VITAL SIGN INTEGRATION ON MED/SURG UNITS

Challenges, Successes and Unintended Consequences

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CONFLICT OF INTEREST DISCLOSURE

Lola Rust and Tanna Nelson have no real or apparent conflicts of interest to disclose.
LEARNING OBJECTIVES

- Understand the vendor selection process and guiding operational decisions.
- Learn how THR managed the Vital Signs Integration project and implementation strategies
- Recognize the value added through time savings and data accuracy
- Realize unintended consequence
To provide vital sign integration using mobile noninvasive devices to

- Support the Reliable Care Blue printing practice of obtaining vital signs every 4 hours for low-acuity adult inpatient areas, such as Med Surg and Telemetry.
- Improve nursing efficiency and accuracy (avoid transcription errors)
- Improve near real time documentation of vital signs, to support early detection of sepsis and other conditions leading to patient deterioration.

### Vital Signs
- Vital Signs will standardize across the system to meet best practice standards
- Vital signs will be taken at the following minimum frequency unless directed otherwise by physician order, service line policy or as patient condition indicates
  - ED – on admission and within 1 hour of discharge/transition
  - Inpatient – Every 4 hours
  - ICU – Every hour (exception is temp every 4 hours)
- A full set of vital signs include heart rate, blood pressure, respiratory rate, pulse oximetry, and temperature with route taken
- Vital signs will show as incomplete if:
  - The 5 Vital Signs are documented at different times
  - Nurses will monitor vital sign trends
### ALIGNMENT TO SYSTEM STRATEGY

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td><strong>Extend our culture across the care continuum and into the community</strong></td>
<td><strong>Innovate and expand our Care delivery to reliably deliver compelling value (quality, cost, and service)</strong></td>
<td><strong>Generate the financial capacity to fund our transformation</strong></td>
</tr>
<tr>
<td>- Provides enhanced patient safety, supporting our Mission and vision.</td>
<td>- Reduces cost through decreased documentation errors.</td>
<td>- Provides higher value and lower clinical documentation</td>
</tr>
<tr>
<td>- This continued integration demonstrates</td>
<td>- Increases staff productivity through reduction of device wait times</td>
<td>- Provides a platform to expand growth potential with vital sign and other device integration</td>
</tr>
<tr>
<td>- our commitment to innovation to improve patient safety</td>
<td>- Increases compliance to timely and accurate documentation of vital signs and hourly rounding</td>
<td>- Provides standardization of device hardware, software and licenses for the system.</td>
</tr>
<tr>
<td>- advancing quality of care</td>
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</table>
Definitions - Vital Sign Integration High Acuity

- Integration in intensive care units, emergency department, PACU and procedural areas where the nurse is responsible for obtaining, monitoring and documenting vital signs.
- Values include hemodynamic parameters which populate to the clinical flow sheet rows every one minute.
- Authentication of clinical data occurs in the EMR flow sheet row at a time and interval based on organizational and clinical area policy.
- Monitors are hardwired.
- Device is attached to patient record via device selection within the EMR.
DEFINITIONS-
VITAL SIGN INTEGRATION  LOW ACUITY

- Integration in non-critical care or procedural areas
- Collected vital sign values include B/P, heart rate, respiratory rate, temperature and SpO2
- Include vital sign modifiers
  - Location
  - Source
  - Device
- Includes other documentation options
  - I&O,
  - weight,
  - safety and purposeful rounding
- Devices connect via a wireless network
- Device is attached to patient record via ADT feed
- Values are authenticated at the time values are “SENT” to the EMR
JOURNEY TO VITAL SIGN DEVICE INTEGRATION

2010 Anesthesia

2013 - 2014 Physiologic in Critical Care

April 2016 RCB Vital Sign module implemented

September 2016 Low Acuity Device selection

December 2016 – September 2017 Discovery and Analysis

September 2017 Revised Device selection

October 2017 system funding approved, Project Kick off

January - June 2018 Phase I Low Acuity Implementation

July 2018 Phase II Low Acuity Implementation
PROJECT PLAN/

- Discovery & Analysis
- Design, Build & Test
- Train
- Implement
- Sustain

This Photo by Unknown Author is licensed under CC BY-NC-ND
We can integrate your vital signs right into your EHR

No Problem! Easy as pie!

I don’t believe it for a second.

Really?

What’s integration?

Humm?

WOW! All in!
<table>
<thead>
<tr>
<th>Device Selection</th>
<th>Infrastructure Requirements</th>
<th>Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Option 2 vendors</td>
<td>• ADT Interfaces</td>
<td>• Financial</td>
</tr>
<tr>
<td>• Based on existing Architecture</td>
<td>• Network</td>
<td>• Integration costs</td>
</tr>
<tr>
<td>• Both had limiting factors</td>
<td>• Drivers if needed</td>
<td>• Supported by system or individual entity</td>
</tr>
<tr>
<td>• Price point</td>
<td>• License and implementation costs</td>
<td>• Hardware</td>
</tr>
<tr>
<td>• Interface, network and licensing requirements</td>
<td>• User access security: active directory</td>
<td>• End of Life (EOL) status</td>
</tr>
<tr>
<td>• Compatibility with existing vital sign machines</td>
<td></td>
<td>• Device Software Compatibility</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Allocation of purchased devices: limited supply</td>
</tr>
</tbody>
</table>
INFRASTRUCTURE

Physiologic Monitoring
2010 - 2014

Low Acuity VS Integration
Phase I

Low Acuity Vital Sign Integration
Phase II
COMPATIBLE DEVICES

- Phase I Neuron Capsule compatible with 7 Brands of vital sign machines.

- THR Inventory of Low Acuity
  - > 8 brands and models
  - Devices = > 1,271

Impacts to decision
- End of life status
- Additional software costs and licenses too accommodate an add on configuration
System Discovery and Analysis Success

Device Selection
- Vendor choice supports strategic plan to accommodate existing device hardware and build on the device architecture.
- Price point
- Supports the end user experience
- Building block approach
- Established system standard for Vital Sign Machines*

Infrastructure Requirements
- No change to current architecture
- Uses existing network
- License and implementation costs reduced
- Established system standard for Vital Sign Machines *

Implementation
- Financial
  - Initial hardware, licensing and implementation costs covered by system budget
  - Future costs individual entity responsibility
- Provided a phased approach
  - Upgrading existing VS hardware with neuron
  - All in one implementation
  - Includes single sign on option
PROJECT TEAM

- Executive Sponsor
- Business Owner
- Project Managers
- Team
SCOPE

Phase I
- Wholly owned + 1 Joint Venture Partner (JVP)
- Implementation and device costs covered by ITS
- 166 devices allocated to 13 entities
- Acute Med/Surg Inpatient Units
- Single VS brand and model
- Managed by PM

Phase II
- All in one device, system standard
- Implementation costs covered by system
- Hardware and License costs by entity
- All clinical areas on wireless network except Critical Care/Procedural areas
- Coordinated by HTM and Nursing Informatics
DESIGN

Phase I

System standard: Neuron affixed to 1 brand and model VS machine

Design team comprised of RN, PCT, analysts from clinical documentation, QA, data exchange and vendor

General and relative to med/surg clinical areas

Utilized mobile documentation application as foundation

Includes B/P, HR, SpO2, RR and Temp with up to 5 modifiers

5 clinical documentation fields

Single instance of vital sign and other documentation messages sent

Phase II

System standard: All in one device

Used foundation created in Phase I

General and relative any clinical area except ICU and procedural areas

Incorporated optimization requests from Phase I, modified phase I design

Includes B/P, HR, SpO2, RR and Temp with up to 7 modifiers

7 clinical documentation fields

Supports interval vital sign

Individual or groups of vital signs and other documentation messages can be sent
BUILD/TEST

Build

- Devices
  - Biomed
- Documentation (HL7)
  - Data Exchange/Management
  - Clinical Documentation
- Servers: 5
  - 2 production,
  - 1 test/train
  - Individual server each for joint venture (2)

Testing

- Connectivity
- Active Directory
  - Wholly owned
  - Joint Venture
- Admission Discharge Transfer (ADT)
  - Invision
  - CPSI
  - CC1
- Medical Device integration: results to EMR
- User acceptance: validation of workflow
TESTING

Phase II testing Included

- All components of Phase I
- Negative testing
- Interval testing

You thought what we tested in Phase I was enough!?

Make No Assumptions!!!
TRAIN

Vendor training
- System administration 1 day
- Train the trainer
  - Biomed: device assembly and maintenance 1.5 days
  - Nursing: 3 – 4 hours
- Super User Training
  - Biomed: half a day
  - Nursing: 3 – 4 hours
    - Basic Assembly
    - Functionality
    - Care and Maintenance
    - Trouble shooting
- End User Training
  - User access validation at the elbow
  - Basic functionality
  - At the elbow go live support by super users
IMPLEMENTATION: GO LIVE

Readiness Check list

- Change Management reviewed and approved
- Device assembly validation: Biomed
- Infrastructure validated: Network, driver configurations and servers

- Support
  - Onsite
  - Remote
  - Super Users

- Activate Production
SUSTAINMENT

Requests

- Change management Process

Customer Service

- Service Desk
- Knowledge Articles
  - User Access
  - Ticket routing
  - Downtime

Infrastruc

- Server Updates
- New or changing applications
- Downtime

Device Mgt.

- Preventive and Quality Maintenance
- Medical Component Management
- Cable management

Education

- New employee Competence/Mastery validation Updates

Strategic Goals

- Preventive and Quality Maintenance
- Medical Component Management
- Cable management

Sustain
OUTCOME EVALUATION STRATEGY

- **Cost Savings**
  - Time Savings
    - Time Study
    - Staff resources
  - Data Accuracy
    - Frequency of Corrections
    - Reason for Corrections
  - Patient Safety
    - Timely Entry
  - Staff Satisfaction
    - Pre/Post perception
    - Documentation Burden

- **Vital Signs Integration**
REQUIRED DOCUMENTATION CONSIDERATIONS

Primary Focus

Vital Signs (Every 4 Hours)
- Blood Pressure
- Heart Rate
- Respirations
- Temperature
- Temp Source
- SPO2

Secondary Focus

Additional Flowsheet Rows
- Rounding (every 1 hour)
- Upon Occurrence
  - General activity
  - Oral intake
  - Intake %
  - Urine output
  - Orthostatic position
  - SPO2 monitoring
DATA FLOW

- No Vital Signs
- Heart Rate
- Blood Pressure
- Temperature
- Respirations
- SPO2
- Temp Source
- SPO2 Measure Method
- Orthostatic Position
- General Activity
- Rounding
- Urine Output
- Oral Intake
- Meal %
- No Additional Documentation

Vital Signs

Additional Documentation
RETROSPECTIVE ANALYSIS: VITAL SIGNS

75 nursing units evaluated individually:

- Historical baseline – Manually documented vital signs (n= 9,535,894): July – December 2017
- After implementation – Manually documented and device integrated vital signs (n= 11,253,351)
  - Time varies based on go-live (see timeline)
  - Began data collection 7 days after implementation

Inclusion:
- Patients assigned to participating Med/Surg and Telemetry units
- Documented during the time the patient was assigned to the unit
- Documented by RNs, PCTs, Unit Clerks

Exclusion:
- Integrated through other means (GE monitors, surgery, ED)
- Rows without a vital sign value recorded (comment only documentation)
- Documented by other disciplines not assigned to a specific nursing unit (RT, PT, OT)
GO-LIVE TIMELINE AND DATA ACQUISITION DATES

Jan 10: THAL
Jan 17: THDN
Jan 22: THHEB
Jan 23: THAZ
Jan 16: THP
Jan 31: THSH
Jan 31: THFW
Feb 20: THK
Feb 19: THD
Feb 14: THAM
Feb 13: THS
Feb 12: THA
Mar 27: THFM
Mar 28: THC
Apr 17: TSHW/CF
Sep 6: THRW

2018:
- Jan 17 - Sep 30: 182 days
- Jan 24 - Sep 30: 178 days
- Feb 1 - Sep 30: 172 days
- Feb 7 - Sep 30: 168 days
- Feb 19 - Sep 30: 160 days
- Feb 26 - Sep 30: 155 days
- Apr 3 - Sep 30: 129 days
- Apr 24 - Sep 30: 114 days
- Sep 6 - Sep 30: 17 days
INTEGRATION OF VITAL SIGNS: OVERVIEW

Overall Integration

60.3%
**BOX AND WHISKER OVERVIEW**

- **Outliers**
- **Min/Max**
- **75th Percentile**
- **Median**
- **Mean**
- **25th Percentile**

Shows a lot of information in a small space

Easy comparison between manual vs. integrated documentation
Welch's two-tailed independent t-test

Pre (M = 67.125, SD = 16.254)
Post (M = 85.459, SD = 5.752)
\[ t_{92} = 9.2083 \quad p < 0.0001, \quad CI_{95} = 22.288 \text{ to } -14.379 \]

Pre (M = 17.871, SD = 5.802)
Post (M = 7.840, SD = 3.321)
\[ t_{117} = 12.9933 \quad p < 0.0001, \quad CI_{95} = 8.502 \text{ to } 11.560 \]

Pre (M = 12.869, SD = 10.672)
Post (M = 5.177, SD = 2.589)
\[ t_{82} = 6.0661 \quad p < 0.0001, \quad CI_{95} = 5.169 \text{ to } 10.215 \]

Pre (M = 2.143, SD = 1.961)
Post (M = 1.509, SD = 1.136)
\[ t_{118} = 2.4204 \quad p = 0.0170, \quad CI_{95} = 0.115 \text{ to } 1.151 \]
DATA ACCURACY

Frequency of Data Correction
Reasons for Data Correction
CONSIDERATIONS FOR DATA CORRECTIONS

Average: 1 minute to correct data

Scenario 1
Recognition of Another’s Error
1. Identify the issue
2. Contact the original documenter
3. Clarify VS value
4. Original documenter:
   1. logs in to EHR
   2. opens patient chart
   3. goes to correct flowsheet and time column
   4. enters corrected values

Scenario 2
Recognition of Self Error
1. Identify the issue
2. Clarify VS value
3. Enter corrected values

Assumptions: Original documenter is in close proximity at time of discovery and vital signs information is also nearby.

Assumptions: Individual is at a workstation, logged in to EHR system, and vital signs information is nearby.
DATA CORRECTION: MANUAL VS INTEGRATED

Statistically significant decrease in data correction

pre-implementation (n=75) (M=0.7320, SD =0.2343)
post-implementation (n=75) (M=0.3440, SD =0.4221)

$T_{(115)} = 6.9600, p < 0.0001, CI_{95} 0.2776$ to $0.4984$

Note: Welch's independent two-tailed t-test
DATA CORRECTION: MANUAL VS INTEGRATED

Manual Documentation

7.3 corrections per 1,000 entries

Device Integration

3.6 corrections per 1,000 entries

50.7% decrease in data correction
## Examination of Comments Associated with Data Correction: Why Was the Correction Made?

<table>
<thead>
<tr>
<th>Category</th>
<th>Finding</th>
<th>Why is this important?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wrong Patient</strong></td>
<td><strong>Significant</strong></td>
<td>Integration and the use of barcode scanning helps significantly with documentation on the correct patient</td>
</tr>
<tr>
<td>Manual (n=75)</td>
<td>(M=0.075283, SD =0.168792)</td>
<td></td>
</tr>
<tr>
<td>Device Integration (n=75)</td>
<td>(M=0.000000, SD =0.000000)</td>
<td></td>
</tr>
<tr>
<td>(T_{(74)}= 3.8626, p = 0.0002, CI.95 0.036447 to 0.114118)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Error in Entry</strong></td>
<td><strong>Non-Significant</strong></td>
<td>More study of the use of “Error” is needed</td>
</tr>
<tr>
<td>Manual (n=75)</td>
<td>(M=0.095929, SD =0.173518)</td>
<td></td>
</tr>
<tr>
<td>Device Integration (n=75)</td>
<td>(M=0.106221, SD =0.250473)</td>
<td></td>
</tr>
<tr>
<td>(T_{(131)}= 0.2925, p = 0.7704, CI.95 -0.079895 to 0.059311)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Recheck</strong></td>
<td><strong>Non-Significant</strong></td>
<td>Integration does not significantly decrease the use of comments to clarify reasons for data correction</td>
</tr>
<tr>
<td>Manual (n=75)</td>
<td>(M=0.154647, SD =0.203744)</td>
<td></td>
</tr>
<tr>
<td>Device Integration (n=75)</td>
<td>(M=0.185593, SD =0.304861)</td>
<td></td>
</tr>
<tr>
<td>(T_{(129)}= 0.7309, p = 0.4662, CI.95 -0.114718 to 0.052824)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Notified</strong></td>
<td><strong>Non-Significant</strong></td>
<td>Integration does not significantly decrease the use of comments to explain next steps if needed.</td>
</tr>
<tr>
<td>Manual (n=75)</td>
<td>(M=0.305951, SD =0.254203)</td>
<td></td>
</tr>
<tr>
<td>Device Integration (n=75)</td>
<td>(M=0.327423, SD =0.394107)</td>
<td></td>
</tr>
<tr>
<td>(T_{(126)}= 0.3965, p = 0.6924, CI.95 -0.128639 to 0.085695)</td>
<td></td>
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</tbody>
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Note: Welch’s independent two-tailed t-test
TIME SAVINGS

Time Study
Staff resources
INFORMAL TIME STUDY

Convenience Sample

2 Hospitals
5 Nursing Units
8 Users (6 PCTs, 2 Nurses)
63 total observations

Limitations

- Time study done at the end of project implementation
- Two of the eight users were observed doing both manual documentation and device integration
**Overall Results:**
Observations (n=63)
Statistically significant difference in time to obtain vital signs and document
Manual Doc. (n=32) (M=4.3537, SD =1.1049)
Integration (n=31) (M=2.4671, SD =0.6701)

\[ T_{(51)} = 8.2236, \ p <0.0001, \ CI_{95} 1.4261 \text{ to } 2.3472 \]

Time savings of 1.89 minutes per episode obtaining routine vital signs

**Individual Results:**
User A: time savings of 2.0 minutes
User B: time savings of 1.87 minutes
STAFF SATISFACTION

Pre/Post perception
Documentation Burden
COST SAVINGS

Patient Safety
Data Accuracy
Time Savings
Staff Satisfaction
COST & TIME SAVINGS: ROUTINE VITAL SIGNS

A 25 bed unit obtaining Vital Signs every 4 hours saves 1.89 minutes per “episode”

4.73 hours savings per day with Vital Signs Integration

1,725 hours of savings per year per nursing unit
COST & TIME SAVINGS: DATA ACCURACY

Average Med/Surg or Tele nursing unit takes 254,291 vital signs annually.

50.7% decrease in data correction equates to 0.4 hours savings daily.

146 hours saved annually per nursing unit.
LESSONS LEARNED

- Don’t make a device decision based on probability
- Device integration expanding rapidly
  - Options change faster than infrastructure capabilities
  - Costs change as vendor implementations increase
- Complete an inventory of assets and life span before analysis
- Modifications to build should not be based on “low use”
- Critical need for biomed on-site presence at go live
UNINTENDED CONSEQUENCES

- Identified competency and mastery of tasks
  - Competence
    - “The ability to observe and gather information, recognize deviations from expected patterns, prioritize data, make sense of data, maintain a professional, response demeanor, provide clear communication, execute effective interventions, perform nursing skills correctly, evaluate nursing interventions, and self reflect for performance improvement within a culture of safety.”
  - Mastery
    - Attained through deliberate practice
      - “Effortful activities designed to optimize improvement
    - Lost due to inconsistent teaching, testing, retention and skill drift
    - Diminishes without routine validation
REFERENCES


Texas Board of Nursing. (2011). Differentiated essential competencies of Texas nursing programs.
QUESTIONS

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