The Next Frontier of Biomedical Device Integration
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Conflict of Interest

Linda Burnes Bolton, DrPH, RN, FAAN
Has no real or apparent conflicts of interest to report.

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Has no real or apparent conflicts of interest to report.
Agenda

• The value of device integration for Nursing
• Leading the change
• Bridging Technology and Clinical Practice: the COOL Team
• User-centric implementation: one case study
• Looking ahead: Wearables and Patient Engagement
Learning Objectives

• Describe how biomedical devices can be integrated to achieve a continuum of care and communication
• Discuss optimization of workflow both inside and outside the EHR
• Outline the internal processes and safeguards needed for effective device integration
An Introduction of How Benefits Were Realized for the Value of Health IT

Satisfaction improved for

- Staff
- Provider
- Patient

Treatment/Clinical

- Improved clinical documentation
- Reduced potential for medication-related errors
- Improved staff efficiency
Established in 1902, Cedars-Sinai Medical Center is renowned for:

• Providing the highest quality patient care
• Expanding scientific and medical knowledge through research that benefits patients
• Educating healthcare professionals for the future
• Improving the health status of the community
Overview of Cedars Sinai

- Established in 1902 and located in Los Angeles, California

- By the Numbers, from our 2014 Community Report:
  - 886 licensed beds, Level I Trauma Center
  - 251,803 Patient days
    - Approximately 690 per day
  - 630,269 Outpatient visits
    - Approximately 1730 per day
  - 85,305 Emergency Department visits
    - Approximately 235 per day
  - $43.4 million in research funding from NIH and other federal sources
  - $652.6 million in total quantifiable community benefits, including the unreimbursed cost of caring for Medicare patients

- Primary service area includes 3.3 million people
Leading Change

• Nursing staff from across the country identified the need for change to improve their workflow enabling staff to spend more time with patients.

• Study funded by the Robert Wood Johnson Foundation and conducted by the American Academy of Nursing (AAN) found that more time spent with patients positively impacted the incidence of nurse sensitive adverse events.

• The AAN serves the public and the profession by advancing health policy and practice through the generation, synthesis and dissemination of knowledge.

• The Technology Drill Down (TD2) research was conducted over a three year period engaging leaders in health care and technology to generate and synthesize knowledge related to the design and use of technology in acute care settings\(^1\)

1. [http://www.aannet.org/technology-drill-down](http://www.aannet.org/technology-drill-down)
The value of device integration for Nursing

• TD2 findings related to biomedical device integration
  – The discovery team ranked improving device integration as one of their top priorities.
  – Following the published report we recommended that the two industries work in collaboration to create products that improved the ability of health professionals to use technology in an efficient and effective manner.
  – Value was defined using the triple aim as a guiding framework. We postulated that device integration would benefit patients and staff.2

From Idea to Practice
Bringing TD2 recommendations to Cedars-Sinai

• The team at Cedars Sinai was one of multiple institutions to engage health professionals and technology colleagues across the country in the quest to lead change that would improve patient care.

• We identified the work needed to accomplish our goal and set out to find partners that would join us on the quest to improve patient care outcomes, prevent medical errors, improve staff workflow and experience and reduce costs associated with both human error and staff time.
Bridging Technology and Clinical Practice: the COOL Team

Unique collaboration across disciplines yields improved system design
Clinical Operations Optimization Liaisons
The COOL Team

- Multidisciplinary team
- Active clinical staff
- Trained in performance improvement tools/techniques
- Function as Project Managers
- Primary touch point for operational requests and ideas
- Vet ideas and bring forward for prioritization
- Work directly with Analysts to design and test build
- Bring forward for Committee approval
- Work with Educators and SMEs to determine impact and design training/communication
Establish a Partnership Model

**IT**
- Guides timelines
- Utilizes technical wisdom
- Applies clinical experiences
- Proposes “best practices”
- Mocks up multiple options
- Facilitates testing
- Responsibility to identify risk

**Operations**
- Establishes Priorities
- Understands workflow intricacies
- Facilitates options
- Drives operational change
- Validates Build in POC/BLD
- Designs Training Methods
- Responsibility to mitigate risk
User-centric implementation: one case study

Improving pulse oximetry monitoring for patients
Device integration as part of the technology requirement
SpO2 monitoring for PCA patients previously...

- Truly “stand alone” – alarms and data only exist on device
- Current devices didn’t support patient mobility
- SpO2 recordings are not logged in CS-Link frequently
- Troublesome with our policies and procedures regarding SpO2 monitoring during PCA
- Not workflow friendly to continuously monitor (human monitoring, not device) and react to alarms
Updated SpO2 monitoring technology requirements:

- Allow for patient mobility (wifi-enabled, still sound alarms and do data export)
- Support data and alarm integration using existing technical protocols
- Support current clinical workflow
- Address how to do patient association without adding one more central monitor to an already-crowded nursing station
SpO2 monitoring for PCA patients
Improved care through device integration

Objectives of pilot:

• To validate vendor claims on monitor capabilities:
  – Ease of use for clinical staff
    • Patient association/disassociation at the bedside
• Alarms and data connectivity
  – SpO2 and pulse rate data to CS-Link (EHR), alarms to Cedars Nursing phones
• Patient mobility/use of device as “wearable”

• Pilot Phase I from 08-24-2015 through 11-23-2015
• Pilot Phase II expansion from 11-18-2015 to present
Sensor + monitoring for PCA patients overview
Summary Report for 1 unit - 11/18 through 11/23

### 1.1 Event Report: Clinical Event

<table>
<thead>
<tr>
<th>TYPE</th>
<th>COUNT</th>
<th>%</th>
<th>TOTAL DURATION (SEC)</th>
<th>%</th>
<th>MAX DURATION (SEC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SpO2 Low</td>
<td>162</td>
<td>63.03</td>
<td>1858</td>
<td>71.26</td>
<td>110</td>
</tr>
<tr>
<td>PR High</td>
<td>5</td>
<td>1.945</td>
<td>59</td>
<td>2.263</td>
<td>28</td>
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<tr>
<td>PR Low</td>
<td>88</td>
<td>34.24</td>
<td>671</td>
<td>25.73</td>
<td>60</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>255</strong></td>
<td></td>
<td><strong>2588</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 2.2 Event Duration Report: Non-Clinical Event

<table>
<thead>
<tr>
<th>TYPE</th>
<th>2-15 (sec)</th>
<th>16-30 (sec)</th>
<th>31-60 (sec)</th>
<th>61-180 (sec)</th>
<th>3-4 (min)</th>
<th>4-5 (min)</th>
<th>&gt;5 (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replace Sensor</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>‘Wearable’ Disconnect</td>
<td>19</td>
<td>28</td>
<td>17</td>
<td>16</td>
<td>7</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>Interference</td>
<td>79</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Sensor</td>
<td>11</td>
<td>5</td>
<td>6</td>
<td>11</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Battery Low</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Sensor Off</td>
<td>283</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>392</strong></td>
<td><strong>36</strong></td>
<td><strong>23</strong></td>
<td><strong>28</strong></td>
<td><strong>10</strong></td>
<td><strong>7</strong></td>
<td><strong>26</strong></td>
</tr>
</tbody>
</table>
SpO2 monitoring for PCA patients
Clinical Team Feed Back

• Switch to staff assignments application caused confusion with format of messages being sent (resolved)

• Forgetting to place receiver device on Standby when patient out of room causing alarms (resolved with additional education)

• Forgetting to swap out wearable battery at the change of shift (resolved with additional education)
SpO2 monitoring for PCA patients
Clinical Team Feedback

• This makes ambulation with the patient so much easier” *physical therapist*
• “Now a patient can use the bathroom and walk around without having to call for help while they are still being monitored!” *nurse*
• “It’s great to be notified with the clinical information and not just a random device is alarming” *charge nurse*
• “We are anxious to expand this to other non-critical care units as we have seen good clinical interventions” *nurse managers*
Snapshot of CSMC Medical Device Connectivity

Infusion Pumps
• 1523 Infusion pump brains wirelessly communicate
  – With EHR: bidirectional interface; order goes to pump, flow rate and volume goes to patient chart

Patient Monitoring
• ~255 telemetry patients’ data imported to EHR (288 max – will increase in 2016)
• 690 multi-parameter monitoring devices imported to EHR
• 120 terminal servers in critical care areas for connection to ventilators, urimeters, CCO monitors, BIS monitors, etc..
• 85 anesthesia machine ‘systems’
• Mobile vital signs collection – data validated instantly

Fetal monitoring
• 24 Fetal monitors (LDR + Prenatal Clinic) interfaced with fetal monitoring system, then to EHR
• Additional integration with smartphone application for near-real time remote monitoring

Cardiology
• 35 EKG carts are wireless
• Orders/results for cath lab hemodynamic systems

Alarms/Alerts
• Nurse Call alarms/patient requests– sent to smartphones
• Pulse Oximetry and some cardiac monitoring – sent to smartphones
• Medical Device (“aux”) jack in each room for technologies not ready for network connectivity (i.e. chair exit alarm devices)
• Tele monitor based alarms managed through central monitoring, filtered
Going Outside the Hospital
Device Integration and Patient Engagement
Wearables and Patient Engagement

- Providing the patients with a way to manage their own biometric data
  - Separate patient flowsheet – not combined with data from inpatient or outpatient encounters
  - Few limits on which wearables the technology will support
    - Biggest hurdle is around creating the interface between the wearables and the patient health record
    - Working on unique integration engine to allow for multiple “ingestion” paths (phone OS-agnostic) and for unique cohort groups
- Not clear yet where “wearables” ends and “telehealth home monitoring” begins
A Summary of How Benefits Were Realized for the Value of Health IT

Satisfaction improved for
- Staff
- Provider
- Patient

Treatment/Clinical
- Improved clinical documentation
- Reduced potential for medication-related errors
- Improved staff efficiency
## A Summary of How Benefits Were Realized for the Value of Health IT

### Satisfaction improved for

<table>
<thead>
<tr>
<th>Staff</th>
<th>integration designed to align with user workflow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provider</td>
<td>higher resolution of patient data, entered near-real time</td>
</tr>
<tr>
<td>Patient</td>
<td>better alarm and data management -&gt; peace of mind, peace and quiet</td>
</tr>
</tbody>
</table>

### Treatment/Clinical

<table>
<thead>
<tr>
<th>Improved clinical documentation</th>
<th>less prone to human-related data entry errors/delays</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced potential for medication-related errors</td>
<td>pump integration article submitted showing use of integration/automation prevents errors</td>
</tr>
<tr>
<td>Improved staff efficiency</td>
<td>less time transcribing at workstation</td>
</tr>
</tbody>
</table>
Closing Remarks

• TD2 identified the need for improved care using technology-enabling processes

• Improvements found in Staff Satisfaction, Quality and Safety, and Patient Engagement with robust biomedical device integration program

• Strong leadership with a clear, cohesive vision required to change care at the bedside
  – Reinforces the message that a project isn’t just about integrating a medical device to the EHR, but a clinical process transformation
  – Enables clinical teams to collaborate to standardize practices
  – Closes the gap between the clinical and the technology stakeholders
Questions

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