What Will It Take to Make Healthcare Better?

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Medical Director of Clinical and Quality Analysis, Partners Healthcare

WIHSE 2018
Conflict of Interest

- Dr. Bates has served as a consultant for EarlySense, mentioned in this presentation
- Coinventor on Patent No. 6029138 held by Brigham and Women’s Hospital, licensed to Medicalis Corporation
- Minority equity position; Medicalis
- Board; SEA Medical Systems
- Clinical Advisory Board; Zynx, Inc.
- Equity and cash compensation; QPID, Inc.
- Cash compensation; CDI (Negev), Ltd
- Equity; Enelgy
- Equity; Ethosmart
- Equity; Intensix
- Equity; MDClone

❖ Does not intend to discuss off-label/investigative use.
Overview

• Safety, quality, efficiency
• Who should lead?
• Examples of the problem
• Examples of solutions
• The policy picture
• Future vision
• Conclusions
A Health System That Doesn’t Work

- Unsustainable cost (18% GDP; 2x inflation)
- Poor quality and safety compared to other developed nations
- “Supply driving demand” (McAllen, Texas)
Health Care Quality: A Coin Flip?

- 54.9% received recommended care overall
- 53.5% received preventive care
- 53.5% received acute care
- 56.1% received recommended care for chronic conditions

<table>
<thead>
<tr>
<th>Country Rankings</th>
<th>1.00-2.33</th>
<th>2.34-4.66</th>
<th>4.67-7.00</th>
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<tbody>
<tr>
<td><strong>Exhibit ES-1. Overall Ranking</strong></td>
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<table>
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<th>OVERALL RANKING (2010)</th>
<th>AUS</th>
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<td>3</td>
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<td>Coordinated Care</td>
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<td>6</td>
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<td>Patient-Centered Care</td>
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<td>4</td>
<td>2</td>
<td>6.5</td>
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<td>3.5</td>
<td>2</td>
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<td>1</td>
<td>7</td>
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<tr>
<td>Timeliness of Care</td>
<td>6</td>
<td>7</td>
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<td>1</td>
<td>3</td>
<td>4</td>
<td>5</td>
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<td>5</td>
<td>3</td>
<td>1</td>
<td>6</td>
<td>2</td>
<td>7</td>
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<tr>
<td>Long, Healthy, Productive Lives</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
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<tr>
<td>Health Expenditures/Capita, 2007</td>
<td>$3,357</td>
<td>$3,895</td>
<td>$3,588</td>
<td>$3,837*</td>
<td>$2,454</td>
<td>$2,992</td>
<td>$7,290</td>
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</table>

Note: *Estimate. Expenditures shown in $US PPP (purchasing power parity).
Source: Calculated by The Commonwealth Fund based on 2007 International Health Policy Survey; 2008 International Health Policy Survey of Sicker Adults; 2009 International Health Policy Survey of Primary Care Physicians; Commonwealth Fund Commission on a High Performance Health System National Scorecard; and Organization for Economic Cooperation and Development, OECD Health Data, 2009 (Paris: OECD, Nov. 2009).
Solving Big Problems

No problem can be solved from the same level of consciousness that created it.

*Albert Einstein*

The creative solutions to most big problems come from groups of people with very different backgrounds working together.

Corollary: It can be very uncomfortable to work with people who are not like you—but it is essential to do it!
## Disruptive Innovation in Healthcare

### Health Care Sectors Most in Need of Disruptive Innovation

Please rank the top three health care sectors that are most in need of disruptive innovation.

<table>
<thead>
<tr>
<th>Sector</th>
<th>Net Top 3 Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospitals/Health systems</td>
<td>65%</td>
</tr>
<tr>
<td>Health care IT (vendor technologies such as EMRs and clinical decision support)</td>
<td>47%</td>
</tr>
<tr>
<td>Primary care</td>
<td>36%</td>
</tr>
<tr>
<td>Pharmaceuticals</td>
<td>34%</td>
</tr>
<tr>
<td>Commercial payers</td>
<td>33%</td>
</tr>
<tr>
<td>Public payers (Medicare/Medicaid)</td>
<td>31%</td>
</tr>
</tbody>
</table>

Dafny and Mohta, NEJM Catalyst 2017
Building a Better Delivery System

Goal: to transform the U.S. health care sector from an underperforming conglomerate of independent entities (individual practitioners, small group practices, clinics, hospitals, pharmacies, community health centers et. al.) into a high performance "system"

- Systems-engineering tools
- Information technologies
- Complementary knowledge in social sciences, cognitive sciences and business/management

NAE/NAM 2005
What Specific Disciplines?

- Physicians
- Nurses
- Pharmacists
- Social workers
- Physical therapists
- Operations research
- Data analytics
- Devices/wearables
- Human factors engineering
- Human-centered design
- .....
Examples of Problems
The App Marketplace

- Several hundred thousand health apps
  - Billions of dollars being funneled in
- But most not targeted at chronically ill, may not be usable by sickest patients

Did a review of health apps for chronically ill:

Singh et al, Health Affairs 2016

- Consumers' ratings were poor indications of apps' clinical utility or usability
- Most apps did not respond appropriately when a user entered potentially dangerous health information
Findings

Were clinical experts and patients involved in app development or quality control?

- No clinical expert involved, No patients involved: 67%
- Clinical expert involved, No patients involved: 22%
- Clinical expert involved, Patients involved: 11%
Findings

Does the app reward the user for engaging with the app or achieving health goals?

- Yes: 22%
- No: 78%
Usability of Commercially Available Mobile Applications for Diverse Patients

Urmimala Sarkar, Gato I. Gourley, Courtney R. Lyles, Lina Tieu, Cassidy Clarity, Lisa Newmark, Karandeep Singh, David W. Bates

Original Research
First Online: 14 July 2016
DOI: 10.1007/s11606-016-3771-6

Cite this article as:
doi:10.1007/s11606-016-3771-6
Results

- Three groups
  - 9 caregivers
  - 10 patients with depression
  - 10 with diabetes

- Given condition-specific tasks
  - Enter your blood glucose

- Completion rate 43% without assistance

- Key themes
  - Lack of confidence with technology
  - Frustration with design features and navigation
  - Interest in having technology to support their self-management
Use of User-Centered Design by Vendors

• Required as part of meaningful use
• 11 vendors studied
• Fell into 3 categories
  • Well-developed UCD
  • Basic UCD
    • Understand importance but do not have UCD fully integrated into environment
  • Misconceptions of UCD
    • No UCD in place

*Ratwani et al, JAMIA 2015*
Patients Care Services leverages weekly and seasonal trends to flex their staffing. However, without better tools they cannot perfectly align staffing with census and acuity (Hours per Work Load Index)

If Patients Care Services had the tools to reduce the gap between budgeted and actual HPWI by 50% it could save ~$230k per year on CWN8 alone

1. Estimated based on reducing the FY14 Q1 CWN8 actual compared to budgeted HPWI by 50% and annualizing the savings. Assumes an average hourly rate of $55
2. CWN8 FY13 labor expense was $7.1M
Examples of Solutions
Big Data in Clinical Care

Six Use Cases:

- High-cost patients
- Readmissions
- Triage
- Decompensation
- Adverse events
- Treatment optimization
High-Cost Patients

• About 5% of patients account for 50% of spending
  • First step in managing population is identifying this group

• Need to include data about mental health, socioeconomic status, marital and living status

• Identification of specific actionable needs and gaps
  • Can make managing these patients much more cost-effective
iCMP Claims-Based Approach

• Uses LACE to risk stratify
• Claims data from past 12 months
• Clinical conditions from a list of ~30 are categorized as high, moderate or low acuity
• Combinations of conditions from each category determine level of clinical complexity
• Hospitalizations, ER visits and other types of utilization trigger inclusion
Population

- About 3000 patients currently
- Majority female (61%)
- Elderly (mean age 71, range 21-102 years)
- 32% with a mental health diagnosis
- An average of 17 medications per patient
- PMPM ~$2000
- 2-4 times higher than average
- Hospital admissions account for > 50% of costs
iCMP IT Infrastructure

- Patient registry
  - Notification of admissions, ER visits
- EHR tools
  - iCMP icon to encourage communication
• 2,064 inpatient discharges from BWH 2/1/13 – 12/31/14
• Average admit per 1000 rate Feb 2013 – Dec 2013 was 49 and in 2014 was 40
• 18% reduction
EarlySense: Continuous Patient Supervision on General Care Floors

- LCD monitor
- Nurse’s phone
- Central Nurse’s Station
- Bed side monitor

**Full floor overview at a glance**

**Real time alerts to nurses & supervisors + reports on team performance**

**Nurse / physician communication support**

**Facilitation of critical thinking by nurse**
## Demographics and Clinical Baseline Information for The Study Unit

<table>
<thead>
<tr>
<th></th>
<th>Control Unit</th>
<th>Intervention (Study) Unit</th>
<th>P Value</th>
<th>Control Unit</th>
<th>Intervention (Study) Unit</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Patients, n</strong></td>
<td>1535</td>
<td>2361</td>
<td></td>
<td>1433</td>
<td>2314</td>
<td></td>
</tr>
<tr>
<td><strong>Age, mean (SD)</strong></td>
<td>49.8 (19.6)</td>
<td>49.6 (20.3)</td>
<td>0.76</td>
<td>49.5 (19.6)</td>
<td>49.3 (19.9)</td>
<td>0.73</td>
</tr>
<tr>
<td><strong>Males %</strong></td>
<td>46.2</td>
<td>45.0</td>
<td>0.57</td>
<td>44.5</td>
<td>48.9</td>
<td>0.04</td>
</tr>
<tr>
<td><em><em>Acuity Level</em>, mean (SD)</em>*</td>
<td>2.9 (0.4)</td>
<td>2.9 (0.4)</td>
<td>0.36</td>
<td>2.8 (0.4)</td>
<td>2.8 (0.4)</td>
<td>0.70</td>
</tr>
<tr>
<td><strong>Charlson score, mean (SD)</strong></td>
<td>1.8 (2.4)</td>
<td>1.9 (2.4)</td>
<td>0.62</td>
<td>1.8 (2.3)</td>
<td>1.8 (2.4)</td>
<td>0.61</td>
</tr>
</tbody>
</table>

*Acuity level based on internal acuity scale of 1 to 4 (4 being the highest acuity)*

Total # of patients: 7643

Harvey Brown, MD,a Jamie Terrence, RN,a Patricia Vasquez, RN, BSN,a David W. Bates, MD, MSc,b,c Eyal Zimlichman, MD, MSc b,c. The American Journal of Medicine. March 2014, Volume 127, Number 3

a. California Hospital Medical Center, a member of Dignity Health, Los Angeles;
b. The Center for Patient Safety Research and Practice, Division of General Internal Medicine, Brigham and Women’s Hospital, Boston, Mass;
c. Harvard Medical School, Boston, Mass.
Continuous Monitoring in an Inpatient Medical-Surgical Unit: A Controlled Clinical Trial

### Study Outcomes Comparing Study Units Before and After Implementation of Monitor

<table>
<thead>
<tr>
<th></th>
<th>Control Unit</th>
<th>Intervention (Study) Unit</th>
<th>3 Arms p value*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline (Pre)</td>
<td>Control (Post)</td>
<td>P Value</td>
</tr>
<tr>
<td>LOS in Med. Surg./ Units (mean)</td>
<td>3.80 (1.26-4.25)</td>
<td>3.61 (1.19-4.12)</td>
<td>0.07</td>
</tr>
<tr>
<td>LOS in ICU for patients coming from Med/Surg. units (mean)</td>
<td>1.73 (1.06-2.28)</td>
<td>4.48 (0.94-4.09)</td>
<td>0.01</td>
</tr>
<tr>
<td>Code Blue Events/ 1000 Pt.</td>
<td>3.9</td>
<td>2.1</td>
<td>0.36</td>
</tr>
</tbody>
</table>

*P – value comparing 3 arms: intervention unit post, intervention unit pre and control unit post
Alert Frequency and Positive Predictive Value

- EarlySense had 2.2 alerts per 100 recording hours
  - 50% resulted in nurse action
- Pulse oximetry, telemetry, cardiovascular monitors have 161-730 alerts per 100 hours
  - Much lower proportions result in action
Economic Analysis of Smart Monitor

• Modeled only ICU length of stay and pressure ulcers

<table>
<thead>
<tr>
<th>Case</th>
<th>5-year ROI</th>
<th>Annual Benefit</th>
<th>Breakeven</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Case</td>
<td>$9.1 million</td>
<td>$2.1 million</td>
<td>0.5 years</td>
</tr>
<tr>
<td>Conservative</td>
<td>$3.3 million</td>
<td>$0.66 million</td>
<td>0.75 years</td>
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</table>

*Slight, Critical Care Medicine 2014*
# PROSPECT MICU Results

<table>
<thead>
<tr>
<th></th>
<th>Pre-intervention</th>
<th>Intervention</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preventable harms/ 1000 patient days</td>
<td>65.2</td>
<td>46.6</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Overall hospital rating (patient)</td>
<td>71.8%</td>
<td>93.3%</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Overall satisfaction (care partners)</td>
<td>84.3%</td>
<td>90.0%</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Mean global concordance overall goal of hospitalization</td>
<td>26.9%</td>
<td>34.0%</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Resource utilization</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Mean (Median) Length of Stay (days)</td>
<td>4.9 (2)</td>
<td>5.0 (2)</td>
<td>0.61</td>
</tr>
<tr>
<td>• 30-day hospital readmission</td>
<td>19%</td>
<td>18.4%</td>
<td>0.82</td>
</tr>
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</table>

*Dyke, Critical Care, 2017*
Making Acute Care More Patient-Centered

• Conducting three core projects over a four-year period
  1. Fall Prevention Toolkit
  2. Patient Safety Checklist Tool
  3. MySafeCare

• Focus on patient safety, development and enhancement of tools, health system interventions, and translation into practice

• Architecture overview
  • Tools are web-based, built outside of Epic but use data from Epic
  • Require some services
Unit-Level Dashboard

### MICU-3B Unit Safety Dashboard

<table>
<thead>
<tr>
<th>Vent</th>
<th>Delirium Mgmt</th>
<th>Sedation Mgmt</th>
<th>Early Mobility</th>
<th>Family Mgt</th>
<th>Glucose Control</th>
<th>Nutrition</th>
<th>PPX</th>
<th>Devices</th>
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<tr>
<td>SAT</td>
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<td>Pharm VTE</td>
<td>CVC</td>
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<td>SBT</td>
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<td>Mech VTE</td>
<td>A-line</td>
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<td>Oral Care</td>
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<td></td>
<td>GI</td>
<td>Foley</td>
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<td>WE, WILLIA</td>
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<td>HI, DOBBY</td>
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<td><strong>38</strong></td>
<td>TO, THEODO</td>
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<td><strong>40</strong></td>
<td>MO, BULLWI</td>
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06/23/15 18:45
Patient-Level Dashboard

- Data from EHR (and Safety Checklist in MICU) used to describe high-risk states alerted in unit-level dashboard

<table>
<thead>
<tr>
<th>Granger, Hermione</th>
<th>3C-311</th>
<th>25y F #15025281</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vent Bundle</strong></td>
<td></td>
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<tr>
<td>SAT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety Screen:</td>
<td>Safe to perform</td>
<td>Performance: Performed 6/23/15 00:46</td>
</tr>
<tr>
<td>SBT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety Screen:</td>
<td>Safe to perform</td>
<td>Performance: Performed 6/23/15 01:06</td>
</tr>
<tr>
<td>Oral Care</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety Screen:</td>
<td>Safe to perform</td>
<td>Performance: Performed 6/23/15 09:06</td>
</tr>
<tr>
<td>HOB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety Screen:</td>
<td>Safe to perform</td>
<td>Performance: Current HOB 30°</td>
</tr>
<tr>
<td><strong>RASS Monitoring</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 mL/kg/min = 400 mL</td>
<td>Current Vt = 380 mL</td>
<td></td>
</tr>
</tbody>
</table>

| **Sedation Mgmt** |        |                 |
| On continuous sedation since: 6/20/15 | Goal: -1 to 0 | 12-hour average: -0.33 |

| **PPX** |           |                 |
| Pharm VTE | Indicated: Yes | Safety Screen: Unsafe to perform |
|          | Performance: No current orders |
| Mech VTE | Indicated: Yes | Safety Screen: Safe to perform |
|          | Performance: No current orders |
| GI       | Indicated: Yes | Safety Screen: Safe to perform |
|          | Performance: Pantoprazole ordered |

| **Devices** |            |                 |
| CVC         | QUADRUPL LUMEN Right Internal jugular |
|             | Day 2 (inserted 06/22/2015) |
|             | Indication today: Hemodynamic monitoring |
| A-line      | Arterial Line Left Radial |
|             | Day 9 (inserted 06/21/2015) |
|             | Indication today: Iliopelvic pressure monitoring |
| Foley       | Urinary Catheter Non-latex 16 Fr. |
|             | Day 10 (inserted 06/14/2015) |
|             | Indication today: AWAITING REMOVAL |

| **Early Mobility** | Consult placed: 6/21/15 16:04 |
|                   | Mgmt Discussion: No new mobility status |

| **Family Mtg** | Last Care Conference Note: 6/21/15 16:04 |
|                | Need Meeting: No |

| **Nutrition** | Diet Order: NPO since 6/22/15 |
|              | Mgmt Discussion: Performed 6/23/15 |
| **Glucose Control** | Goal: 60-180 mg/dL (default) |
|                  | 12-hour average: 136 mg/dL |
|                  | Current insulin order: None |

| **Last Checklist Update** | 6/23/15 9:22 |

<table>
<thead>
<tr>
<th><strong>Glucose Monitoring</strong></th>
<th></th>
<th></th>
</tr>
</thead>
</table>

| **Last Checklist Update** | 06/23/15 18:45 |
The Patient-Centered Safety Plan

A SHARED VIEW

Another new technology, the Bedside Display, presents information to help everyone entering the patient’s room stay informed about the patient’s specific care and safety measures.

In addition to telling hospital staff about the patient’s specific needs, the bedside display also gives patients and their caregivers safety information, fall prevention tips, and other reminders to help them take part in staying safe.
**Patient Safety Dashboard**

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<th>SA</th>
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<th>MO</th>
<th>TU</th>
<th>WE</th>
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No improvement  Goal: open every day

**Top Users**
- June-Ho Kim (MD)
- Brenda Bailey (RN)
- Heather Mortimer (RN)

**Number of Dashboard Logins***:

15

*Includes Epic Express logins

**Patient SatisfActive**

Patients/families with documented need, concern, or expectation: 83%  Down 9% of patients  Goal: 95% of patients

Number of Needs, Concerns, and Expectations documented: 33

**MySafeCare Submissions to Date on 14CD**

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<th>Submission Type</th>
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- Plan: 15
- Medication: 10
- Room: 5
- Communication: 0
- Hygiene: 0
- Pain: 0
- Waiting Time: 0
- Other: 0
- Compliment: 5

**Anonymous**  14CD (Anonymous)  14CD (Identified)  No new submissions

**Dashboard Team View now available! See all of your service’s patients in one view!**

**PSLL highlight of the week:**

**Patient Portal on 14CD**

Last week: 4  To Date: 174

Patients and family members given the portal:

Up 2 patients  Research assistant goal: 7 patients

Questions? Concerns? Feedback? Contact us at psllresearch@partners.org
Key Gaps Regarding Safety

- Safety outside the hospital
  - Primary care, long-term care, home care
- Evaluation of solutions
  - All levels of development, but especially in developing/transitional countries
  - Especially cost-benefit
- Leveraging IT technologies—mobile, other
- Spreading successful solutions
- Strategies for measurement which can be used operationally
Key Gaps in Quality

• So many metrics
• Little robust evidence about which are the most important
• Development of electronic quality metrics which can be routinely extracted from EHRs
• Approaches for routinely rewarding providers for better performance
Key Gaps in Value

• Significant overuse of ineffective tests, treatments
• Failure to optimize in areas like staffing
• Little movement forward in standardizing in management of conditions for which it is possible
• Use of resources outside the hospital
Ways Current EHRs Fall Short

• Decision support falls short both with respect to content and mechanisms for delivering
• Do not deal well with extracting information in real time
• Don’t enable population health management
• Do enable extracting limited information in real-time, but hard bringing insights back
• Do not enable assessment of quality, safety or efficiency
What’s Next?

- Technical
- Sociotechnical
- Crossing care settings/communications
Technical

• Use of multiple types of sensor technologies
• Leveraging analytics
• Improved tools around communication
Sociotechnical

• Improved design
• Learning from how providers interact with technology
• Better approaches to enabling adoption
• Team training
• Patient engagement, especially around chronic diseases
Crossing Care Settings/Communications

- Too often no common goal, people are not on same page
- Harm frequent around transitions, medication-related is particular issue
- Communication within teams, across teams needs to be better
- Adherence a problem
Crossing Care Settings

Automatic pill dispensers so your loved ones can stay independent

MedMinder helps your mom/dad stay independent. Giving you reassurance that you will know if your parents have taken their medication. Enjoy peace of mind today!

- Simple and Easy to Use
- User Reminders
- Remote Monitoring
- No Charge for the Equipment
- Free Shipping
Patient-Centered Tool Kit (PCTK) Components, Including Microblog

“Patient-facing”

“Provider-facing”
Conclusions

• Safety, quality and value of healthcare all need to improve
• This will require better design, redesign
  • Must involve multiple disciplines
• Issue goes far beyond HIT but is near-term opportunity
  • Especially here in Madison, the home of EPIC!
• Examples illustrate how dysfunctional many of today’s approaches are
• However, is possible to make changes, bring in new approaches
  • Uptake of electronic records in particular offers opportunities
• Accountable care promises to reward organizations which do this
  • How fast this moves forward will be rate-limiting
“Good design is actually a lot harder to notice than poor design, in part because good designs fit our needs so well that the design is invisible.”

Donald A. Norman, The Design of Everyday Things