A National Web Conference on Using Health IT to Enable Greater Care Coordination Across Acute and Outpatient Settings of Care

May 14, 2013
1:30 pm – 3:00 pm ET
Moderator and Presenters

Disclosures

Moderator:
Angela Nunley, MSEd*
Agency for Healthcare Research and Quality

Presenters:
Ilana Graetz, Ph.D.*
David Dorr, M.D., M.S.†
Anuj Dalal, M.D., F.H.M.*

*Have no financial, personal, or professional conflicts of interest to disclose.

† Dr. Dorr would like to disclose that he receives royalties for non-exclusive licensing from Oregon Health and Science University to various entities.
The Impact of EHR Use & Teamwork on Care Coordination

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Kaiser Permanente, Division of Research

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In 2009 ARRA HITECH allocated over $30 billion to promote adoption and meaningful use of electronic health records (EHRs)
- Provides up to $60K per doctor
- Meaningful Use criteria defined to target improvements in care coordination and clinical care quality

In 2012 40% of physicians working in outpatient clinics used EHRs
- Up from 17% in 2008

Conflicting evidence on the effect of EHRs
Background: Primary Care Teams

- 2001 Institute of Medicine (IOM) report called for health care redesign with emphasis on primary care teams

- Multidisciplinary primary care teams typically include:
  - Physicians
  - Nurse practitioners
  - Registered nurses
  - Behavioral medicine specialists
  - Physical therapists
  - Clinical health educators
  - Medical assistants
Theoretical and structural models promote use of primary care teams and health IT
  – Chronic Care Model
  – Patient-Centered Medical Homes

Organizational theory
  – Collective learning
  – Technology adoption

Limited information on how the organizational context may impact the EHR effect
EHR is not a Silver Bullet

- Provides more information and new channels for communication
  - "Now primarily using [the EHR] across all providers, which has helped a lot. Less gets lost through the cracks."
  - "[The EHR has] made it easier to check on hospital course, tests, discharge summaries, consults, etc."

- However, can also result in information overload
  - "There is so much information and repetition in the system. It's easy to miss the important points."
  - "Handoffs continue to be a problem. Communication is still needed, not just relying on [the EHR] messages. Info is generally available but sometimes hard to access—that is, it is "buried" and not easily found."

Source: Quotes from KPNC primary care clinician surveys (2005-2008) on barriers to care coordination
Teams and Informal Learning

Team member relationships reinforce informal learning

- Reinforced by communication and strength of working relationships
- Members more open to experimenting, trial and error
- Sharing best practices with each other

“Colleagues taught me more [on how to use EHRs] than formal presentations.”

“I learned to use EHRs] mostly by practicing, trying to solve problems, talking to other people, and a lot of trial and error.”

“Learned [to use the EHR] the most from colleagues; it’s helpful when we all meet to share knowledge.”

Source: Quotes from KPNC primary care clinician surveys (2005-2008) on how they learned to use the EHR.
Care Coordination and Electronic Health Records: Connecting Clinicians
Ilana Graetz\textsuperscript{1,2}, Mary Reed\textsuperscript{1}, Thomas Rundall\textsuperscript{2}, Jim Bellows\textsuperscript{3}, Richard Brand\textsuperscript{2}, John Hsu\textsuperscript{1,2}

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Abstract
Objective: To examine the association between use of electronic health records (EHR) and care coordination.
Study Design: Two surveys, in 2005 and again in 2006, of primary care clinicians working in a prepaid integrated delivery system during the staggered implementation of an EHR system. Using multivariate logistic regression to adjust for clinician characteristics, we examined the association between EHR use and clinicians’ perceptions of three dimensions of care coordination: timely access to complete information; treatment goal agreement; and role/responsibility agreement.
Results: Compared to clinicians without EHR, clinicians with 64 months of EHR use more frequently reported timely access to complete information, and being in agreement on treatment goals with other involved clinicians. There was no significant association between EHR use and being in agreement on roles and responsibilities with other clinicians.
Conclusions: EHR use is associated with aspects of care coordination involving information transfer and communication of treatment goals.

INTRODUCTION
The number of Americans living with at least one chronic condition is large and growing. In 2005, an estimated 175 million Americans had at least one chronic condition, and this number is expected to grow to 240 million by 2020. Chronic conditions are among the leading causes of disability and death in the United States, and they place a substantial burden on both the individual and the health care system. Effective care coordination is critical for managing chronic conditions, yet existing evidence indicates that clinicians rarely have access to complete medical information when patient care is transferred across providers and that patient safety may be jeopardized during these transitions in care\textsuperscript{6,8}. Lack of timely information often results in inadequate patient monitoring, redundant care, medical errors\textsuperscript{11}, or greater use of hospital and emergency services\textsuperscript{12}. Any practical realization of a model for coordinated care must rely heavily on the timely availability of comprehensive clinical information, likely provided through an integrated EHR system. Integrated EHR systems, which compile a comprehensive patient clinical record, have clear potential to significantly improve the coordination of clinical care delivery by improving the availability and timeliness of patient’s medical information\textsuperscript{6,8}.

In this study, we investigate the impact of implementing a commercially available, integrated EHR system on multiple measures of care coordination. Using primary care clinician surveys collected in 2005 and 2006, we investigate the association between use of EHR and three clinician reported measures of care coordination: 1) availability and timeliness of relevant medical information; 2) agreement on treatment goals and plans among a patient’s clinicians; 3) and agreement.
Outpatient Electronic Health Records and the Clinical Care and Outcomes of Patients With Diabetes Mellitus

Mary Reed, DrPH; Jie Huang, PhD; Ilana Graetz, BA; Richard Brand, PhD; John Hsu, MD, MBA, MSCE; Bruce Fireman, MA; and Marc Jaffe, MD

Background: Physicians can receive federal payments for meaningful use of complete certified electronic health records (EHRs). Evidence is limited on how EHR use affects clinical care and outcomes.

Objective: To examine the association between use of a commercially available certified EHR and clinical care processes and disease control in patients with diabetes.

Design: Quasi-experimental design with outpatient EHR implementation sequentially across 17 medical centers. Multivariate analyses adjusted for patient characteristics, medical center, time trends, and facility-level clustering.

Results: 169,711 patients with diabetes mellitus.

Intervention: Use of a commercially available certified EHR.

Measurements: Drug treatment intensification and hemoglobin A1c (HbA1c) and low-density lipoprotein cholesterol (LDL-C) testing and values.

Results: Use of an EHR was associated with statistically significant improvements in treatment intensification after HbA1c values of 9% or greater (odds ratio, 1.10 [95% CI, 1.05 to 1.15]) or LDL-C values of 2.6 to 3.3 mmol/L (100 to 129 mg/dL) (odds ratio, 1.06 [CI, 1.00 to 1.12]); increases in 1-year retesting for HbA1c and LDL-C levels among all patients, with the most dramatic change among patients with the worst disease control (HbA1c levels $\geq$9% or LDL-C levels $\geq$3.4 mmol/L [$\geq$130 mg/dL]); and decreased 90-day retesting among patients with HbA1c levels less than 7% or LDL-C levels less than 2.6 mmol/L (<100 mg/dL). The EHR was also associated with statistically significant reductions in HbA1c and LDL-C levels, with the largest reductions among patients with the worst control (0.06-mmol/L [2.19-mg/dL] reduction among patients with baseline LDL-C levels $\geq$3.4 mmol/L [$\geq$130 mg/dL]; $P < 0.001$).

Limitation: The EHR was implemented in a setting with strong baseline performance on cardiovascular care quality measures.

Conclusion: Use of a commercially available certified EHR was associated with improved drug treatment intensification, monitoring, and physiologic control among patients with diabetes, with greater improvements among patients with worse control and less testing in patients already meeting guideline-recommended glycemic and lipid targets.

Primary Funding Source: National Institute of Diabetes and Digestive and Kidney Diseases.
Objective

To examine whether the effects of EHR use on care coordination are different depending on the primary care team members’ working relationships.
Objective

- To examine whether the effects of EHR use on care coordination are different depending on the primary care team members’ working relationships.
Methods: Setting

- **Kaiser Permanente Northern California**
  - Large, prepaid integrated delivery system (IDS)
  - 17 medical centers and 110 primary care teams
  - Outpatient and inpatient care for over three million members

- **EHR System**
  - Commercially available, Epic-based system
  - Certified → eligible for ‘Meaningful Use’ payments
    - Integrated patient clinical information at the point-of-care
    - Clinical decision support
    - Computerized physician order entry
    - Secure messaging with patients and other clinicians
Staggered EHR Implementation

Note: This figure shows the schedule of staggered outpatient (light blue) and inpatient (dark blue) EHR implementation across all study medical centers during the study period 2005-2010. After implementation, the EHR completely replaced the paper medical chart and a limited patchwork of preexisting non-integrated health IT tools. Use of those early health IT tools was limited, as paper-based alternatives were still in use. EHR = Electronic Health Record.
Staggered EHR Implementation

Note: This figure shows the schedule of staggered outpatient (light blue) and inpatient (dark blue) EHR implementation across all study medical centers during the study period 2005-2010. After implementation, the EHR completely replaced the paper medical chart and a limited patchwork of preexisting non-integrated health IT tools. Use of those early health IT tools was limited, as paper-based alternatives were still in use. EHR = Electronic Health Record.
Survey: Coordination of Care

How often does each of the following occur when care is transferred across delivery sites?

1. All relevant medical information is available.
2. The information transfer is timely, i.e., available when it is needed.
3. All clinicians agree on the treatment goals and plans.
4. All clinicians agree on roles and responsibilities of each party.

Response categories: [never, rarely, sometimes] and [usually and always]
1. When there is conflict on this team, the people involved usually talk it out and resolve the problem successfully.

2. Our team members have constructive work relationships.

3. There is often tension among people on this team (reverse scored).

4. The team members operate as a real team.
   - Response: Likert agreement scale (1-5)
   - Responses averaged over 4 items per responded and aggregated across team members. We categorized team cohesion scores into quartiles and created an indicator variable for teams in the lowest quartile.

Cronbach’s alpha = 0.83
Primary Care Team Cohesion

<table>
<thead>
<tr>
<th>Quartile</th>
<th>Mean (SD)</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st (lowest)</td>
<td>3.3 (0.1)</td>
<td>2.8</td>
<td>3.5</td>
</tr>
<tr>
<td>2nd</td>
<td>3.6 (0.1)</td>
<td>3.5</td>
<td>3.7</td>
</tr>
<tr>
<td>3rd</td>
<td>3.8 (0.1)</td>
<td>3.7</td>
<td>3.9</td>
</tr>
<tr>
<td>4th (highest)</td>
<td>4.1 (0.1)</td>
<td>3.9</td>
<td>4.4</td>
</tr>
</tbody>
</table>
Primary Care Team Cohesion

<table>
<thead>
<tr>
<th>Quartile</th>
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<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(^{st}) (lowest)</td>
<td>3.3 (0.1)</td>
<td>2.8</td>
<td>3.5</td>
</tr>
<tr>
<td>2(^{nd})</td>
<td>3.6 (0.1)</td>
<td>3.5</td>
<td>3.7</td>
</tr>
<tr>
<td>3(^{rd})</td>
<td>3.8 (0.1)</td>
<td>3.7</td>
<td>3.9</td>
</tr>
<tr>
<td>4(^{th}) (highest)</td>
<td>4.1 (0.1)</td>
<td>3.9</td>
<td>4.4</td>
</tr>
</tbody>
</table>

1\(^{st}\) quartile
Lower Cohesion

2\(^{nd}\) – 4\(^{th}\) quartiles
Higher Cohesion
## Participant Characteristics:
**Primary Care Clinicians**

<table>
<thead>
<tr>
<th>Survey collection year</th>
<th>2005 (N=565)</th>
<th>2006 (N=678)</th>
<th>2008 (N=626)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Response Rate (%)</strong></td>
<td>48.1</td>
<td>61.5</td>
<td>60.8</td>
</tr>
<tr>
<td><strong>Gender:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>45.3</td>
<td>46.0</td>
<td>48.3</td>
</tr>
<tr>
<td>Female</td>
<td>54.7*</td>
<td>54.0*</td>
<td>51.7</td>
</tr>
<tr>
<td><strong>Race/Ethnicity:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-white</td>
<td>51.0</td>
<td>56.9</td>
<td>60.8</td>
</tr>
<tr>
<td>White</td>
<td>49.0</td>
<td>43.1</td>
<td>39.2</td>
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<tr>
<td><strong>Training:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N.P/P.A.</td>
<td>15.8*</td>
<td>11.7*</td>
<td>5.6</td>
</tr>
<tr>
<td>M.D./D.O.</td>
<td>84.3</td>
<td>88.4</td>
<td>94.4</td>
</tr>
<tr>
<td><strong>Age:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25-39</td>
<td>36.0</td>
<td>38.1*</td>
<td>39.5*</td>
</tr>
<tr>
<td>40-54</td>
<td>47.5</td>
<td>45.1</td>
<td>44.8</td>
</tr>
<tr>
<td>55+</td>
<td>16.5</td>
<td>16.8</td>
<td>15.7</td>
</tr>
<tr>
<td><strong>EHR Status:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No integrated EHR</td>
<td>100.0</td>
<td>93.7</td>
<td>52.2</td>
</tr>
<tr>
<td>Integrated EHR</td>
<td>0.0</td>
<td>6.3</td>
<td>47.8</td>
</tr>
</tbody>
</table>

*p<0.05 comparing respondents and nonrespondents
Primary Care Team Characteristics by Survey Year

<table>
<thead>
<tr>
<th>Survey collection year</th>
<th>2005 (N=105)</th>
<th>2006 (N=106)</th>
<th>2008 (N=104)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (SD)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary care clinicians per team</td>
<td>11.14 (3.78)</td>
<td>10.4 (3.86)</td>
<td>9.86 (5.92)</td>
</tr>
<tr>
<td>Respondents per team</td>
<td>5.39 (2.32)</td>
<td>6.40 (2.71)</td>
<td>6.01 (4.24)</td>
</tr>
<tr>
<td>Team cohesion score:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower</td>
<td>3.30 (0.35)</td>
<td>3.23 (0.35)</td>
<td>3.18 (0.42)</td>
</tr>
<tr>
<td>Higher</td>
<td>3.87 (0.27)</td>
<td>3.87 (0.23)</td>
<td>3.83 (0.19)</td>
</tr>
</tbody>
</table>
Methods: Analysis

- **Model**: Logistic regression with random intercepts for clinician and medical center (GLLAMM)
- **Outcome variables**: Three reported dimensions of care coordination across delivery sites (binary)
- **Predictor variables**: Interaction
  - Integrated outpatient-inpatient EHR
  - Team Cohesion Indicator
- **Covariates**: Survey year (2005, 2006, or 2008) and clinician characteristics (gender, age, race/ethnicity, and M.D. vs. N.P./P.A.)
Adjusted Coordination of Care Across Delivery Sites: By Integrated EHR and Team Cohesion

Note: We computed the marginal adjusted percent of respondents who reported each outcome by fitting the logistic regression models as if all respondents had (1) no EHR and low team cohesion, (2) no EHR and high team cohesion, (3) EHR and low team cohesion, and (4) EHR and high team cohesion. *p<0.05, **p<0.01, ***p<0.001, p-values compare EHR with no EHR for clinicians working in team with high and with low cohesion.
Limitations

- All data collected from a single, integrated delivery system
  - Single EHR system
  - High baseline level of quality within the system
- Limited survey response rate
- Self-reported data
Conclusion

Improvements in clinician reported measures of care coordination associated with EHR-use varied by level of team cohesion

- Significant improvements for clinicians working in teams with higher cohesion
- No improvements for clinicians working in primary care teams with lower cohesion
Implications

- The organizational context is important for understanding the EHR effect on quality.

- Teams with a strong working relationships more successfully leveraged the EHR to achieve greater improvements in care coordination.

- Efforts to increase EHR use should consider including combined interventions that also target team function.
Contact Information

Thank You!

Ilana Graetz
ilanag@gmail.com
An Automated Notification Strategy for Managing Tests Pending at Discharge (TPADs)

Anuj K Dalal, M.D., F.H.M.
BWH Hospitalist Service
Division of General Medicine
Brigham and Women’s Hospital
Partners HealthCare, Inc.
DESIGN & IMPLEMENTATION

Supported by BWH HIT Innovations Program
Think Like a Doctor: Doubled Over in Pain Solved!

By LISA SANDERS, M.D., Columnist

On Thursday, we challenged Well readers to figure out the diagnosis for a 30-year-old man with a two-week history of severe abdominal pain.

More than 600 readers wrote in with some very thoughtful assessments of this patient's problem.

The correct diagnosis is...

Acute Intermittent Porphyria

The first person to figure it out was Dr. Hilary Seligman, from the University of California, San Francisco. She wrote that during her medical school years at Baylor in the 1970s, there were five causes of severe abdominal pain that she overlooked. Porphyria was one of them. And she has since seen a patient with that kind of pain.

A Problem in the System:

In this case, the patient benefited from a fairly rapid diagnosis of his porphyria. Although those weeks of pain may have seemed like years to the patient, the average time to diagnosis for most patients with this disease is counted in years rather than weeks, according to Desiree Lyon Howe, the executive director of the American Porphyria Foundation. When the patient and his wife met others with porphyria at the Mount Sinai clinic, they were amazed and horrified to hear the common story of years of painful episodes before a diagnosis was made.

Nevertheless, this diagnosis was almost missed. If the patient hadn't gone back to Mount Sinai when the pain returned, it is very unlikely that he would have found out about his positive test. Who knows how long it might have taken for him to get the right diagnosis?
TPADs: Epidemiology†

- 41% patients discharged with TPADs
  - 43% abnormal
  - 31% heme, chem, path; 27% radiology; 42% microbiology
  - 9.4% considered potentially actionable

- Physicians are aware of only 40% of the final results of TPADs.

- Few institutions have standardized systems to manage this patient safety concern.

What about Discharge Documentation?

Lots of info, but are we transferring timely knowledge?

<table>
<thead>
<tr>
<th>Table 1. Timeliness, Completeness, and Accuracy of Information Transfer at Hospital Discharge*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Discharge Letters</strong></td>
</tr>
<tr>
<td>Availability and timeliness</td>
</tr>
<tr>
<td>Received by primary care physician</td>
</tr>
<tr>
<td>Within 48-72 h</td>
</tr>
<tr>
<td>Within 7 days</td>
</tr>
<tr>
<td>Within a week</td>
</tr>
<tr>
<td>At all</td>
</tr>
<tr>
<td>Available in hospital medical record</td>
</tr>
<tr>
<td>Content missing in summary</td>
</tr>
<tr>
<td>Administrative data</td>
</tr>
<tr>
<td>Patient’s surname</td>
</tr>
<tr>
<td>Patient’s age</td>
</tr>
<tr>
<td>Dates of admission and discharge</td>
</tr>
<tr>
<td>Name of responsible hospital staff</td>
</tr>
<tr>
<td>Name of physician preparing discharge summary</td>
</tr>
<tr>
<td>Name of primary care physician</td>
</tr>
<tr>
<td>Medical information</td>
</tr>
<tr>
<td>Main diagnosis</td>
</tr>
<tr>
<td>Other diagnoses</td>
</tr>
<tr>
<td>Presenting symptoms</td>
</tr>
<tr>
<td>History of present illness</td>
</tr>
<tr>
<td>Medical history</td>
</tr>
<tr>
<td>Social history</td>
</tr>
<tr>
<td>Physical examination findings</td>
</tr>
<tr>
<td>Diagnostic test results</td>
</tr>
<tr>
<td>Consultant recommendations</td>
</tr>
<tr>
<td>Treatment/hospital course</td>
</tr>
<tr>
<td>Discharge medications</td>
</tr>
<tr>
<td>Test results pending at discharge</td>
</tr>
<tr>
<td>Follow-up plans</td>
</tr>
<tr>
<td>Patient or family counseling</td>
</tr>
</tbody>
</table>

*Values represent the median percentage and range reported across studies (superscript citations).
†Results for the interval 5 to 9 days since discharge were accepted to accommodate variable reporting across studies.
The Fundamental Problem...

Right Information

Right Person

Right Time
To be successful, HIT systems must

- Conform to workflow of both inpatient and ambulatory providers
- Support coordination of care across care settings
- Promote a seamless transition in knowledge and responsibility
- Facilitate test result acknowledgement
BWH Pilot System Automated Email Notification for TPADs

- Identify patients discharged with TPADs
- Notify responsible physicians of the finalized results of TPADs via secure, network email at the time they become available
  - TO Discharging Inpatient Attending
  - CC Primary Care Physicians (Network PCPs)
- Three email notification types:
  1. Chemistry, Hematology
  2. Radiology, Pathology
  3. Microbiology (culture† and non-culture)

Design of System: A Coordinated Sequence of Events

Email Notification Types:
1. Chem/Heme
2. Rad/Path
3. Micro

- Triggers emails until all non-suppressed TPADs finalized
- Limits one email to provider per notification type per day
- Sends emails to inpatient attendings and network PCPs
Design Considerations

Alert Fatigue

Goal: Maximize utility of system by timely notification of relevant results

Important Questions:

1. Should we notify providers only on abnormal results?
2. Should we notify providers on negative results and, if so, which ones?
3. Should we exclude only commonly ordered inpatient results with fast turn-around (i.e., all basic metabolic panels, CBCs, coags, etc.)?
Design Considerations: Alert Fatigue

- Incorporated logic to suppress certain, inpatient-specific, non-essential TPADs, modifiable “on-the-fly”
- Kept to a minimum during pilot period to see what is coming through (i.e., kept sensitivity high)
  - Chemistry: ABG, VBG
  - Hematology: RBC, MCV, MCH, MCHC, Diff Count
  - Radiology:
    - Fluoroscopy use
    - Uploaded outside hospital images (no reports generated)
  - Pathology/Microbiology: none
- Limited notification volume to no more than one email per notification type per day until all TPADs finalized.
  - Micro alerts: after initial notification, sent subsequent notifications only on abnormal results
Configurable System: Lab Selection

BICS Terminal Emulator - oc11.partners.org

HEMATOLOGY

Check labs to send notifications for:

[ ] Select All
[ ] Deselect All

Press L for the List

PREVIOUS OK RESET CANCEL
**Important Post-Discharge Test Results - send secure**

**BWH Post DC Test Results**

*Sent:* Thu 8/23/2012 12:05 AM  
*To:* Dalal, Anuj K., M.D.

---

**Status:** Results **FINALIZED**

**Chemistry**

<table>
<thead>
<tr>
<th>Test Name</th>
<th>Results</th>
<th>Normal Range</th>
<th>Date Resulted</th>
</tr>
</thead>
<tbody>
<tr>
<td>IGM</td>
<td>32*</td>
<td>(40-230 mg/dL)</td>
<td>08/22/2012 13:46:00</td>
</tr>
<tr>
<td>IGA</td>
<td>234</td>
<td>(70-400 mg/dL)</td>
<td>08/22/2012 13:46:00</td>
</tr>
<tr>
<td>IGG</td>
<td>784</td>
<td>(700-1600 mg/dL)</td>
<td>08/22/2012 13:46:00</td>
</tr>
</tbody>
</table>

**Hematology**

Malaria, Babesia smear: No parasites seen on thin and thick smears.

*Date:* 08/22/2012 13:46:00
Chemistry/Hematology Notification

March 29, 2011
Dear Dr. HOSPITALIST, M.D.:  

DISCHARGED PATIENT (BWH# 12345678), from you were the attending of record, was discharged from Brigham and Women's Hospital on 03/27/2011. Some tests from this hospitalization were still pending at the time of discharge. We have listed below 1) tests whose results have been finalized after discharge, and 2) tests whose results are still pending. Chemistry and Hematology test types are included in this service. Radiology, Pathology, and Microbiology test types are available in separate notifications.

The patient’s PCP, NON-NETWORK PROVIDER, did not receive this notification because s/he does not have a Partners email address listed.

This is a new service we are piloting that we hope you will find to be helpful. Note: Any corrections or changes made after tests are finalized are not captured by this service but are reported per current lab protocol.

Inpatient Attending: HOSPITALIST, M.D. Work Phone: 111-111-1111
Primary Care Physician: NON-NETWORK PROVIDER, M.D. Work Phone: 222-222-2222

**Status: Results **FINALIZED** Hematology**

<table>
<thead>
<tr>
<th>Test Name</th>
<th>Results</th>
<th>Normal Range</th>
<th>Date Resulted</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANTITHROMBIN III</td>
<td>76</td>
<td>(69-127 %)</td>
<td>03/28/2011 11:29:00</td>
</tr>
<tr>
<td>FUNCTIONAL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>APCR (FACTOR 5 LEIDEN)</td>
<td>4.17; NEW REFERENCE RANGE EFFECTIVE 03/19/08; PREVIOUS REFERENCE RANGE 0.8-2.50</td>
<td>(2.3-15.0)</td>
<td>03/28/2011 11:21:00</td>
</tr>
</tbody>
</table>

**Status: Results PENDING Chemistry**

<table>
<thead>
<tr>
<th>Test Name</th>
<th>Specimen Login Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANTI-PROTHROMBIN</td>
<td>03/25/2011 17:04:00</td>
</tr>
<tr>
<td>CARDIOLIPIN IGG</td>
<td>03/25/2011 17:04:00</td>
</tr>
<tr>
<td>CARDIOLIPIN IGM</td>
<td>03/25/2011 17:04:00</td>
</tr>
</tbody>
</table>

Please email the [BWH Post-Discharge Results Notification Service](#) for any questions, comments, and concerns related to this alert.
March 30, 2011
Dear Dr. HOSPITALIST, M.D.:

DISCHARGED PATIENT (BWH# 12345678), for whom you were the attending of record, was discharged from Brigham and Women’s Hospital on 03/27/2011. Some tests from this hospitalization were still pending at the time of discharge. We have listed below 1) tests whose results have been finalized after discharge, and 2) tests whose results are still pending. Chemistry and Hematology test types are included in this service. Radiology, Pathology, and Microbiology test types are available in separate notifications.

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This is a new service we are piloting that we hope you will find to be helpful. Note: Any corrections or changes made after tests are finalized are not captured by this service but are reported per current lab protocol.

Inpatient Attending: HOSPITALIST, M.D. Work Phone: 111-111-1111
Primary Care Physician: NON-NETWORK PROVIDER, M.D. Work Phone: 222-222-2222

### Chemistry

<table>
<thead>
<tr>
<th>Test Name</th>
<th>Results</th>
<th>Normal Range</th>
<th>Date Resulted</th>
</tr>
</thead>
<tbody>
<tr>
<td>CARDIOLIPIN IGG</td>
<td>18; METHODOLOGY CHANGE 8/23/99 : PRE CHANGE REFERENCE RANGE 0-22 GPL, POST CHANGE REFERENCE RANGE 0-15 GPL</td>
<td>(0-15 GPL units)</td>
<td>03/29/2011 11:46:00</td>
</tr>
<tr>
<td>CARDIOLIPIN IGM</td>
<td>14</td>
<td>(0-15 MPL units)</td>
<td>03/29/2011 11:46:00</td>
</tr>
</tbody>
</table>

### Hematology

<table>
<thead>
<tr>
<th>Test Name</th>
<th>Results</th>
<th>Normal Range</th>
<th>Date Resulted</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANTITHROMBIN III FUNCTIONAL</td>
<td>76</td>
<td>(69-127 %)</td>
<td>03/28/2011 11:29:00</td>
</tr>
<tr>
<td>APCR (FACTOR 5 LEIDEN)</td>
<td>4.17; NEW REFERENCE RANGE EFFECTIVE 3/19/08; PREVIOUS REFERENCE RANGE 0.8-2.50</td>
<td>(2.3-15.0)</td>
<td>03/28/2011 11:21:00</td>
</tr>
</tbody>
</table>

Status: Results **FINALIZED**

**Chemistry**

<table>
<thead>
<tr>
<th>Test Name</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANTI-PROTHROMBIN</td>
<td>Specimen Login Time</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Specimen Login Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>03/25/2011 17:04:00</td>
</tr>
</tbody>
</table>

Status: Results **PENDING**

Please email the BWH Post-Discharge Results Notification Service for any questions, comments, and concerns related to this alert.
March 31, 2011
Dear Dr. HOSPITALIST, M.D.:

DISCHARGED PATIENT (BWH# 12345678), for whom you were the attending of record, was discharged from Brigham and Women’s Hospital on 03/27/2011. Some tests from this hospitalization were still pending at the time of discharge. We have listed below 1) tests whose results have been finalized after discharge, and 2) tests whose results are still pending. Chemistry and Hematology test types are included in this service. Radiology, Pathology, and Microbiology test types are available in separate notifications.

The patient’s PCP, NON-NETWORK PROVIDER, did not receive this notification because s/he does not have a Partners email address listed.

This is a new service we are piloting that we hope you will find to be helpful. Note: Any corrections or changes made after tests are finalized are not captured by this service but are reported per current lab protocol.

Inpatient Attending: HOSPITALIST, M.D. Work Phone: 111-111-1111
Primary Care Physician: NON-NETWORK PROVIDER, M.D. Work Phone: 222-222-2222

### Test Name | Results | Normal Range | Date Resulted
--- | --- | --- | ---
**Chemistry**
ANTI-PROTHROMBIN | 3 | (0-20 UNITS) | 03/30/2011 14:23:00
CARDIOLIPIN IGG | 16; METHODOLOGY CHANGE 8/23/99; PRE CHANGE REFERENCE RANGE 0-22 GPL, POST CHANGE REFERENCE RANGE 0-15 GPL. | (0-15 GPL units) | 03/29/2011 11:46:00
CARDIOLIPIN IGM | 14 | (0-15 MPL units) | 03/29/2011 11:46:00

### Hematology

<table>
<thead>
<tr>
<th>Test Name</th>
<th>Results</th>
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</tr>
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<td>03/28/2011 11:21:00</td>
</tr>
</tbody>
</table>

Status: Results **FINALIZED**

Status: Results **PENDING**

Please email the BWH Post-Discharge Results Notification Service for any questions, comments, and concerns related to this alert.
Measures

- **Background performance**
  - What’s happening “under the hood”?
    - TPAD processing: volume, % flagged abnormal, % suppressed by rules
    - Reliability: discharge time, provider identification

- **Email notification performance**
  - What did physicians see?
    - Volume of notifications by discharged patient, provider, and test type?
83 discharged patients (~1 month, general medicine, cardiology)
- 1 incorrect discharge time stamp

Identification providers from administrative databases

Files TPADs in a queue

Updates status of TPADs at 12:01 AM

Any TPAD finalized?

YES

Detected 405 chem/heme TPADs
- 4.9 per patient
- 264 chemistry (65%), 141 hematology (35%)
- 73 flagged abnormal (18%)

Excludes selected TPADs

Suppressed 19 (4.7%, 19/405), all hematology

136 emails triggered
- ~1.7 alerts per discharged patient (136/82)
- 2 or more emails on 34% (28/82)

Email sent: TO Attending CC PCP (network)
Background Performance

- One incorrectly entered discharge time stamp (1.2%, 1/83)
  - Unit clerk inadvertently “discharged” patient on Day 4 of 10-day hospitalization
    - Detected 510 TPADs (249 chem, 261 heme)!
    - Triggered 9 emails!
    - A rare event

- 3 responses from physicians (on 3 distinct patients) claiming email sent to incorrect provider (3.6%, 3/83)
  - 2 from inpatient attending
  - 1 from PCP
Email Notifications Sent to Providers on 95 Discharged Patients with All TPADs Finalized

1.6 alerts per discharged patient

Volume of Alerts

- Inpatient Attending Alerts:
  - Micro: 47
  - Rad/Path: 18
  - Chem/Heme: 18

- PCP Alerts:
  - Micro: 51
  - Rad/Path: 7
  - Chem/Heme: 22

- Abnormal Results:
  - Micro: 18
  - Rad/Path: 16
  - Chem/Heme: 38

Non-network PCPs
Conclusions: Design

- Automated email notification is a feasible and reliable strategy for managing results of TPADs and is compatible with workflow.

- Successful implementation is dependent on accuracy and reliability of:
  - Discharge time stamp
  - Provider identification

Garbage in, garbage out phenomena
Conclusions: Design

- The high volume of TPADs and notifications to providers are challenging to negotiate
  - Logic to limit volume and frequency of notifications to minimize alert fatigue
  - A user-configurable system to modify suppression rules is desirable
Key Features of BWH Pilot

- Recognizes and highlights TPADs as an important subset of test results
- Reliably identifies the responsible provider
  - Contact info for non-network PCPs when available
- Opens a communication thread with PCP at the time potential actions need to be taken
  - i.e., knowledge transfer
- Facilitates transfer of responsibility to next provider
  - i.e., acknowledgment
- Logic and configurable rules to minimize alert fatigue

EVALUATION

DID WE IMPROVE AWARENESS?
DID PHYSICIANS LIKE IT?

Supported by AHRQ Grant 1R21HS018229-01
Study Aims

Purpose:
- To evaluate the impact of automated email notification system

Primary outcome:
- Inpatient attending awareness of TPAD results

Secondary outcomes:
- PCP awareness of TPAD results
- Physician awareness of actionable TPADs
- Satisfaction with notification system
Physician Clustered RCT

- Activated system for independently randomized inpatient attendings and PCPs
- Inpatient general medicine and cardiology services from 10/2010 thru 5/2011
- Surveyed intervention and control physicians with regard to:
  - Primary outcome: Awareness of TPAD results by inpatient attending
  - Overall satisfaction with the system
### Randomization Scheme

<table>
<thead>
<tr>
<th>Randomized Physician</th>
<th>$\text{Att}_I$</th>
<th>$\text{Att}_C$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\text{PCP}_I$</td>
<td>$\text{PCP}_I\text{Att}_I$ \n PATIENT INCLUDED</td>
<td>$\text{PCP}_I\text{Att}_C$ \n PATIENT EXCLUDED</td>
</tr>
<tr>
<td>$\text{PCP}_C$</td>
<td>$\text{PCP}_C\text{Att}_I$ \n PATIENT EXCLUDED</td>
<td>$\text{PCP}_C\text{Att}_C$ \n PATIENT INCLUDED</td>
</tr>
</tbody>
</table>

Patients of discordant pairs excluded

1. Inpatient attendings (Att) & PCPs randomized prior to study initiation or at the time of discharge
2. Discharged patients with TPADs were identified by the notification system and assigned to intervention or control by randomized physician.
549 patients with TPADs with physician randomized to concordant arms (survey generated):
Intervention = 295; Control = 254

54 excluded:
0 physicians opted out;
16 attendings misidentified;
2 no test result/test cancelled;
8 alerts not firing properly;
28 duplicate survey generated

Intervention

241 patients with TPADs (surveys sent)

53 patients with incorrect or misidentified PCP

241 surveys sent to 56 attendings
188 surveys sent to 137 PCPs

No response:
102 surveys sent to 17 attendings
121 surveys sent to 87 PCPs

139 surveys completed by 39 attendings
67 surveys completed by 50 PCPs

Control

200 patients with TPADs (surveys sent)

32 patients with incorrect or misidentified PCP

200 surveys sent to 55 attendings
168 surveys sent to 134 PCPs

No response:
64 surveys sent to 14 attendings
86 surveys sent to 73 PCPs

136 surveys completed by 41 attendings
82 surveys completed by 61 PCPs
<table>
<thead>
<tr>
<th>Inpatient Attendings</th>
<th>Intervention N (%)</th>
<th>Usual Care N (%)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age – yr</strong></td>
<td>N=56</td>
<td>N=55</td>
<td></td>
</tr>
<tr>
<td>45.4 (9.4)</td>
<td>44.7 (11.1)</td>
<td>0.26</td>
<td></td>
</tr>
<tr>
<td><strong>Male sex – no. (%)</strong></td>
<td>35 (64)</td>
<td>36 (65)</td>
<td>0.84</td>
</tr>
<tr>
<td><strong>Attending Experience (years)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;5</td>
<td>23 (41)</td>
<td>33 (62)</td>
<td>0.09</td>
</tr>
<tr>
<td>5-10</td>
<td>17 (30)</td>
<td>10 (19)</td>
<td></td>
</tr>
<tr>
<td>10+</td>
<td>16 (29)</td>
<td>10 (19)</td>
<td></td>
</tr>
<tr>
<td><strong>Specialty</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospitalist</td>
<td>21 (38)</td>
<td>14 (25)</td>
<td>0.48</td>
</tr>
<tr>
<td>Traditional Internist</td>
<td>6 (11)</td>
<td>5 (9)</td>
<td></td>
</tr>
<tr>
<td>Cardiologist</td>
<td>22 (40)</td>
<td>28 (51)</td>
<td></td>
</tr>
<tr>
<td>Other Subspecialist</td>
<td>6 (11)</td>
<td>8 (15)</td>
<td></td>
</tr>
<tr>
<td><strong>Years Employed at BWH (mean)</strong></td>
<td>10.62 (8.42)</td>
<td>10.87 (9.04)</td>
<td>0.89</td>
</tr>
<tr>
<td>Discharged Patients†</td>
<td>N=241 (I)</td>
<td>N=200 (C)</td>
<td>p-value</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------</td>
<td>-----------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>Age – yr</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td>61.0</td>
<td>59.5</td>
<td>0.83</td>
</tr>
<tr>
<td>Inter-quartile range</td>
<td>44.0-75.0</td>
<td>45.5-73.0</td>
<td></td>
</tr>
<tr>
<td><strong>Male sex – no. (%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>114 (47)</td>
<td>97 (49)</td>
<td>0.80</td>
<td></td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>149 (62)</td>
<td>120 (60)</td>
<td>0.71</td>
</tr>
<tr>
<td>Black</td>
<td>52 (22)</td>
<td>42 (21)</td>
<td></td>
</tr>
<tr>
<td>American Indian</td>
<td>1 (&lt;1)</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>32 (13)</td>
<td>27 (14)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>7 (3)</td>
<td>10 (5)</td>
<td></td>
</tr>
<tr>
<td><strong>Socioeconomic status (Median Income by Zip Code)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;=39,000</td>
<td>80 (34)</td>
<td>60 (31)</td>
<td>0.88</td>
</tr>
<tr>
<td>39,001 – 47,000</td>
<td>51 (22)</td>
<td>47 (24)</td>
<td></td>
</tr>
<tr>
<td>47,001 – 63,000</td>
<td>52 (22)</td>
<td>43 (22)</td>
<td></td>
</tr>
<tr>
<td>&gt;63,000</td>
<td>53 (22)</td>
<td>46 (23)</td>
<td></td>
</tr>
<tr>
<td><strong>Case-Severity Mix</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DRG weight median (IQR)</td>
<td>1.10 (0.80-1.75)</td>
<td>1.03 (0.80-1.62)</td>
<td>0.37</td>
</tr>
<tr>
<td>No. with network PCPs</td>
<td>123 (72)</td>
<td>107 (69)</td>
<td>0.63</td>
</tr>
<tr>
<td>No. with non-network PCPs</td>
<td>48 (28)</td>
<td>48 (31)</td>
<td></td>
</tr>
<tr>
<td>30-day readmission</td>
<td>56 (23)</td>
<td>34 (17)</td>
<td>0.10</td>
</tr>
<tr>
<td>30-day mortality</td>
<td>2 (&lt;1)</td>
<td>2 (1)</td>
<td>1.00</td>
</tr>
<tr>
<td>Avg comorbidity score per discharge</td>
<td>2.06 (2.18)</td>
<td>2.06 (2.38)</td>
<td>0.76</td>
</tr>
<tr>
<td>PRIMARY OUTCOME</td>
<td>Intervention</td>
<td>Control</td>
<td>Crude OR [95% CI] p-value</td>
</tr>
<tr>
<td>-----------------</td>
<td>--------------</td>
<td>---------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Awareness of Any TPAD Result(s) by Inpatient Attending</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% (No.) Inpatient Attendings Aware</td>
<td>76% (106/139)</td>
<td>38% (52/136)</td>
<td>5.19 [3.08, 8.74] p&lt;0.0001</td>
</tr>
<tr>
<td>Hospitalist</td>
<td>80% (76/95)</td>
<td>36% (31/86)</td>
<td>7.10 [3.64, 13.8] p&lt;0.0001</td>
</tr>
<tr>
<td>Non-Hospitalists</td>
<td>72% (28/39)</td>
<td>43% (20/47)</td>
<td>3.44 [1.39, 8.50] p=0.007</td>
</tr>
</tbody>
</table>
## Impact

<table>
<thead>
<tr>
<th>SECONDARY OUTCOMES</th>
<th>Intervention</th>
<th>Control</th>
<th>Crude OR [95% CI] p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Awareness of Any TPAD Result(s) by PCP</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% (No.) PCPs Aware</td>
<td>57% (39/69)</td>
<td>33% (27/83)</td>
<td>2.70 [1.39, 5.22] p=0.003</td>
</tr>
<tr>
<td>Network PCP</td>
<td>65% (35/54)</td>
<td>33% (24/73)</td>
<td>3.76 [1.79, 7.90] p=0.0004</td>
</tr>
<tr>
<td>Non-network PCP</td>
<td>18% (2/11)</td>
<td>29% (2/7)</td>
<td>0.56 [0.06, 5.24] p=0.61</td>
</tr>
<tr>
<td><strong>Awareness of Actionable TPAD Result(s)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% (No.) Inpt Attendings Aware</td>
<td>59% (16/27)</td>
<td>29% (8/28)</td>
<td>3.64 [1.18, 11.18] p=0.02</td>
</tr>
<tr>
<td>% (No.) PCPs Aware</td>
<td>65% (13/20)</td>
<td>48% (13/27)</td>
<td>2.00 [0.61, 6.57] p=0.25</td>
</tr>
<tr>
<td>SATISFACTION MEASURES</td>
<td>Satisfied</td>
<td>Neutral</td>
<td>Dissatisfied</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----------</td>
<td>---------</td>
<td>--------------</td>
</tr>
<tr>
<td>Physician Satisfaction with Current System (Usual Care)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% (No.) Inpatient Attendings</td>
<td>11% (15)</td>
<td>17% (23)</td>
<td>72% (95)</td>
</tr>
<tr>
<td>Hospitalist</td>
<td>7% (6)</td>
<td>16% (14)</td>
<td>77% (66)</td>
</tr>
<tr>
<td>Non-Hospitalists¥</td>
<td>19% (9)</td>
<td>19% (9)</td>
<td>62% (29)</td>
</tr>
<tr>
<td>% (No.) PCPs</td>
<td>17% (14)</td>
<td>15% (12)</td>
<td>68% (54)</td>
</tr>
<tr>
<td>Network PCP</td>
<td>15% (11)</td>
<td>16% (12)</td>
<td>69% (50)</td>
</tr>
<tr>
<td>Non-Network PCP</td>
<td>42% (3)</td>
<td>-</td>
<td>58% (4)</td>
</tr>
<tr>
<td>Physician Satisfaction with Automated Email Notifications (Intervention)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% (No.) Inpatient Attendings</td>
<td>89% (118)</td>
<td>4% (5)</td>
<td>7% (10)</td>
</tr>
<tr>
<td>Hospitalist</td>
<td>93% (88)</td>
<td>2% (2)</td>
<td>5% (5)</td>
</tr>
<tr>
<td>Non-Hospitalists¥</td>
<td>79% (30)</td>
<td>8% (3)</td>
<td>13% (5)</td>
</tr>
<tr>
<td>% (No.) PCPs</td>
<td>70% (43)</td>
<td>19% (12)</td>
<td>11% (7)</td>
</tr>
<tr>
<td>Network PCP</td>
<td>81% (43)</td>
<td>11% (6)</td>
<td>8% (4)</td>
</tr>
<tr>
<td>Non-network PCP</td>
<td>-</td>
<td>67% (6)</td>
<td>33% (3)</td>
</tr>
<tr>
<td>Comment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“I find this extremely useful, knowing the final results of tests, both test results that are positive as well as negative.”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Was unaware of this test even being ordered—had it not been for auto-notification, would never have known about test or result. No call to PCP as test is in normal range and will not affect management.”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“The concept is great. All the notifications I have received are for negative results. Might be more worthwhile for blood tests if it was only for abnormal results.”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“I think this is terrific. Results are clear and trail of ownership is, too. Keep up the good work.”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“I would prefer if results that were pending showed up in my results manager list.”</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Conclusions: Evaluation

- Awareness of finalized TPAD results under usual care is still poor.
- Physicians receiving automated email notifications are significantly more aware of TPAD results compared to usual care physicians.
- Intervention physicians are highly satisfied.
  - Physicians vary with regard to type of results they wish to receive.
Limitations

- A robust culture of email utilization by inpatient physicians
- Small sample size → powered to detect difference in awareness of any test result, not actionable test results
- Generalizability → single institution, two services, proprietary system
Implications

Automated email notification is a promising strategy to improve awareness of the results of TPADs by physicians
- Potential to mitigate an important patient safety concern

Future studies
- Analyze downstream actions taken
- Elucidate desired features to maximize utility for physicians (e.g., electronic acknowledgment)
- Demonstrate effectiveness for other clinical services, hospitals, and electronic medical record platforms.
Contact Information

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Redesigning Primary Care: Addressing the Needs of Our Most At-risk Patients with Care Management Plus

David A. Dorr, M.D., M.S.
Associate Professor / Vice Chair
Department of Medical Informatics & Clinical Epidemiology
General Internal Medicine & Geriatrics
Oregon Health and Science University

Funding for this research from The John A. Hartford Foundation, AHRQ, Intermountain Healthcare, the Gordon and Betty Moore Foundation and the National Library of Medicine
Why Do We Need Care Innovation?

- Ms. Viera: 75-year-old woman with diabetes, systolic hypertension, mild congestive heart failure, arthritis, and recently diagnosed dementia.

She comes to clinic with five issues + two more “hallway issues”!

What can a primary care team do?
Past: Heroism in the Face of Multiple Illnesses

Multiple diseases increase risk and coordination exponentially (5+ : 90 x risk of hospitalization; 10x Rx; 13 providers vs. 2). Managing in a primary care panel would take 18 hrs/day. Patients have better process scores, but worse preventable hospitalizations.

Intervention: Care Management Plus
Dissemination to over 200 clinical teams

Care management
- Care manager
  - Assess & plan
  - Catalyst
  - Structure
- Technology
  - Access
  - Best Practices
  - Communication

Evaluation
- Ongoing with feedback
- Based on key process and outcome measures

Larger infrastructure: Electronic Health Record, quality focus

Anderson, 2004; Woolf, 2002; Baron, 2007, 2010; Werner, 2008
Summary of Studies from CM+

The TRIPLE aim of health care

Improved diabetes, depression outcomes

Population Health

Experience of Care

Per Capita Cost

Reduction in hospitalizations, cost

Improved patient, care manager, and provider experience

http://www.caremanagementplus.org/pubs.html
Dissemination: 688 (+49) people in 349 (+21) clinical teams

- SFHP (12 sites)
- Intermountain (16 teams)
- OHSU (9 teams)
- PeaceHealth (20 teams)
- Colorado Access (16 teams)
- Daughters of Charity (5 teams)
- HealthCare Partners (2 sites)
- SEARHC
- NEQCA
Components: TEAM READINESS

The right people on the team with the right training is a core principle.

**Patients** are taught to self-manage and have a **guide** through the system.

**Care managers** receive special training in
- Education, motivation, coaching
- Disease-specific protocols, care for seniors, caregiver support
- Connection to community resources

**Providers / other staff**
- Need to participate in protocol development, implementation, adaptation
- Need to learn about care management (usually from the care managers)
IT Component:
Provides a means to track and enroll high risk patients.
The tickler is a centralized reminder list of tasks and communications that were proactively planned, but incomplete, which allows population-based tasks to be merged with individual encounter tasks into one easy-to-use list.

<table>
<thead>
<tr>
<th>Scheduled Date</th>
<th>Encounter Type</th>
<th>EHR ID</th>
<th>First Name</th>
<th>Last Name</th>
<th>Phone</th>
<th>PCP</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011-05-31, 12:25</td>
<td>Telephone Contact, Clinical Protocol(s)</td>
<td>EHRID99738</td>
<td>Annie</td>
<td>A126</td>
<td>(503)999-9734</td>
<td>Beatrice Carter</td>
<td>Quality Measure: PHQ2, score = 2 on 12/20/2010. Follow up with Annie to see how she is doing with her depression.</td>
</tr>
<tr>
<td>2011-04-11</td>
<td>Telephone Contact, Goals</td>
<td>EHRID99927</td>
<td>Augustus</td>
<td>A445</td>
<td>(503)999-9928</td>
<td>Parnel Fieldman</td>
<td>Goals Follow-Up: Activity: take the stairs instead of the elevator; Goals Follow-Up: Activity: take the stairs instead of the elevator; Need to discuss Annie's difficulties reconciling different care plans.</td>
</tr>
<tr>
<td>2011-04-11</td>
<td>Care Conference, Diabetes</td>
<td>EHRID99738</td>
<td>Annie</td>
<td>A126</td>
<td>(503)999-9734</td>
<td>Beatrice Carter</td>
<td>This is Tim's first encounter. Remember to do a PHQ9 and discuss what he does and doesn't know about his recent diagnosis of diabetes.</td>
</tr>
<tr>
<td>2010-08-16</td>
<td>CM Office Visit, Diabetes</td>
<td>978253344</td>
<td>Timothy</td>
<td>Hartline</td>
<td>456.235.1125</td>
<td>Carl Generic</td>
<td></td>
</tr>
<tr>
<td>2010-06-18</td>
<td>Telephone Contact, Clinical Protocol(s)</td>
<td>65748398</td>
<td>Bobby</td>
<td>Cline</td>
<td>987.546.7765</td>
<td>Hillary Caseman</td>
<td>Quality Measure: Diabetes : HbA1c Lab Date: never</td>
</tr>
</tbody>
</table>
Offers the ability to document exclusions at multiple levels and generate targeted population-based review cycles, which avoids the problems caused by static quality reports and allows providers to efficiently focus outreach efforts on high risk populations.
Many health information exchange efforts falter at the value proposition versus technical and legal requirements.

With ICCIS, we mapped seven different EHRs to a population management system / registry (PracticePartner, Epic, Centricity, TouchWorks, Intergy, CPRS, eClinicalWorks).

We limited the exchange to targeted areas and pragmatic approaches to maximize value.

Starting as research, legal issues may be easier but operations for care coordination and quality improvement are covered under HIPAA.
ICCIS Randomized Trial

Needs and requirements; build ICCIS

Care management training
Randomize by clinic

Goals for IT use

Arm 1. Coordination of care
  1.1 Complete assessment/care plan
  1.2 Education (self-management, etc.)
  1.3. Goal setting and follow-up
  1.4 Communication
  1.5 Motivation / coaching
  1.6 Completing CM services

Arm 2. Quality
  Choose 5 of 20 quality measures: Prevention, Diabetes, Vulnerable Elderly, Asthma, Congestive Heart Failure

Medical Home-Based

Data for patients with complex health care needs

Evaluation:
Cost of patient illness / patient satisfaction and relationship to implementation and use of information technology

All clinics participate; both quality measurement and coordination of care taught

PCPI/NQF approved
Were the Incentives Effective?

Absolute adherence change for study arms

Length of intervention (quarters)
## Incentives: Care Coordination Activities

<table>
<thead>
<tr>
<th>Arms reimbursed</th>
<th>Activity</th>
<th>All clinics</th>
<th>Care Coord to quality ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both</td>
<td>Care managed patients</td>
<td>4,043</td>
<td>1.3:1</td>
</tr>
<tr>
<td></td>
<td>Sharing patient summaries</td>
<td>819</td>
<td>1:3</td>
</tr>
<tr>
<td>Arm 1 only</td>
<td>Completed encounters</td>
<td>12,605</td>
<td>1.8:1</td>
</tr>
<tr>
<td></td>
<td>Assessment</td>
<td>1,176</td>
<td>1.8:1</td>
</tr>
<tr>
<td></td>
<td>Education</td>
<td>2,925</td>
<td>4.3:1</td>
</tr>
<tr>
<td></td>
<td>Goals</td>
<td>202</td>
<td>1:1.3</td>
</tr>
<tr>
<td></td>
<td>Communication</td>
<td>3,820</td>
<td>3:1</td>
</tr>
<tr>
<td></td>
<td>Motivational interviewing</td>
<td>2,108</td>
<td>1:3</td>
</tr>
<tr>
<td>Arm 2 only</td>
<td>Quality encounters</td>
<td>4,440</td>
<td>3:1</td>
</tr>
<tr>
<td></td>
<td>Quality measure query runs</td>
<td>1,203</td>
<td>2:1</td>
</tr>
<tr>
<td></td>
<td>Quality measure increases</td>
<td>119</td>
<td>1:1.3</td>
</tr>
</tbody>
</table>
Health Reform: Goals and Evidence

- Goals of health reform are the triple aim: improved population health, improved patient experience, reduced costs.

- Has it been shown? Large integrated systems, in nonrandomized trials, have shown substantial savings: $1.5 to $3 / $1 invested (Geisinger, GroupHealth, Intermountain Healthcare – CM+).¹

- But other trials have shown mixed effects:
  - National Demonstration Project mixed outcomes²
  - Physician Group Practice CMS demonstration (University of Michigan, Marshfield clinic cost savings, others mixed)³

- Opportunity: Oregon was engaging in both Patient-Centered Medical Homes (including the Comprehensive Primary Care program from CMS) and Accountable Care Organization Redesign. Can we study and learn from this—and push them to “high value elements” that have been found but NOT instituted universally?⁴

Transforming Outcomes for Patients through Medical Home Evaluation and reDesign (TOPMED)

Cluster randomized controlled trial in 8 clinics

Patient-centered primary care home evaluation, training

**Intervention**
- Incentives with multiplier
- Focused practice support
- Rapid cycle IT improvement

**Control**
- Same incentives without multiplier
- General practice support
- Same IT components

Sponsored by the Gordon and Betty Moore Foundation
## High Value Elements and Mapping

<table>
<thead>
<tr>
<th>High Value Element</th>
<th>Description</th>
<th>Patient-centered Medical Home Mapping</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Identification of At-Risk Populations</strong></td>
<td>Identifies and proactively addresses patients with high risk.</td>
<td>‘Comprehensive care planning’, 5.F.2</td>
</tr>
<tr>
<td><strong>Care Management Based on Need</strong></td>
<td>Assigns person or team to work closely with high-risk patients, providing higher access and services.</td>
<td>‘Care management for complex patients’, 5.C.2</td>
</tr>
<tr>
<td><strong>Patient Engagement and Proactive Goal Setting</strong></td>
<td>Coaches patients to set goals and follow up.</td>
<td>‘Education &amp; self-management support’ 6.B</td>
</tr>
<tr>
<td><strong>Population Management Tools</strong></td>
<td>Uses quality improvement for identification of need, corrective action, and longitudinal tracking.</td>
<td>Demonstrates improvement/meets benchmarks in quality (PCPCH 2.A.2-3); also 5.A</td>
</tr>
</tbody>
</table>
Oregon Health & Science University
- David Dorr, PI
- Susan Butterworth
- Marsha Pierre-Jacques Williams
- Kimberley Gray
- Jesse Wagner
- Doug Rhoton

Columbia University
- Adam Wilcox

Intermountain Healthcare
- Cherie Brunker, Co-PI (UU)
- Liza Widmier
- Ann Larsen
- Iona Thraen

For more information:
http://topmedtrial.org
http://Caremanagementplus.org
ICCIS demo: http://caremanagementplus.org/iccis_captivate/ICCIS_captivate.swf
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Please submit your questions by using the Q&A box to the right of the screen.
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Participants must complete an online evaluation in order to obtain a CE certificate.

A link to the online evaluation system will be sent to participants who attend the Web Conference within 48 hours after the event.