No Cause for Alarm:
A Holistic Approach to Identification, Prioritization, and Reduction

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Objectives

- Identify performance improvement opportunities to decrease non-actionable alarms
  - Discuss how to capture, analyze, and utilize data
  - Differentiate actionable versus non-actionable alarm signals using an evidence-based approach
  - Describe the components of a successful alarm management strategy through improvements in clinical care and operational effectiveness

Presentation Outline

- Alarm Overview
- Georgia Regents Initiative
- Initial Data Collection & Analysis
- Georgia Regents Changes & Process
- Post Change Data Results
- Next Steps

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Alarm Fatigue: The Healthcare Worker Perspective

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Staff Feedback

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Alarm Fatigue: The Patient Perspective

"The nurse told me it wasn't anything important and I could just silence it any time it went off. What if I hit the wrong button or did it for the wrong thing?"

"They said it didn't mean anything. Then why is it going off?"

"The alarms go off and on all the time and nobody seems to notice or to care."

"I waited and waited, but nobody came in to see what the alarm was for. It eventually went off on its own."

"When my mom was in the ICU, it seemed like alarms were going non-stop."

These are representative comments from patients and family members in discussing the need for improved noise and alarm management.

Photos courtesy of Lisa Pahl

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Causes of Alarm Fatigue

- Units have high noise levels and numerous alarms
  - Monitors
  - Infusion pumps
  - Call bells
  - Phones
  - Bed alarms
  - Ventilator alarms
  - Etc.,
- Alarm limits are not tailored to patients
- Poor skin prep and electrode placement
- Lack of preventive maintenance/troubleshooting
- Lack of “trust” in the system

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Alarm Management Must be a Priority

- Alarms cause stress for healthcare professionals
  - Sound levels of 80 decibels common in clinical units
  - Alarm fatigue results in depression and reduced productivity in nursing staff
  - More than 50% of nursing staff identify themselves as affected by alarm fatigue

- Alarms cause stress for patients and interrupt sleep
  - This may delay recovery, extend length of stay, and result in worse long term function

- Most alarm signals are NOT actionable
  - 50-80% according to published literature

Actionable Alarm Signals

- Require clinical intervention or some type of action
  - Life threatening, immediate response or action required
  - Change in patient status, requires action to reverse or prevent further deterioration
  - Requires action to prevent harm
  - Requires action to correct a technical problem to assure proper patient monitoring (e.g., leads off, SpO2 sensor disconnected)

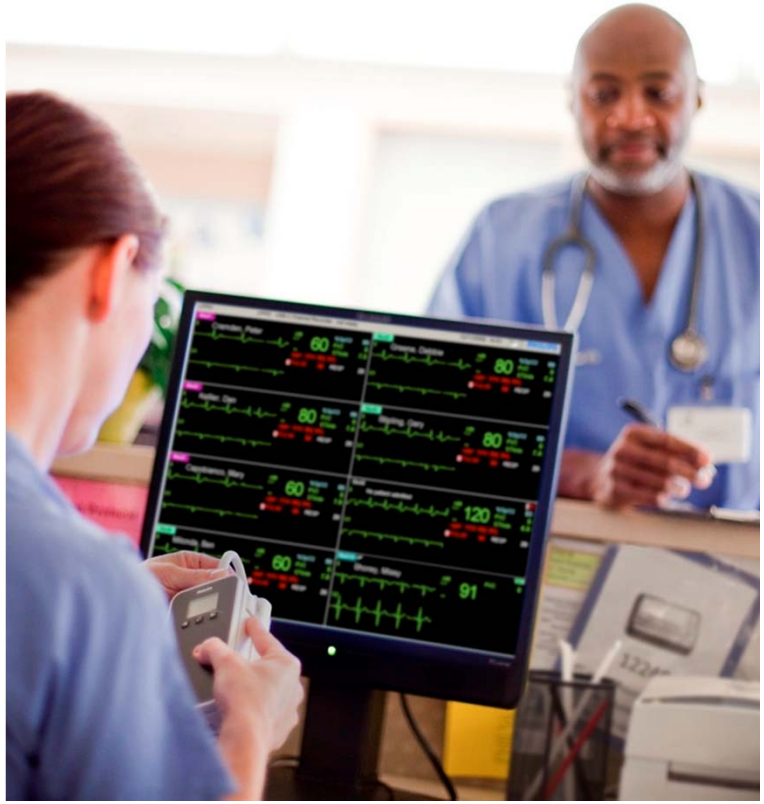
Non-actionable Alarm Signals

- Do not require a clinical intervention or action
  - Short duration, self correcting (e.g., SpO2 alarm signal)
  - Intentional (e.g., suctioning or positioning/moving a patient)
  - Triggered due to tight limits rather than actionable ones
  - False alarm
    - System itself incorrectly identifies an alarm condition
    - Something interferes with system causing it to detect an alarm, e.g., artifact or low voltage triggered asystole

Alarm Management Strategy And Goals

Use a comprehensive, multi-faceted approach to incorporate experts and best practices

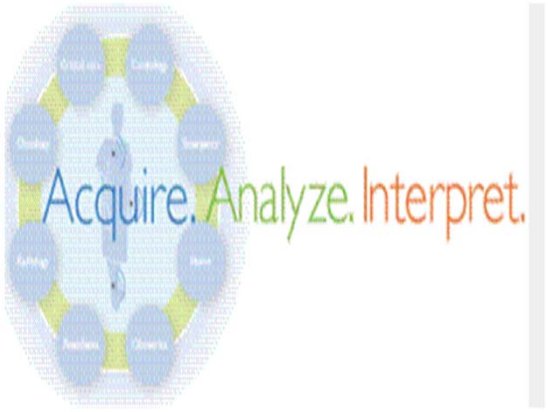
- Reduce non-actionable alarms and alarm fatigue
- Ensure staff accountability and responsiveness to alarms
- Enhance patient care, patient safety, and patient experience
- Create a quieter, more healing environment
- Evaluate and optimize technology
- Improve productivity and work flow
- Increase patient and staff satisfaction
- Promote and model a culture of safety
- Enhance patient and family trust
- Align/meet TJC NPSG on Alarm Management



Alarm Management Current State Assessment

A comprehensive, holistic approach to provide sustainable solutions

CULTURE



People

Processes

Technology

DATA ANALYSIS

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Children's Hospital of Georgia
GEORGIA REGENTS HEALTH SYSTEM

Georgia Regents Health System
Academic Health Center in Augusta, Georgia

- 478 bed Georgia Regents Medical Center
- 154 bed Children's Hospital of Georgia including the region's only Level IV NICU
- Critical Care Center, housing a regional Level I Trauma Center

- **GR Health ⇔ Philips formed a 15 year business alliance in 2014**

Response to TJC National Patient Safety Goal

GRHealth System Leadership chartered a multidisciplinary

Clinical Alarm Management Work Group

Phase I (beginning January 2014):

Identify the most important alarm signals to manage based on the following

1. Input from the medical staff and clinical departments
2. Risk to patients due to lack of response or malfunction
3. Specific alarms that are not needed or simply contribute to noise/fatigue
4. Potential for patient harm based on internal incident history
5. Published best practices and guidelines

GRU Clinical Alarm Management Work Group

- Pascha Schafer, MD (Co-Chair, CCU)
- Ruth Wilson (Co-Chair, NICU)
- Sue Ellen Abney-Roberts (OB)
- Jennifer Anderson (RT)
- Stephanie Bowden (NICU)
- Jackie Bryant (Pharm)
- Kelley Connelly (Phillips)
- LeeAn Courtney (ED)
- Aleasha Couture (MICU)
- Kevin Dellsperger, MD (CMO)
- Julie Dey (4S/Dialysis)
- Steven Duckworth (IT)
- Leslie Edney (Perioperative)
- Theresa Ehntholt (PICU)
- Judith Gast (QM)
- Kristy Hardin (MICU)
- Colleen Hirschkorn (Phillips)
- Jody Hodges (Biomed)
- Michele Hoehn (CHOG/Surg)
- Latasha Holmes (Nursing Informatics)
- Sandra Klein (Perioperative)
- Brad Landrum (IT)
- Anni Mathews (PICU)
- Trent McGlynn (Phillips)
- Diana Minks (Phillips)
- Gloria Moxley (Perioperative)
- Steve Whitney (SICU/Card)
- Jill Williams (3W)
- Gloria Wright (CHOG 4/5)

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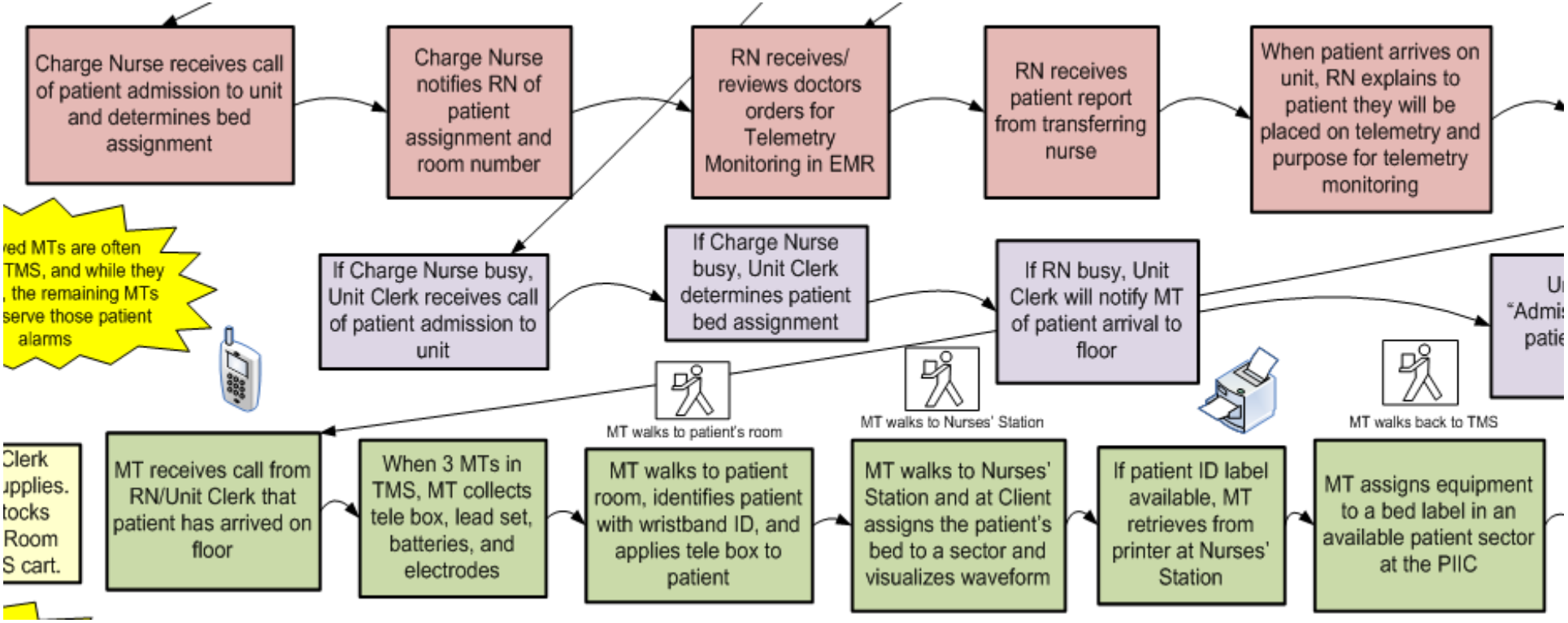
Monitoring Process Mapping

Many sources of non-actionable alarms exist due to monitoring process complexity



One piece of an extensive process mapping

Unit Clinical Alarm Inventory*

Y or N	Clinical Equipment Alarms	Typical usage: 1=Constantly 2= Regularly 3=Infrequently	Centrally Monitored Y or N	Priority A=Highest; could result in death if unattended B=High priority; may lead to unintended consequence if unattended C= Low priority; little risk if unattended	Is adequate level of oversight typically available? Y or N	Comments
	Telemetry monitors					
	IV Infusion pump					
	Syringe pump					
	Ventilator					
	CPAP/BIPAP					
	Pacemaker (transcutaneous)*					
	IABP					
	Blood/fluid Warmer					
	Fetal monitor					
	Infant Radiant Warmer					
	ET CO2 (refer to Ventilators)					
	High flow O2 (Refer to Ventilators)					
	Oxygen Analyzer					
	Pulse oximeter (free standing)					
	Dialysis - CVVHD					
	Dialysis - PD Cycler					
	Transport monitor					
	Transport Vents (direct)					
	Defib (Transport Monitor)					
	ICP					
	CVP					
	Heart Rate					
	Respiration Rate					
	Pulse Ox (refer to above for continu.)					
	CORE Temp.					
	Arrhythmia					
	Bed Alarm-Fall prevention					
	Chair Alarm-Fall prevention					
	PCA pumps					
	Hyperthermia blanket					
	Hypothermia blanket					
	Isolette					
	Nurse Call					
	Humidifier					
	Feeding pump					
	SCD machine					
	Wound VAC					
	Free standing VS machine					
	Pneumatic tubes					
	Med Gas					
	Bed lock					
	Cooling Pumps					
	Home Apnea monitors/ PCG Monitors**					
	Transport Isolette*					
	Water Treatment					
	Video EEG					

*Association for the Advancement of Medical Instrumentation (AAMI) website

Unit Clinical Alarm Inventory*

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	IV Infusion pump					
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	Defib (Transport Monitor)					
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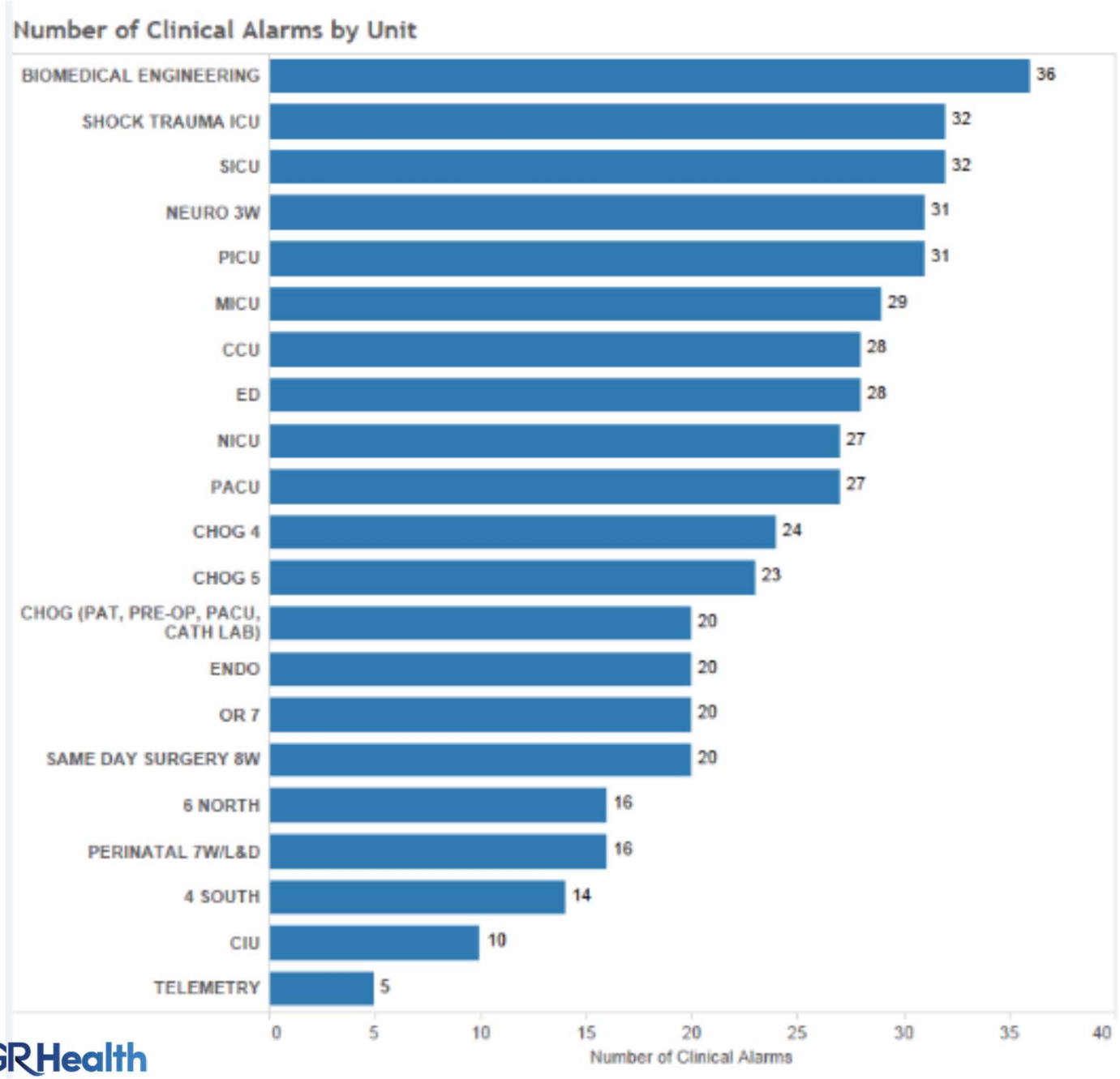

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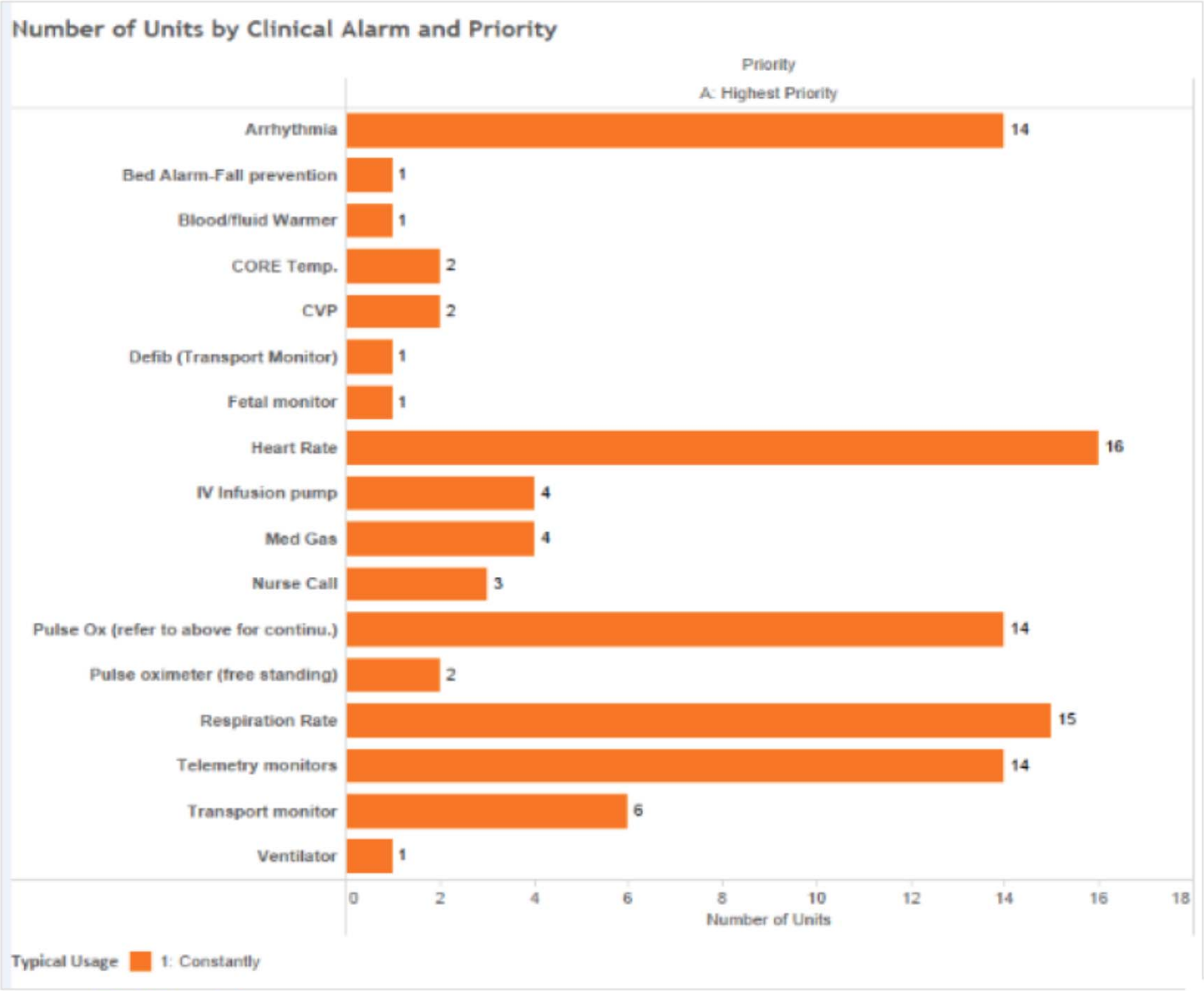
Number of Units by Clinical Alarm and Priority
Priority
A: Highest Priority
Arrhythmia
14
Bed Alarm-Fall prevention
1
Blood/fluid Warmer
1
CORE Temp.
2
CVP
2
Defib (Transport Monitor)
1
Fetal monitor
1
Heart Rate
16
IV Infusion pump
4
Med Gas
4
Nurse Call
3
Pulse Ox (refer to above for continu.)
14
Pulse oximeter (free standing)
2
Respiration Rate
15
Telemetry monitors
14
Transport monitor
6
Ventilator
1
0
2
4
6
8
10
12
14
16
18
Number of Units
Typical Usage
1: Constantly

Additional CAMW Action: Phase I

- Reviewed published best practices
- Attempted internal incident history review

- Identified highest priority alarms
  - Adult telemetry/arrhythmia (GRMC)
  - Pediatric pulse oximetry (CHOG)

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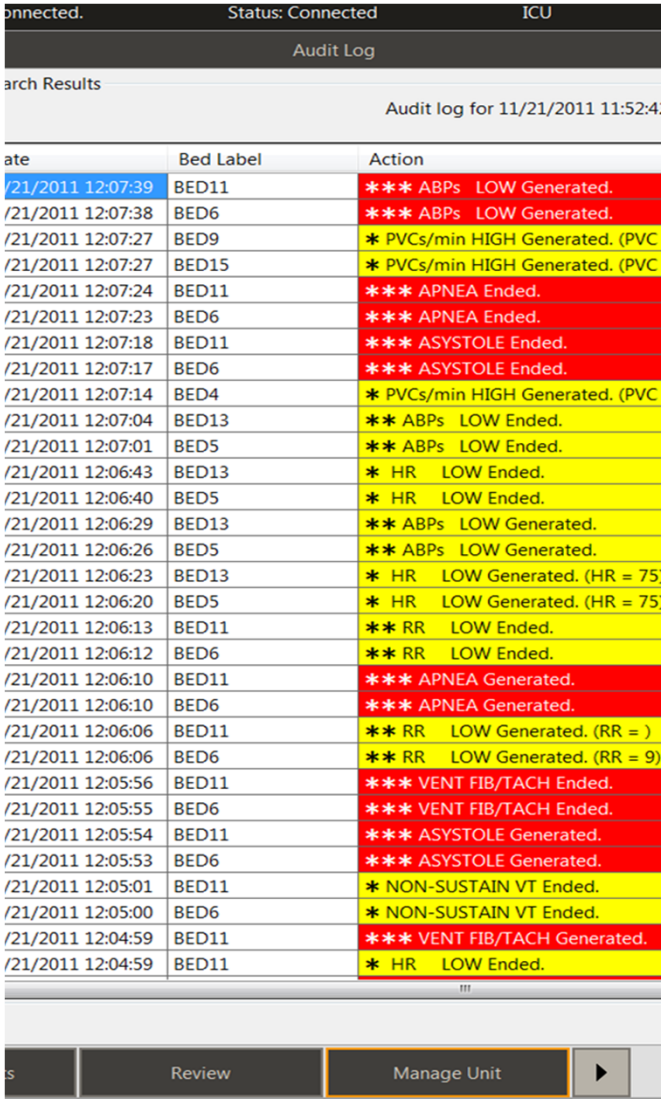
Data Collection Modalities

PIIC iX (Central Station)

- Audit log is incorporated into the product
- Can review alarm data directly at any time
- Can export data onto a thumb drive or obtain remotely
- Data is available for any PIIC iX device attached to the server
- Includes data for selected Inop alarms
- Can download up to 90 days of alarm data

IntelliSpace Alarm Reporting (IAR) Tool

- SW on a separate PC that pulls data from either the PIIC or the PIIC iX
- Can collect data from either the PIIC or the PIIC iX
- Can export data onto a thumb drive or obtain remotely
- Provides data on all monitoring alarms, including all inop/technical alarm signals
- Expanded storage capabilities of up to 15 months of alarm data



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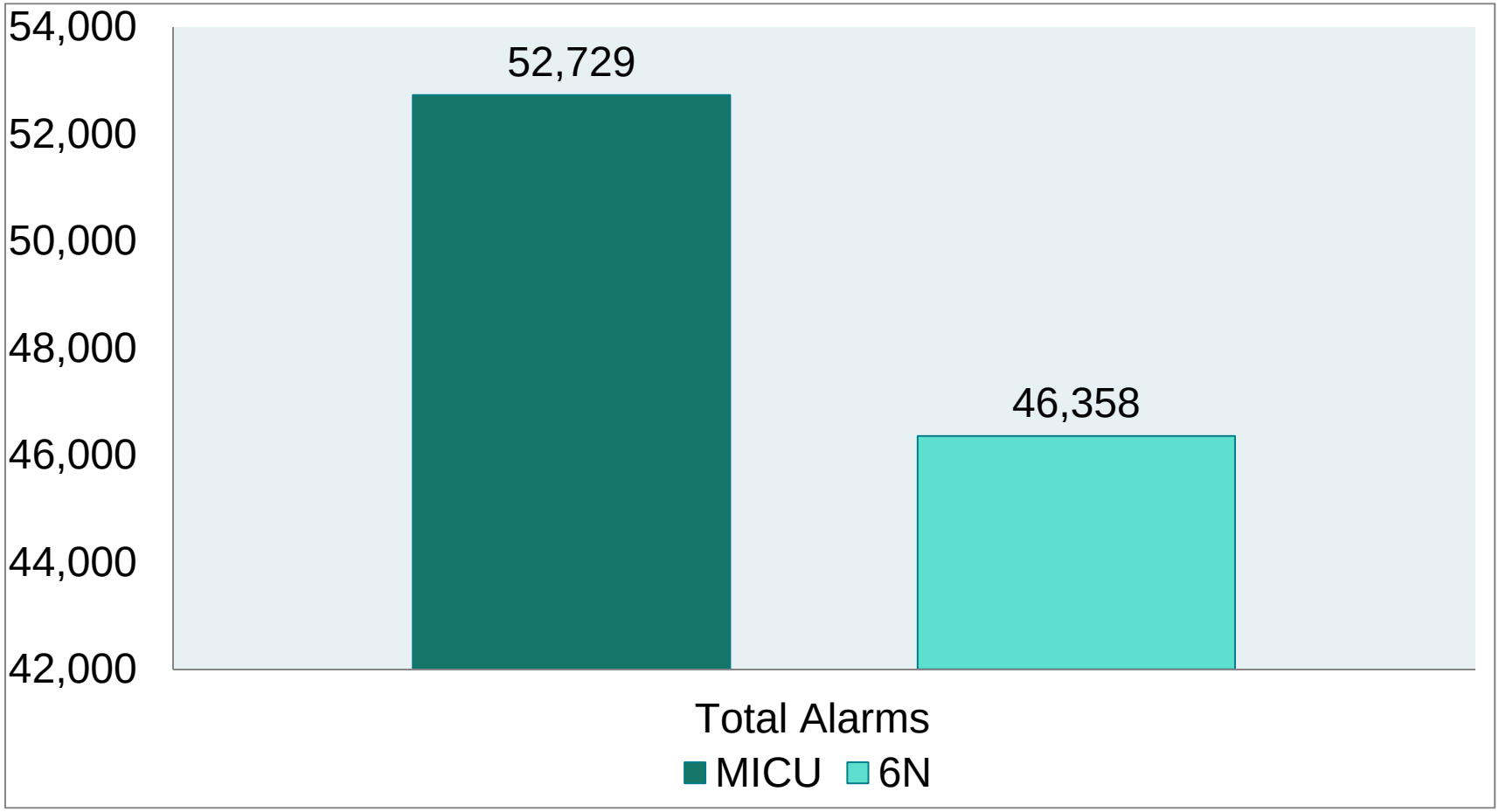
Initial Alarm Data For MICU and 6N (Telemetry)

Collected over a two week time period



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Broad Categories of Alarm Signals Captured

Assessing high, medium, and low priority occurrences

Red (High Priority) Arrhythmia Alarm Signals	Yellow (Medium Priority) Arrhythmia Alarm Signals	Red (High Priority) Bed/Parameter Alarm Signals	Yellow (Medium Priority) Bed/Parameter Alarm Signals	Inop/Technical Alarm Signals
•Asystole •Vfib/Tach •Vtach •Extreme Tachy •Extreme Brad	•PVC Alarms •Beat Detection Alarms •Rate/Rhythm Alarms •HR Limit Alarm	•SpO2 Desat •Apnea •Invasive Line Disconnect •Extreme Pressure Limit	•Low or High Limits for: •SpO2 •Resp •NBP •Invasive Pressure •Temp •QTc •CO2	•Leads Off •Replace Battery

Key Point

The list of alarms within each of the broader categories is not all inclusive. Data captured will vary depending on parameters monitored, age of devices, and whether PIIC iX or the IAR tool was utilized.

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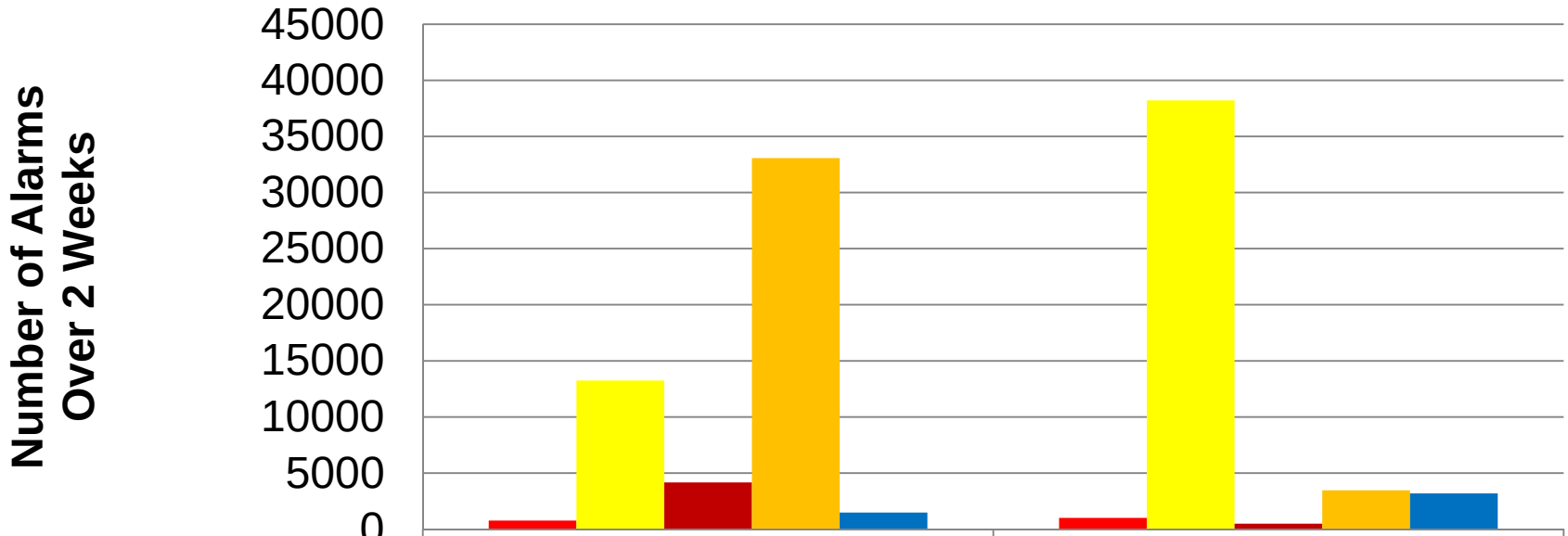
Initial Alarm Data For MICU & 6N

Alarms totals per category can help prioritize focus areas



	MICU	6N
Red Arrhythmia	764	1004
Yellow Arrhythmia	13252	38218
Red Parameter	4166	487
Yellow Parameter	33073	3457
Inop/Technical	1474	3192

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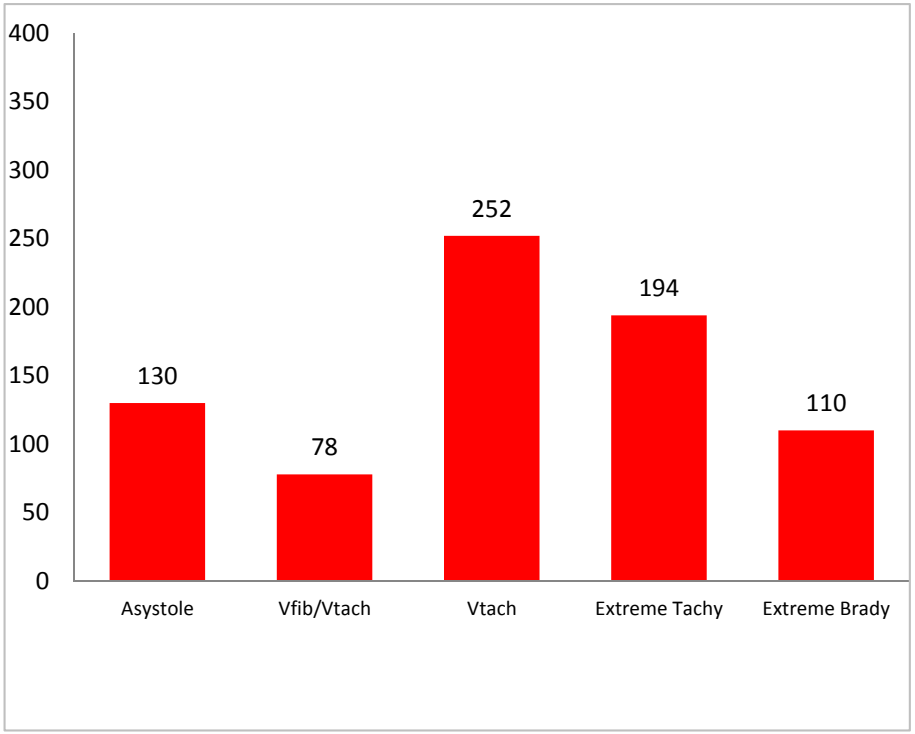
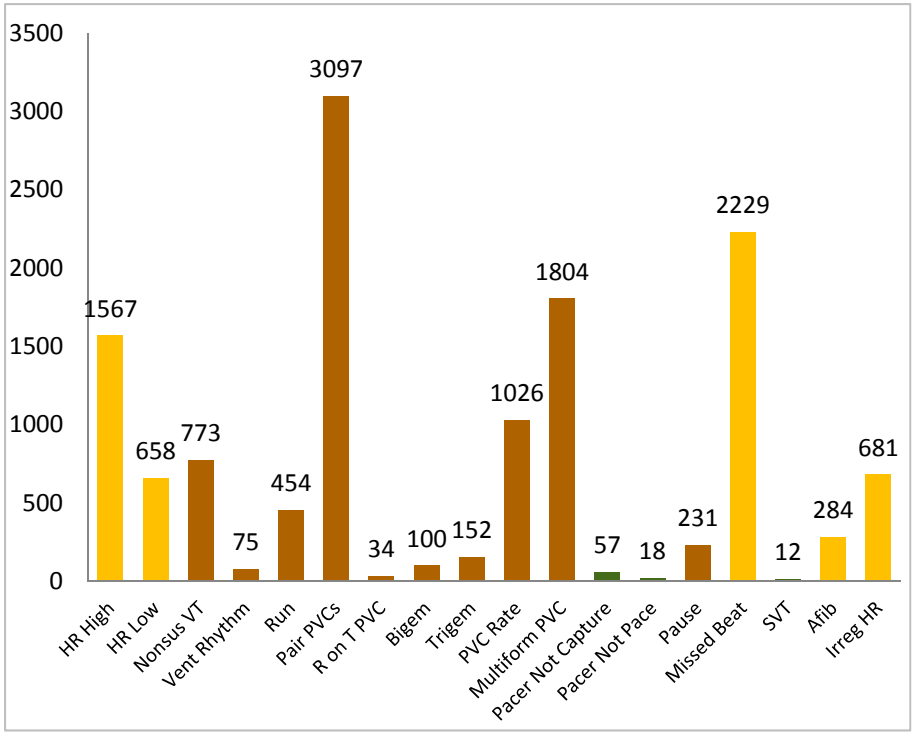
Alarm Data By Each Type Of Alarm: MICU

Can identify specific alarms to address

MICU Red Arrhythmia Alarm Totals



MICU Yellow Arrhythmia Alarm Totals



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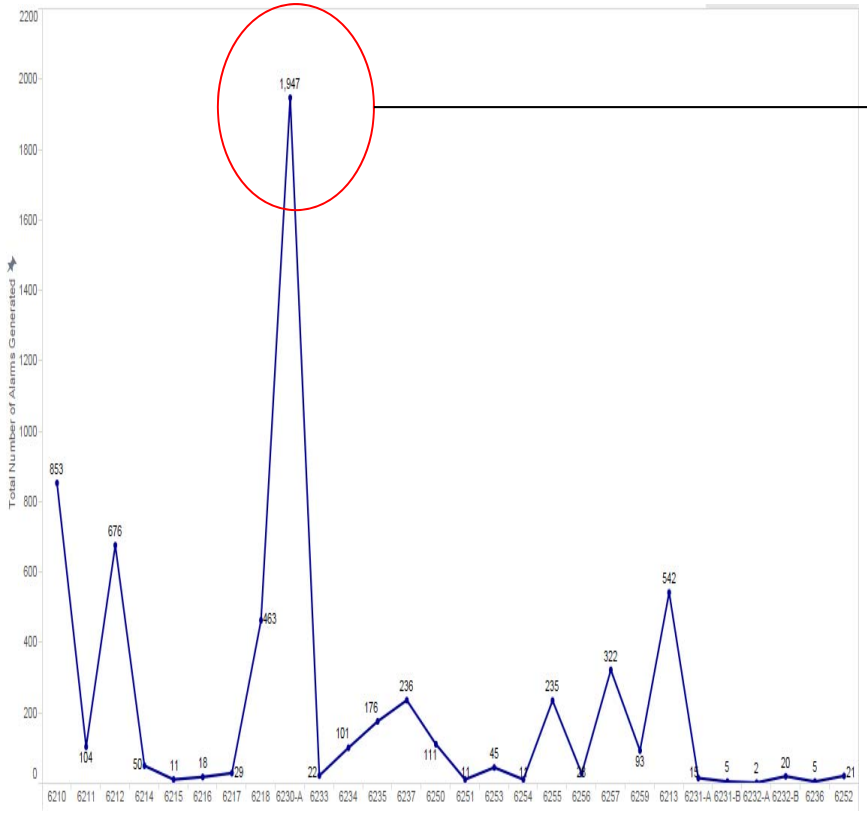
Alarms Per Patient: Patient Outliers?

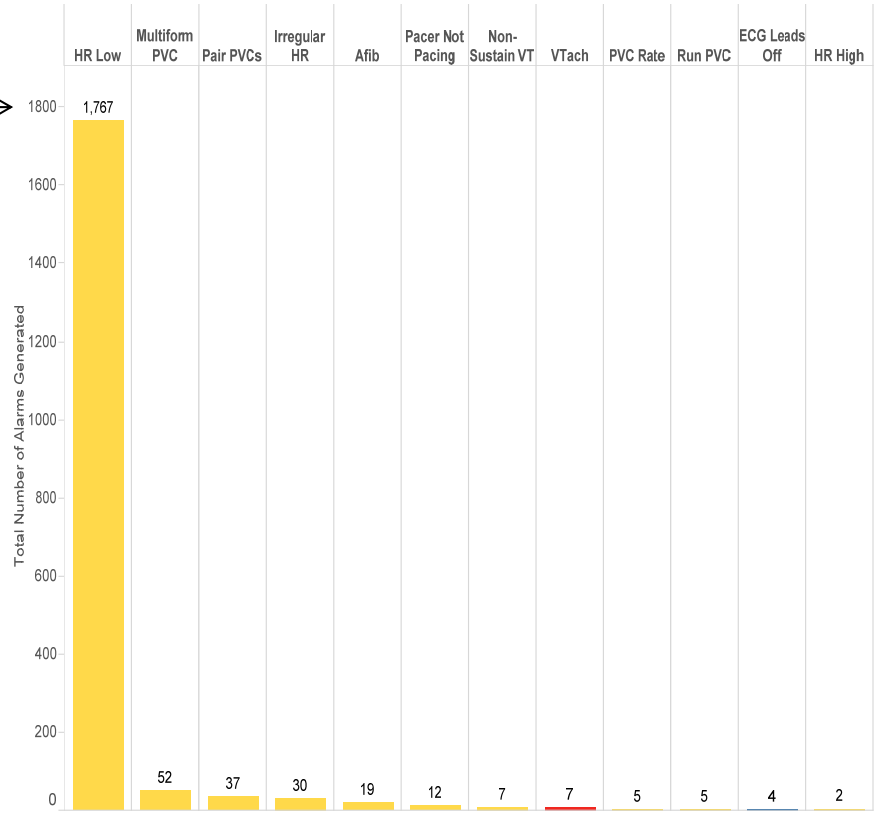
Deep dives can provide information on **process and customization**

Summary

A total of 1,947 alarms were generated by one patient and the majority of the alarms for Low Heart Rate. The low limit was set at 75. Except for 12 of the alarm signals, all of the alarms that occurred were triggered by heart rates between 70 and 74.

Total Alarm Signals Per Patient Bed Over 24 Hours





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Evaluating The Potential Impact Of Alarms

It is not just alarm fatigue for the nurses

One patient in an ICU had a total of
907 alarms
in a 24 hour time period

A disruption every 1.5 minutes for the nurse and for the patient!

Impacts patient care, patient and staff satisfaction and workflow

This does not include all of the other alarms going off in the patient room (i.e. ventilators, IV pumps, etc.)

CAMW Action: Phase II (by January 2016)

- Develop and implement specific components of policies and procedures that address
  - Clinically appropriate settings
  - When alarms can be disabled
  - When parameters can be changed
  - Who can set and change parameters and or set to “off”
  - Monitoring and response expectations
  - Checking individual alarm signals for accurate settings, proper operation and detectability
- Educate those in the organization about alarm system management for which they are responsible

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Baseline Data Collection

- Two week blocks in MICU and 6N
- Number of alarms indexed per patient per day

- Plan for serial interventions with follow up data collection (2 week blocks) to assess response to each individual intervention
  - Distributed in dashboard format
  - Successful interventions will go house-wide on rolling basis

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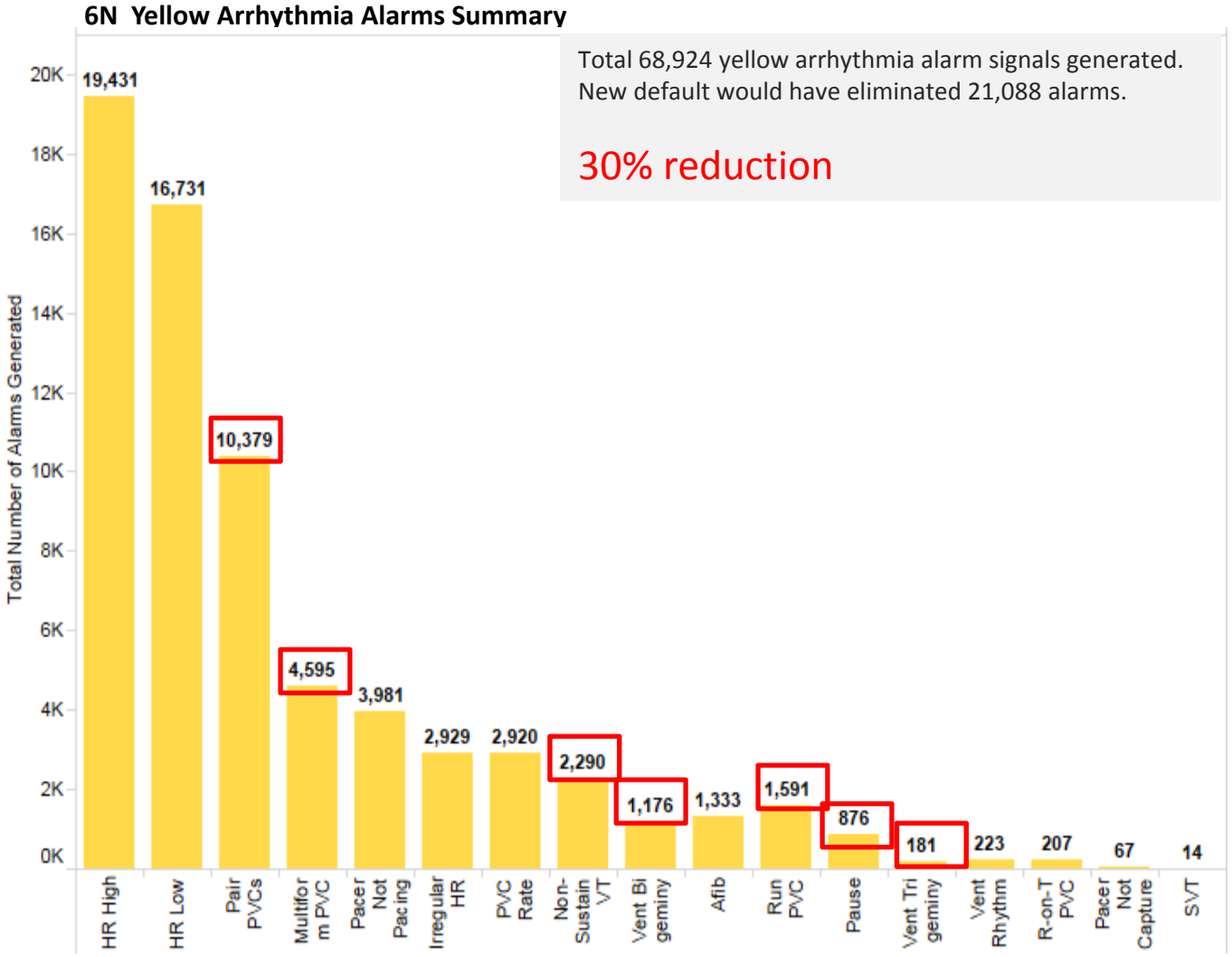
Intervention 1: Adjust Yellow Arrhythmia Defaults



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Alarm Management Communication Example

This was distributed and posted on the unit

The Following Changes Will Be Made On 6N

On February 19th we will initiate our first intervention to address the issue of Alarm Fatigue at our institution. The following alarms will be defaulted to OFF:

1. Non-sustained ventricular tachycardia (which only applies to 3 and 4 beat runs)
2. Run PVCs (redundant with #1)
3. Pair PVCs
4. Ventricular Bigeminy
5. Ventricular Trigeminy
6. Multiform PVCs
7. Pause (currently set greater than 2 seconds)

In addition, the red alarm default for asystole will be changed from 4 seconds to 3 seconds.

Notifications

The physicians have been notified by the physician Co-Chair that these changes are being made

The 6N nursing staff has been notified by the Nurse Manager that these changes are being made

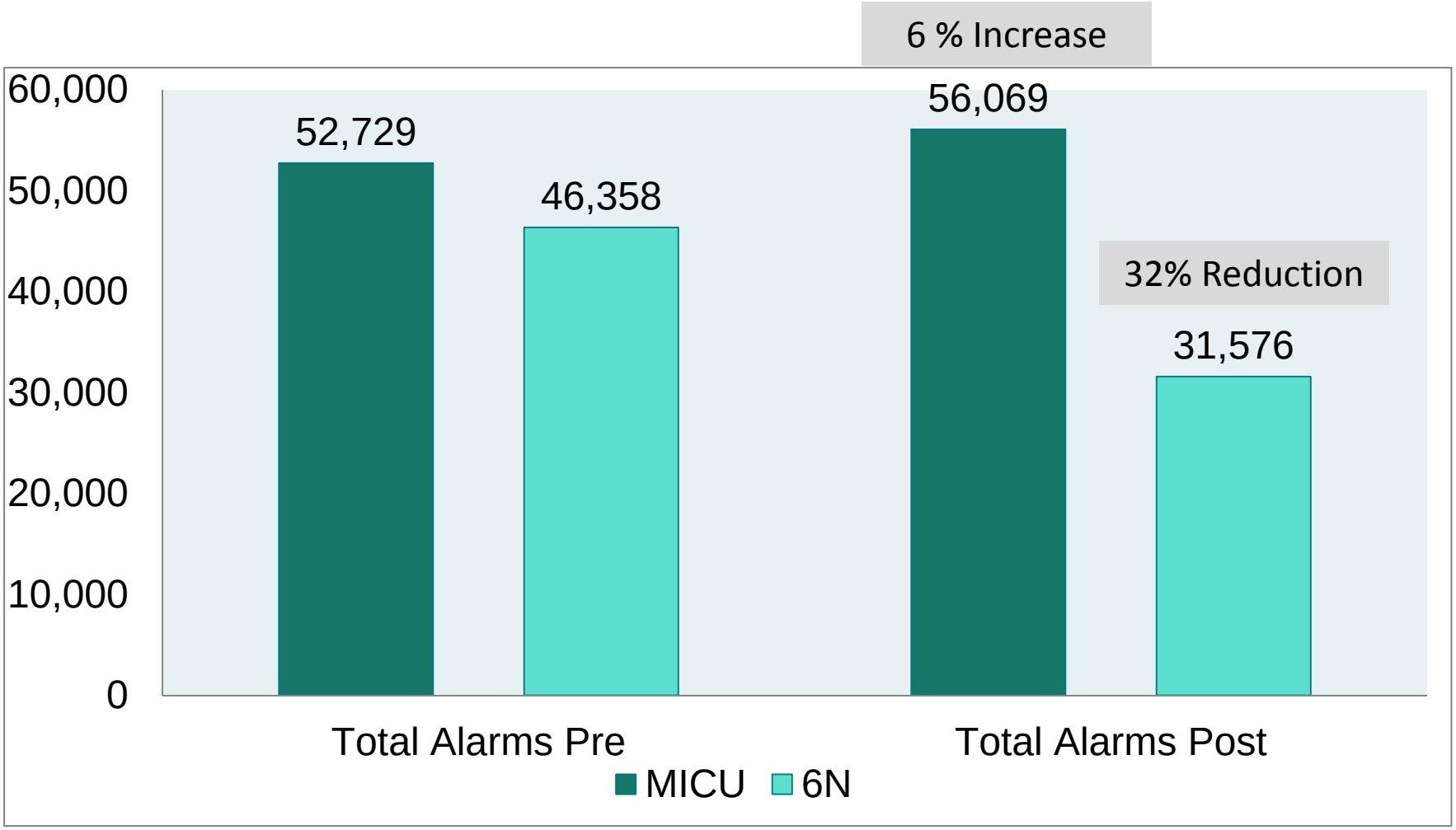
Assessing The Impact

- Alarm data was collected and analyzed for two weeks previously
- Alarm data will be collected and analyzed for two weeks following the configuration changes in order to evaluate the impact on the total number of alarms occurring

Expectations

- Any of the above alarms may be turned back on if deemed clinically appropriate, and the physicians and nurses may coordinate with the 6N alarm techs to do this
- The plan is to keep a close record of any possible negative outcomes related to these changes, including any near-misses, Rapid Response calls, or Code Blue events
- If you perceive any near miss events, please document and notify the Nurse Manager of 6N
- If you have any other questions or concerns, please contact your Nurse Manager

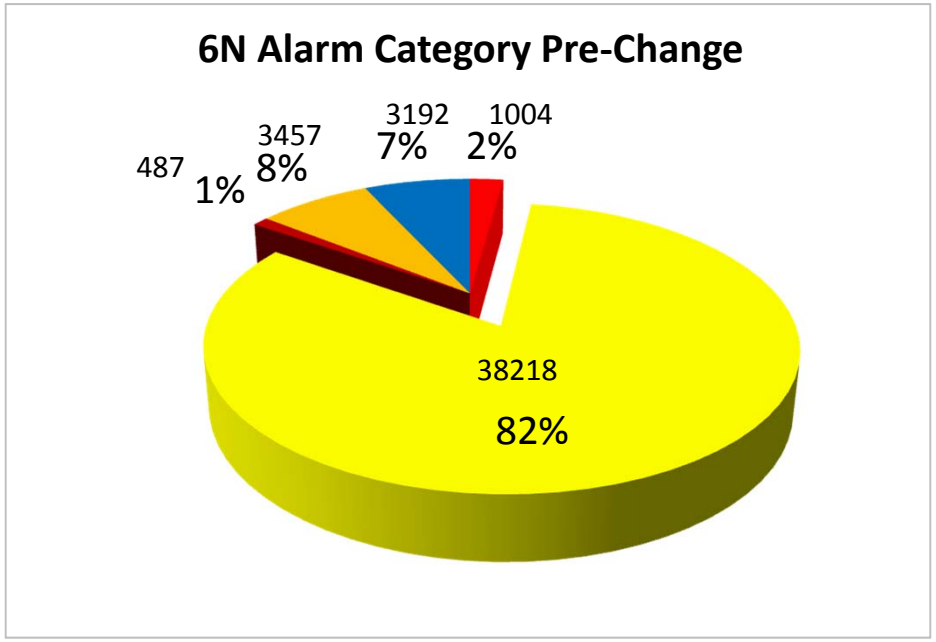
Post-Change Alarm Data Comparisons



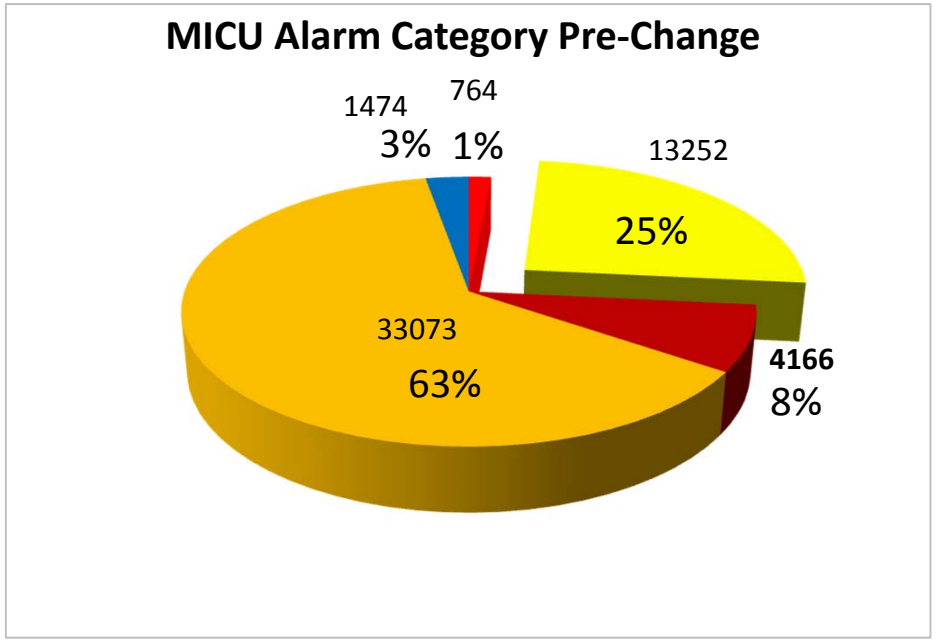
Pre-Change Data 6N & MICU: Category Variation

Expectation that adjusting yellow arrhythmia would have greatest impact on 6N

6N Total Alarms Per 2 Weeks: **46,358**



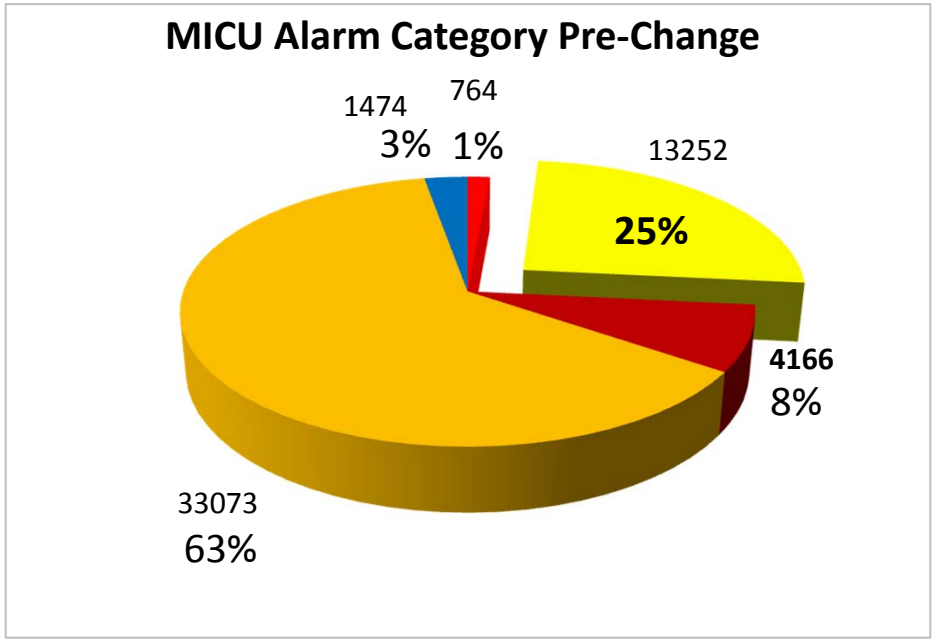
MICU Total Alarms Per 2 Weeks: **52,729**

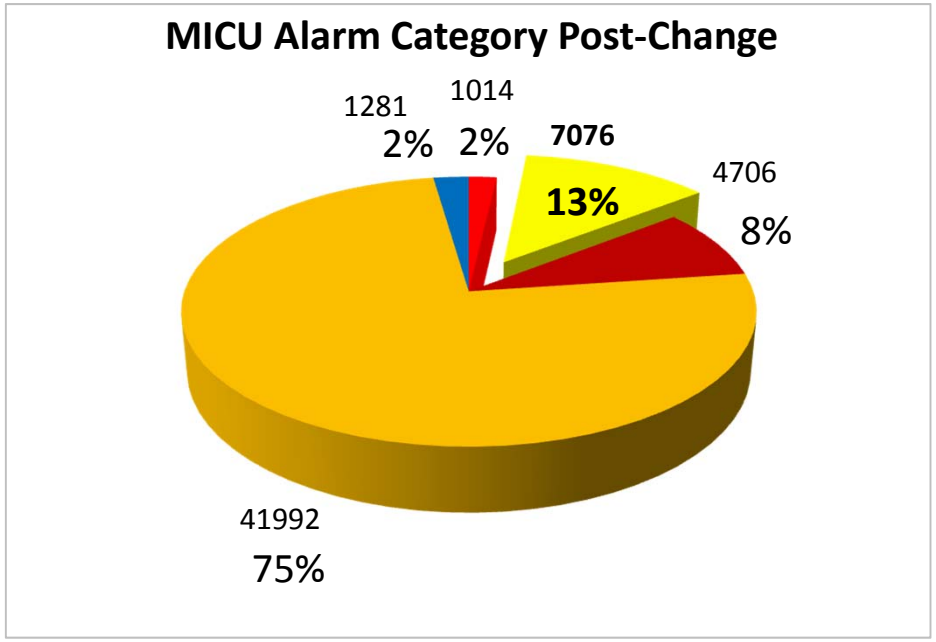


Red Arrhythmia
Yellow Arrhythmia
Inop/Technical
Red Parameter
Yellow Parameter

Assessing Pre and Post Change Data MICU

Yellow arrhythmia category only a small portion of MICU alarms





Red Arrhythmia
Yellow Arrhythmia
Red Parameter
Yellow Parameter
Inop/Technical

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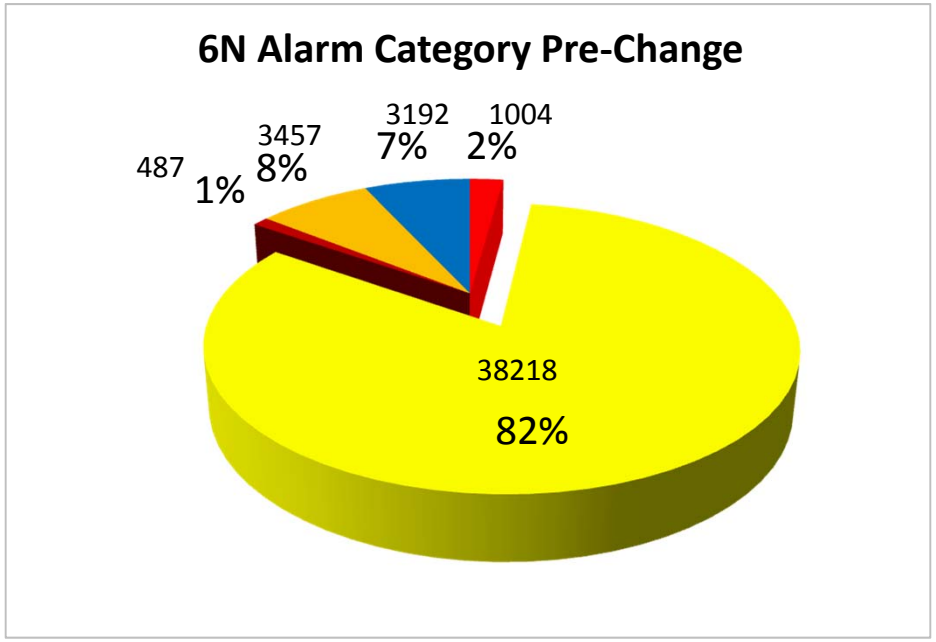
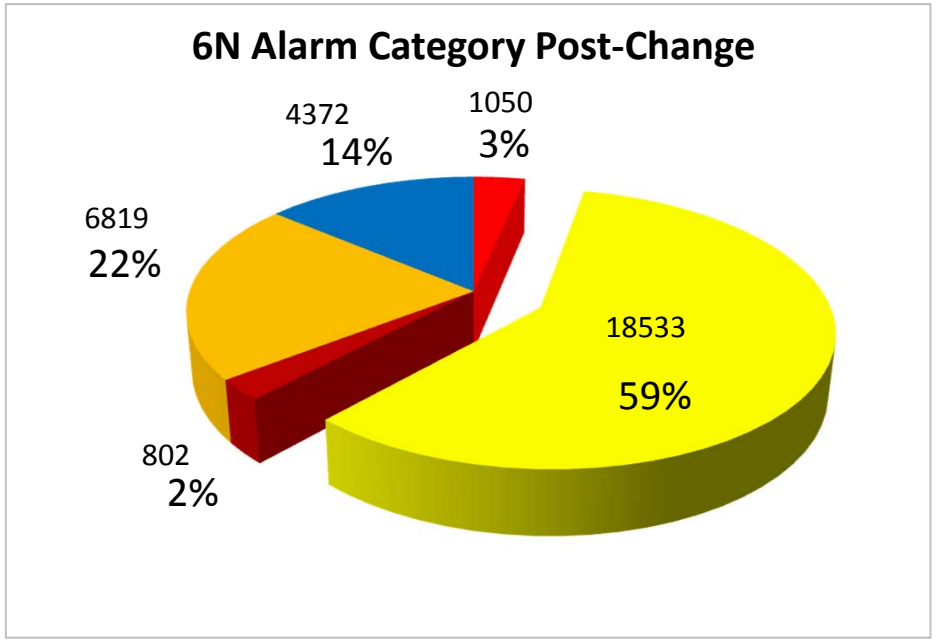
Assessing Pre and Post Change Data 6N

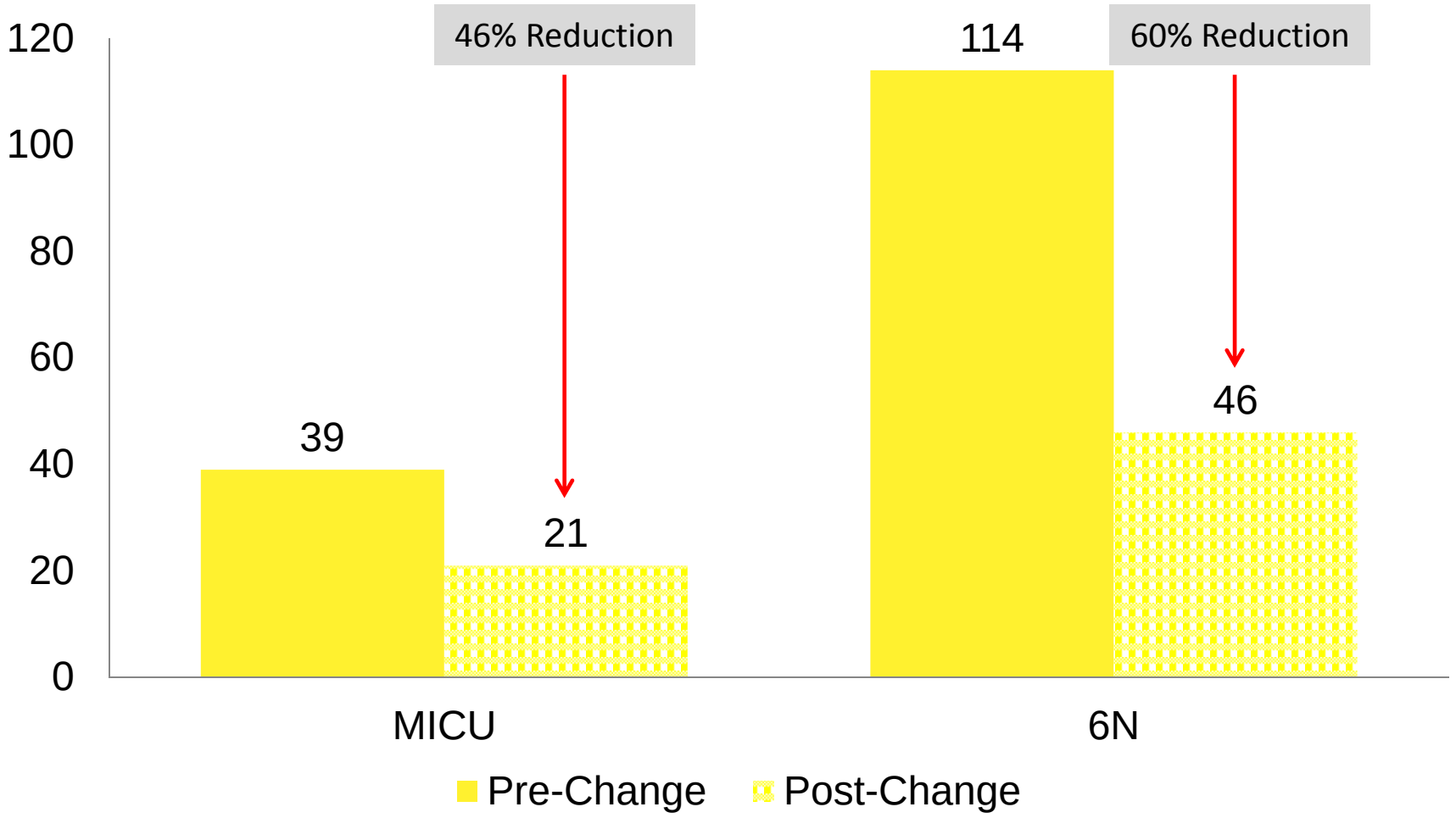
Yellow arrhythmia category a large portion of the 6N alarms





Red Arrhythmia
Yellow Arrhythmia
Red Parameter
Yellow Parameter
Inop/Technical

Yellow Arrhythmia Alarms Per Patient Bed Per Day



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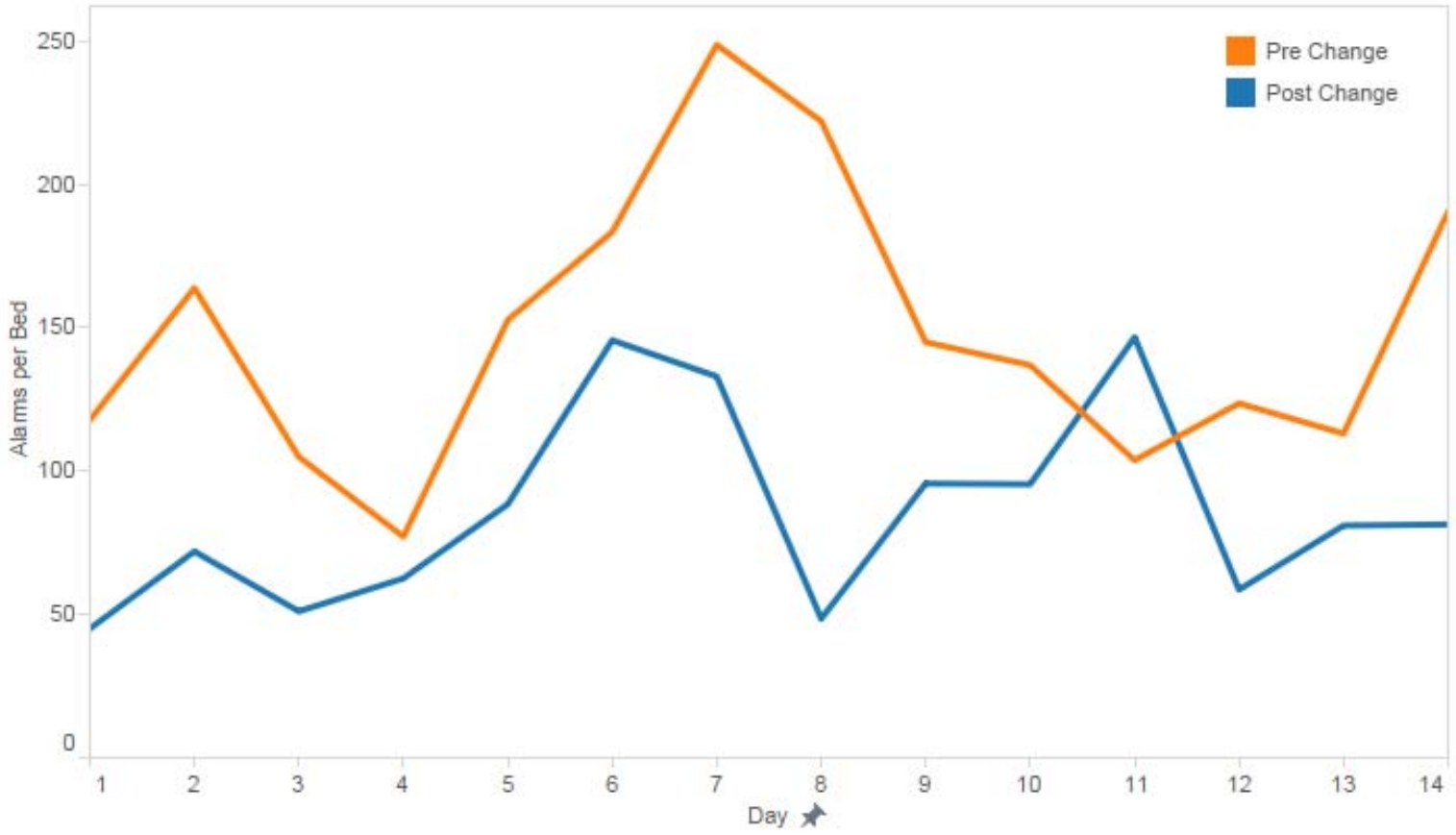
Total Alarms Per Patient Bed Per Day for 6N

Comparing pre and post change data



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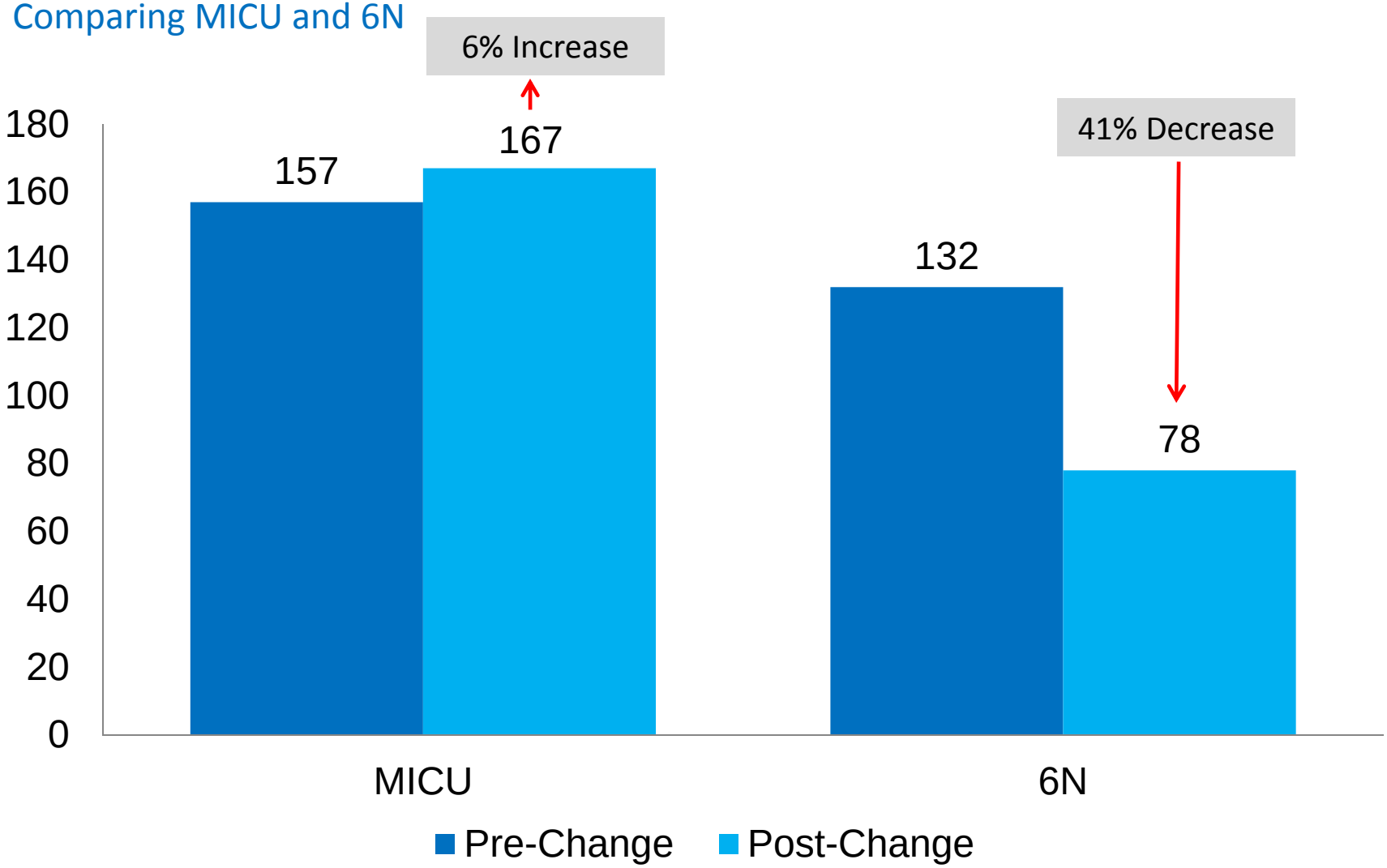
Impact On Total Alarms Per Patient Bed Per Day

Comparing MICU and 6N



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Additional CAMW Action: Phase II

- Educating Faculty and Staff on Clinical Alarm Management
  - Grand Rounds, Section Meetings, and Quality Unit Councils
  - Nursing Skills Fair
  - Online training (Future)

- Educational program for lead placement
  - Skin prep and proper electrode placement
  - Routine battery replacement
  - Routine change of electrodes
    - Documentation in nursing assessment in EMR

- New Clinical Alarm Management Policy

- Telemetry order set based on AHA Telemetry Practice Standards

- CHOG pilot units
  - Tailoring baseline settings and lead size to age group

- MICU default parameter settings

Next Steps

- Continue with incremental changes and measure the results
- Engage Alarm Champions (staff) to partner with Alarm Committee to roll out changes and be change agents
- Explore technology optimization and use of IntelliSpace Event Management (IEM):
  - Evaluate use model
  - Identify ROI

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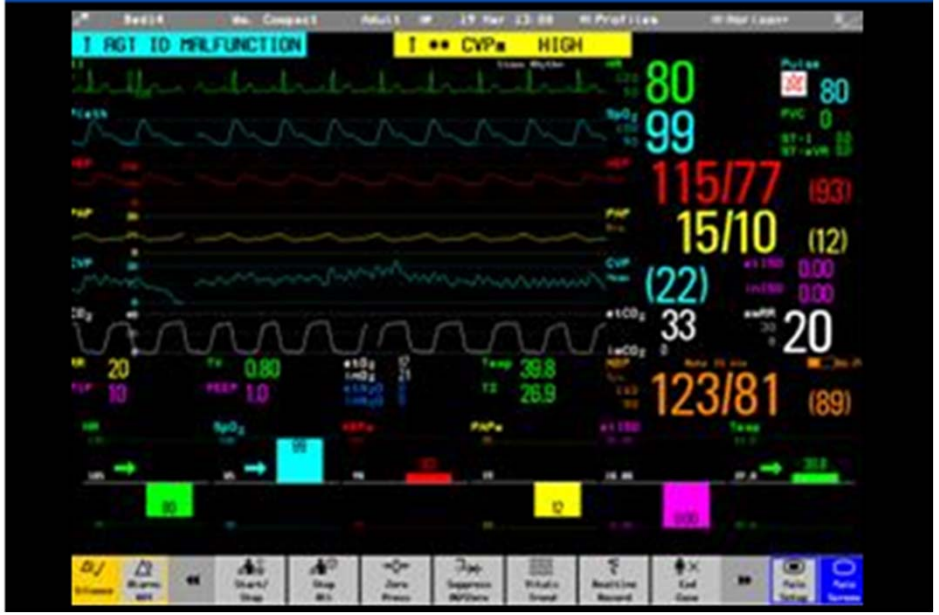
Technology Optimization

Utilize other tools to analyze trends and changes in patient status in conjunction with alarms

Horizon Trends



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In Summary

Any Alarm Management Strategy must be carefully planned, tested, and continuously evaluated to assure achievement of the right balance of patient safety and quality of care with the reduction of alarm fatigue.

Photo courtesy of Lisa Pahl

Thank you

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