

Use of Middleware in Alarm Management: Ancillary Notification and Obtaining Alarm Data

January 28, 2014

Co-Conveners

AMERICAN
ASSOCIATION
of CRITICAL-CARE
NURSES

ACCE
AMERICAN COLLEGE OF CLINICAL ENGINEERING


American Hospital
Association®

ECRI Institute
The Discipline of Science. The Integrity of Independence.

HTF Healthcare Technology
FOUNDATION

 The Joint Commission


VA National Center for Patient Safety
Safer Systems • Safer Care

 NPSF

Thank You to Our Sponsors



GE Healthcare



PHILIPS

sense and simplicity



This webinar series is offered at no charge thanks to commercial grants from the companies shown here. HTSI and its co-convening organizations appreciate their generosity. AAMI and HTSI are managing all costs for the series. None of the co-convening organizations participated in seeking, discussing, or otherwise facilitating the commercial grants. The companies had no role in content development, and the webinars do not contain commercial content. Webinar presenters were selected based on topic expertise without regard to industry affiliation by a multi-disciplinary HTSI volunteer planning committee.

Speaker Introductions

- **Paul Coss, RN**, Principal, Coss Associates
- **Ramya Krishnan, MS**, Senior Project Engineer, Health Devices Group, ECRI Institute
- **Tim Gee, BA**, Principal, Medical Connectivity Consulting
- **Andrew Currie, MS**, Director of Clinical Engineering, Johns Hopkins Hospital
- **Marjorie Funk, PhD, RN, FAHA, FAAN**, Professor, Yale University School of Nursing (Moderator)

Overview of Middleware

Paul Coss, RN
Principal
Coss Associates

Middleware

Oreo Cookies

- The Stuff in the Middle

Some Types of Middleware

- Paging Systems
- Phone Systems
- Data Retrieval Systems
- Workflow Systems
- Remote Monitoring Systems



Middleware is a term most commonly used for software that enables communication and management of data in distributed application

Middleware – Alarm Solutions

- An increasing number of MEDICAL DEVICES are designed to exchange information electronically with other equipment, including other MEDICAL DEVICES
- Such information is frequently exchanged through an information technology network (IT-NETWORK) that also transfers data of a more general nature
- ALARM SIGNALS are frequently used to indicate unsatisfactory physiological PATIENT states, unsatisfactory functional states of the MEDICAL DEVICE or other parts of the DISTRIBUTED ALARM SYSTEMS, or to warn the OPERATOR of HAZARDS to the PATIENT or OPERATOR
- These ALARM SIGNALS are often transmitted across the MEDICAL IT-NETWORK, creating a DISTRIBUTED ALARM SYSTEM

IEC Working Group

Middleware: Alarm Solution Issues

- DISTRIBUTED ALARM SYSTEMS provide great benefits
- However, as with any technology, certain RISKS are introduced that can affect the 3 KEY PROPERTIES:
 - SAFETY
 - EFFECTIVENESS
 - DATA AND SYSTEMS SECURITY
- The FDA and other regulatory groups are looking at these systems to better understand their use and impact

IEC Working Group

Middleware: Manage the Risk

- There are risks in using the IT infrastructure to communicate alarms to clinicians
- A responsible organization can analyze the risks and weigh them against the benefits that come with using distributed alarm systems
- Talk with your equipment provider

Components of an Ancillary Alarm Notification System

Ramya Krishnan, MS

Senior Project Engineer, Health Devices Group

ECRI Institute

ECRI Institute

ECRI Institute, a nonprofit organization, dedicates itself to bringing the discipline of applied science research in healthcare to uncover the best approaches to improving patient care. As pioneers in this science for more than 40 years, ECRI Institute marries experience and independence with the objectivity of evidence-based research.

More than 5,000 healthcare organizations worldwide rely on ECRI Institute's expertise in patient safety improvement, risk and quality management, healthcare processes, devices, procedures, and drug technology. ECRI Institute is one of only a handful of organizations designated as both an Evidence-based Practice Center by the U.S. Agency for Healthcare Research and Quality and listed as a federal Patient Safety Organization by the U.S. Department of Health and Human Services.

For more information, visit www.ecri.org.

Introduction

- Four major tenets of an alarm management effort
 - Culture
 - Infrastructure
 - Practices
 - Technology
- Where do technologies that facilitate notification fit in?

Alarm Notification

- Primary notification – Medical devices
 - Bedside monitors
 - Central stations
 - Ventilators
 - Bed-exit
- Ancillary notification
 - Pagers
 - Phones
 - Remote displays

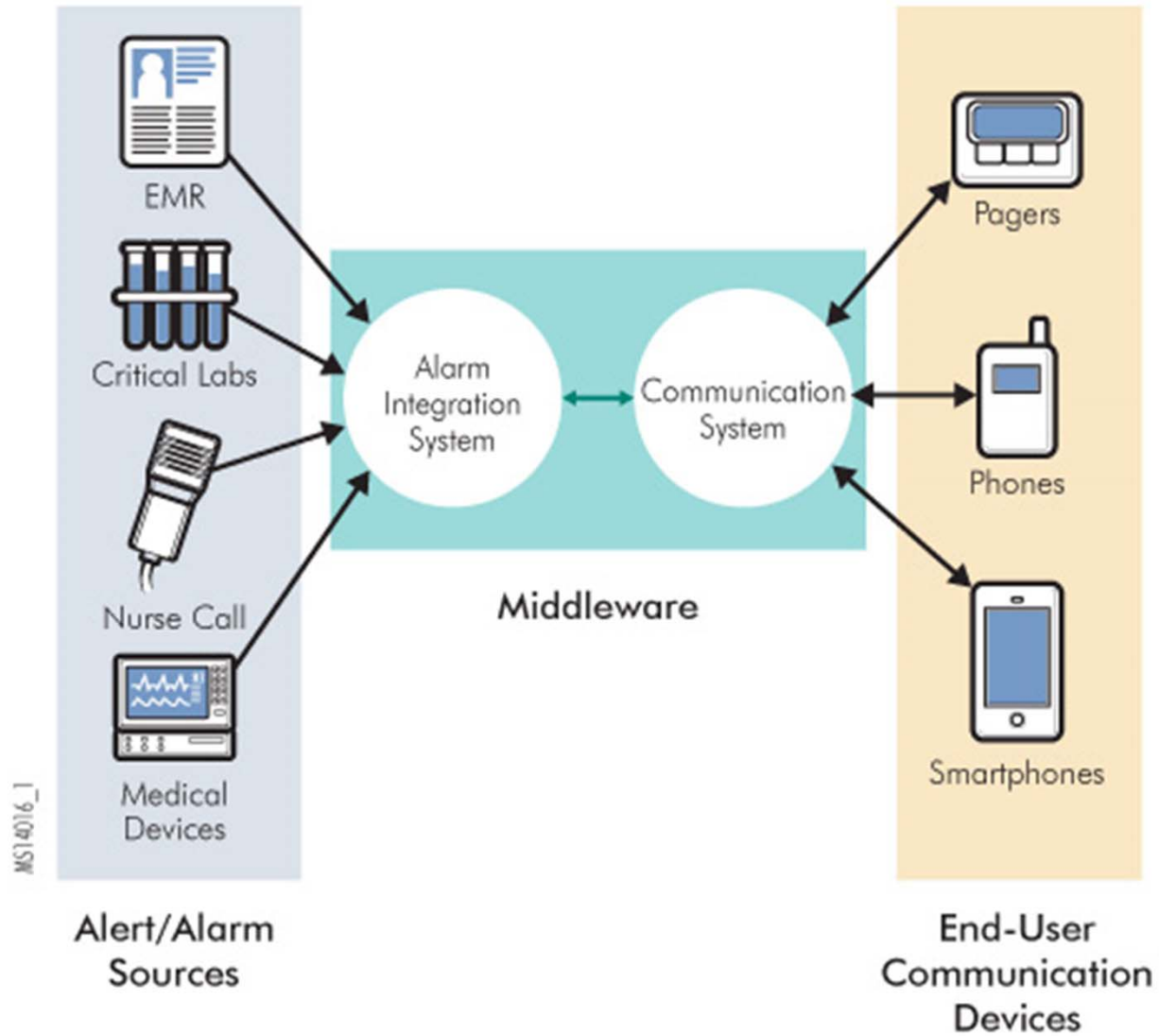
Ancillary Alarm Notification

- Notification models
 - Depends on the individual hospital and care-unit needs
- Technology used can vary depending on the approach chosen
 - War-room vs. on-the-floor notification
 - Displays vs. end-user communication devices
 - Single source vs. multiple sources

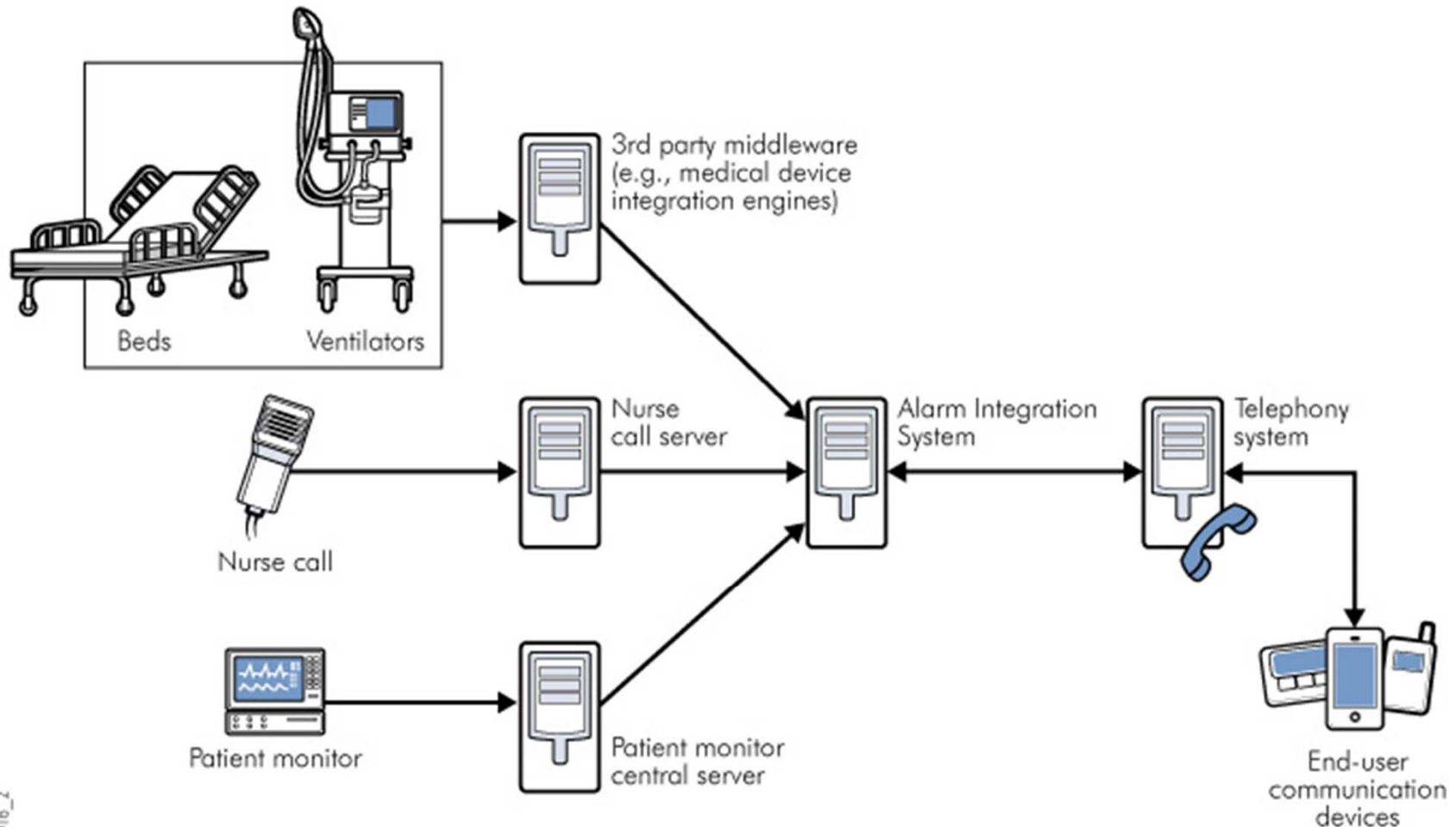
Alarm Integration Systems

- Middleware that facilitates
 - Direct notification of caregiver,
 - To relevant alerts from multiple sources,
 - Via end-user communication devices
- Goal is to get relevant alerts to the appropriate caregiver in a timely fashion to make clinical decisions.

Basic Alarm Integration



Medical Device Alarm Integration



MS14016_2

Key Features

- The key features of an alarm integration system are:
 - **Prioritization**
 - **Escalation**
 - **Reporting**

Prioritization

- Prioritization of all alarms communicated through the middleware
- Multiple levels
 - Medical device
 - Middleware
 - End-user device
- Accurate mapping of priorities

Escalation

- Ensure back-up coverage via escalation schemes
 - When to escalate and to whom
- Need to consider all failure scenarios
 - Caregiver busy with another patient
 - Caregiver on a break
 - Caregiver interrupted in the process of responding to the patient
- Delays built into an escalation scheme depend on priority of alert

Reporting

- Alarm load
 - Care-unit specific
 - Device specific
 - Priority specific
- Audit trails
 - Delivery times
 - Response times

Communication System

- What is its role?
 - Controls distribution and display of alerts on the end-user communication devices
- How does it fit in with the alarm notification system?
 - Integrated API
 - Separate interface

Implementation Factors

- Alarm management
 - Selection and prioritization of appropriate alarms to communicate
- Developing escalation schemes
- Managing assignments
 - Nurse to communication device
 - Nurse to patient
 - Patient to device

Implementation Factors

- Communication devices
 - Wireless coverage
 - Display clarity
 - Battery life
 - Queuing/logging capacity
 - Clinician communication capabilities

System Differentiators

- Communication system interface
- End-user devices supported
- Medical devices supported
- Display of waveforms
- Connection to information systems
- Facilitation of clinical communications

Bottom Line

- Ancillary alarm notification systems have the potential to be an important aspect of effective alarm management
 - Implementation requires an effective alarm management process in place to identify and transmit actionable alarms
- Effective implementation of the system is critical
 - Inefficient implementation can aggravate alarm issues

Conducting a Needs Assessment

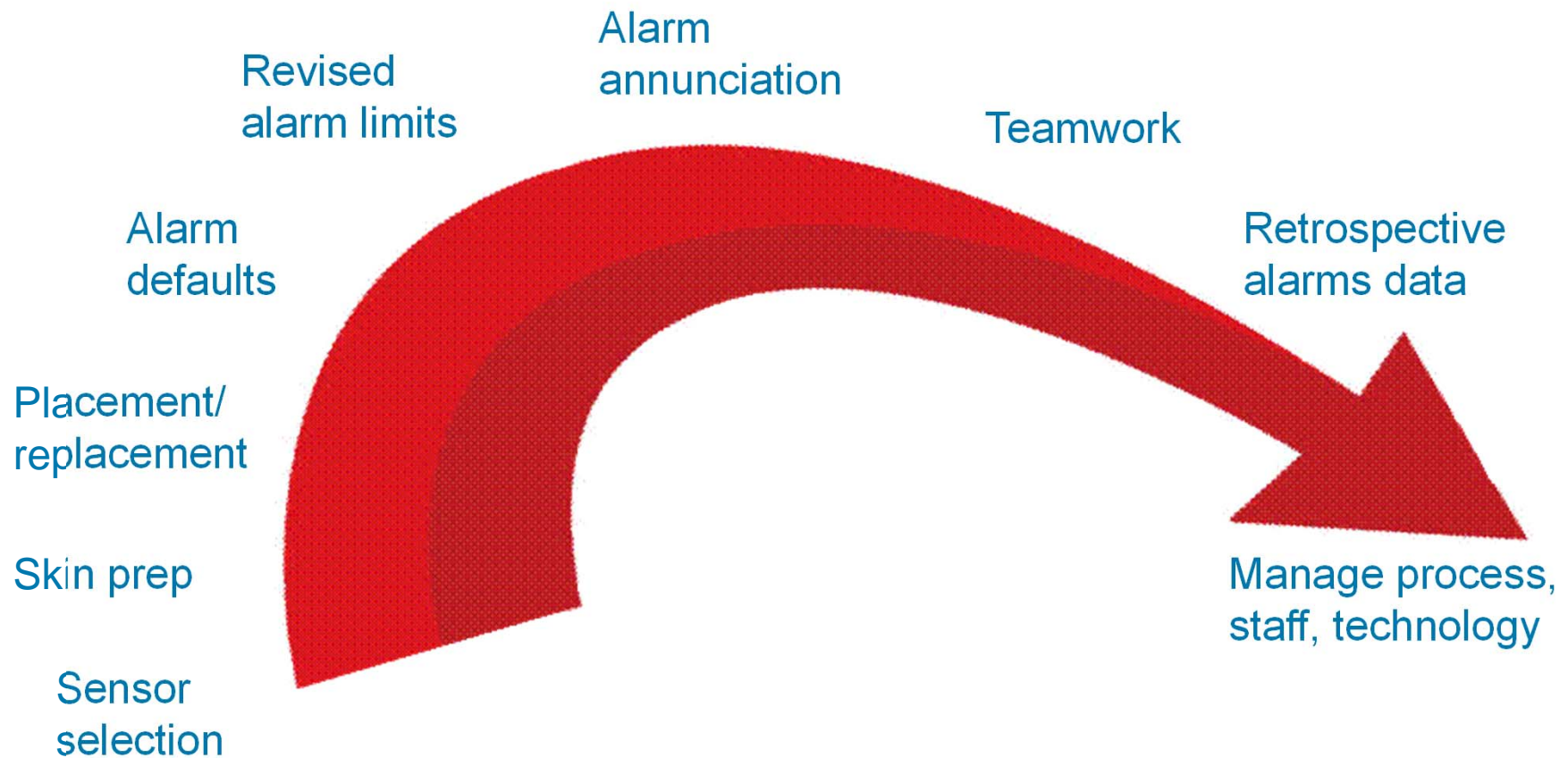
Tim Gee, BA

Principal

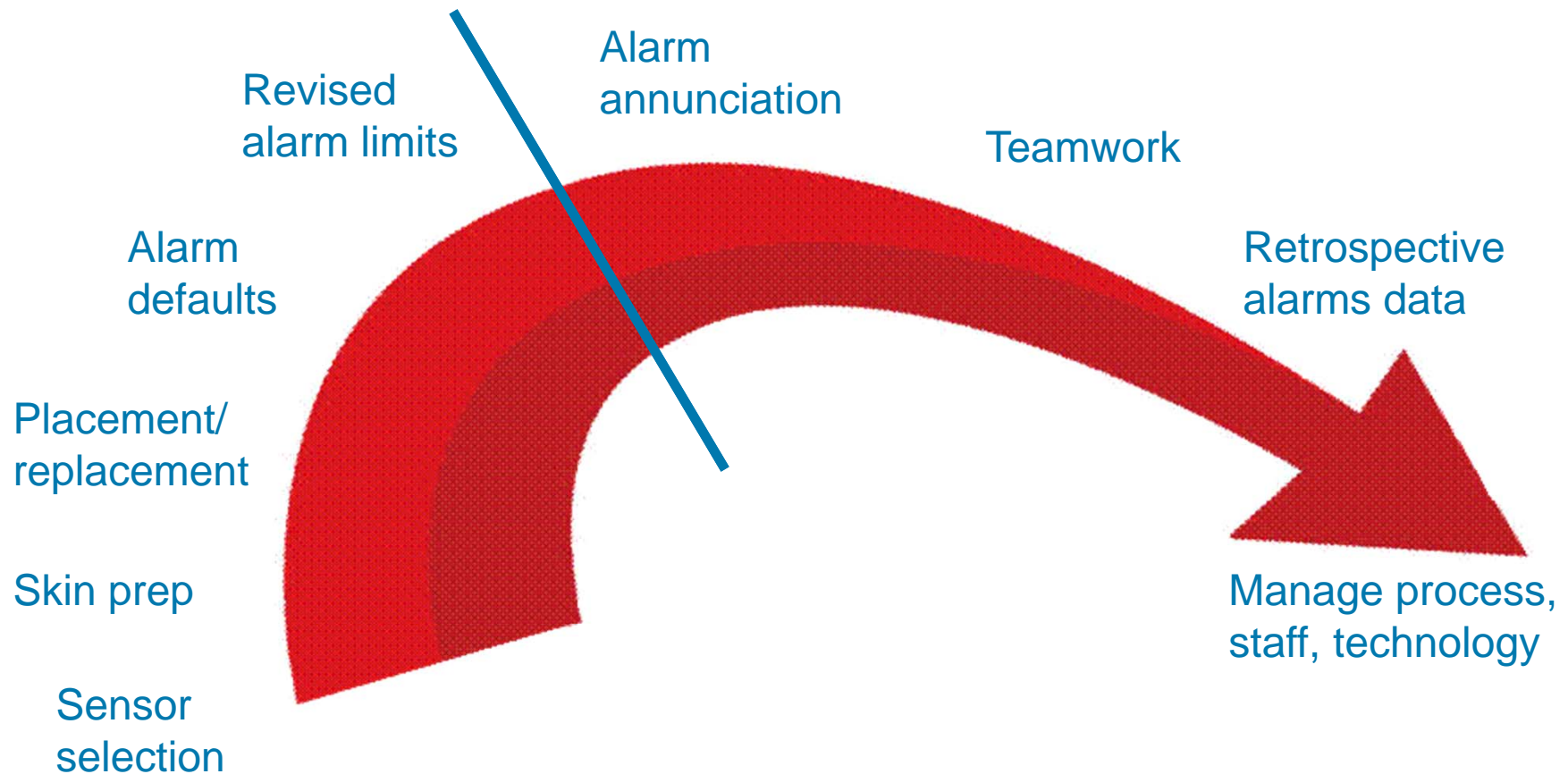
Medical Connectivity Consulting

www.medicalconnectivity.com

Alarm Notification Continuum



Alarm Notification Continuum



Organizing the Continuum

- Create reliable actionable alarms
- Effective communications and resolution of alarms
- Operational data reporting and analysis

Organizing the Continuum

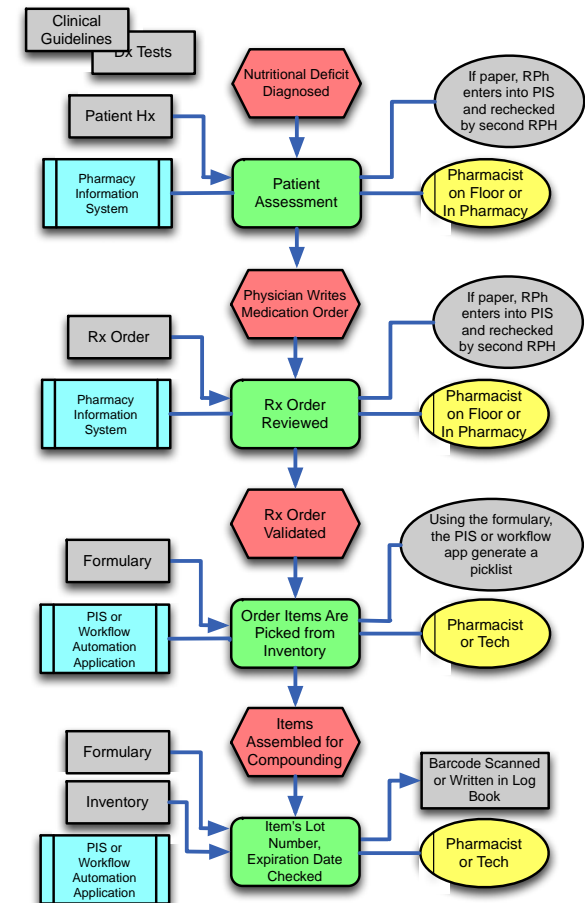
- ~~Create reliable actionable alarms*~~
- Effective communications and resolution of alarms
- Operational data reporting and analysis

Alarm Notification Challenges

- Limited experience – for most this is only the first or second such purchase
- Multi dimensional – multiple stakeholders, technologies and systems of systems
- Workflow implications are not self-evident
- How many alarms are generated, what kind?
- Are they different in different units?
- How are you going to measure improvement?

Needs Assessment Tactics

- Understand and *document in detail* your current environment
- Existing technologies, products, and systems
- Workflows associated with alarm notification and response

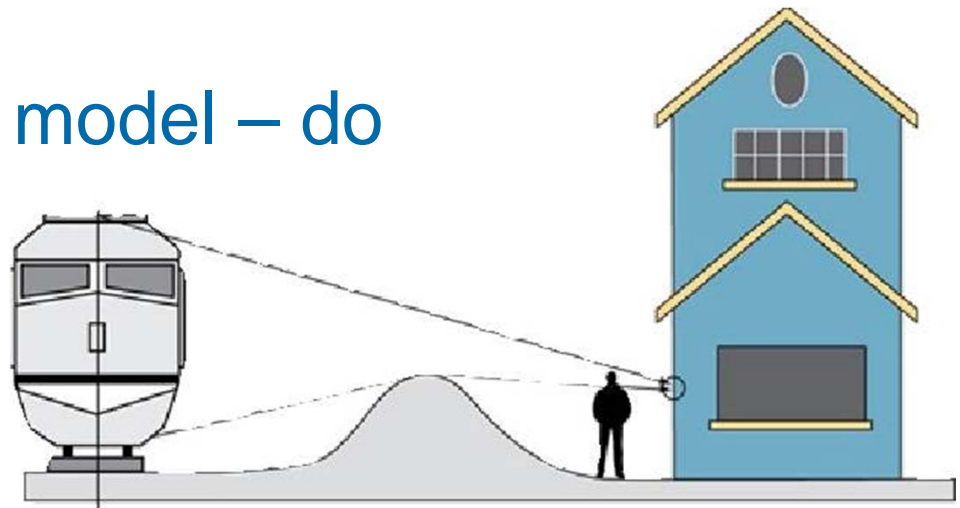


Assessment Considerations

- Physical layout and design of unit
- Conventional extensions of the medical device
- Alarm notification systems
- Systems integration requirements
- Survey of existing infrastructure

Physical Layout and Design

- Patient locations, staff flows, and work/storage areas
- Acoustic treatment – existing or proposed
- Is layout consistent with practical acoustic treatments?
- Source/path/receiver model – do practical paths exist?



Conventional Extensions

- Surveillance – duplicate remote central stations
- Alarm annunciation
 - Message panels
 - Dome lights
 - Remote speakers
- Staff flow and work areas



Alarm Notification Systems

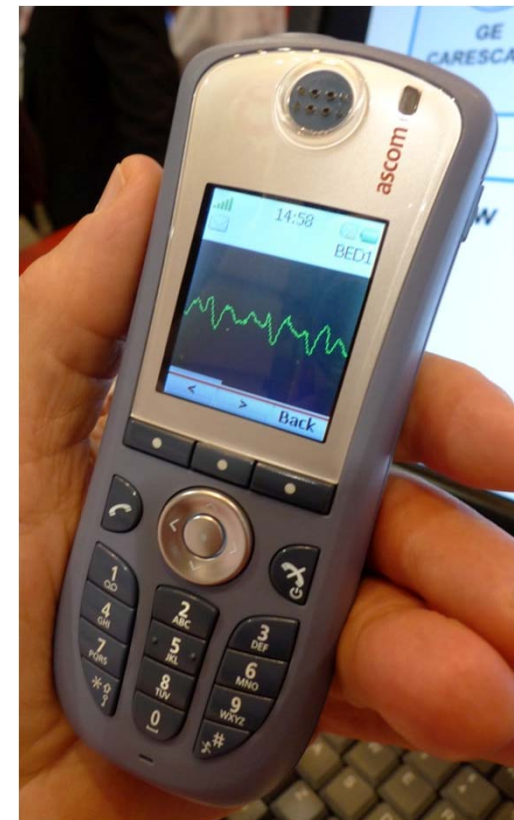
- Nurse-to-patient assignments
- Shift change and report
- Alarm workflow, especially high volumes of alarms
- Ability to reduce transient nuisance alarms with “time stand-offs”

Systems Integration Issues

- Interfaces to medical devices generating alarms
- Integration with ADT and other HIT to automate workflow
- Nurse-to-patient assignments integration

Existing Infrastructure

- Confirm Wi-Fi coverage and performance
 - Quality of Service settings
 - Number of wireless devices, bandwidth
 - Requires site survey prior to go-live
- Mobile device to receive alarms
 - User interface supporting workflow
 - Alarm content – alphanumeric, waveforms
 - Management of mobile devices



Case Study

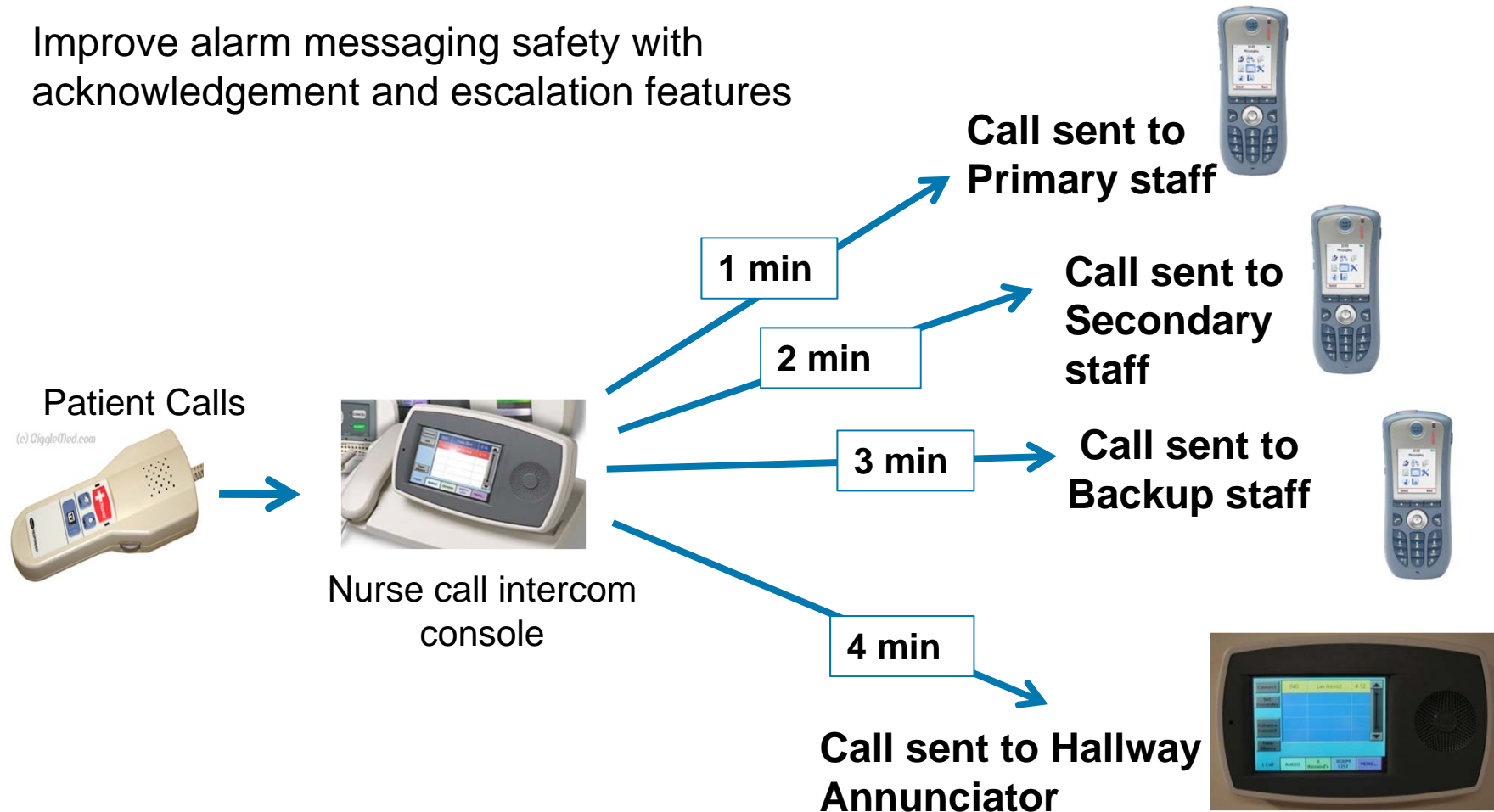
Andrew Currie, MS
Director of Clinical Engineering
Johns Hopkins Hospital

Why Middleware?

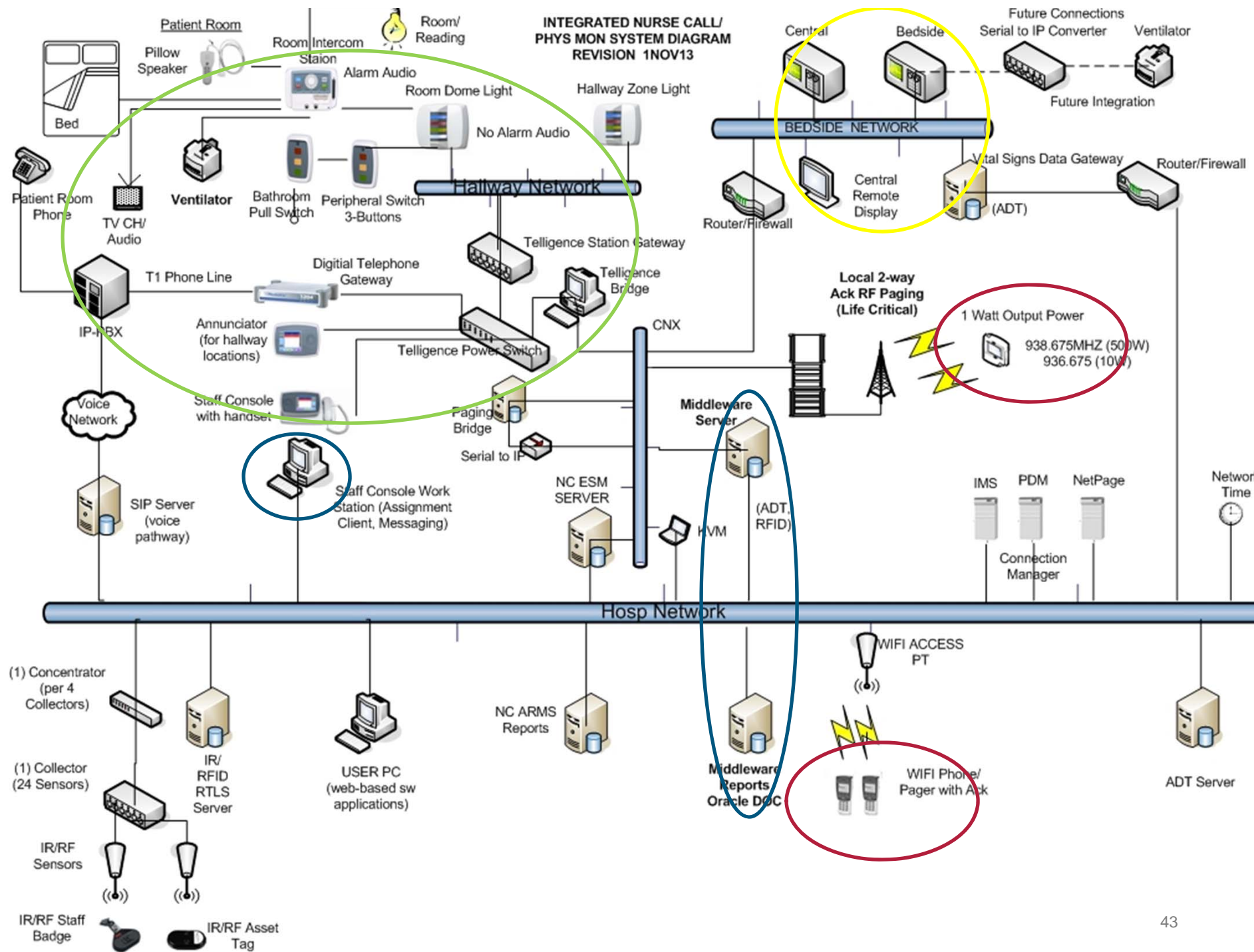
- Improve alarm messaging
- Reduce noise from nurse call and physiologic monitoring systems
- Single program for staff assignment needs
- Utilize messaging and mobile devices to improve workflow efficiency
- Capture alarm data

Why Middleware?

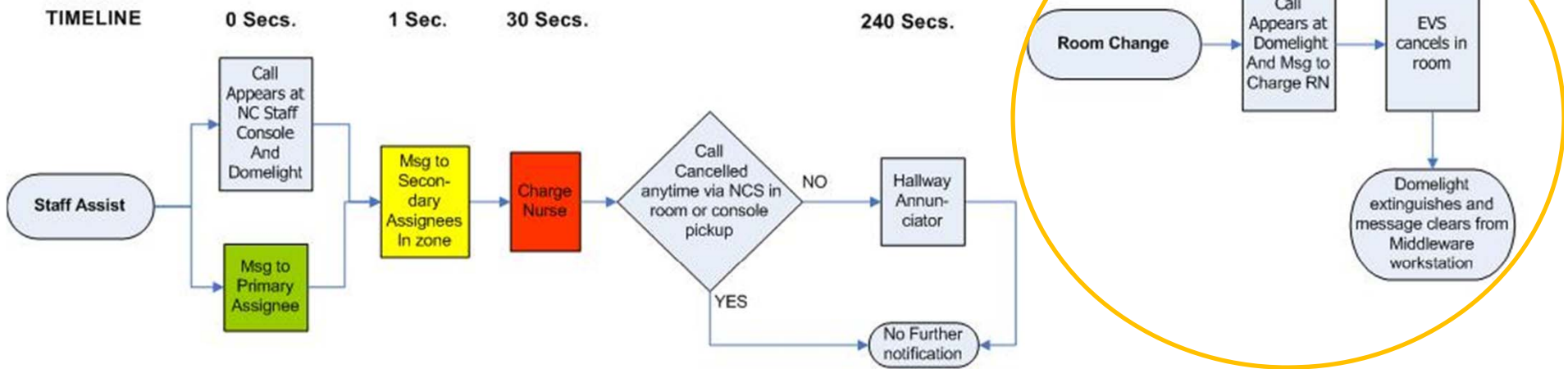
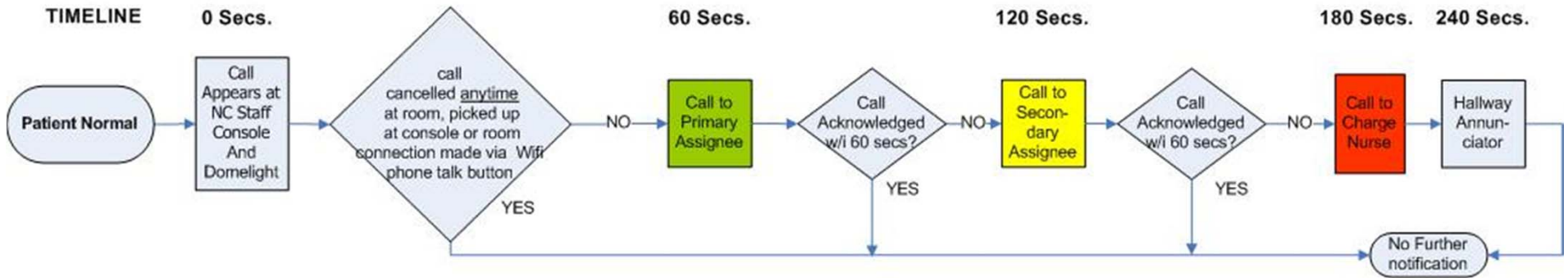
Improve alarm messaging safety with acknowledgement and escalation features



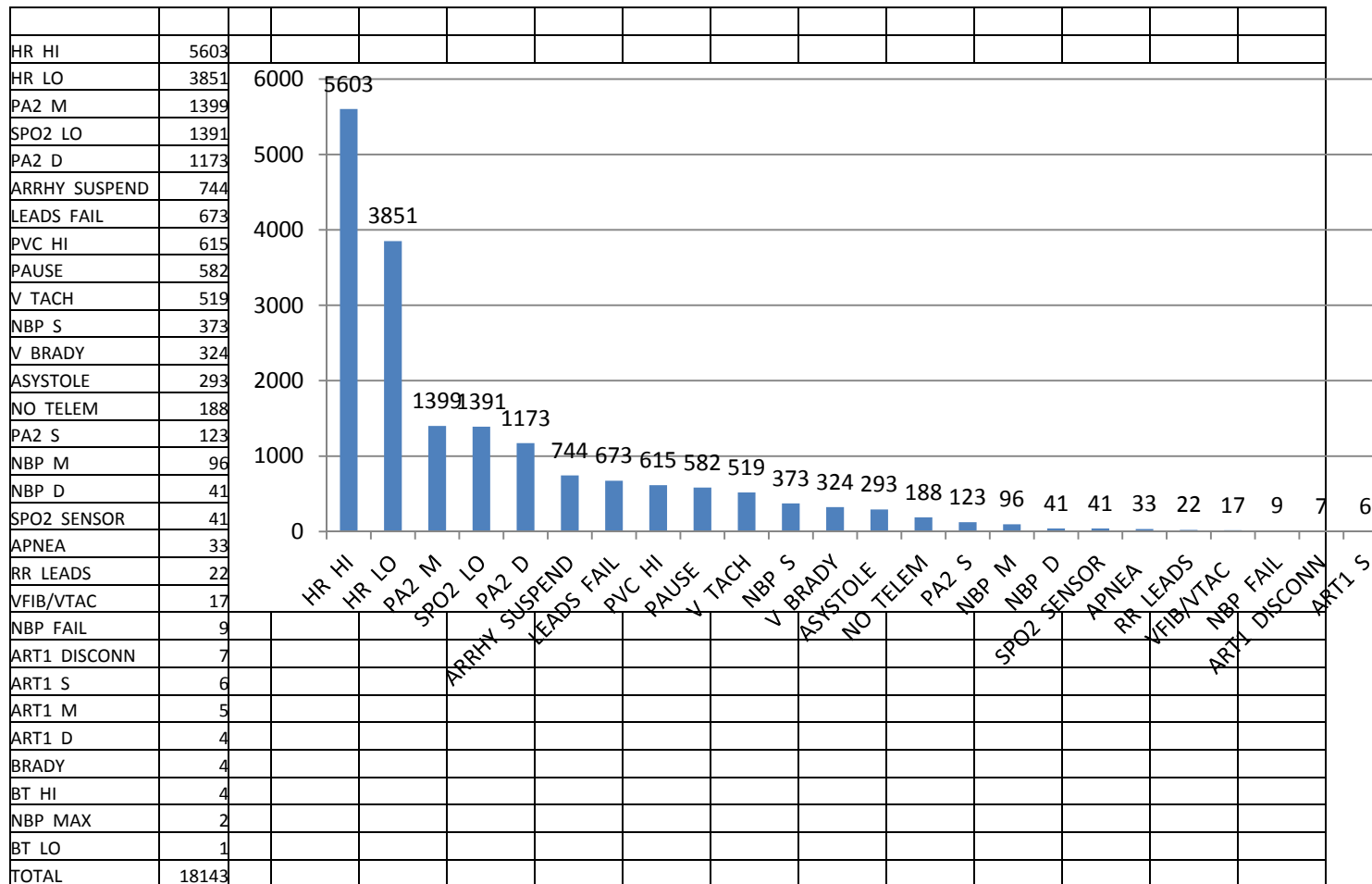
**INTEGRATED NURSE CALL/
PHYS MON SYSTEM DIAGRAM
REVISION 1NOV13**



Delay and Escalation Scheme Using Middleware for Nurse Call System (NCS) VERSION 6 9/28/11



Alarm Data for Clinical Area



Additional Benefits of Middleware

- Consolidated alarm data that supports QI projects
- Customized messaging workflows for staff efficiency
- Adverse event investigations with time/day stamped events
- Documentation for alarm management program
- Test signals and automatic notification of system failures

Closing Reminders

Thank you for your time and attention!

Mark Your Calendars!

Best Practices for Alarm Management - Kaiser
Permanente, Children's National Medical Center,
and Johns Hopkins Hospital
Wednesday, March 5, 2014

1:00-2:00 pm Eastern

www.aami.org/htsi/events.html

Continuing Nursing Education 1.0 contact hour

For those desiring CNE, please visit the link below
for the test, evaluation form, and certificate:

<http://www.aacn.org/DM/CETests/Overview.aspx?TestID=1041&mid=2864&ItemID=1033&menu=CETests>

The American Association of Critical-Care Nurses (AACN) is accredited as a provider of continuing nursing education by the American Nurses Credentialing Center's Commission on Accreditation.

Evaluation Form and Certificate of Attendance (Non-CNE)

Please let us know how we did!

<http://aami.confedge.com/ap/survey/s.cfm?s=Middleware>

After you fill out the evaluation form and enter your email address, you will receive an electronic certificate by email