

• Notification about Transitions
  – Medical homes
  – Patients
  – Care managers

• Request of Information
  – Discharge summaries
  – ED encounter notes
  – Specialty care consult notes
Intervention Overview

Data from Hospitals → COACH HIE Community Network Clinical Database
Data from Medical Homes → COACH HIE Community Network Clinical Database
Data from NCHSS Claims → COACH HIE Community Network Clinical Database
Data from Care Manager Notes → COACH HIE Community Network Clinical Database

Query Database

SEBASTIAN CDS System

Email Notices → Care Managers
Patient Letters → Care Managers
Event Reports → Care Managers
Release of Information → Care Managers

Care Sites: Hospitals Emergency Depts Specialty Clinics → Medical Home

Patients
# Sample Event Report

## Notice of Hospitalization for Lincoln Community Health Center

**Patient Information:**

- **Name:** Smith, Sample P.
- **DOB:** 8/17/1943
- **Age:** 64
- **Gender:** F
- **Phone #s on file:** 919-111-1111 (h); 919-222-2222 (w)
- **Address on file:** 1234 Maple Street, Roxboro, NC 27573
- **MRNs on file:** Lincoln (B15304), Durham Regional Hospital (1849302), Medicaid (574829491S)

**Hospitalization Information:**

- **Date:** 2/1/08 – 2/6/08
- **Location:** Durham Regional Hospital
- **Primary diagnosis:** congestive heart failure
- **Secondary diagnoses:** diabetes mellitus, type II; essential hypertension; obstructive chronic bronchitis
- **Procedures performed:** right heart catheterization, echocardiogram, chest radiograph, electrocardiogram
- **Billing providers:** Joshua Maynard, MD
- **Request for discharge summary:** sent on 2/11/08

**Pending Appointments:**

- 2/25/08 Duke Cardiology Clinic

**No pending appointment found for Lincoln Community Health Center**

**Recent Encounter History (past 12 months or 12 encounters):**

<table>
<thead>
<tr>
<th>Date</th>
<th>Type</th>
<th>Location</th>
<th>Provider</th>
<th>Primary Diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>02/01/08</td>
<td>In</td>
<td>Durham Regional Hospital</td>
<td>Joshua Maynard, MD</td>
<td>congestive heart failure</td>
</tr>
<tr>
<td>12/07/07</td>
<td>Sp</td>
<td>Duke Cardiology Clinic</td>
<td>Elizabeth Smith, MD</td>
<td>congestive heart failure</td>
</tr>
<tr>
<td>11/24/07</td>
<td>ED</td>
<td>Durham Regional ED</td>
<td>Angela Daniels, MD</td>
<td>congestive heart failure</td>
</tr>
<tr>
<td>10/15/07</td>
<td>PCP</td>
<td>Lincoln Com.Health Ctr.</td>
<td>William Donavan, MD</td>
<td>diabetes mellitus, type II</td>
</tr>
<tr>
<td>08/18/07</td>
<td>Sp</td>
<td>Duke Cardiology Clinic</td>
<td>Elizabeth Smith, MD</td>
<td>congestive heart failure</td>
</tr>
<tr>
<td>07/28/07</td>
<td>Sp</td>
<td>Duke Pulmonary Clinic</td>
<td>Terry Sanders, MD</td>
<td>chronic bronchitis</td>
</tr>
</tbody>
</table>

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Sample Event Report (con’t)

Recent Encounter History (past 12 months or 12 encounters):

<table>
<thead>
<tr>
<th>Date</th>
<th>Type</th>
<th>Location</th>
<th>Provider</th>
<th>Primary Diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>02/01/08</td>
<td>In</td>
<td>Durham Regional Hospital</td>
<td>Joshua Maynard, MD</td>
<td>congestive heart failure</td>
</tr>
<tr>
<td>12/07/07</td>
<td>Sp</td>
<td>Duke Cardiology Clinic</td>
<td>Elizabeth Smith, MD</td>
<td>congestive heart failure</td>
</tr>
<tr>
<td>11/24/07</td>
<td>ED</td>
<td>Durham Regional ED</td>
<td>Angela Daniels, MD</td>
<td>congestive heart failure</td>
</tr>
<tr>
<td>10/15/07</td>
<td>PCP</td>
<td>Lincoln Com. Health Ctr.</td>
<td>William Donavan, MD</td>
<td>diabetes mellitus, type II</td>
</tr>
<tr>
<td>08/18/07</td>
<td>Sp</td>
<td>Duke Cardiology Clinic</td>
<td>Elizabeth Smith, MD</td>
<td>congestive heart failure</td>
</tr>
<tr>
<td>07/28/07</td>
<td>Sp</td>
<td>Duke Pulmonary Clinic</td>
<td>Terry Sanders, MD</td>
<td>chronic bronchitis</td>
</tr>
<tr>
<td>06/02/07</td>
<td>Sp</td>
<td>Triangle Ophthalmology</td>
<td>Dana Copeland, MD</td>
<td>diabetes mellitus, type II</td>
</tr>
<tr>
<td>05/02/07</td>
<td>PCP</td>
<td>Lincoln Com. Health Ctr.</td>
<td>William Donavan, MD</td>
<td>diabetes mellitus, type II</td>
</tr>
<tr>
<td>03/10/07</td>
<td>Sp</td>
<td>Duke Cardiology Clinic</td>
<td>Elizabeth Smith, MD</td>
<td>congestive heart failure</td>
</tr>
<tr>
<td>02/19/07</td>
<td>In</td>
<td>Duke Hospital</td>
<td>Donna Sullivan, MD</td>
<td>congestive heart failure</td>
</tr>
<tr>
<td>01/22/07</td>
<td>PCP</td>
<td>Lincoln Com. Health Ctr.</td>
<td>William Donavan, MD</td>
<td>diabetes mellitus, type II</td>
</tr>
</tbody>
</table>

Medical Home Information:
Most recent medical home provider: William Donavan, MD (last saw patient on 10/15/07, 5/2/07, and 1/22/07)
Patient also seen in last 24 months by Mary Langley, MD (on 4/22/06)
If you have any questions regarding this notice, please contact: Jan Willis, MS, MBA, project coordinator, Duke University Division of Clinical Informatics, at (919)684-2340.

PLEASE NOTE: The above information was generated from claims data and may be inaccurate or incomplete. Please verify the information, as the provider is acknowledged as the final authority for all care decisions.
Sample Care Manager Notice

COACH Alerts for Ms. Madeline Maturo
02/11/08 (Mon)

If you have any questions, please contact Jan Willis, MS, MBA, Duke University (jan.willis@duke.edu; 919-684-2340).

Patients requiring attention (highest priority patients listed first):

| Medicaid #: 574829491S | Lincoln MRN: B15304 | Priority: 5.0 |
| 1234 Maple Street, Roxboro, NC 27573 | | Home #: 919-111-1111 |

Hospitalizations that may require follow-up:

- **Hospitalization Discharge of Complex Patient.** Location: Durham Regional Hospital. Date: 02/01/08 to 02/06/08. Primary diagnosis: congestive heart failure. # hospitalizations in past 12 months: 2. Pending appointment at medical home: None scheduled.
# Request for Release of Medical Information

**To:**
Durham Regional Hospital  
Attn: Medical Information Release Unit  
P.O. Box 3016  
Durham, NC 27710

**From:**
Lincoln Community Health Center  
1301 Fayetteville St.  
P.O. Box 32119  
Durham, NC 27717-2119  
(919) 956-4000

**Information Requested For:**
Name: Smith, Sample P.  
DOB: 8/17/1943  
Gender: F  
Durham Regional Hospital MRN: 1849302

**Information Requested:**
Discharge summary from hospitalization starting on 2/1/08

Please fax the above information to:  
Lincoln Community Health Center  
Attn: Claire Crenshaw, RN, clinic manager  
Re: Sample P. Smith, Lincoln MRN B15304. DRH discharge summary, PCP William Donavan  
Fax: (919)956-4001

We are attaching a return fax cover sheet for your convenience. Please use the attached cover sheet if possible, as it will help us with internal routing of the information.

If you have any questions or concerns, please contact: Claire Crenshaw, clinic manager, Lincoln Community Health Center, at (919)856-4000 extension 15.
# Project Challenges → Lessons

<table>
<thead>
<tr>
<th>People</th>
<th>Working with diverse stakeholders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Politics</td>
<td>Working with systems, institutions and their policies</td>
</tr>
<tr>
<td>Pragmatism</td>
<td>What we wish we had known sooner</td>
</tr>
</tbody>
</table>
Lessons: People

- Controlling expectations
- Avoiding “Scope Creep”
- Securing buy-in from end users
  - Decision rules
  - Letter content
- Creating familiar associations
  - Letterhead from clinic sites
Lessons: Politics

- Obtaining data from partners
- Complying with HIPAA regulations
- Receiving IRB approval
- Working with community partners
- Working in the community setting
- Navigating the academic institution
Lessons: Pragmatism #1

- Limiting the volume of notifications
- Providing adequate content in notices
  - Dates
  - Values
- Accommodating flexibility
- Assuring accuracy of CDS information
Lessons: Pragmatism #2

• Enabling local configuration of CDS
  – End user control of notification distribution
  – Narrow scope of options
• Configuring CDS for individual patients
• Understanding the data
  – Accommodating data differences
Acknowledgments

• Division of Clinical Informatics
  – Connie Bishop, RN, MS
  – Chris Dedam
  – Guilherme Del Fiol, MD, PhD
  – Megan Hunt
  – Kensaku Kawamoto, MD, PhD
  – Kathy Kimrey
  – Kevin Kooy, ME
  – Jennifer M. Macri, MS
  – Allen Mayers
  – Chet Orton
  – Garry Silvey
  – Jan Willis, MBA, MS
  – Laura Wood, RN, MS

• Division of Community Health
  – Fred Johnson, MBA
  – Michelle Lyn, MPH, MBA
  – Gwyn Murphy, PhD
  – Pam Phillips
  – Tia Simmons, MPH
  – Jessica Simo, MHA
  – Susan Yaggy, MPA
  – Kim Yarnall, MD

• Other Duke Groups
  – Kevin Anstrom, PhD
  – Rex Edwards, MS
  – Eric Eisenstein, DBA
  – Vic Hasselblad, PhD
  – Paul Lee, MD, JD
  – Bob Rezzarday
  – Dwight Smith
  – Pete Woods

• Outside Collaborators
  – Richard Low (Topsail Technologies)
Project Publications


Thank you!

David Lobach
Duke University
Durham, NC
david.lobach@duke.edu
Questions & Answers

Our Panel:

Ben-Tzion Karsh, PHD, MSIE, University of Wisconsin
Department of Industrial and Systems Engineering

Ross Koppel, PHD, MA, University of Pennsylvania
Department of Sociology, and Center for Clinical
Epidemiology and Biostatistics, School of Medicine

David F. Lobach, MD, PhD, Division of Clinical
Informatics, Department of Community and Family
Medicine, Duke University
Save the Date!

Our Next Event

A National Web Conference on How CDS Can Be Used to Monitor or Improve Population Health

Third teleconference in our four-part series on Clinical Decision Support

November 18, 2008, from 3:30 – 5:00 PM Eastern Time

Watch your inbox for information on how to register
Thank You for Attending

This event was brought to you by the AHRQ National Resource Center for Health IT

The AHRQ National Resource Center for Health IT promotes best practices in the adoption and implementation of health IT through a robust online knowledge library, Web conferences, toolkits, as well as AHRQ-funded research outcomes.

A recording of this Web conference will be available on the AHRQ National Resource Center Web site in approximately one week.

http://healthit.ahrq.gov

AHRQ National Resource Center for Health Information Technology