About the Presenter – Joe Ouellette

- Graduated from UConn with a Bachelor’s in Biomedical Engineering and a Master’s in Clinical Engineering, interning at the VA Hospital in West Haven, CT.
- Obtained a Master’s in Healthcare Informatics from Sacred Heart University.
- Has worked at the Yale New Haven Health System (YNHHS) for 6+ years doing Biomedical Device Integration and Systems Engineering.
VISION
Yale New Haven Health enhances the lives of the people we serve by providing access to high value, patient-centered care in collaboration with those who share our values.

MISSION
Yale New Haven Health is committed to innovation and excellence in patient care, teaching, research and service to our communities.

VALUES
- PATIENT-CENTERED: Putting patients and families first
- RESPECT: Valuing all people
- COMPASSION: Being empathetic
- INTEGRITY: Doing the right thing
- ACCOUNTABILITY: Being responsible and taking action
Topics

• Meaningful Use
• Planning
• Scope
• Devices
• Infrastructure
• Initial Testing
• Data Management
• HL7 Message
• Epic Configuration
• Device Association
• Final Testing

• Updates Since Completion of Initial Project
• Other Integration Projects
  o Mobile Vitals
  o Fetal Monitoring
  o Tele-ICU
  o Secondary Alerting
What pushed Yale to implement Epic?

• American Recovery and Reinvestment Act (ARRA) of 2009
• Title XIII of the ARRA is the Health Information Technology for Economic and Clinical Health (HITECH) Act
  o Allocated $19.2 billion for development of healthcare IT
  o Incentivized implementation and “Meaningful Use” of Electronic Health Records (EHRs) through Medicare and Medicaid reimbursement
What is Meaningful Use?

• Implementing and utilizing an EHR in a meaningful way:
  o Improve healthcare quality and efficiency
  o Enable patients to access their information more easily
  o Maintain the privacy and security of that information

• Must implement a Certified Electronic Health Record Technology (CEHRT)
  o The EHRs need to attest for certification as well

• Can attest to both Medicare and Medicaid requirements
What is Meaningful Use?

Current Stage 3 Requirements:
1. Protect Electronic Health Information
2. E-Prescribing
3. Patient Electronic Access & Patient Specific Education
4. Coordination of Care
5. Health Information Exchange
6. Public Health Reporting
What is Meaningful Use?

Current Stage 3 Requirements:

1. Protect Electronic Health Information
   - Authentication
   - Auditing
   - Encryption
   - Automatic Time Outs
   - Microsoft Updates
   - Must at least have a plan
What is Meaningful Use?

Current Stage 3 Requirements:
1. Protect Electronic Health Information
2. E-Prescribing
   - Generate and transmit discharge prescriptions electronically
   - Refills
   - Include mediation history information and diagnosis as reason for prescription
What is Meaningful Use?

Current Stage 3 Requirements:
1. Protect Electronic Health Information
2. E-Prescribing
3. Patient Electronic Access & Patient Specific Education
   - Make informed decisions about their own care
   - Share clinical information with other providers
   - Must be available within 36 hours
   - Use clinically relevant information to identify educational resources
What is Meaningful Use?

Current Stage 3 Requirements:
1. Protect Electronic Health Information
2. E-Prescribing
3. Patient Electronic Access & Patient Specific Education
4. Coordination of Care
   • Common Clinical Data Set
   • Secure Electronic Messaging both ways between Provider and Patient
   • Incorporate patient generated or nonclinical data into the EHR
What is Meaningful Use?

Current Stage 3 Requirements:
1. Protect Electronic Health Information
2. E-Prescribing
3. Patient Electronic Access & Patient Specific Education
4. Coordination of Care
5. Health Information Exchange
   • Summary of Care Record
   • Make available for other providers when transitioning a patient
   • Receive the same and incorporate it into the EHR
   • Perform reconciliation on the information provided
What is Meaningful Use?

Current Stage 3 Requirements:
1. Protect Electronic Health Information
2. E-Prescribing
3. Patient Electronic Access & Patient Specific Education
4. Coordination of Care
5. Health Information Exchange
6. Public Health Reporting
   • Active engagement with a public health agency
   • Send data to some form of approved registry
What is Meaningful Use?

- Able to attest to qualify for incentive payments through 2015
- Could only collect for 4 years, ending in 2016
- Payment decreases each year
- Amount is dependent on the number of discharges
  - Anywhere between $2M-$6.4M
  - As of August 2017, more than $24.8 billion has been paid

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Pre Epic EHR Landscape

• BH
  o Cerner Clinical Enterprise
  o SDK Revenue Cycle
• GH
  o Meditech Enterprise
  o Picis OR
• YNHH
  o Eclipsys/Allscripts Sunrise IP and Oncology OP
  o GE OR/Anesthesia
  o Links ED
  o GE Centricity Ambulatory
  o Soft Lab
  o SDK Revenue Cycle

• YMG
  o Paper
  o GE Centricity Ambulatory
  o Sunrise Ambulatory OP Oncology
• NEMG
  o Varied
• Yale Health
  o AllScripts
  o McKesson Pharmacy
Decided on Epic to be the sole electronic clinical and revenue cycle platform for Yale New Haven Health System.
Planning

• June 2010 – YNHHS signed a contract with Epic
• October 2010 – Hired and trained Epic analysts
• January-April 2011 - Collaborative build meetings
  o Advisory Councils made up of Subject Matter Experts (SMEs)
  o Discuss and implement policies, such as documentation standards, problem list management, interaction with patients, etc.
  o Decided that Biomedical Device Integration (BMDI) was important and chose Capsule as a vendor
Planning

• June 2011 – I started at Yale as a part of the newly formed BMDI team
  o Part of YNHHS ITS
  o Clinical Engineering was still siloed into individual hospitals
• Team of 4 with the sole focus of implementing Device Integration as Epic went live at each site:
  o April 2012 – Greenwich Hospital (200 beds)
  o February 2013 – Yale New Haven York Street Campus (1000 beds)
  o June 2013 – Yale New Haven St. Raphael’s Campus (500 beds)
  o September 2013 – Bridgeport Hospital (425 beds)
Scope

• The scope decided upon included:
  o Anesthesia
  o ICU & Step Down Monitoring
  o Emergency Monitoring
  o Sedation Monitoring (Procedures, Cardiology, Radiology)
  o Invasive Respiratory Ventilators

• Excluded from scope
  o Med/Surg Monitoring
  o Telemetry Monitoring
  o Non-Invasive Ventilators
  o Intra-Aortic Balloon Pumps (IABPs)
  o Anything else
Alignment with Existing Processes

- Scenario 1: No Change Management
- Scenario 2: Reactive Change Management
- Scenario 3: Proactive Change Management

- Organizational Equilibrium (current state)
- Disruption/ Potential Productivity Dip
- Implementation of Initiative Begins
- Return to Equilibrium

Align Processes
Align Policies
Simply Install
Scope

• Met with committees consisting of Clinical Leaders from each site
  o Anesthesia
  o Respiratory
  o ICU
• Created lists of the desired vital signs that were being requested for each area
• Started with Greenwich, but kept all sites in mind to consolidate their processes into the new standard within Epic
Devices

- Acquired inventory export from Clinical Engineering CMMS
- Confirmed the information in the inventory through site survey
  - Manufacturer
  - Model
  - Serial Number
  - Software Version
  - Location
  - Serial Connections
  - Special configurations required to activate serial output
Devices

• Monitors:
  o GE Solar
  o GE Dash
  o Invivo (MRI Compatible)

• Anesthesia Ventilators:
  o Datex Aestiva

• Invasive Respiratory Ventilators:
  o Viasys Avea
Devices

• Confirmed with Capsule that the equipment was compatible
• Capsule integration hardware is called a Neuron
Devices

• Looked at all potential integration options for each device
• For devices connecting to a Capsule Neuron:
  o Purchased necessary serial cables
  o Each device has a Device Identification Module (DIM) that tells the system which device is sending the information.
  o Configure the baud rate and bit parity on the device
• GE Carescape Gateway already in place and collects data from all mounted monitors to send directly to Capsule without a Neuron
Devices

• Wireless was not yet reliable at Greenwich, so we decided to mount Capsule Neurons at every potential respiratory or mobile monitor location
• Included “Point-to-Point” (P2P) wiring to enable maximum connectivity while keeping the Neuron out of the way
• Mounted Capsule Neurons on the anesthesia machines with wired connections in all areas they may be used
Infrastructure

• Did walk throughs in all areas with an engineering firm
• Created detailed documentation:
  o Where will the Neuron be mounted?
  o Where is power required and how much?
  o Where is data required and how much?
  o Is a P2P necessary and where is it going if so?
  o Is there enough room in the network switch?
  o If not, where will the new switch go?
• From this documentation, plans were drawn up
• The project was sent out for bid, a vendor was chosen, and the work was performed
Infrastructure

- Based on the number of devices, how many Capsule servers are needed?
  - How much storage, RAM, CPU, etc.?
  - What is the backup plan in case of a downtime?
- If using Neurons, how many should be purchased?
- If connecting through central monitoring servers:
  - Get the IP addresses and ports to connect to.
  - If it sits behind a firewall, update it to allow data to pass through.
- Will there be an integration engine between Capsule and the EMR?
  - We used Cloverleaf as an intermediary to consolidate multiple connections to Epic Bridges.
  - Set up monitoring to alert you when the connections go down.
Initial Testing

• Built a test server
• Installed the appropriate drivers for the device types being connected
• Ran tests with each different model device to confirm how the requested vital signs appear
• Created documents to track everything
• Using the Capsule DataCaptor application, we configured our “Data Management Modules” or DMMs
Data Management

Data Sampling

- How frequently do we want to send data to the EMR?
- Do we want to send the first or last value?
- Minimum allowed by Epic is 60 seconds
- After a lot of troubleshooting, we actually chose 57 seconds.
Data Management

Data Selection

• What variables do we want to pull from the device?
• Can be used to either filter the selected variables out or allow them to pass through
• Can specify variables based on assorted information:
  o Variable #
  o Driver/Device Type
  o Channel
  o Source
    ▪ Ex. Invasive BP having multiple labels to choose from on the monitor (ART, ABP, FEM, RAP, LAP, ICP, CVP...)

Yale New Haven Health
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<th>Variable</th>
<th>Variable Name</th>
<th>Address</th>
<th>Value</th>
<th>Unit</th>
<th>Unit Description</th>
<th>Computer Time</th>
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Data Management

Unit Translation
• Need to convert from one unit to another
• Ex. Map Liter to Milliliter or Celsius to Fahrenheit

Decimal Truncation
• Need to round to a specific decimal place
• Many are rounded to a whole number
• Some variables, like temperature, are rounded to 1 or 2 decimals
Data Management

Variable and Unit Mapping

• Take a variable ID and change it to something else
• Can be used to separate variables that have the same ID, but come in from different Channels or Sources
<table>
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Data Management

**Conditional Selection**

- If / Then statement
- Used to make variables non-significant under certain circumstances
- Ex. If an Avea Ventilator is in Standby, variable #2343 becomes a negative number. If this number becomes negative, all other variables from the Avea are made non-significant. This prevents them from being sent to the EMR.
Data Management

Concatenation

• Necessary when combining two variables into one
• Ex. Puritan Bennett 840 Ventilator
  o Has two vent modes that both have information we need (Avea has this info in one variable)
  o First has the method of control (A/C, SIMV, Spontaneous, etc.)
  o Second has the vent method (Pressure, Volume, etc.)

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Data Management

Value Mapping

- Change the value of a variable from one thing to another
- Ex. Used to change the concatenated PB840 vent mode to match the values output by the Avea.

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Data Management

• Where should the data go once it reaches the EMR?
• How does the system know where to send it?
  o Is the device associated to the patient in the EMR?
  o Can the device receive Admission, Discharge, Transfer (ADT) messages that allow it to include the patient’s information in the message?
HL7 Message

Time Stamp

Message Type

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HL7 Message

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Yale NewHaven Health
Epic Configuration

Create records in Epic for:

- Each Variable
  - Associated to a Flowsheet Row
  - Assigned a specific Variable ID
Epic Configuration

Create records in Epic for:

• Each Variable
  - Associated to a Flowsheet Row
  - Assigned a specific Variable ID

• Each Device
  - Assigned a specific Device ID
  - Associated to a Device Type
  - Fixed or Non-Fixed
  - Assigned to a Department
Create records in Epic for:

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  - Associated to a Flowsheet Row
  - Assigned a specific Variable ID
- Each Device
  - Assigned a specific Device ID
  - Associated to a Device Type
  - Fixed or Non-Fixed
  - Assigned to a Department
- Device Type
  - Variables are associated to it
Device Association

Devices are associated to a patient in order for vitals to flow into their record. This is done in one of three ways:

• **Fixed Device** – The patient is transferred into a bed that the device is assigned to and it is automatically associated to them.

• **Non-Fixed Device** – The clinician must manually search in Epic for the correct device and choose to associate it to the patient.

• **Anesthesia** – There is a PC mounted on every anesthesia machine. When a case is started from one of these PCs, the anesthesia monitor and ventilator it is mounted on are automatically associated to the patient.
Final Testing

• Done once all of the equipment has been installed, DMMs configured, interfaces connected, and devices created in the EMR.
• Simulate every variable from each different device model type
• Simulate basic information from each individual device
• Develop a method to keep track of everything
  o Variable Testing
  o Device Inventory
Updates Since Completion of Initial Project

• Added Locations:
  o Lawrence & Memorial Hospital (280 beds)
  o Westerly Hospital (125 beds)
  o Several Ambulatory Operatory Sites
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• Added Capability:
  o Improved wireless led to mounting neurons directly on equipment and removing of wires
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• Added Capability:
  o Improved wireless led to mounting neurons directly on equipment and removing of wires

• Added Scope:
  o Med/Surg Monitoring
  o Non-invasive Ventilators
  o More devices and variables
Mobile Vitals

- Capsule Neuron mounted on top of assorted Vital Sign Machines
Mobile Vitals

• Capsule Neuron mounted on top of assorted Vital Sign Machines
• Receives ADT from EMR
Mobile Vitals

• Capsule Neuron mounted on top of assorted Vital Sign Machines
• Receives ADT from EMR
• Clinical user logs into device for security
Mobile Vitals

• Capsule Neuron mounted on top of assorted Vital Sign Machines
• Receives ADT from EMR
• Clinical user logs into device for security
• Scan wristband barcode for positive patient identification
Mobile Vitals

• Capsule Neuron mounted on top of assorted Vital Sign Machines
• Receives ADT from EMR
• Clinical user logs into device for security
• Scan wristband barcode for positive patient identification
• Pulls vitals directly from medical device and add more info manually
Mobile Vitals

• Validate information and send it into the record from the bedside
• Positive patient identification via barcoding (PPID)
• Data accuracy by eliminating manual charting, reducing the chance for transcription errors
• Reduce documentation time
• Real-time data to support timely decision making
• Gives clinical users more time to care for the patient
Mobile Vitals

• Capsule Vitals Plus
  o Neuron is the Vital Sign Machine
  o Attachments allow it to collect information
  o Works the same as before

• Working with Capsule to improve this equipment
  o Alarms
  o Interval Vitals Collection & Submission
  o Increased options for attachments
Other Integration Projects

• Fetal Monitoring – OBIX
  o System displays and stores fetal monitoring strips
  o ADT from EMR is sent into the system to link the two
  o Vitals are sent into EMR
  o Results are sent back after vitals are validated and they are displayed on the strip at the time they were validated
Other Integration Projects

• Fetal Monitoring - OBIX
• Perfusion – Spectrum
  o No true link to the EMR, due to limitations within orders functionality
  o Generates a PDF report that is imported into the EMR
Other Integration Projects

- Fetal Monitoring - OBIX
- Perfusion – Spectrum
- Tele-ICU – Bernoulli
  - Allows 24x7 monitoring of ICU patients remotely
  - Two way video communication to the room
  - Receives waveform information from a device connected to the physiological monitor at the bedside
Other Integration Projects

- Fetal Monitoring - OBIX
- Perfusion – Spectrum
- Tele-ICU – Bernoulli
- Neonatal ICU Secondary Alerting System
  - Alarms to Mobile Phone from medical devices and nurse call
  - Call back into the room from Mobile Phone
Questions?

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