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A team approach to improving the acoustical environment

Healthcare Transformation Services, Philips

October, 2021

innovation + you

Today’s speakers

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Objectives

At the end of the session, the attendee will be able to:

- Differentiate between the acoustical environment, hospital soundscape, and noise
- Identify potential negative impacts of noise on patients and staff
- Explain the goals of an effective sound management strategy
- Utilize a co-create methodology and champion program to help teams collaboratively identify and implement strategies to reduce unnecessary noise, non-actionable alarms, alerts, and notifications, and other sound disruptions
- List metrics/KPIs that can be used to evaluate the impact of noise reduction strategies

Contents

Noise, the acoustical environment, and soundscape

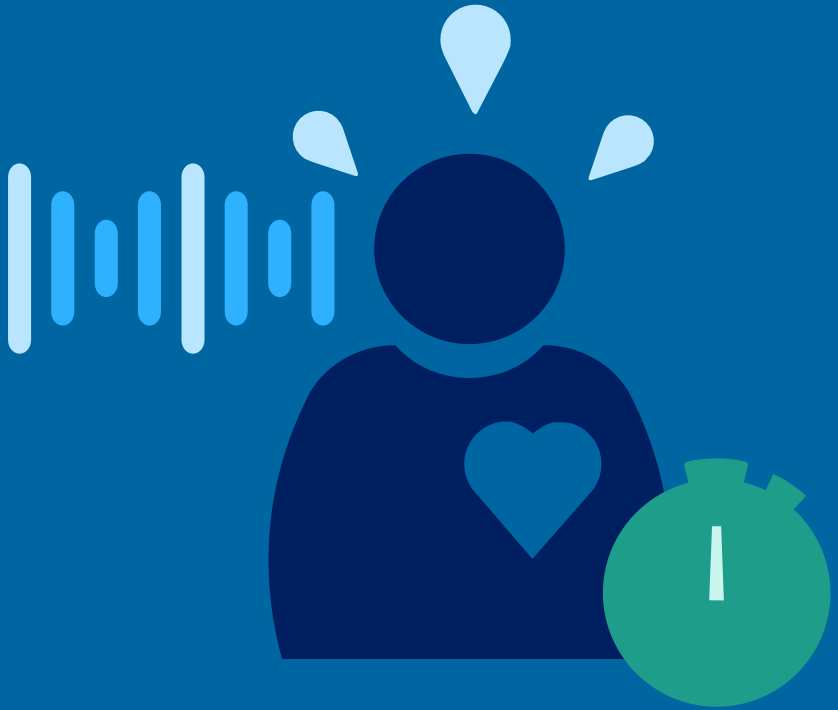
How are these different?

“Unnecessary noise is the most cruel abuse of care which can be inflicted on either the sick or well.”

Florence Nightingale, “Notes on Nursing,” 1859

Image from Wikipedia

What is noise and who decides?



“ Any sound that may produce an undesired physiological or psychological effect in an individual or a group.”

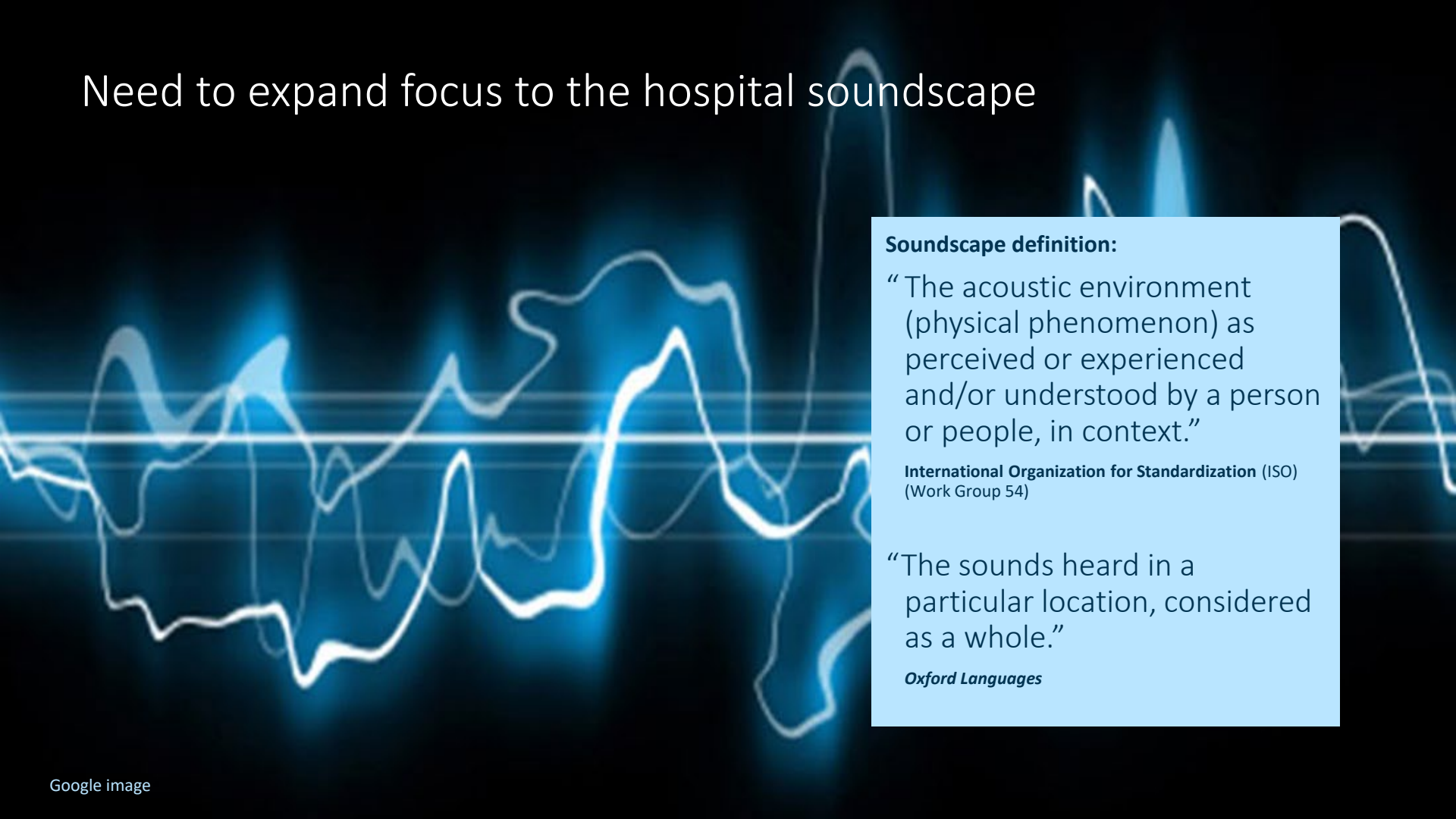
– Environmental Protection Agency

“Unwanted sound judged to be unpleasant, loud or disruptive.”

Wikipedia

https://mynoise.net/Data/CLOCK/fb.jpg

Need to expand focus to the hospital soundscape



Soundscape definition:

" The acoustic environment (physical phenomenon) as perceived or experienced and/or understood by a person or people, in context."

International Organization for Standardization (ISO) (Work Group 54)

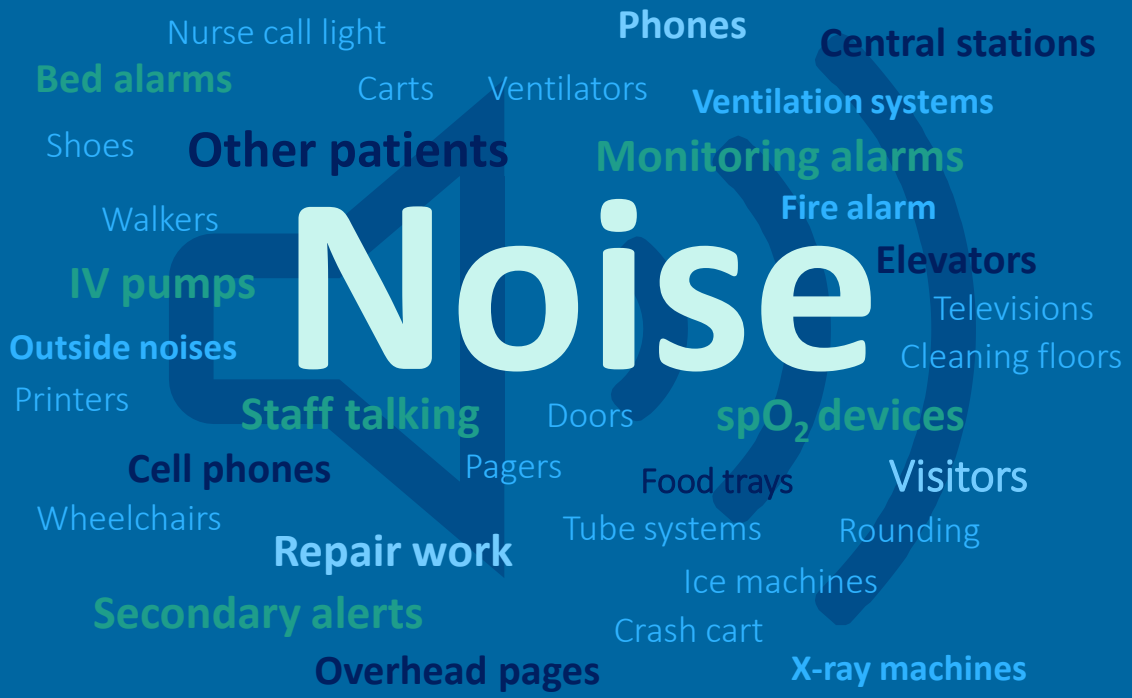
"The sounds heard in a particular location, considered as a whole."

Oxford Languages

Google image

Sources and impact of noise

A study identified 86 different sources of noise in the hospital

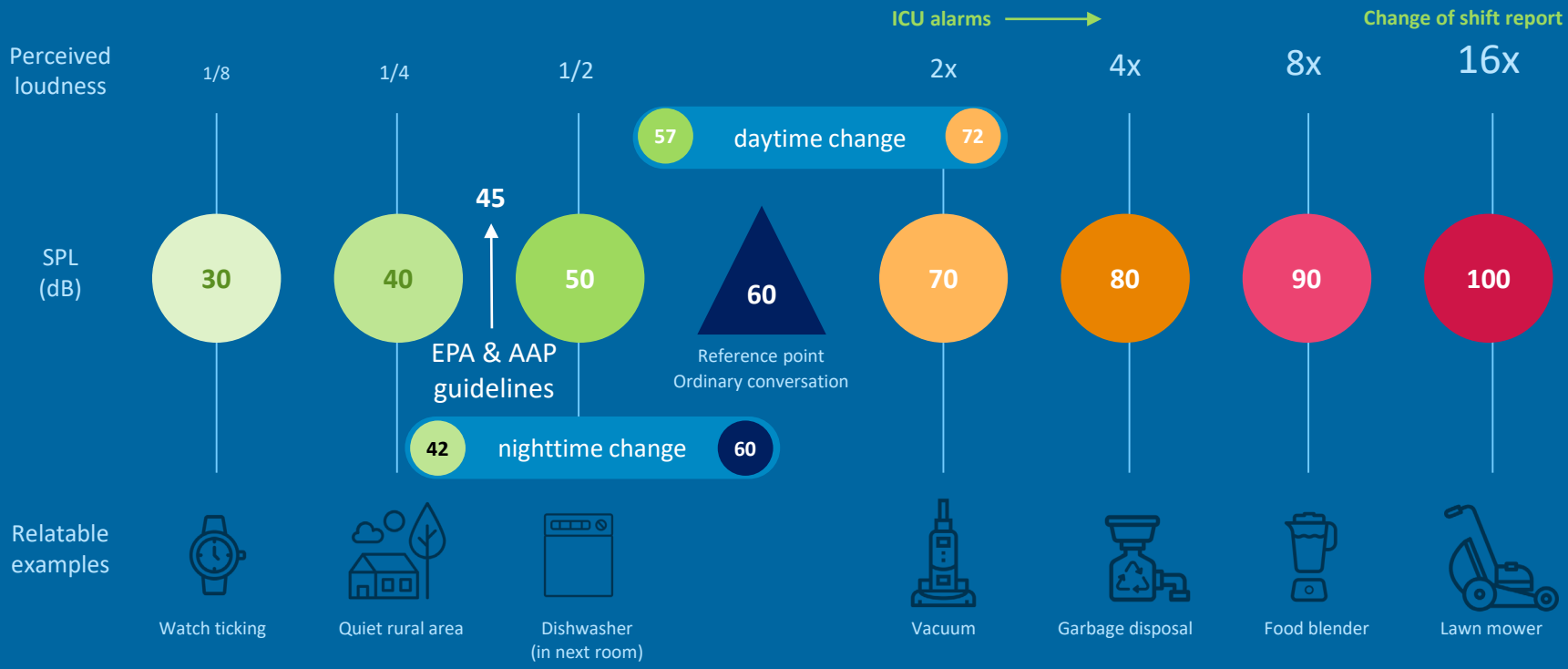


"Since 1960, average daytime hospital sound levels around the world have risen from 57 decibels to 72; nighttime levels have jumped from 42 decibels to 60."

Science Daily, "Rise In Hospital Noise Poses Problems For Patients And Staff," November 2005

Sound levels and perception

Decibel measurement is logarithmic: 10-dB increase represents a doubling of noise level



http://www.ecaudio.com/resources/howtos/loudness.html, http://www.cyberphysics.co.uk/topics/medical/Ear/dba.htm, Image Source: Google Images

*"UC San Diego Researchers Try To Quiet Noisy Hospitals," Tuesday, February 25, 2014, By Angela Carone

Potential effects of noise

" Excessive ambient noise in hospitals adversely affects patients' sleep and recovery, causes stress and fatigue in staff and hampers communication."

" In critical care areas, disruption of patients' sleep patterns may contribute to the development of delirium."

"Mapping Sources of Noise in an Intensive Care Unit" by J. L. Darbyshire M. Müller-Trapet J. Cheer F. M. Fazi J. D. Young,, Anesthesia 2019, 74, 1018–1025.

" Noise can have a cumulative effect: when hospitalized for several nights, patients can feel trapped in a stress inducing soundscape, leading to requests for premature discharge and heightened risk of poor recovery and readmission."

BMJ 2018;363:k4808 doi: 10.1136/bmj.k4808 (Published 19 November 2018)

A study found that "noise levels interfered with attending and resident interactions in more than a third of shift-change communication."

Redesigning Hospital Alarms for Reliable and Safe Care by Paul Barach and Juan A. Sanchez in © Springer International Publishing Switzerland 2017 263

Noise and sleep

Hospital Project on Noise, Sound and Sleep (HPNoSS):

Hospital soundscape can have positive and not just negative effects

Multidisciplinary symposium in 2017

Need holistic understanding of sound in the hospital and the connection between noise, sleep, rest, treatment and recovery

Looking at testing interventions in clinical settings

HPNoSS Symposium & Workshop on Positive Hospital Soundscapes, a collaborative project between King's College London's Florence Nightingale Faculty of Nursing, Midwifery & Palliative Care and the University of the Arts London, facilitated by the Cultural Institute at King's.

The 2018 Clinical Practice Guidelines for the Prevention and Management of Pain, Agitation/Sedation, **Delirium**, Immobility, and **Sleep Disruption** in Adult Patients in the ICU

ICU-acquired risk factors affecting sleep quality (adults): pain, environmental stimuli, healthcare-related interruptions, psychologic factors, respiratory factors and medications

More research needs to be done

Suggest using a noise or light reduction strategy

SCCM (Chair)1,2; Yoanna Skrobik, MD, FRCP(c), MSc, FCCM (Vice-Chair)3,4; et al, Critical Care Medicine, 2018, p.85

Where to start?

"Of course, medical device alarms at the patient's bedside present one of the biggest challenges to noise reduction strategies."

Creating the Quiet Zone: Improving noise control in hospitals, July 12, 2016

ECRI top 10 technology hazards 2020

#6

Alarm, alert and notification overload

Alarms, alerts and notifications

Known problem

85%-99% of alarms are non-actionable*

Patient deaths have occurred due to missed alarms*

5 ICUs had 2.5M monitoring alarm in 31 days ~ 30M alarms in a year**

Goals

Patient safety

Standardization

Noise reduction

Reduce non-actionable alarms, alerts and notifications

*The Joint Commission

**Drew BJ, Harris P, Zègre-Hemsey JK, Mammone T, Schindler D, et al. (2014) Insights into the Problem of Alarm Fatigue with Physiologic Monitor Devices: A Comprehensive Observational Study of Consecutive Intensive Care Unit Patients. PLOS ONE 9(10):

Establish a multidisciplinary team: Identify sponsors, experts and key stakeholders needed (permanent or ad-hoc)

Resources Needed?

Function	
CEO	Unit(s) Manager
CNO	Director
CFO	Providers
CMO	Nursing staff
CIO	Ancillary staff-MTs, PCTs, etc.
CTO	Respiratory Therapists
Chief Experience Officer	Pharmacists
IT Services	Pastoral care
Clinical Engineering	Quality improvement
Facility Services	Patients and families
Risk Management	Other? (e.g., vendors, consultants)

Team goal: Short term is to reduce noise

Reduce non-actionable alarms, alerts, notifications, and unnecessary noise in order to improve patient safety, patient care, patient and staff satisfaction, and to ensure actionable alarms are responded to and appropriate action taken

Team alignment on what constitutes non-actionable and unnecessary alarms, alerts, notifications and noise

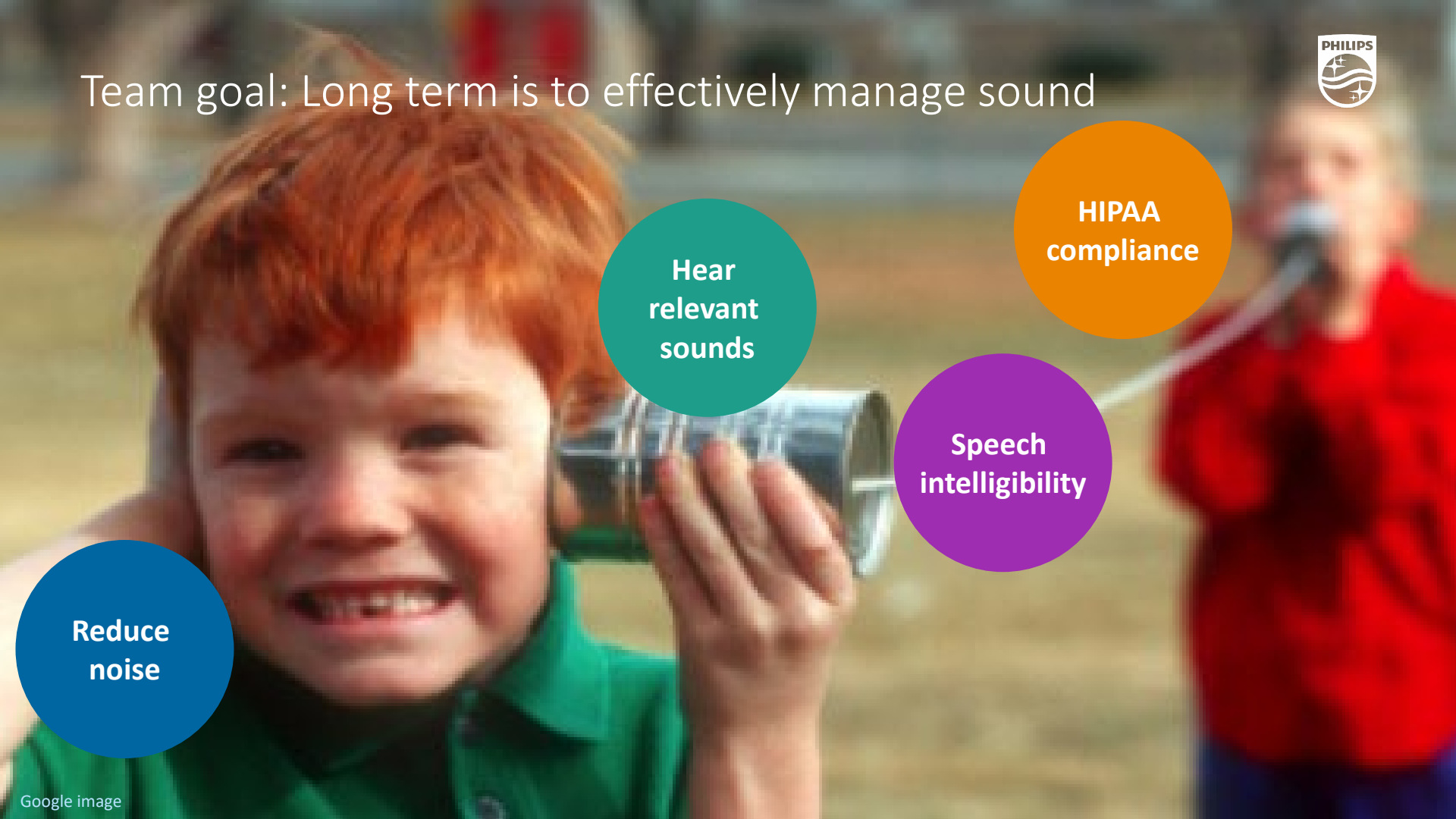
Actionable alarms	**REQUIRES** clinical intervention or some type of action

- Life threatening, immediate response & action required
- Change in patient status, requires action to reverse or prevent further deterioration
- Requires action to correct a technical problem to assure proper patient monitoring (ex. leads off, SpO_2 sensor disconnected)

Non-actionable alarms	**DOES NOT** require clinical intervention or action

- Short duration, self correcting (ex. SpO_2 alarm signal)
- Intentional (ex. 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 (ex. artifact or low voltage triggered asystole)

Team goal: Long term is to effectively manage sound



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Current state assessment

Standard assessment steps

Data analysis

Alarm & alert data; sound measurements, HCAHPS/survey scores

People

Interviews, surveys and observations

Processes

End-to-end monitoring and alarm, alert and notification workflows and processes

Technology

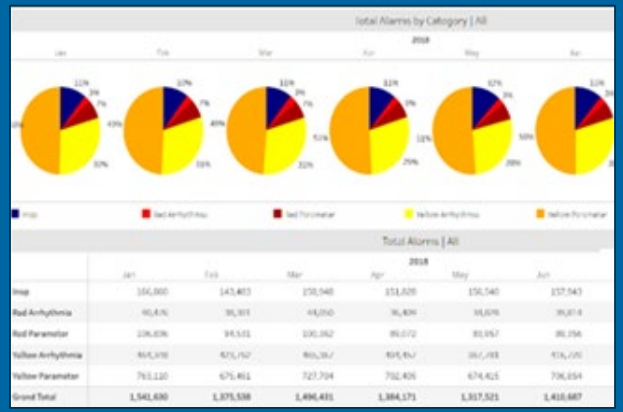
Understanding, use and integration

Culture

Noise reduction programs, alarm committee, deciders, on-boarding and event reporting

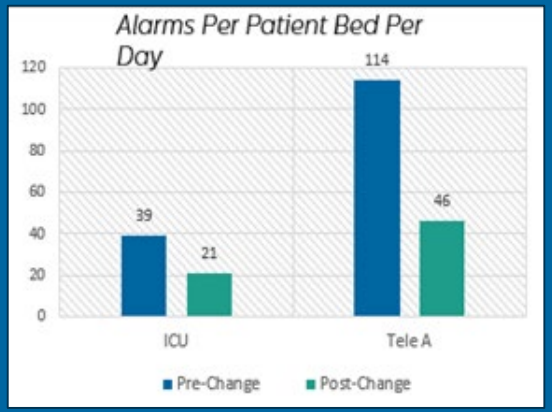
Data analytics pre, post and on-going

Obtain baseline



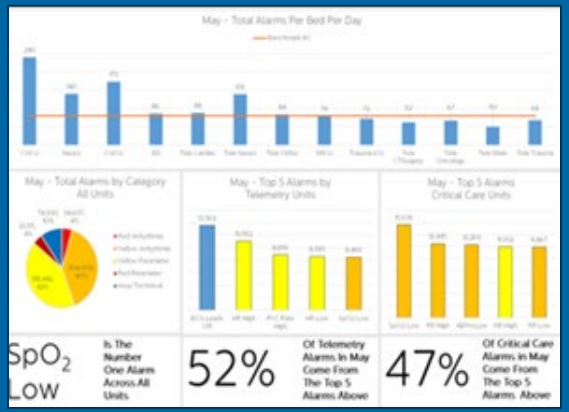
Possible quick wins

Evaluate impact of changes



Pilot changes

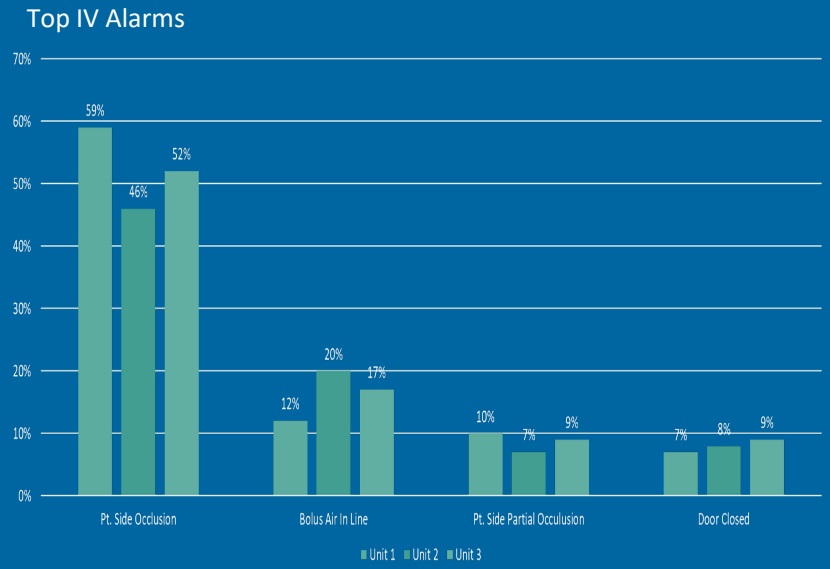
Monitor sustainability

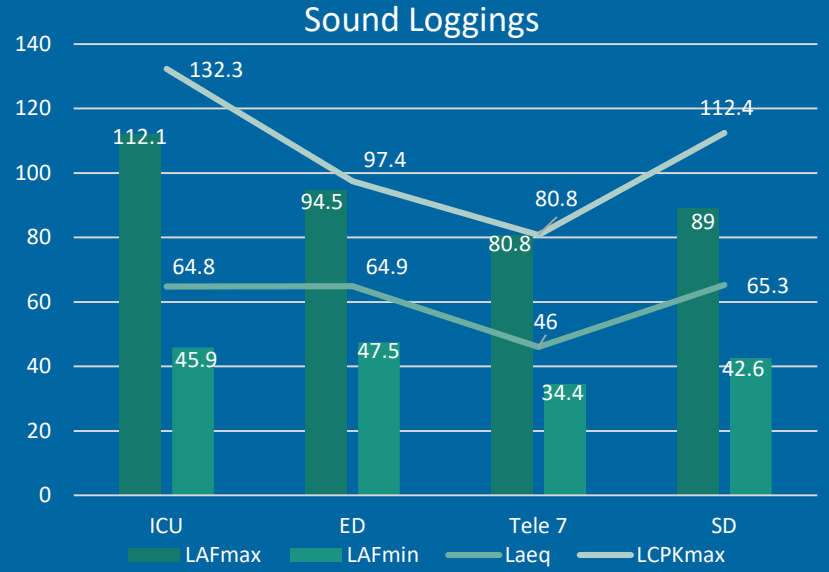


Share results

Other alarm and noise data

Assess as many systems as possible as part of an overall noise reduction strategy



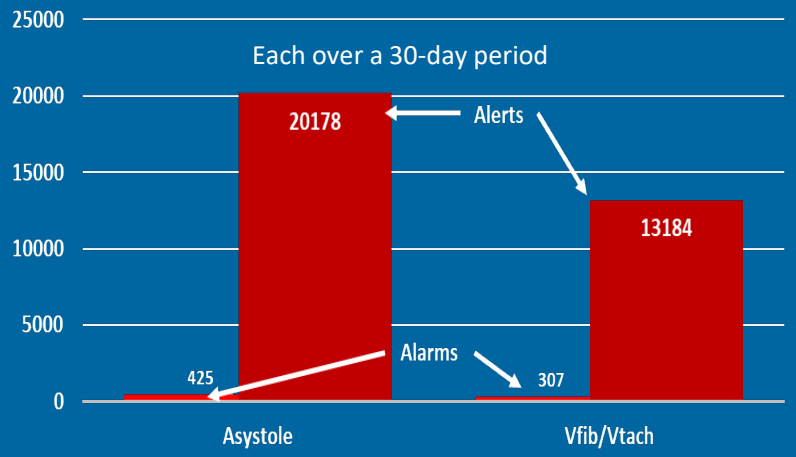


IV alarms loudest in patient rooms so when looking at sound levels, you want overall in the unit for staff impact but also in patient rooms to better understand and try to minimize for the patients.

Alert data and notifications

Need to balance safety with disruptions

Comparison of number of Asystole and Vfib/Vtach alarms and paging alerts for critical care units



CALL TYPE:	ORIGIN:	DELAY	CNA	DELAY	CS #2	DELAY	CS #3
PATIENT	PILLOWSPEAKER			2 MIN	RN	2 MIN	CHARGE
PATIENT	1/4" JACK ON PT ST "SIP & PUFF" OR SOFT TOUCH PILLOWSPEAKER			2 MIN	RN	2 MIN	CHARGE
WATER	PILLOWSPEAKER			3 MIN	RN		
GO TO TOILET	PILLOWSPEAKER			2 MIN	RN		
PS CORD OUT	PATIENT STATION	15 SEC		1 MIN	RN		
CORD OUT "SIP & PUFF" OR SOFT TOUCH PILLOWSPEAKER	PATIENT STATION	15 SEC		1 MIN	RN		
BED OUT	37-PIN RECEPT.	15 SEC		1 MIN	RN		
CHAIR ALARM	AUX JACK STATION			0 SEC	RN	0 SEC	CHARGE
TOILET	YELLOW BUTTON ON PULL CORD STATION			30 SEC	RN	10 SEC	ALL STAFF
TOILET	PULL CORD STATION			30 SEC	RN	10 SEC	ALL STAFF
SHOWER	PULL CORD STATION			30 SEC	RN	10 SEC	ALL STAFF
BED EXIT	37-PIN RECEPT.			0 SEC	RN	0 SEC	CHARGE

Who is receiving notifications and how many – from all of your systems.

Why all this data matters: overall impact to staff and patients

If one unit over a 30-day period has **36,100** monitoring alarms, **54,700** monitoring alarm alerts and **4,801 nurse call** alerts

average disruptions per minute

of ~ over a million alarms/ alerts per year for that one unit

Other data and information

"During this hospital stay, how often was the area around your room quiet at night?"

Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey question

Per Hospital Compare, the national average response of those who reported it was quiet is 62% - this is one of the lowest rated satisfaction survey responses.

Review current configurations and understand options

Arrhythmia	On	On	Off
Pause Threshold	2.00 sec	2.00 sec	1.50 sec
Afib/IHR End Dly	5 min	5 min	5 min
VTach HR	100 bpm	120 bpm	150 bpm
VTach Run	5	5	5
Vent Rhythm	14	14	14
SVT HR	180 bpm	200 bpm	210 bpm
SVT Run	5	5	5
PVCs/min	10 bpm	5 bpm	5 bpm
Non-Sustain	On	On	On
--> Non-Sustain	Unlocked	Unlocked	Unlocked
Vent Rhythm	On	On	On
--> Vent Rhythm	Unlocked	Unlocked	Unlocked
Run PVCs	On	On	On
--> Run PVCs	Unlocked	Unlocked	Unlocked
Pair PVCs	Off	On	On
--> Pair PVCs	Unlocked	Unlocked	Unlocked
R-on-T PVCs	On	On	On
--> R-on-T PVCs	Unlocked	Unlocked	Unlocked
V.Bigeminy	On	On	On
--> V.Bigeminy	Unlocked	Unlocked	Unlocked
V.Trigeminy	On	On	On
--> V.Trigeminy	Unlocked	Unlocked	Unlocked
PVCs/min	On	On	On
--> PVCs/min	Unlocked	Unlocked	Unlocked
Multif.PVCs	Off	On	On
--> Multif.PVCs	Unlocked	Unlocked	Unlocked
Pacer n.Cap	On	On	On
--> Pacer n.Cap	Unlocked	Unlocked	Unlocked

Hospital Compare, www.medicare.gov/hospitalcompare

People, process and practice

"We are not allowed to change any limits without a physician order.

"I get so many alerts on my phone that I stop looking at them.

"I hear alarms in my head when I go home.

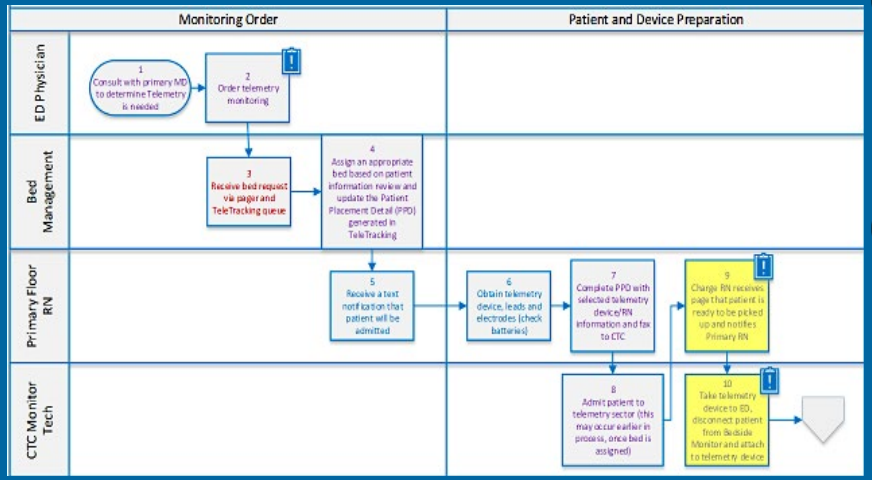
"It is too noisy in here.

"The two things my Mom complained about? The food and the alarms.

"If I responded to every alert, I wouldn't get anything done.

"There are alarms going off constantly in here (CMU).

"I worry we are going to miss an important alarm or notification and the patient will be harmed.



On boarding process

Staff, patient, & family surveys/input

Who are the deciders?

Safety culture

Our way of working?

Simulations for technology/ workflow changes and integration

Patient and family education

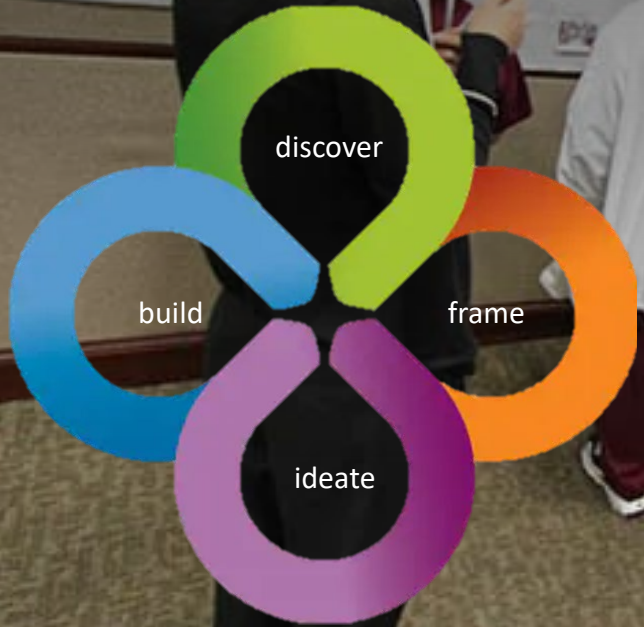
Competency assessments

Near miss/event reporting

Assessment findings and recommendations

CoCreate workshop

Cocreate workshop: team to define the future state

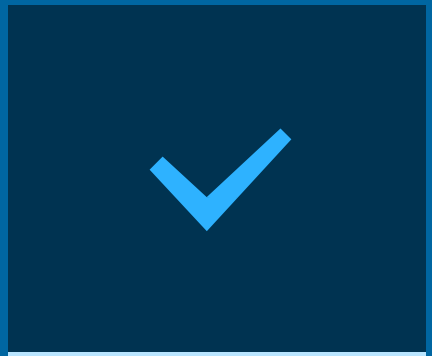


Initial goal of workshop

Prioritization

Review and prioritize identified recommendations

Plan pilot(s)

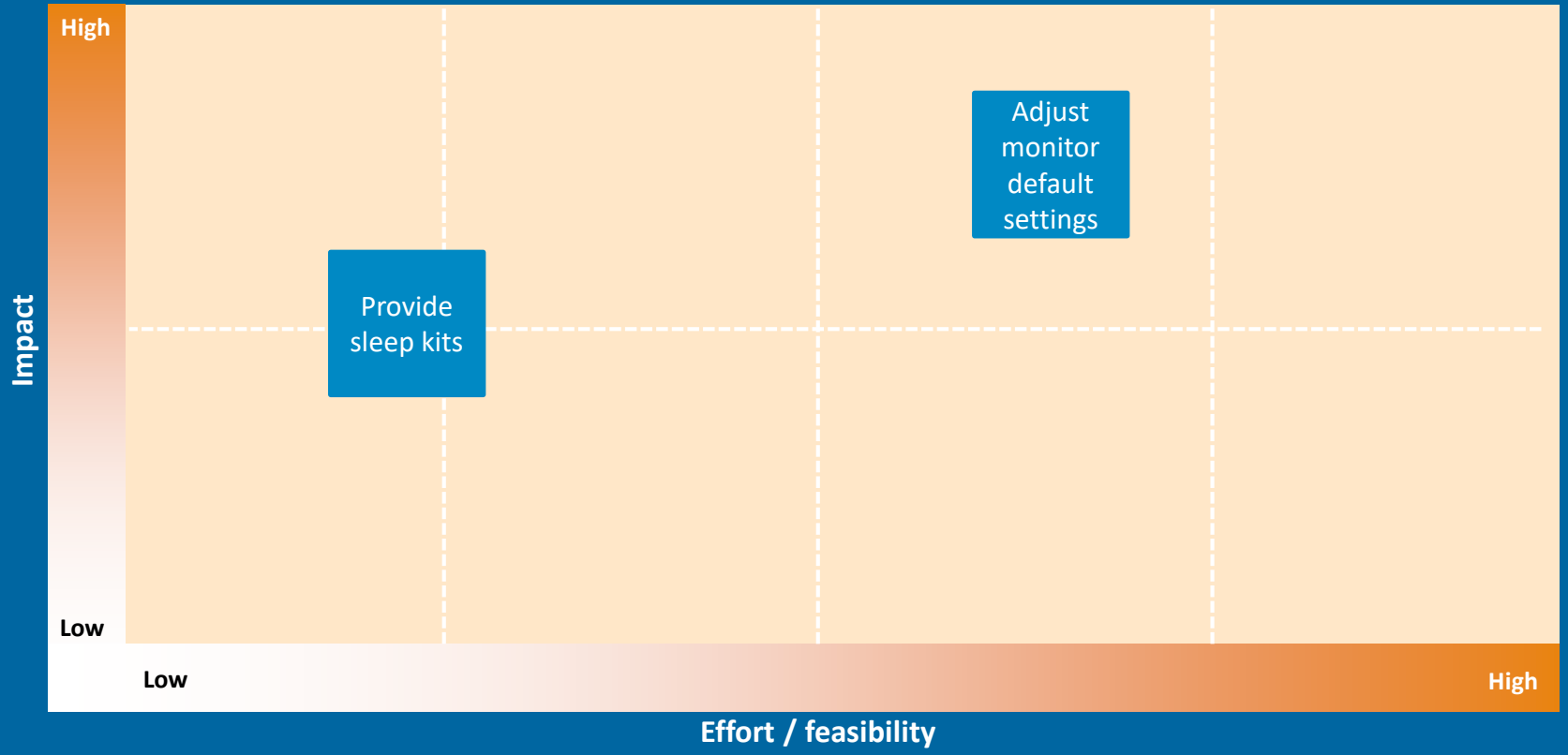


Identity incremental changes with measurable metrics

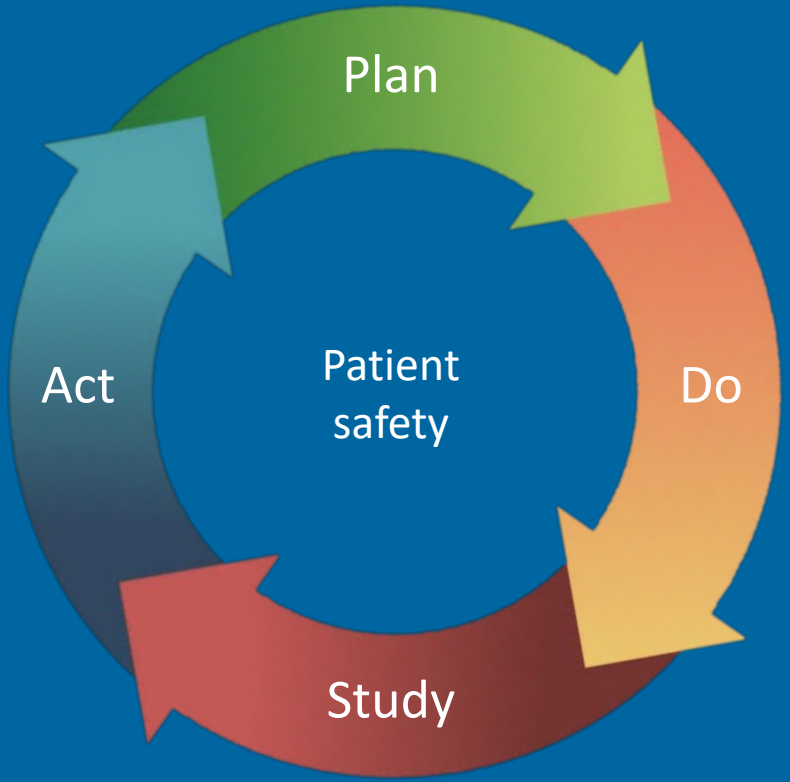
Impact analysis

Evaluate pilot(s) results and anticipated versus actual impact; and lessons learned

Team activity: individual input, discussion and final alignment



Pilot implementation and impact analysis



Team outlines pilot strategy

Goals:

Activities to be completed:

Resources:

Metrics/KPIs:

Project owners:

Implementation plan:

Approvals needed and process for obtaining:

Education, communication and near miss/event reporting

Timeline

Q?201?

Q?201?

Obtain feedback from CoCreate team: most valuable aspects

100%

Number of respondents who felt the session was helpful to think about opportunity prioritization with colleagues

"Getting full participation and consensus from colleagues."

"Everyone's opinions were heard and inputs counted."

"The group felt confident that they were able to identify short and long term team opportunities that will be helpful in achieving the future state."

Champion model

Change management and adoption support

Champions and change

"The ultimate success of the change initiative almost always rests on a multidisciplinary effort and the emergence or designation of a champion or champions."

Champions

- **Role Model:** Skills and attitude
- **Subject Matter Expert (SME):** Knowledgeable on best practices, organizational expectations, etc., related to area of focus
- **Peer Mentor:** Provide education and support to peers and enhance competencies
- **Change Agent:** Support adoption of new behaviors, identify and resolve problems, provide feedback, and monitor metrics

Editor(s): Proehl, Jean A.; Hoyt, K. Sue Clinical Inertia and Champions for Change, Advanced Emergency Nursing Journal: July/September 2014 - Volume 36 - Issue 3 - p 207-208 doi: 10.1097/TME.0000000000000028

Monitoring and alarm champions at a large academic medical center

Plan

- Outline expectations
- Selection criteria
- Oversight and structure
- Education plan
- Selection notification and acceptance
- Evaluation process

Education

- Lecture and hands on
- Combined Philips and site instructors
- Monitor functionality and alarm capabilities
- Site alarm management expectations

Outcomes

- Total of 4 eight-hour classes
- Total of 45 staff educated
  - 34 staff from adult units
  - 11 staff from pediatrics
- Pre to post test results
  - Adult units: 59.1% to 85.8%
  - Pediatric units: 65.5% to 89%
- Positive evaluations

On-going plan

- Monthly champion meetings: strategy, lessons learned, celebrate successes
- Representation on alarm and technology committee
- Metric evaluation support

Case study summaries

Augusta University Health

"Team-Based Intervention to Reduce the Impact of Nonactionable Alarms in an Adult Intensive Care Unit," Justin Yeh, BA; Ruth Wilson, MHS, RNC-NIC, NE-BC; Lufei Young, PhD, APRN; Lisa Pahl, MSN, RN; Steven Whitney, MSN, RN, CCRN; Kevin C. Dellsperger, MD, PhD; Pascha E. Schafer, MD, The Journal of Nursing Care Quality, April–June 2020, Volume 35, Number 2

- Established a multidisciplinary clinical alarm management workgroup to review and assess environmental noise from alarms
- Workgroup composed of nurses, physicians, a respiratory therapist, patient safety and performance improvement members, patient and family advisors, Philips clinical alarm system engineers, subject matter experts, and clinical data analysts
- Used the Association for the Advancement of Medical Instrumentation (AAMI) clinical alarm management inventory tool to identify potential alarms of interest to target
- Obtained baseline alarm data and decided to focus initially on default settings
- The team used published best practices and subject matter experts to identify the settings to modify
- All proposed changes were presented to and approved by the Medical Staff Executive Committee
- The study was performed utilizing the Plan-Do-Study-Act (PDSA) cycle to test the effectiveness
- of the interventions

Alarm & noise management: Some results

Reducing non-actionable alarms

Challenge:
Help reduce non-actionable alarms, decrease hospital alarm fatigue, and create a comprehensive alarm management system at AU Health.

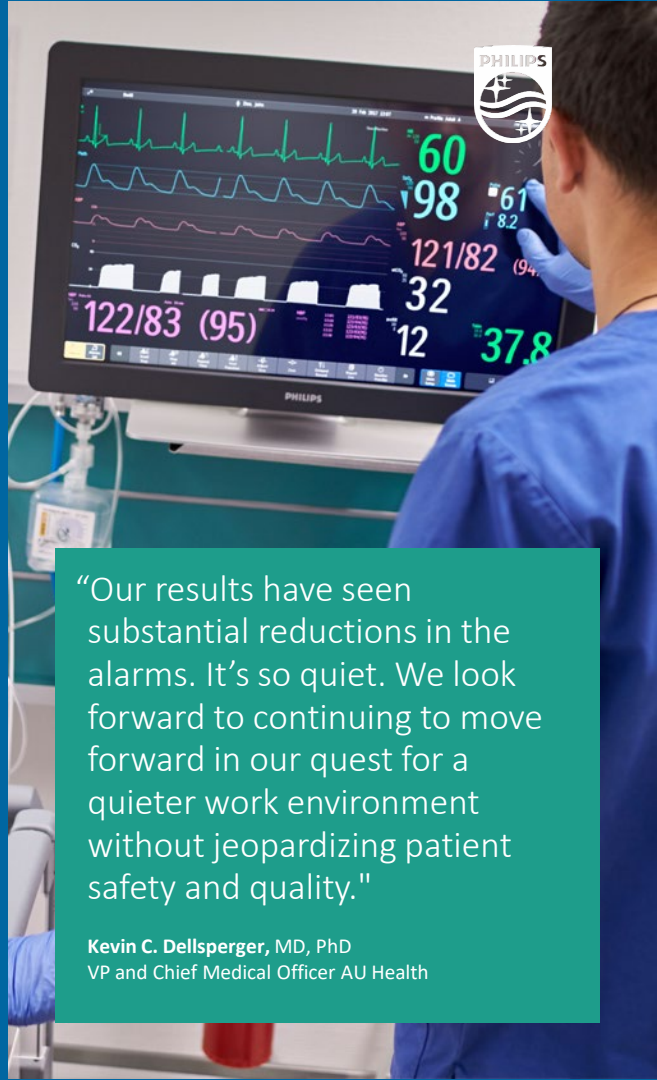
Solution:
Comprehensive assessment of alarm data with stakeholder input, identification of root causes of the non-actionable alarms, and recommendations for change initiatives and staff training.

Results:*

32% reduction in non-actionable alarms in 3 months at AU Health

Reduced disruption caused by non-actionable alarms

Several new **Alarm Management Strategies** implemented



"Our results have seen substantial reductions in the alarms. It's so quiet. We look forward to continuing to move forward in our quest for a quieter work environment without jeopardizing patient safety and quality."

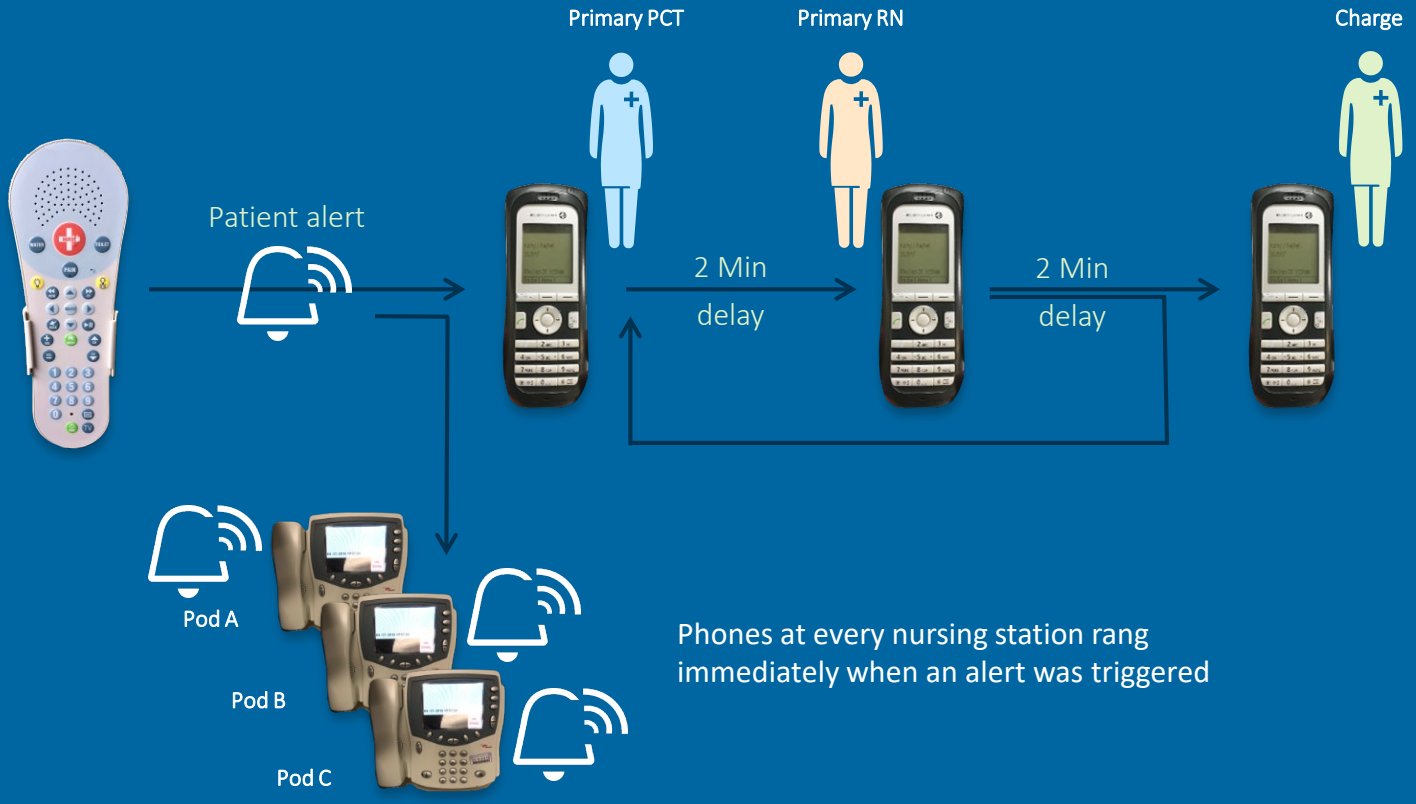
Kevin C. Dellsperger, MD, PhD
VP and Chief Medical Officer AU Health

* Results from case studies are not predictive of results in other cases. Results in other cases may vary.

Large IDN

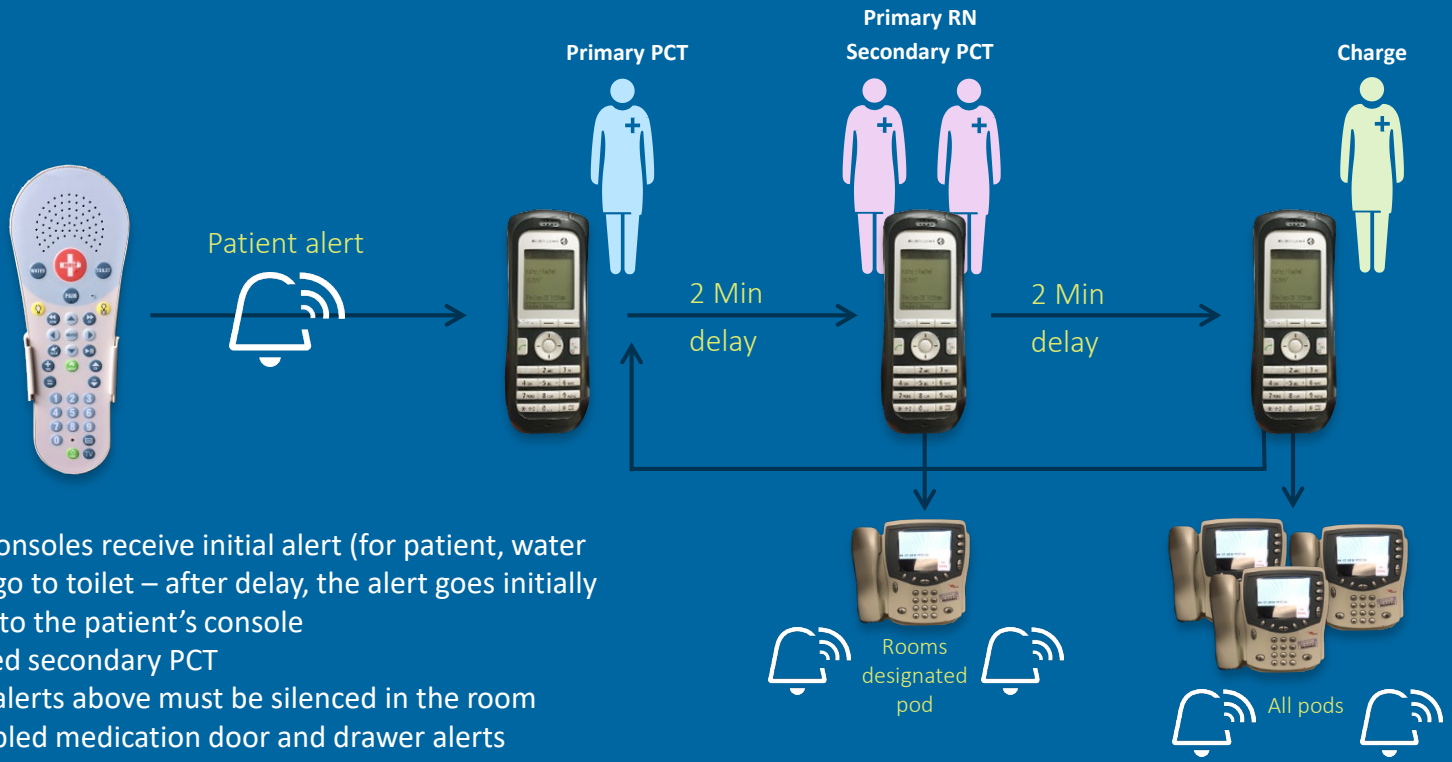
- Established a multidisciplinary alarm management taskforce to assess several different alarming devices/systems:
  - Monitoring alarms
  - IV pump alarms
  - Nurse call notifications
- Taskforce team consisted of nurses (leadership and staff), physicians, monitor techs, Clinical Engineering, Human Factors specialist, clinical data analysts, IT, and Phlips consultants
- Assessed multiple sites and units
- Vendor collaboration from the systems being assessed
- Some key learnings: the Care Techs were the first receivers for multiple alarm/alert notifications and the nurse call system was not standardized across the sites

Nurse call system alert notification process



Phones at every nursing station rang immediately when an alert was triggered

Pilot changes



- No consoles receive initial alert (for patient, water and go to toilet – after delay, the alert goes initially only to the patient's console
- Added secondary PCT
- The alerts above must be silenced in the room
- Disabled medication door and drawer alerts
- Added night tones to consoles

Pilot results

HCAHPS score improvements for response time for call light and toilet*

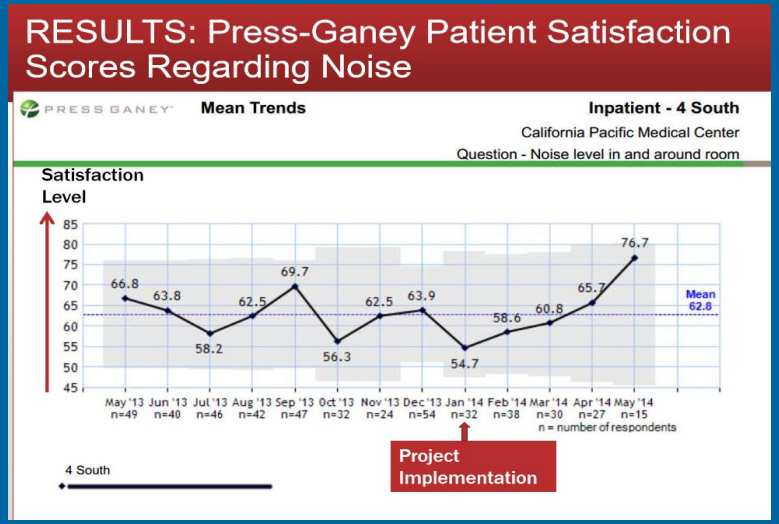
Call light from **64%** to **78.9%**

Toilet from **61.9%** to **80%**

7,990 reduction in audible nurse call system alerts

*HCAHPS data provided by the hospital

Noise impact



"With a centralized monitoring room, the noise level alone is often overwhelming to technicians. The recommended changes made an immediate difference in the noise level that was noticed and felt by all, making for a much healthier and safer work environment. We feel patients are also much safer because the technicians can focus on true and valid alarms and limit the number of notifications to RNs thereby reducing their workload."

Wendy Cantrell, MSHR
Manager, Telemetry Monitoring
Huntsville Hospital

"Wake Up From Alarm Fatigue: Using Our Monitors Wisely"

S. Jill Ley RN, MS, CNS, FAAN
- Cardiac Surgery Clinical Nurse Specialist, California Pacific Medical Center
- Clinical Professor, University Of California, San Francisco, CA

Partnership with Philips for Alarm Management Assessment: In-depth analysis of 4 units Detailed alarm and clinician response data

Other outcomes and results

37% reduction of total alarms from 765,103 to 498,832

155,580 less alarms heard by patients & families in their rooms

61% reduction in alarms with q24h electrode changes and using appropriate size lead sets

Approximately **10,000 hours of non-value added work eliminated** due to process and workflow improvements in a 9 month period

29% reduction in select IV pump alarms

23% reduction in alarms with alarm customization process

00.00 adverse patient or near miss events during pilots

32% reduction in non-actionable alarms with default settings changes

Sustainable results over time with **enhanced patient and staff experience**

*ICU patient comment when we told her we working on reducing the alarms that went off in her room

Results can vary from site to site

Other noise reduction options beyond alarms and alerts

- Quiet hours
- Patient care kits (e.g., ear plugs, eye masks, etc.)
- Ensure TVs and other devices are off when not in use
- Limit overhead pages
- Dim lights and minimize noise on night shifts, e.g., cleaning during the day
- Adjust phone volumes – at desk and cell
- Routine maintenance on easily fixable items, e.g., squeaky cart or walker wheels
- Time non-nursing activities, e.g., restocking supplies, cleaning floors, etc.
- Sound reducing curtains and/or ceiling tiles
- Engage and educate patients, families, and visitors
- Monitoring for clinical need based on guidelines
- Explore positive sounds, e.g., fountains, music, etc.

When remodeling or building:

- White noise devices
- Private rooms
- Planned location of elevators and ice machines
- Stagger patient room doors on opposite side of hallways
- Staff and transport hallways separate from patient rooms
- Staff rooms for communication

Study using a bundled strategy to reduce noise

"Reduction of ICU noise and alarms with a nighttime noise reduction bundle and modified alarm profile."

Anne Marie Mattingly1, E. Kate Valcin1; 1University of Rochester Medical Center, Rochester, NY Crit Care Med 2013 • Volume 41 • Number 12 (Suppl.)

Implemented a nighttime noise reduction bundle (NNRB) including the following:

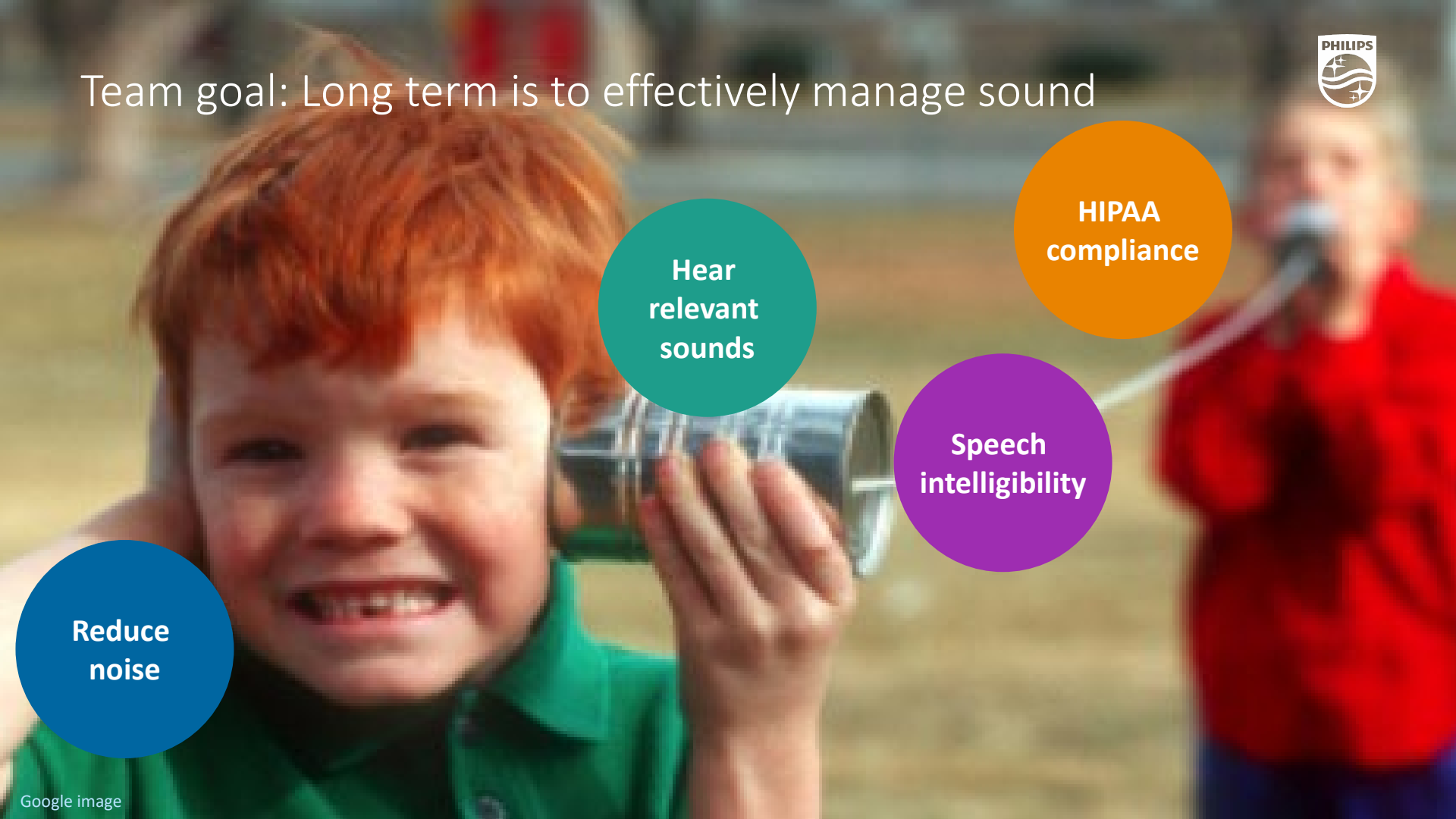
- Posting quiet hours signs
- Closing patient room doors
- Reducing IV pump and monitor volumes
- Modifying workflow to avoid precipitating alarms
- Turning off TVs and radios
- Reducing the volume of staff voices

Patient monitoring alarm profile targeted at reducing nuisance alarms

Reduction of several metrics, including noise over 24 hours (median 54.3 to 53.0 dB, $p<0.0005$) and noise at night (median 52.8 to 51.3 dB, $p<0.0005$). Total alarms, total yellow alarms, and red arrhythmia alarms were all significantly decreased.

Long term considerations

Team goal: Long term is to effectively manage sound



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“The sense of hearing cannot be closed off at will. There are no earlids. When we go to sleep our perception of sound is the last door to be closed and it is also the first to open when we awaken.”

- R. Murray Schafer, “The Soundscape: Our Sonic Environment and Tuning of the World” 1977

Questions?

Thank you!

For more information about Philips Acute and Critical Care consulting services, contact **John Davanzo** (john.davanzo@philips.com).


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