



CMMS Update

March 4, 2021



Ted Cohen, MS, CCE, FACCE
Clinical Engineering Consultant
tedcohen@pacbell.net

1

Agenda

- CMMS Basics
- Data Integrity and Data Entry Efficiency
- Data Standardization
- AEMs
- Data Analytics
- Service Call Management
- Management of Network Connected Medical Devices
- CMMS Interfaces
- Thoughts on selecting a new CMMS



2

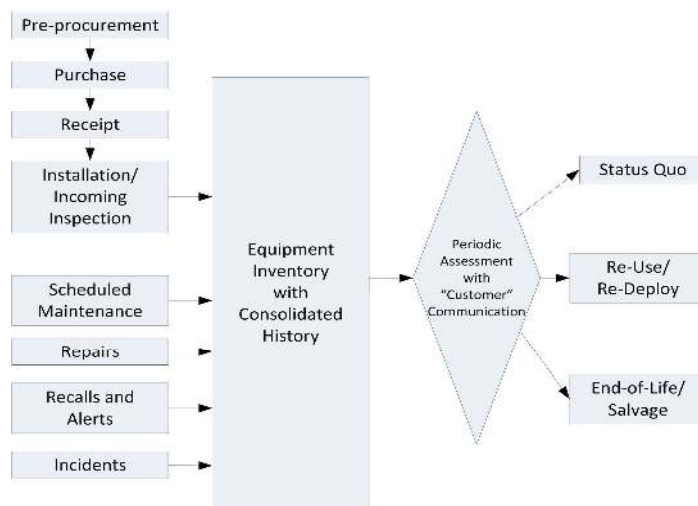
CMMS Basics



- CMMS: tools to help you manage
 - People
 - Technology
 - Budget
 - Regulations

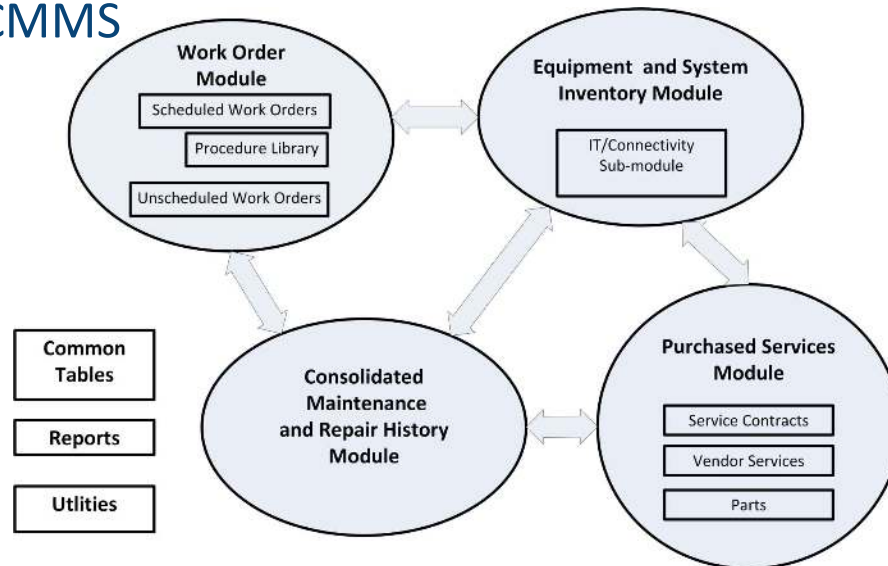
3

CMMS Throughout the Device Lifecycle



4

Basic CMMS



Ted Cohen, CCE, Webinar for New England Society of Clinical Engineering, March 4, 2021

5

5

Data Integrity

- **Data quality:** Good data quality is mandatory for good decision making (converting data to actionable information)
- **Simplify data entry:** Make it easy and efficient for techs to enter high-quality, accurate and complete workorder data
- **Unfortunately, poor data quality is common in HTM**

Ted Cohen, CCE, Webinar for New England Society of Clinical Engineering, March 4, 2021

6

6

Data Integrity



- **Tech “Tools” for easy data access**
- **Management:** CMMS data definitions, HTM department policies and standards, HDO business rules
- **Staff training:** CMMS, HTM department, HDO, policies, practices
- **Staff “buy-in” and accountability**
 - Day-to-day reports and dashboards
 - Audits
 - Employee periodic performance reports
- **CMMS error checking**
 - Real-time error checking at data entry for immediate feedback
 - Aggregate error checking reports

Ted Cohen, CCE, Webinar for New England Society of Clinical Engineering, March 4, 2021

7

7

“Local” Data Definition Examples



- Internal HDO/HTM department data definitions and standards
 - **Field definitions:** HTM department and/or CMMS vendor should create a definition **for every field**
 - **Port example:** What is the definition of this port field? Is it the logical port (e.g. 33001) used for HL-7 data or the physical port (e.g. data jack D2767)

Port

Ted Cohen, CCE, Webinar for New England Society of Clinical Engineering, March 4, 2021

8

8

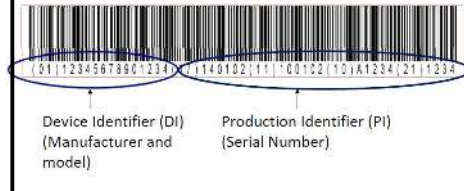
External Standardized Data Definitions



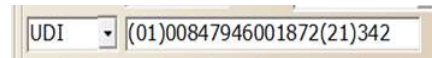
ECRI Institute's Universal Medical Device Nomenclature System (UMDNS)

20770	Physiologic Monitor Modules
20771	Physiologic Monitor Modules, Electrocardiography
20772	Physiologic Monitor Modules, Invasive Blood Pressure
20773	Physiologic Monitor Modules, Noninvasive Blood Pressure
20774	Physiologic Monitor Modules, Cardiac Output
20775	Physiologic Monitor Modules, Apnea/Respiratory Rate
20776	Physiologic Monitor Modules, Exhaled Carbon Dioxide
20777	Physiologic Monitor Modules, Inspired Oxygen
20778	Physiologic Monitor Modules, Anesthetic Gas
20779	Physiologic Monitor Modules, Temperature
20780	Physiologic Monitor Modules, Transcutaneous Blood Gas
20781	Physiologic Monitor Modules, Pulse Oximetry
20782	Physiologic Monitor Modules, Intravascular Oximetry
20783	Physiologic Monitor Modules, Electroencephalography
20784	Physiologic Monitor Modules, Multiparameter
22856	Physiologic Monitor Module Housings
22857	Physiologic Monitor Module Housings, Signal Processing
23437	Physiologic Monitor Modules, Neuromuscular Block
32878	Physiologic Monitoring Modules, Neurology, Level-of-Cons
33559	Physiologic Monitoring Modules, Fetal

FDA's Universal Device Identifier (UDI)



Zoll R Series Defib UDI in CMMS



Ted Cohen, CCE, Webinar for New England Society of Clinical Engineering, March 4, 2021

Standardizing CMMS Failure Codes



Option	Definition	Examples
Accessory or Disposable Failure <input checked="" type="checkbox"/>	Failure of device accessory or disposable, not a failure of the device itself.	ESU footswitch. Infusion pump cassette.
Calibration Failure <input checked="" type="checkbox"/>	Failure of a device to meet calibration parameters, requiring recalibration.	Need to adjust low-battery alarm trigger point.
Component Failure (Battery) <input checked="" type="checkbox"/>	Failure of the battery that provides power for device operation.	Battery fails to hold a charge. Battery reconditioning fails.
Component Failure (Not Battery) <input checked="" type="checkbox"/>	Failure of a device component other than the battery.	Infusion pump pressure sensor. Device power cord. Device display.
Failure Caused by Maintenance <input checked="" type="checkbox"/>	Failure of a device resulting from maintenance activities.	Physical damage during maintenance. Overvoltage during testing.
Failure Caused by Abuse or Negligence	Failure of a device resulting from damage caused by intentional misuse or negligent use.	User drops defibrillator. Patient damages infusion pump.
Network or Connectivity Failure	Functional failure external to device from failure of network or connectivity.	Network connection not accessible. Infusion pump library not updated.

Reference: "Optimizing the CMMS Failure Code Field": <https://www.aami.org/HTM/htm-resources/cmms-collaborative-white-papers>
 Ted Cohen, CCE, Webinar for New England Society of Clinical Engineering, March 4, 2021

PM-related failure

Standardizing CMMS Failure Codes



Option	Definition	Examples
Software Failure	Functional failure of a device resulting from malfunctioning software.	Infusion pump software malfunctions. Physiological monitor required rebooting.
Use Error (Use Failure)	Failure of a device to support achievement of a clinical objective.	User error. Infusion pump programming error.
Failure Caused by Utility System	Functional failure of a device resulting from failure of or access to a utility system.	Electrical power. Medical gas or vacuum. Ventilation.
Failure Cause by Environmental Factor	Functional failure of a device resulting from an environmental factor.	Excessive ambient temperature. Excessive relative humidity.
Failure Could Not Be Identified	Reported failure could not be reproduced or identified by testing.	Inaccurate or incomplete report of failure. Intermittent device failure.
Failure Not Diagnosed—Device Not Repaired	Reported failure indicated that testing or repair was unwarranted.	Device replacement was more cost-effective than testing or repair.
No Failure Associated with the WO	There was no failure associated with the work order (included for completeness).	PM work order completed normally. PM work order could not be completed.

Reference: "Optimizing the CMMS Failure Code Field": <https://www.aami.org/HTM/htm-resources/cmms-collaborative-white-papers>
 Ted Cohen, CCE, Webinar for New England Society of Clinical Engineering, March 4, 2021

11

11

AEMs and the CMMS



AEM program candidates

- Equipment types with lengthy, time-consuming OEM PM procedures
- Equipment types that include many individual devices
- Equipment types that are safe with "run to fail" maintenance strategies (e.g., low risk equipment)

Ted Cohen, CCE, Webinar for New England Society of Clinical Engineering, March 4, 2021

12

12

PM-Related Risk Assessment



Level of PM-Related Risk	Devices with PM-Preventable Failure Modes				Devices with No PM-Preventable Failure Modes
	LOS 3: Serious, life-threatening injury	LOS 2: Less serious injury	LOS 1: No injury, disruption of care	LOS 0: Negligible impact	
Potentially high PM-risk devices	CMS "critical equipment" (about 20 device types)				
Potentially moderate PM-risk devices		About 45 device types			
Potentially low PM-risk devices			About five device types		
Negligible PM-risk devices				Numerous device types	
Zero PM-risk devices				Numerous device types	

LOS=Level of Severity

From: A Rational Approach to Efficient Equipment Maintenance, Part 1, A Simple, Basic AEM Program, BI&T, July/August 2018

Ted Cohen, CCE, Webinar for New England Society of Clinical Engineering, March 4, 2021

13

13

AEMs and the CMMS



For AEMs, one way to classify devices in the CMMS is:

- AEM-1: Medical equipment maintained under manufacturer recommendations and **not eligible** for AEM
- AEM-2: Medical equipment maintenance under manufacturer recommendations; **eligible** for AEM but **not currently under an AEM**
 - AEM-2x: Potentially eligible for AEM, but **Insufficient repair and maintenance history** to support AEM
- AEM-3: Medical equipment **maintained under AEM procedure and/or interval**
- AEM-4: N/A (e.g., Non-medical equipment)

Derived from: "AEM Program Guide, Alternative PM for Patient Safety", Baretich, AAMI 2018

Ted Cohen, CCE, Webinar for New England Society of Clinical Engineering, March 4, 2021

14

14

AEMs and the CMMS



- Follow-up is required. The AEM program cannot “reduce equipment safety”
 - Use CMMS analytics to look at MTBF before and after AEM
 - Have a dedicated “PM-Preventable field
 - Document and review failures that are “PM Preventable”
 - Could the failure have been prevented (or made less likely) by change in procedure or interval

15

CMMS – Reports, Dashboards, and Analytics



- Standard reports and dashboards for CE management and customer communication
- Data analytics: Aggregating data and turning it into actionable information
 - Replacement planning (e.g., MTBF, End of Support)
 - Downtime analysis of critical systems
 - PM Preventable for AEM analysis and followup
 - Service contract effectiveness (ROI)
 - Effective Hourly Rate and COSR for benchmarking & aggregate cost analysis
 - Tech accountability and productivity
 - Use error trends
 - Utilization studies for optimizing capital budgets

16

Monthly Customer Report Example



CUSTOMER REPORT for SHCNC-FACILITIES MGMT (3900) : December 2013

Manager: 5

UC DAVIS HEALTH SYSTEM

The following workorders had no problem verified:

WO#	Request Date	End Date	Act Type	Service Source	Service Description	Model	Serial #	Lbr Hrs	Lbr Cha	Matl Cha
3932056	PUMPS, ENTERAL FEEDING	THE KENDALL CO DIV TYCO HEALTH	032006	C0616322						
308740	REQUEST BROKEN									
11/27/2013	12/02/2013	CM	DAVE		Start Time = 12/02/2013 09:00			0.00	0.00	0.00
11/27/2013	12/02/2013	CM	DAVE		Prk (Pass) Prk (per Service Manual) Prk (Pass)			0.00	62.00	0.00
Status as of 12/02/2013: CLOSED ROOT-CAUSE: No Problem Verified										

The following workorders had a use-related problem:

WO#	Request Date	End Date	Act Type	Service Source	Service Description	Model	Serial #	Lbr Hrs	Lbr Cha	Matl Cha
3932055	PUMPS, ENTERAL FEEDING	THE KENDALL CO DIV TYCO HEALTH	032006	09825						
308811	REQUEST ROOT STOP REPAIR									
12/04/2013	12/04/2013	CM	DAVE		Start Time = 12/04/2013 11:00			0.00	0.00	0.00
12/04/2013	12/04/2013	CM	DAVE		Prk (Pass) Prk (per Service Manual) Prk (Pass)			0.00	61.00	0.00
Status as of 12/04/2013: CLOSED ROOT-CAUSE: Use Error Knowledge Problem										

The following scheduled maintenance services were performed:

WO#	Request Date	End Date	Act Type	Service Source	Service Description	Model	Serial #	Lbr Hrs	Lbr Cha	Matl Cha
3932230	INFUSION PUMPS, GENERAL PURPOSE	CAREFUSION (FORMERLY CARDINAL/)	8000	32764236						
307097	REQUEST PRK per Service Manual - Next Scheduled Date: 11/01/2014									
11/01/2013	12/17/2013	PM	DAVE		Prk (Pass) in Display			0.00	0.00	0.00
Status as of 12/04/2013: OPEN										

Summary for Cost Center 3900: SHCNC-FACILITIES MGMT (3900), December 2013

	Lbr Hrs	Lbr Cha	Matl Cha	Subtotal
Clm Engr	1.00	125.00	0.00	125.00
Vendor	0.00	0.00	0.00	0.00
Subtotal	1.00	125.00	0.00	125.00

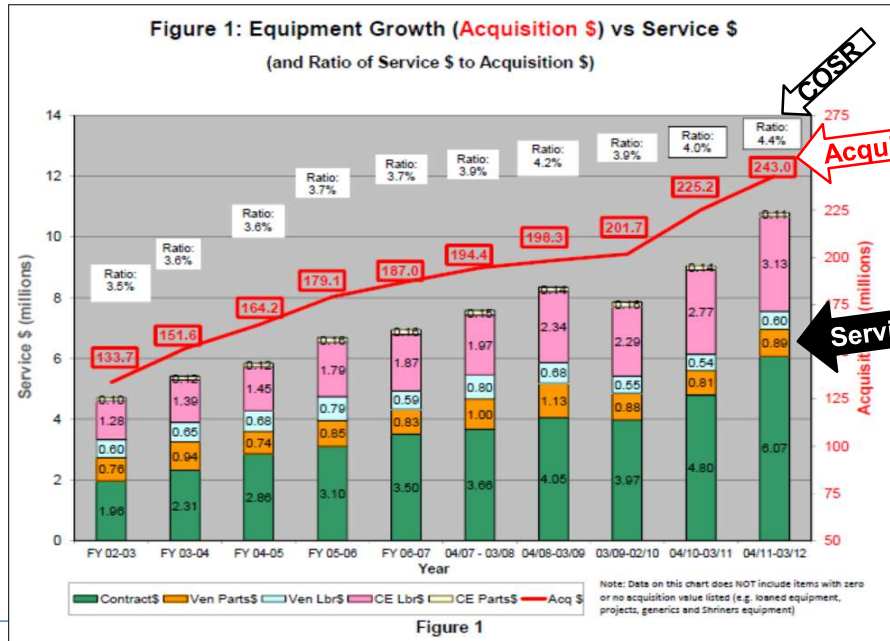
Clinical Engineering is always interested in improving its services. If you have any suggestions, please contact: Ted Cohen, Manager, Clinical Engineering at (916)734-2846 or email theodore.cohen@ucdmc.ucdavis.edu

Ted Cohen, CCE, Webinar for New England Society of Clinical Engineering, March 4, 2021

17

17

Excel Report from CMMS Data

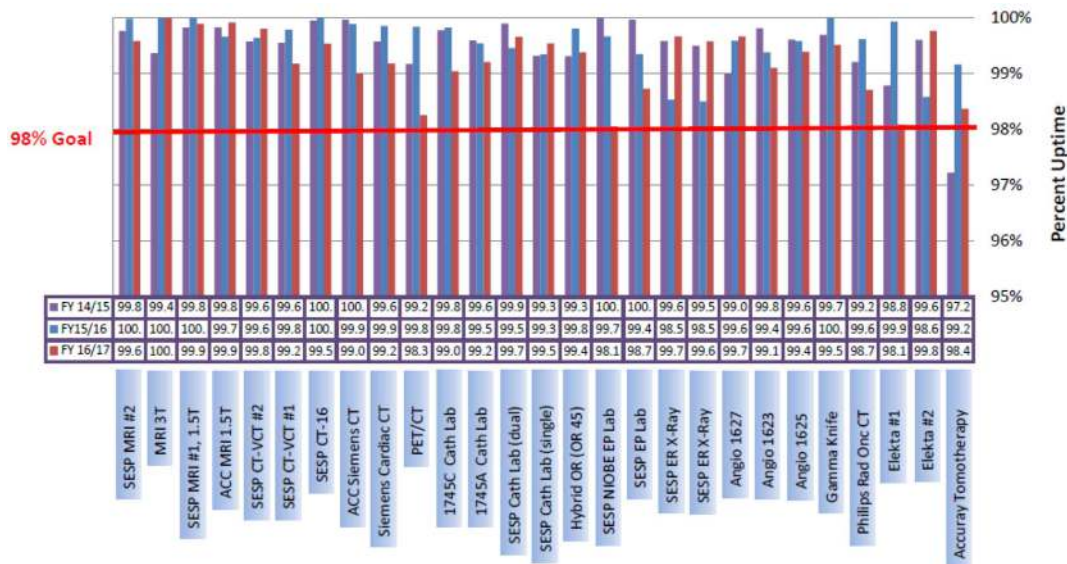


Ted Cohen, CCE, Webinar for New England Society of Clinical Engineering, March 4, 2021

18

18

Reports and Analytics: Critical System Uptime



Ted Cohen, CCE, Webinar for New England Society of Clinical Engineering, March 4, 2021

19

19

Service Call Management



- Automated repair workorder triage (End user should not have to know which department supports which system or problem (e.g. IT or CE))
- Automated dispatch (Route requests to first line support by product line, user dept etc)
 - Workorder acceptance by tech
 - Automated escalation
- On-line status, dashboards
- SLAs (Service-Level Agreements)

Ted Cohen, CCE, Webinar for New England Society of Clinical Engineering, March 4, 2021

20

20

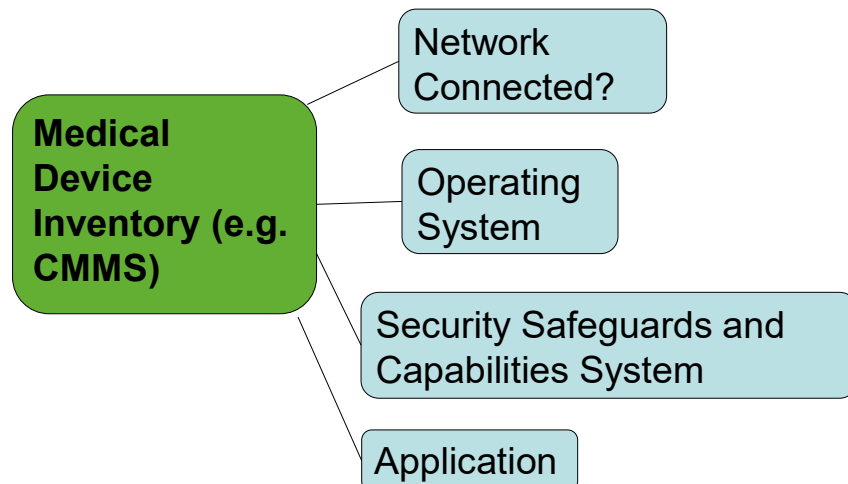
Management of Network-Connected Medical Devices



- Tracking medical device data connections for EHR, PACS and other Clinical Applications
 - Clinical Orders
 - Clinical Results
 - Patient Images
- Security and privacy management
- Configuration Management Database (CMDB)

21

Management of Network-Connected Medical Devices



Reference: *Medical Device Patch Management*, Mehring, Wirth. HIMSS 16.

22

Management of Network-Connected Medical Devices



Network
Connected?

- Host Name/DNS
- MAC Address
- IP Address/DHCP
- Subnet Mask
- Gateway
- VRF/Segment
- Wireless?/Wireless Interface Type
 - SSID

Reference: *Medical Device Patch Management*, Mehring, Wirth. HIMSS 16.

Ted Cohen, CCE, Webinar for New England Society of Clinical Engineering, March 4, 2021

23

23

Management of Network-Connected Medical Devices



Operating
System

- OS and OS Version
- OS Patch Level and latest update date
- List of installed patches
- BIOS and version

Reference: *Medical Device Patch Management*, Mehring, Wirth. HIMSS 16.

Ted Cohen, CCE, Webinar for New England Society of Clinical Engineering, March 4, 2021

24

24

Management of Network-Connected Medical Devices



Security Safeguards & Capabilities

- Authentication Control
- Credential Management
- Anti-Malware
- Encryption
- Event alerts/logging (audit)
- Remote access

Reference: *Medical Device Patch Management*, Mehring, Wirth. HIMSS 16.

Ted Cohen, CCE, Webinar for New England Society of Clinical Engineering, March 4, 2021

25

25

Management of Network-Connected Medical Devices



Applications

- Version
- Last update date
- License information
- System backup location
- Last backup date
- AE Title
- HL-7 Port
- Target IPs
- Remote login info

Reference: *Medical Device Patch Management*, Mehring, Wirth. HIMSS 16.

Ted Cohen, CCE, Webinar for New England Society of Clinical Engineering, March 4, 2021

26

26

Management of Network-Connected Medical Devices: CMDB



- It's very difficult to keep multiple fields in multiple databases synchronized
- IT and CE focused on different device attributes
- One solution: Some newer CMMS use CMDB (Configuration Management Database)
 - CMMS and IT use the same sync'd equipment inventory database
 - "One point of truth" for network connected devices
 - Can also create topology diagram

Ted Cohen, CCE, Webinar for New England Society of Clinical Engineering, March 4, 2021

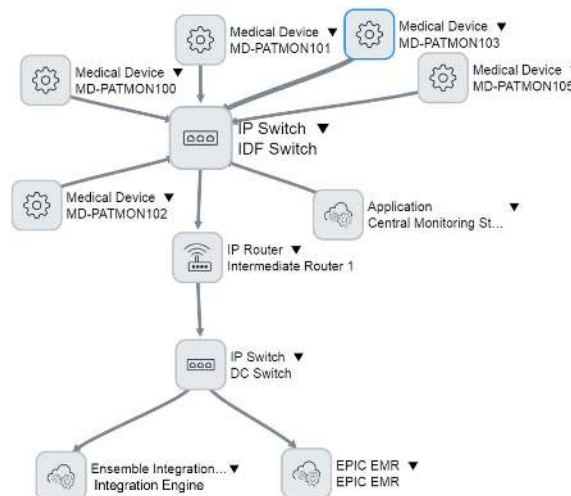
27

27

Management of Network-Connected Medical Devices



Topology from Configuration Management Database (CMDB)



Ted Cohen, CCE, Webinar for New England Society of Clinical Engineering, March 4, 2021

28

28



Other CMMS Interfaces

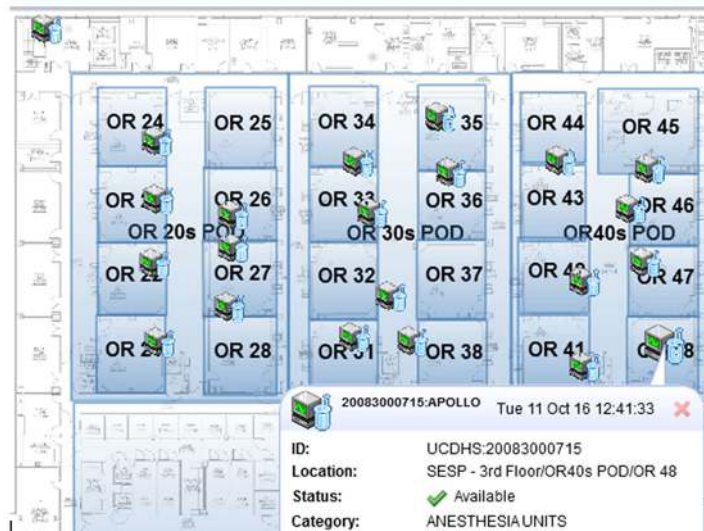
- Product recall and alert systems
- Materials management & procurement
- Parts vendors
- Financial systems
- Payroll & timecard systems
- Real-Time Location Systems (RTLS)
- End-Point IT Security Applications
- IHE-PCD-MEM

Ted Cohen, CCE, Webinar for New England Society of Clinical Engineering, March 4, 2021

29

29

CMMS Interfaces: RTLS / RFID



Ted Cohen, CCE, Webinar for New England Society of Clinical Engineering, March 4, 2021

30

30

CMMS Interfaces: Medical Devices via IHE-PCD-MEM



- **IHE-PCD-MEMLS**: Location services. Standardized RTLS for location and in some cases, utilization data, sent to CMMS from location services application.
 - Location
 - Device status (e.g., powered on and in use by a patient)

Ted Cohen, CCE, Webinar for New England Society of Clinical Engineering, March 4, 2021

31

31

CMMS Interfaces: IHE-PCD-MEM



- **IHE-PCD-MEMDMC**: Device management protocol for sending device status data to CMMS including:
 - Device information: Model, hardware, software/firmware rev levels
 - Network information (e.g., on-line, off-line, MAC and IP address)
 - Update and Patch management info
 - Equipment power transitions: (e.g. mains to battery or back to mains)
 - Self-test status report (i.e., last self test, pass or fail, and fail mode)
 - Battery status/level for all batteries. Battery charging success
 - PM status and meter information
 - More to be added

References: PCD-MEMDMC, IHE International, Rev 1.3, 2017-11-09, https://www.ihe.net/uploadedFiles/Documents/PCD/IHE_Suppl_PCD_MEM-DMC.pdf
The Center for Medical Interoperability Specification, ASUM Solution for IHE PCD Clients Using MEMDMC
<http://medicalinteroperability.org/specifications/D01/CDI-SP-F-ASUM-MEM-DMC-D01-20190311.pdf>

Ted Cohen, CCE, Webinar for New England Society of Clinical Engineering, March 4, 2021

32

32

Thoughts on Selecting a New CMMS



- Think about your **current CMMS**.
 - What do you **like** about it?
 - What do you **dislike** about it?
 - Does it support **basic repair and maintenance activities**?
 - Does it support **CE program management**?
 - What **new requirements** do you need that it does not have?
 - What would you like it to do? (**nice to haves**)
- Do you have a **budget** and administration support to replace it?

Ted Cohen, CCE, Webinar for New England Society of Clinical Engineering, March 4, 2021

33

33

Thoughts on Selecting a New CMMS



- What do you need beyond generic CMMS functions
 - Mobile data access
 - Dispatch options
 - Reports and dashboards
 - Data analytics
 - Integrations & interfaces
 - Supply chain & financial systems
 - RTLS
 - CMDB and other IT
 - Safety alerts & recalls

Ted Cohen, CCE, Webinar for New England Society of Clinical Engineering, March 4, 2021

34

34

Thoughts on Selecting a New CMMS



- What additional support will you need to transition to a new CMMS:
 - Physical inventory
 - Data cleanup
 - Inventory data transfer
 - Service data transfer
 - CMMS configuration/customization for HDO business rules
 - Integration consulting/configuration/customization
 - Other consulting services

Vendor Presentation Schedule



- Phoenix/AIMS: 4:00-4:20 PM, EST
- Accruent/Connectiv: 4:20-4:40
- EQ2/HEMS: 4:40-5:00
- Nuvolo: 5:00-5:20

- Q & A: 5:20-5:30