Alarm Fatigue for Clinical Nurses
Managing the Risk of Alarm Fatigue for Clinical Nurses

This course will explore the research that defines the concept of alarm fatigue, contributing factors, and strategies nurses can apply to minimize alarm related risks to patient safety.
Managing the Risk of Alarm Fatigue for Clinical Nurses

Our goal for this program is to enable you with the knowledge you need to question how alarms are managed in your clinical environment, and to empower you with the resources you need to respond to the call to decrease the incidence of alarm related adverse events and fatalities in your patient care area.
Managing the Risk of Alarm Fatigue for Clinical Nurses

By the end of this course we hope you will:

– Understand the concept of alarm fatigue and define the problem
– Identify who is at risk for alarm fatigue and why they are at risk
– Discuss the most common types of alarms related to alarm fatigue, and
– Be prepared to help develop tools and strategies for managing alarm fatigue in your work environment
Clinical alarms are designed to keep patients safe by alerting caregivers to potential problems or changes in patient status, such as:

- Patients with high fall risk attempting to exit a chair or bed unassisted
- Changes in respiratory rate and pattern, or decreases in oxygen saturation
- Changes in cardiac rhythms or significant variations in blood pressure
Clinical alarms are designed to keep patients safe by alerting caregivers to potential problems or changes in patient status, such as:

- Problems with the flow of intravenous fluids and medications or enteral feedings through infusion pumps
- Obstructed air flow or loss of pressure in wound exudate evacuation devices or sequential compression devices designed to promote venous return and prevent deep vein thrombosis
Clinical alarms are designed to keep patients safe by alerting caregivers to potential problems or changes in patient status, such as:

- Call light alarms
- Pagers and communication devices
What is Alarm Fatigue, and Why is It Important to Know More About the Concept?

A clear understanding of the concept of alarm fatigue can help caregivers to develop effective strategies and policies for managing the problem of alarm sound desensitization in nursing care environments where device alarms are being used more and more to manage safety concerns of patients.
What is Alarm Fatigue, and Why is It Important to Know More About the Concept?

Phrases and terms used to describe the concept of alarm fatigue include:

- Sensory overload caused by frequent alarms
- Excessive number of alarms
- Sheer number of overwhelming alarms
- Desensitization due to frequent alarms
- Incessant din of beeping monitors that numb the senses or distract hospital staff
What is Alarm Fatigue, and Why is It Important to Know More About the Concept?

Phrases and terms used to describe the concept of alarm fatigue include:
- Cacophony of alarm sounds
- Complex interactions between people, processes and technology
- A plague of auditory and visual alarm sounds in a milieu of sensory overload
- Hazard caused by sirens calling
What is Alarm Fatigue, and Why is It Important to Know More About the Concept?

Phrases and terms used to describe the concept of alarm fatigue include:

- Distracting alarms that interfere with the ability of nurses to perform critical patient care tasks
- Alarms often unheard, unheeded
- Onslaught of alarms coming from cardiac monitoring devices
- Noise polluted environment
What is Alarm Fatigue, and Why is It Important to Know More About the Concept?

Phrases and terms used to describe the concept of alarm fatigue include:

● A plethora of medical devices, each with its own unique characteristics
● One of the greatest annoyances in critical care settings
Alarms can become a hazard when they overwhelm the senses of caregivers, causing desensitization to the sound.

Contributing to the hazard are:

● Too many devices alarming at the same time
● Alarm limits are set too wide or too narrow
● Inability to adjust default settings so they reasonably match the physiologic needs or norms of the patient
● Insufficient knowledge of how to manage device alarms
Alarms can become a hazard when they overwhelm the senses of caregivers, causing desensitization to the sound.

Contributing to the hazard are:

- Silencing or turning off alarms
- Failure to reconnect monitoring equipment or maintain it properly
- Inaccurate discernment or ‘tuning out’ alarm sounds resulting in missed alarms
Alarm fatigue is a major patient safety hazard, caused by increasing use of technology that applies visual and auditory alerts to signal caregivers of potentially significant events that are a threat to patient safety. If this concept sounds like a catch 22, it is!
Monitors and equipment are smarter than ever before at being able to alert us to check on our patients’ conditions. Alarms are very good at detecting true positive events (sensitivity), but not well equipped to determine a true negative event (specificity). As a result, the frequency of alarms on a given day in a specific nursing unit can be overwhelming!
In a study performed at Johns Hopkins Hospital in Baltimore, Maryland in 2011 on a 15-bed unit, staff documented an average of 942 alarms per day, including about 1 critical alarm every 90 seconds.
Research supports that physiologic monitoring systems are highly sensitive to changes, but do not, of course have the ability to apply human discernment to alarm alerts to distinguish between meaningful changes versus insignificant ones. As a result, more than ¾ of the alarms a nurse experiences each day are false alarms.
If we applied that statistic to the 942 alarms per day documented at Johns Hopkins, more than 700 of those alarms were likely not clinically significant.
ECRI Institute listed alarm hazards as the No. 1 danger threatening patients in the 2014 Top 10 Health Technology Hazards list.
– ECRI Institute first identified alarm fatigue as a potential hazard to patient safety in 1974.

– In 2011, the Boston Globe enlisted ECRI to analyze the Food and Drug Administration’s database on adverse events involving medical devices between 2005 and 2010. The Globe investigation reported there were 216 deaths nationwide related to monitor alarms.
ECRI found 13 more cases in its own database, and believes the 216 cases identified in the FDA database denotes and underreporting by hospitals of the actual number of adverse events related to alarm problems.

A large number of the incidents resulting in deaths involved cardiac monitors, dying batteries in monitor boxes, or disconnected leads or cables.
The Globe investigation was spurred by a 2010 case in which an 89-year-old patient’s heart rate trended down over 20 minutes before he suffered a fatal arrest. Ten staff working the unit that day could not recall hearing the alarms. An investigation revealed the staff had become desensitized to the warning alarm and the crisis alert alarm had been turned off.
The Joint Commission implemented Hospital National Patient Safety Goal 6 in 2014 to reduce the harm associated with clinical alarm systems.
National Patient Safety Goal 6.01.01

– In 2013, The Joint Commission issued a Sentinel Event Alert warning of the dangers of alarm desensitization. Hospitals were urged to improve alarm management protocols and alarm-setting guidelines.

– In January 2014, The Joint Commission mandated that hospitals make alarm safety a priority and identify the types of alarms they plan to target.

– By 2016, hospitals will be required to have in place specific protocols to control insignificant or unnecessary alarms.
Who is at Risk for Alarm Fatigue?

Acute care and clinical nurses are at most risk for alarm fatigue. Those who work the closest with physiologic monitoring devices are at highest risk:

- Telemetry
- Progressive Care
- Intensive Care
- Emergency Care
- Perioperative Suites
- Specialty Care (ex. bone marrow transplant units)
Who is at Risk for Alarm Fatigue?

When alarm frequency is high in any unit, nurses are at risk for alarm fatigue and desensitization, especially nurses who work frequently with physiologic monitoring systems.
Who is at Risk for Alarm Fatigue?

Research supports that, even with optimal staffing, nurses could not respond to every alarm in most clinical situations where there is a high rate of “nuisance” or false alarms because these alarms may occur on average of every 37 seconds.
Who is at Risk for Alarm Fatigue?

When caregivers are subjected to too many alarms:

- Workflow is disrupted
- Errors occur due to:
  - Omission
  - Distraction
  - Inattention
- Patient care deteriorates
Who is at Risk for Alarm Fatigue?

- False alarms, or those that are caused from factors not related to changes in a patient’s condition, and nuisance alarms, or those that reflect physiologic changes that are not clinically significant, are two of the major causes of nursing sensory overload and desensitization to alarm sounds.
Who is at Risk for Alarm Fatigue?

- A 2006 survey of over 1300 nursing care professionals demonstrated that the majority of the nurses surveyed believed that when nuisance alarm rates are high, patient care is disrupted, nurses lose trust in the value of the alarms, and sometimes the alarms are disabled, putting the nurse at risk for missing critical changes, and the patient at risk for suffering ill consequences.
In an integrative review of literature related to alarm fatigue, Cvach (2012) organized research evidence into 5 major themes:

1. Excessive alarms and effects on staff
2. Nurse response to alarms
3. Alarm sounds and audibility
4. Technology to reduce false alarms
5. Alarm notification systems

Let’s focus a little more deeply on nursing perception and response.

Nurse’s response time was found to depend on 6 factors affecting perception of urgency. These include:

1. How critical the nurse perceived the patient’s condition
2. Duration or length of the alarm signal time
3. Rarity of the alarming device
4. Nurse workload
5. Complexity of nursing tasks
6. How familiar the nurse was with the device

• The study revealed that nursing-perceived alarm urgency is higher when the alarm system is perceived to be reliable.

• Inversely, the response time was lower when nurse-perception of alarm reliability is lower.
● Reactivity to alarms was greater when patient conditions were perceived to warrant more rapid response.

● Alarms with longer signal duration received more response, as well.

● However, as complexity of tasks and workload increased, response and performance declined.
As a side note, in normal ear function, sound waves are transmitted from the environment. The outer ear gathers the sound waves and sends them down the ear canal to the eardrum.

The eardrum begins vibrate as it receives the sound waves, which sets three tiny bones in the middle ear into motion, causing the fluid in the inner ear or cochlea to move.

The movement of the inner ear fluid triggers hair cells in the cochlea to bend, which converts the movement of the fluid into electrical pluses.

The auditory nerve transmits the electrical impulses to the brain, where they are interpreted as sound.

Now, image the effects of hundreds of electrical sound impulses barraging the brain that is struggling to focus on other important tasks!
– Alarm sounds were perceived to be difficult to identify and discriminate from one another when nursing tasks overlap.

– Nurses reacted quicker and more accurately to medium priority alarms than they did to high priority alarms that sounded more urgent, suggesting that the international standard may need to be redesigned.
– As a result of research study, a change in the international standard for audible sounds has been proposed to standardize all medical device alarm sounds.

– Humans can typically discriminate 5 to 7 different categorical sounds.

– The proposal suggests simple melodic alarm sounds to distinguish 8 alarm sources with priority codes for high, medium and low.
The literature review supported that many alarms have a very high decibel level that exceeds World Health Organization recommendations of 35 decibels during the daytime and 30 decibels at night. Many alarms sound at more than 70 decibels. This level of sound equates to that of a band saw or chainsaw!

Adding to the problem of high decibel alarm sounds was hospital noise in general, which can exceed 80 decibels during peak daytime hours!
A variable that can lead to ICU Psychosis in patients is over-stimulation of the senses in the ICU environment. Sound overstimulation affects nurses as well as patients. Hospital noise contributes to nursing stress and causes physical fatigue, problems with concentration, and tension headaches.
University Medical Center in Lubbock, Texas recognized sound as a problem in hospitals a few years ago. The hospital enacted a program using posters in the corridors and elevators, handouts in patient admission packets, and education of all hospital staff to be mindful of noise in all of the patient care areas.
What are the most common problem alarms?

Stokowski (2014) writes,

“Think about all of the devices used in patient care -- vital sign monitors, pulse oximeters, ventilators, infusion pumps, feeding pumps, and wound evacuators. All of these devices have alarms -- or multiple alarms. Collectively, the devices in use on a single patient can produce hundreds of alarms every day.[3] On an entire unit, the number of daily alarms can easily reach into the thousands, even tens of thousands.[4]”


Physiologic Monitoring Device Alarms

Physiologic monitoring devices monitor some aspect of human physiology. Three of the most common types of physiologic monitors are:

- Cardiac
- Ventilator
- Pulse Oximetry

“Users report that more than 350 alarms per patient per day result from monitoring systems alone in some acute care environments, but less than 5% of these alarms require clinical intervention to avoid patient harm.” (Welch, 2012)
Physiologic Monitoring Device Alarms

- Physiologic alarms are alarms that were designed to protect patients from life-threatening events by alerting staff of the need for immediate assessment and intervention. Physiologic monitoring devices are used in high acuity nursing areas.
Drew, et. al. (2014) conducted a study in which they looked at intensive care unit alarms of 461 patients in a 17 bed unit over a 31 day period of time. During that time, there were 187 audible alarms per bed per day. Of 12,671 annotated arrhythmia alarms, 88% were false positives. The most frequently occurring alarm was for premature ventricular contractions that did not require treatment (many of which were identified as artifact from movement), followed by atrial fibrillation.

Out of 4,361 ventricular arrhythmia alarms, only 168 were true ventricular tachycardia alarms, and only 12 of those required treatment. 93% of the ventricular arrhythmia alarms were false positives. ST segment monitoring alarms were found to be 91% nuisance alarms, requiring no nursing intervention.
Take-away Points on Ventilator and Respiratory Device Alarms

Two modes:
● Volume Control
● Pressure Control

Two goals:
● Facilitate gas exchange
● Prevent lung tissue damage
Take-away Points on Ventilator and Respiratory Device Alarms

Modes and Parameters:
- Mode/settings chosen based on patient need
- Alarm parameters are adjusted based on mode
Take-away Points on Ventilator and Respiratory Device Alarms

Common alarms:

- High or Low pressure
- Apnea
- High tidal volume, minute ventilation or respiratory rate
- Low tidal volume or minute ventilation
- Mechanical failure.
- Removal of C-PAP or BiPAP Mask
Ventilator and Respiratory Device Alarms

Ventilators and respiratory devices are responsible for a great deal of the noise pollution in high acuity patient care units. Although respiratory therapists typically manage ventilators and other respiratory devices in these environments, nurses in high acuity units need to have a basic understanding of the causes of alarms in order to optimally coordinate care with respiratory therapists, the patient’s practitioner, and to manage alarms effectively.
Ventilator and Respiratory Device Alarms

Two modes used in mechanical ventilation are volume and pressure control. The goals of all mechanical ventilation are to protect the airway, facilitate gas exchange and prevent lung tissue damage. Practitioners elect ventilator mode settings and parameters based on the patient’s disease process. Recognizing problems indicated by alarms on ventilated patients is not only essential for managing ventilator alarms, it is also a good way to assess your patient for the possible need to adjust settings on the ventilator.
Low pressure and apnea alarms are indications of possible cuff leak, disconnected tubing, or loss of airway. Immediately assess your patient for patency and placement of the endotracheal tube and the ventilator tubing. Be prepared to administer emergency airway management if your patient has become partially or fully extubated.
Ventilator and Respiratory Device Alarms

With low volumes, again, look for leaks or disconnects in the tubing circuit, check for cuff leaks and make sure the patient is receiving adequate gas flow. Check your patient at the same time. Has his respiratory pattern changed? Report your observations to your respiratory therapist and practitioner to coordinate care and collectively determine the best changes that need to be made for your patient.
Always make sure during your shift exchange bedside rounds that there is a functional Ambu bag at your patient’s bedside in the event of ventilator failure or unplanned extubation!
Pulse Oximetry

– Tailor pulse oximetry alarms to your patient. If your patient with COPD lives at 87% saturation at home and is comfortable there, don’t expect him or her to saturate at 90% for you in the hospital!

– Set you SpO2 monitor alarm with a 5 to 15 second delay. This will give the patient’s normal physiological mechanisms an opportunity to respond to transient dips in oxygen saturation and help to eliminate a large number of false or nuisance alarms.
Pulse Oximetry

– Make sure your equipment is in good order and functioning properly. A sensor that is not adhering to the patient’s skin and nailbed, or that has broken connections that are flickering off and on, will set off false alarms.
Infusion Pump Alarms

Types of pumps frequently used in acute care settings:
● Intravenous fluid and medication infusion pumps
● Enteral feeding infusion pumps

Typical causes of infusion pump alarms:
● Occlusion
● Air in the line
● Pump failure

Infusion pump technology measures:
● Pressure
● Flow resistance
Infusion pumps are used to safely deliver intravenous fluids, blood, medications and measureable doses of enteral feedings to optimize patient nutrition and calorie intake. These pumps are also a source of frequent alarms in acute care settings, adding to noise pollution and contributing to alarm fatigue.
Infusion Pump Alarms

The most common types of alarms nurses encounter with infusion pumps are occlusion, air in the line, and pump failure. AACN core management strategies for infusion pump alarms specifies that there is no replacement for nurse assessment of infusion pump alarms.
Infusion Pump Alarms

The AACN recommends proactive identification of problems that interfere with infusion.

- **Occlusion alarms may be caused by obstruction:**
  - Check stopcocks and slide clamps between the pump and the patient’s IV access
  - Look for kinks in the tubing
  - Assess filters and tubing for buildup of precipitates
  - Assess the patient’s IV access for patency
Infusion Pump Alarms

The AACN recommends proactive identification of problems that interfere with infusion.

- **Air in line alarms:**
  - Optimize alarm settings (seek assistance from your facility’s biomedical team if necessary)
  - Ensure there is adequate IV fluid in the infusion bag and check programed flow and volume with each assessment to prevent fluid from running out before programed volume amount is reached
Infusion Pump Alarms

The AACN recommends proactive identification of problems that interfere with infusion.

- **Change IV tubing**

- **Take failed pumps out of circulation:**
  - Tagged per your facility’s policy for biomedical intervention
Bed or Chair Exit Alarms

Exit alarms are used for prevention of falls in patients with:

- Delirium or psychosis
- Cognitive impairments
- Inability to walk without support or assistance
- Unstable balance or gait
Bed or Chair Exit Alarms

Types of exit alarms in use:
- Built into beds
- Stand-alone technology
- Portable system pad monitors
- Voice alarms
- Seatbelt alarms for wheelchairs
Falls are the most common cause of occurrences reported in hospitals and a leading cause of death in people aged 65 and older. The Joint Commission requires all healthcare facilities to have a fall-prevention program in place and conduct ongoing evaluations of the effectiveness of their program.
Exit Alarms and Fall Risk/Prevention

— Exit alarms are usually a part of facility fall-prevention programs. They can also be a significant source of false alarms.

— Additionally, an exit alarm sound does not always give nursing staff adequate time to intervene before a patient falls.

Harma, A., ten Kate, W., & Espina, J. (2014). Bed exit prediction based on movement and posture data. In Biomedical and Health Informatics (BHI), 2014 IEEE-EMBS International Conference on (pp. 165-168). IEEE.


Exit Alarms and Fall Risk/Prevention

- Research literature related to the effectiveness of exit alarms for preventing falls is ambivalent.

- Fall risk assessments are a standard part of nursing patient care, but fall risk assessments do not necessarily provide criteria to discern who will benefit from exit alarms and who will not.

Harma, A., ten Kate, W., & Espina, J. (2014). Bed exit prediction based on movement and posture data. In Biomedical and Health Informatics (BHI), 2014 IEEE-EMBS International Conference on (pp. 165-168). IEEE.


Other Medical Equipment

- Wound Vac Devices
- Continuous Renal Replacement Therapy Devices
- Sequential Compression Devices
- Balloon Pumps
- Left Ventricular Assist Devices
- Intracranial Pressure Monitoring Devices
- Pacemakers
- Call bells
- Phones ringing
Other Medical Equipment

- Medical devices are used in nursing home facilities, rehab and long term care facilities, hospital general medical wards, operating rooms, emergency rooms, critical care units, x-ray departments, laboratories, emergency response vehicles, clinics, and even in patient homes.

- Many factors affect the performance of these devices, including surrounding noise, lighting, glare-producing or resistant surfaces, the products used to clean the devices, electronic interference, moisture or thermal environmental factors, programming of devices, caregiver stress, and fatigue.
Other Medical Equipment

– Medical devices can be used most safely and effectively if they are designed to suit the environment in which they are used, and to match the capabilities and stress levels of the users.
Other Medical Equipment

– The Food and Drug Administration advocates for medical equipment designers and programs to consider these needs in the development process, for users to be properly trained on any medical equipment they are using, and for healthcare facilities to ensure proper operation and maintenance of medical devices as part of the effort to reduce risks of incidents associated with medical devices.

http://www.fda.gov/RegulatoryInformation/Guidances/ucm094957.htm
What is the Best Way To Respond To Alarm Fatigue?

- Develop alarm setting and response protocols
  - Alter alarm parameters and limits to actionable levels based on patient needs
- Prepare skin preparation
- Daily maintenance of monitoring equipment
- Initial and ongoing training of staff on alarm-based devices
What is the Best Way To Respond To Alarm Fatigue?

- Standardizing alarm sounds and priority ratings
- Quality management and oversight of alarm issues
- Appropriate use of monitoring devices with alarms
Evidence-based practice guidelines provided by the American Association of Critical Care Nurses recommend:

1. **Proper skin preparation for ECG electrodes.** Skin should be washed with soap and water and the area of electrode placement wiped dry with a rough washcloth or gauze. Alcohol should not be used for skin prep.

2. **ECG electrodes should be changed daily and if they become detached.**

3. **Alarm parameters and levels on ECG monitors should be customized to meet the needs of the individual.** Alarm parameters should be checked and adjusted within 1 hour of assuming care of a patient or immediately if the patient’s condition changes.
Evidence-based practice guidelines provided by the American Association of Critical Care Nurses recommend:

4. **Alarm delay and threshold settings on oxygen saturation via pulse oximetry (SpO2) monitors should be customized to meet the patient’s needs.** Disposable, adhesive pulse oximetry sensors should be used according to manufacturer recommendations and replaced when they no longer adhere properly.

5. **Staff using devices should receive initial and ongoing education about devices with alarms.** Education needs to include effective operation and re-evaluation on a regular basis.
Evidence-based practice guidelines provided by the American Association of Critical Care Nurses recommend:

6. **Interprofessional team should be formed to address issues related to alarms and participate in development and review of policies and procedures.**

7. **Only patients with clinical indications for monitoring should be monitored.**

Conclusions

According to The Joint Commission statistics, medical devices alarm at the rate of:

- 100s per patient per day
- 1000s per each nursing unit per day
- 10,000s per hospital per day
- 85-99% of those alarms are nuisance or false alarms
Conclusions

– Alarm fatigue is caused by clinician desensitization to all of those alarms.

– Turning off, turning down, or adjusting alarms outside of safe parameters can have serious or fatal consequences.
Conclusions

The Joint Commission Sentinel Event Database documents reports between January 2009 to June 2012 of:

- 98 alarm related events, including:
  - 80 deaths
  - 13 permanent loss of function
  - 5 extended length of stay or additional care requirements
Conclusions

The Joint Commission recommends facilities:
1. Have a process for safe alarm management and response

2. Inventory alarm-equipped medical devices

3. Have guidelines for alarm settings

4. Have guidelines for tailoring alarm settings and limits for individual patients

5. Inspect, check, and maintain alarm-equipped devices