Smart America Challenge Team: Closed Loop Healthcare: from home to hospital to home

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SmartAmerica Closed Loop Healthcare Team
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Closed Loop HealthCare Team: Home to Hospital to Home

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Closed Loop HealthCare Team: Home to Hospital to Home

1. Fall Detected at home
   Randall doesn’t get up

2. Robot: Randall needs
   Medical help
   alerts 911

3. ER - Smart alarms
   utilize cloud data
   and EHR

4. Surgery –
   all data available

5. Pain meds:
   Reduce risk of injury
   and false alarms

6. Safety
   Certification of
   interoperability

7. Real-time
   blue button

8. Device/Genomic
   Prescription CDS

9. Discharge

**NOTE:**
this graphic depicts a mix
of current and planned
capabilities.
Randall at Home

Depth camera for in-home fall detection so Randall gets help fast.

Bed sensor logs sleep patterns. Motion sensors log activity.
Real-Time Fall Detection

- Alert sent to caregivers with embedded link to depth video clip
Fall Detection and analysis …
Can **change** the course and outcome of the event

More information about the fall can influence medical intervention
Randall’s data from home helps avoid un-necessary head CT scan. Fall > 3 feet, may require CT
Nationally - $30B in wasted MRI/CT imaging
$2,000 each head scan. Radiation = 30 chest x-rays
What if we know his head did not sustain impact?

1. Fall Detected at home Randall doesn’t get up
2. Robot dispatch performs triage alerts 911
3. 911 dispatch
Hospital will have standards-based “Integrated Clinical Environments”, for full data interchange, device coordination, closed-loop control, “black box recorder”, “IoT for Health Care” Not available today, but we prototyped parts of this vision …

In ED: Retrieving data from remote EHR
Then: Transfer all data and device settings from ED->Operating Room
Patient-Controlled Analgesia (PCA) system safety concerns

- Patients can call to request more pain medication, but, cannot call for help when over-medicated.
- Over-medication can cause respiratory and cardiac arrest.
- Comprehensive monitoring is not typically used due to high false and nuisance alarm rate.
- “Safe PCA System” prototype uses information from medical monitors, EMR, and IV pump to prevent overdose.
Reducing false alarms will reduce alarm fatigue
Safer, more effective pain control

Pain Medication-related Injuries could be prevented with Medical CPS:
• Over 6000 patients severely injured/killed each year
• Up to $145M impact
• Untreated pain
• PREVENTABLE events!

Real-time blue button data available to family and staff
Integrated Clinical Environment Architecture

**ICE Network Controller**
- Apps for PCA Safety, Smart Alarms, Remote Notification, Team coordination

**ICE Supervisor (runs apps)**
- ICE Data Logger
- ICE Network Controller

**ICE External Interface**
- EMR

**Medical Devices**
- Medical Device e.g. Pulse Oximeter
- Medical Device or PCA Pump
- Medical Device or other equipment

**Patient and Family**

Standard ASTM F2761 recognized by FDA in August 2013
ICU: 21,000 Alarms/day
ASTM F2761 “ICE” standard for the Integrated Clinical Environment

Safe Interoperability can be enabled by Medical CPS

SmartAmerica Medical device interface performance certification pilot. Identified data persistence from Pulse Oximeter that could results in erroneous diagnosis from Clinical Decision Support app
Data Logger “Black Box Recorder” for the Integrated Clinical Environment (ICE)

- A Data Logger is a foundational component of MCPS clinical network. Required to improve forensic analysis of clinical adverse events and near misses.
- Required to address safety (Regulatory Science) and liability concerns of network medical systems.
- NIST Prototype Features:
  - Platform Independent, Plug-n-play & DDS compliant VM based Data Logger
  - Browser based Playback: Intuitive Data Visualization with Annotation and Search capabilities (Mobile Compatible)
  - Modular Architecture (Loose Coupling)
Personalized Medicine: EMR data & Blood Pressure after Metoprolol Administered
Randall’s Genomic Profile

A
Pt. 18 - Chromosome 9
Avg. Signal Intensity
Heterozygous calls

B
Pt. 38 - Chromosome 9
Idiogram
LOH Detection
 upd(9)(p21.2-pter)

C
Pt. 36 - Chromosome 9
 upd(9)(p21.3-pter)
Pt. 36 - Chromosome 12
del(12)(p13.1-p13.31)
EMR Alert: Don’t use beta blocker class of blood pressure medications
OpenICE + Analytics

IoT for Health Care can provide greater data granularity

SEMOSS is an open analytics technology - can find connections between data stored in multiple repositories. Data from DOCBOX’s ICE Manager and open source middleware + tools. Questions that could be answered:

a. How many times did this patient utilize this device?
b. Who are the various users working with this device?
c. How much time Nurse ABC spend providing direct patient care across the continuum of care (all patients all units)
Patient is discharged … to a smarter home

- Bathroom/Toilet Floor Sensor
- Motion Sensors
- Bed Sensor
- Fall Detection – Kinect
- Auto Light Control
- Capsule Robots
- Real-time blue button
- Wearable sensors
- Home Gait Analysis – Kinect

SMARTAMÉRICA
in-home fall detection and gait analysis

Bed sensor under the mattress logs pulse, respiration & restlessness
Capsule Robots for Non Invasive Healthcare Monitoring and Localized Drug Delivery

Painless Diagnosis & Automated Therapy

Controllable Capsule for Localized Drug Delivery
On Display at the Closed Loop Healthcare Booth