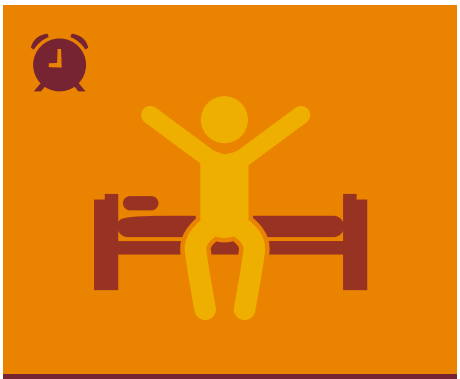
Alarm fatigue:

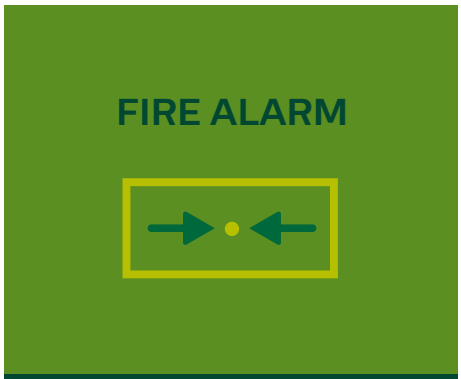
a patient safety hazard

Learn more

Alarms are **good for us**...



An alarm helps you wake up on time.



A fire alarm helps protect against potential fire hazards.

A smoke alarm at work helps us avert a fire hazard.

But what if we are subjected to a high volume of constant alarms? For example, how would you react if eight out of ten fire alarms are false alarms?

Well, in such cases, we develop what's called an "alarm immune system," which prevents us from acting on each and every alarm. Consequently, we respond slowly or with lower urgency to such alarms.

A situation where people are less likely to respond adequately to alarms due to desensitization by false alarms is called "alarm fatigue."

Table of content

What is alarm fatigue?

Alarm fatigue is a problem that can be found around the world where devices or processes are controlled by humans.

Here are some generic and clinical alarm fatigue cases and research, surveys, and findings on the topic of alarm fatigue.

Click a topic to get started.

Note: This is the homepage. You can access any topic and return to this page by clicking the Home icon ⌂.

Alternatively, you can click through the next arrow to view all of these topics in a sequence.

Generic alarm fatigue cases

Overview

Alarm fatigue is a problem that can be found around the world where devices or processes are controlled by humans. Obviously, in industries like transportation or the oil rigging industry, alarm fatigue can have disastrous consequences.

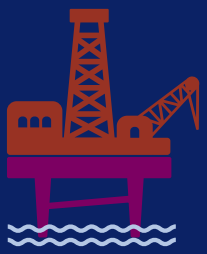
Take a look at the examples on the next pages!

Generic alarm fatigue cases

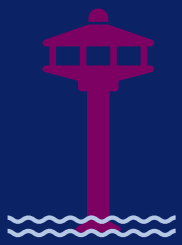
Disastrous mishaps

Click an icon to learn more.

The rig



The control tower



The train on the loose

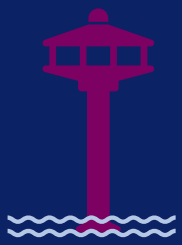
Generic alarm fatigue cases

Disastrous mishaps

Click an icon to learn more.

The rig

The control tower



The train on the loose

What happened?

The BP Deepwater Horizon rig exploded in 2010, killing 15 workers and injuring 180. Millions of gallons of oil spewed into the Gulf of Mexico following the blast.

How did it occur?

The alarm did not sound during the emergency, leaving workers to relay information through the loudspeaker system.

Why did it happen?

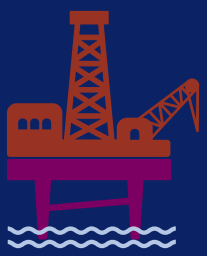
The general safety alarm was habitually set to “inhibited” to avoid waking up the crew with late-night sirens and emergency lights. The rig’s chief electronic technician, Mr. Williams, informed the federal panel of investigators that people did not want to be woken up at 3:00 a.m. from false alarms.

Generic alarm fatigue cases

Disastrous mishaps

Click an icon to learn more.

The rig



The control tower

The train on the loose

What happened?

Korean Airlines flight 801 crashed at Sasa Valley on Aug 6, 1997; 228 of the 254 aboard the Boeing 747 were killed.

How did it occur?

The “minimum safe altitude warning” alarm did not sound as it should have.

Why did it happen?

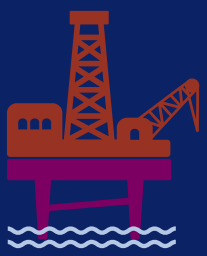
The controllers thought the “minimum safe altitude warning” alarm system in the control tower had sounded too often, so they persuaded a technician to prevent it from sounding under normal circumstances.

Generic alarm fatigue cases

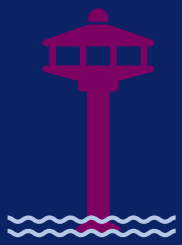
Disastrous mishaps

Click an icon to learn more.

The rig



The control tower



The train on the loose

What happened?

A fatal rail crash was reported in London.

How did it occur?

The train driver repeatedly “acknowledged” an alarm from an Automated Warning System (AWS), signaling a Signal Passed At Danger (SPAD) event.

Why did it happen?

Official investigations mention that the driver’s action of depressing the acknowledge button had become a “conditioned response”, a phenomenon that was not uncommon among conductors. Even though there were three “lines of defense, the signal, the AWS warning that a signal at danger had been passed, and the safety director’s repeated clear written warnings about SPAD incidents in this area, 31 were killed and many injured.

Source:
Whittingham, R.B., 2004. The blame machine: why human error causes accidents. Burlington, MA: Elsevier.
The Guardian, 2000, https://www.theguardian.com/uk

Clinical alarm fatigue cases

Overview

As in the non-clinical examples, in a clinical setting, alarm fatigue can appear in varying shapes and forms. People may turn off alarms, not believe that the alarm is a true one, or simply not react to it.

View the next two pages on ICU and perioperative case vignettes.

Clinical alarm fatigue cases

ICU case vignettes

Here are three further ICU cases that underline the issue of mishaps owing to alarm fatigue:

Click the icons to learn more about each case.

The alarm that never beeped

An hour too late

The Asystole alarm

Clinical alarm fatigue cases

ICU case vignettes

Here are three further ICU cases that underline the issue of mishaps owing to alarm fatigue:

Click the icons to learn more about each case.

The alarm that never beeped

An hour too late

The Asystole alarm

What happened?

A patient died after the unit's monitoring alarms were shut off.

How did it occur?

A registered nurse in the hospital's telemetry unit turned off an array of alarms that were hooked up to all of the patients in that unit. During that time, one of the patient's blood-oxygen level dropped slowly from a normal level in the 90s to the 30s—a dangerously low level—for 45 minutes. The patient was found unresponsive, ashen, pale, and cyanotic. After checking for pulse, RNs were called out and Code Blue was called.

Why did it happen?

All of the alarms in the unit had been shut off for roughly three hours. As a result, when the patient's blood oxygen level dropped, no alarm sounded to alert the nurses of the danger. When asked why the alarms were shut off, the nurse responded, "the alarms were always going off, even if the patients weren't in distress."

Source:
https://www.usatoday.com/

Clinical alarm fatigue cases

ICU case vignettes

Here are three further ICU cases that underline the issue of mishaps owing to alarm fatigue:

Click the icons to learn more about each case.

The alarm that never beeped

An hour too late

The Asystole alarm

What happened?

A 60-year-old man died in an intensive care unit of a medical center.

How did it occur?

Alarms signaling the patient's fast heart rate and potential breathing problems went unanswered for nearly an hour.

Why did it happen?

Nurses exposed to a cacophony of beeps became conditioned to ignore them after some time. That's what appears to have happened in this case. The investigation report mentions that the responsible nurse assumed that somebody else had taken care of the "warning" alarm. Only after a "critical" alarm sounded 45 minutes later, the nurse reacted and found the patient in a fatal condition.

Source:
http://archive.boston.com

Clinical alarm fatigue cases

ICU case vignettes

Here are three further ICU cases that underline the issue of mishaps owing to alarm fatigue:

Click the icons to learn more about each case.

The alarm that never beeped

An hour too late

The Asystole alarm

What happened?

Philips received a complaint involving a fatal event. The customer maintained that a cardiac arrest had not been signaled by the monitor.

How did it occur?

Analysis of the alarm logs revealed that there had been 11 alarms, all of which were acknowledged by the staff. These alarms were acknowledged without walking over to the patient; hence, the patient's condition went unnoticed.

Why did it happen?

This fatal event appears to be very analogous to the rail crash example. Acknowledging false alarms can become a mechanical process, so that nurses no longer check whether an alarm is in fact a false alarm.

Source:
Philips internal analysis of a monitor log after a customer complaint involving a fatal event

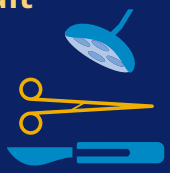
Clinical alarm fatigue cases

Perioperative case vignettes

Here are a few demonstrative perioperative cases that underline the issue of mishaps owing to alarm fatigue.

Click each icon to learn more about the cases.

Deflated tourniquet lawsuit



The muted alarm

More OR cases

Clinical alarm fatigue cases

Perioperative case vignettes

Here are a few demonstrative perioperative cases that underline the issue of mishaps owing to alarm fatigue.

Click each icon to learn more about the cases.

Deflated tourniquet lawsuit

The muted alarm

More OR cases

What happened?

A patient filed a lawsuit blaming the distracted doctor, failure of all alarms, and the carelessness of the anesthesiologist.

How did it occur?

On September 25, 2014, a woman underwent an operation for removal of a ganglion cyst in her wrist in the OR of an Ambulatory Surgery Center. After some time, the circulating nurse noticed that the patient's face had turned "dusky blue." No alarm on the blood pressure monitor, pulse oximeter, and ECG sounded when the tourniquet deflated and released a dangerous bolus dose of lidocaine into the patient's system, causing arrhythmia and downward spiral. She was resuscitated with mask ventilation, epinephrine, and chest compressions. Initially, unable to breathe on her own, she was intubated and transferred to another hospital.

Why did it happen?

The anesthesiologist, though present at the patient side, was looking in a different direction at an electronic device in his hand. Besides, all alarms were turned off.

Source:
http://www.outpatientsurgery.net/

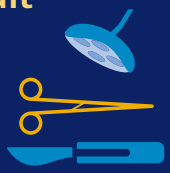
Clinical alarm fatigue cases

Perioperative case vignettes

Here are a few demonstrative perioperative cases that underline the issue of mishaps owing to alarm fatigue.

Click each icon to learn more about the cases.

Deflated tourniquet lawsuit



The muted alarm

More OR cases

What happened?

A patient died during an elective surgical procedure in a German hospital.

How did it occur?

On January 11, 2011, a woman underwent a breast enlargement operation. Early on in the procedure, the patient suffered severely low blood oxygen levels. But the alarm that would warn about such an event had been turned off by the anesthesiologist. Thus the dangerous condition went unnoticed and led to a cardiac arrest. Despite resuscitation, the patient died a few days later while in coma.

Why did it happen?

The investigation revealed several factors contributing to the fatal event. The anesthesiologist stated that she was completely desensitized to the regular sounds of the monitor indicating the heartbeat. Who actually had turned off the alarm on the oxygen saturation remained unclear.

Source:
http://www.sueddeutsche.de
http://www.faz.net

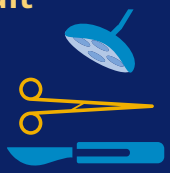
Clinical alarm fatigue cases

Perioperative case vignettes

Here are a few demonstrative perioperative cases that underline the issue of mishaps owing to alarm fatigue.

Click each icon to learn more about the cases.

Deflated tourniquet lawsuit



The muted alarm

More OR cases

Case 1 – Weaver JM: Alarm Fatigue Can Decrease the Safety of Dental Office Sedation and Anesthesia. Anesthesia Progress 2013, 60(3): 93–94

During dental surgery, the dentist noticed an alarm indicating sudden decrease in blood oxygen saturation. He had the oximeter probe replaced to other fingers of the same and then of the opposite hand but the pulse oximeter still showed abnormal reading. He then ordered for another pulse oximeter that too appeared to be faulty. Meanwhile, the patient suffered a hypoxia-induced cardiac arrest.

Source:
https://www.ncbi.nlm.nih.go

Case 2 – AHCmedia.com

A 17-year-old high school junior underwent a tonsillectomy at a Pennsylvania surgery center. In the recovery room she was given a potent painkiller that slowed her breathing. She was left unobserved for 25 minutes. The monitors in the recovery room, which would have alarmed on the condition, were all set to mute. By the time nurses checked on her, she had suffered profound and irreversible brain injury. She died 15 days later.

Her parents won a lawsuit of $6 million malpractice settlement.

Source:
https://www.ahcmedia.com

Research, surveys, and findings

Overview

Seeing as alarm fatigue is both dangerous and widely underestimated, we dug deeper into the topic.

View the next pages to read through some findings related to alarm fatigue and its causes.

Research, surveys, and findings

Alarm fatigue threat around the world

Now that you've read about a few individual alarm fatigue cases, let's review some consolidated reports of alarm fatigue from around the globe.

Click each highlighted country to learn more.

Boston Globe

The Joint Commission warned hospitals that constant beeping of medical devices on patients desensitizes caregivers and causes them to ignore or disable the alarm systems, thus causing critical danger to the life of patients. It also stated that between 2009 and 2012, 80 cases of deaths and 13 cases of severe injuries due to alarm fatigue were reported. As there are no means to track cases of alarm fatigue, authorities depend on hospitals that report such cases voluntarily. It can be safely assumed that the actual number of deaths caused due to alarm fatigue is much higher.

Source:
https://www.bostonglobe.com

Research, surveys, and findings

Alarm fatigue threat around the world

Now that you've read about a few individual alarm fatigue cases, let's review some consolidated reports of alarm fatigue from around the globe.

Click each highlighted country to learn more.

Israel

A study was conducted in Israel to observe and analyze the reactions of nurses toward monitor alarms in NICU. It was observed that nurses do not react directly to alarms, rather they use them as a source of information to be recorded in daily routine activities.

Title: Bitan, Y., Meyer, J., Shinar, D., & Zmora, E. (2004). Nurses' reactions to alarms in a neonatal intensive care unit. Cognition, Technology & Work, 6(4), 239-246.

Source:
https://link.springer.com

Boston Globe

The Joint Commission warned hospitals that constant beeping of medical devices on patients desensitizes caregivers and causes them to ignore or disable the alarm systems, thus causing critical danger to the life of patients. It also stated that between 2009 and 2012, 80 cases of deaths and 13 cases of severe injuries due to alarm fatigue were reported. As there are no means to track cases of alarm fatigue, authorities depend on hospitals that report such cases voluntarily. It can be safely assumed that the actual number of deaths caused due to alarm fatigue is much higher.

Source:
https://www.bostonglobe.com

Research, surveys, and findings

Alarm fatigue threat around the world

Now that you've read about a few individual alarm fatigue cases, let's review some consolidated reports of alarm fatigue from around the globe.

Click each highlighted country to learn more.

Brazil

A study was conducted in Brazil to observe and analyze the reactions of a healthcare team toward monitoring alarms in ICU. It was observed that the reaction time to monitoring alarms is generally very high, thus casting fatal implications for seriously ill patients.

Title: Pergher, A. K. et al. (2014). Stimulus-response time to invasive blood pressure alarms: implications for the safety of critical-care patients. *Revista Gaúcha de Enfermagem*, 35(2), 135-141

Source:
http://www.scielo.br/

Boston Globe

The Joint Commission warned hospitals that constant beeping of medical devices on patients desensitizes caregivers and causes them to ignore or disable the alarm systems, thus causing critical danger to the life of patients. It also stated that between 2009 and 2012, 80 cases of deaths and 13 cases of severe injuries due to alarm fatigue were reported. As there are no means to track cases of alarm fatigue, authorities depend on hospitals that report such cases voluntarily. It can be safely assumed that the actual number of deaths caused due to alarm fatigue is much higher.

Source:
https://www.bostonglobe.com

Research, surveys, and findings

Alarm fatigue threat around the world

Now that you've read about a few individual alarm fatigue cases, let's review some consolidated reports of alarm fatigue from around the globe.

Click each highlighted country to learn more.

France

A study proved that the mere volume of false alarms in ICU or NICU creates noise pollution of more than 80db, resulting in alarm numbness and sleep deprivation in both patients and nurses. Even experienced nurses were able to identify life-threatening alarms by sound only in just 38% cases.

Title: Chambrin, M. C. (2001). Alarms in the intensive care unit: how can the number of false alarms be reduced?. Critical Care, 5(4), 184

Source:
http://paperity.org

Boston Globe

The Joint Commission warned hospitals that constant beeping of medical devices on patients desensitizes caregivers and causes them to ignore or disable the alarm systems, thus causing critical danger to the life of patients. It also stated that between 2009 and 2012, 80 cases of deaths and 13 cases of severe injuries due to alarm fatigue were reported. As there are no means to track cases of alarm fatigue, authorities depend on hospitals that report such cases voluntarily. It can be safely assumed that the actual number of deaths caused due to alarm fatigue is much higher.

Source:
https://www.bostonglobe.com

Research, surveys, and findings

Alarm fatigue threat around the world

Now that you've read about a few individual alarm fatigue cases, let's review some consolidated reports of alarm fatigue from around the globe.

Click each highlighted country to learn more.

Australia

Several under-reported cases of alarm fatigue were brought to light as they caused an average 24 deaths in a year in Australia. Research stated that overworked healthcare professionals tune off the beeping alarms of medical devices that are used to monitor vital statistics of critically ill patients, thus causing deaths. A growing number of incidents are being frequently reported all over the country, owing to noise and alarm fatigue in hospital personnel.

Title: News.com.au

Source:
http://www.news.com.au

The Joint Commission warned hospitals that constant beeping of medical devices on patients desensitizes caregivers and causes them to ignore or disable the alarm systems, thus causing critical danger to the life of patients. It also stated that between 2009 and 2012, 80 cases of deaths and 13 cases of severe injuries due to alarm fatigue were reported. As there are no means to track cases of alarm fatigue, authorities depend on hospitals that report such cases voluntarily. It can be safely assumed that the actual number of deaths caused due to alarm fatigue is much higher.

Source:
https://www.bostonglobe.com

Research, surveys, and findings

Alarm fatigue threat around the world

Now that you've read about a few individual alarm fatigue cases, let's review some consolidated reports of alarm fatigue from around the globe.

Click each highlighted country to learn more.

Korea

A study was conducted to investigate the number of clinical alarms in ICU, nurses' recognition of clinical alarms, and most common obstacles in alarm management. It was found that in one hour in ICU, 63.8% alarms were false alarms that resulted in alarm fatigue in nurses, thereby reducing their attention to critical alarms.

Title: Cho, O. M. et al. (2016). Clinical alarms in intensive care units: Perceived obstacles of alarm management and alarm fatigue in nurses. Healthcare informatics research, 22(1), 46-53

Source:
https://www.ncbi.nlm.nih.gov

The Joint Commission warned hospitals that constant beeping of medical devices on patients desensitizes caregivers and causes them to ignore or disable the alarm systems, thus causing critical danger to the life of patients. It also stated that between 2009 and 2012, 80 cases of deaths and 13 cases of severe injuries due to alarm fatigue were reported. As there are no means to track cases of alarm fatigue, authorities depend on hospitals that report such cases voluntarily. It can be safely assumed that the actual number of deaths caused due to alarm fatigue is much higher.

Source:
https://www.bostonglobe.com

Research, surveys, and findings

Alarm fatigue threat around the world

Now that you've read about a few individual alarm fatigue cases, let's review some consolidated reports of alarm fatigue from around the globe.

Click each highlighted country to learn more.

Iran

Developmental and psychometric properties analysis was conducted on nurses. The analysis was conducted by collecting data from an alarm fatigue questionnaire filled out by the nursing staff. The study was important as alarm fatigue was increasingly causing adverse affect on the efficiency of nurses, thus posing life threat to critically ill patients.

Title: Torabizadeh, C. et al. (2017). A nurses' alarm fatigue questionnaire: development and psychometric properties. Journal of clinical monitoring and computing, 31(6), 1305-1312.

Source:
https://www.readcube.com

The Joint Commission warned hospitals that constant beeping of medical devices on patients desensitizes caregivers and causes them to ignore or disable the alarm systems, thus causing critical danger to the life of patients. It also stated that between 2009 and 2012, 80 cases of deaths and 13 cases of severe injuries due to alarm fatigue were reported. As there are no means to track cases of alarm fatigue, authorities depend on hospitals that report such cases voluntarily. It can be safely assumed that the actual number of deaths caused due to alarm fatigue is much higher.

Source:
https://www.bostonglobe.com

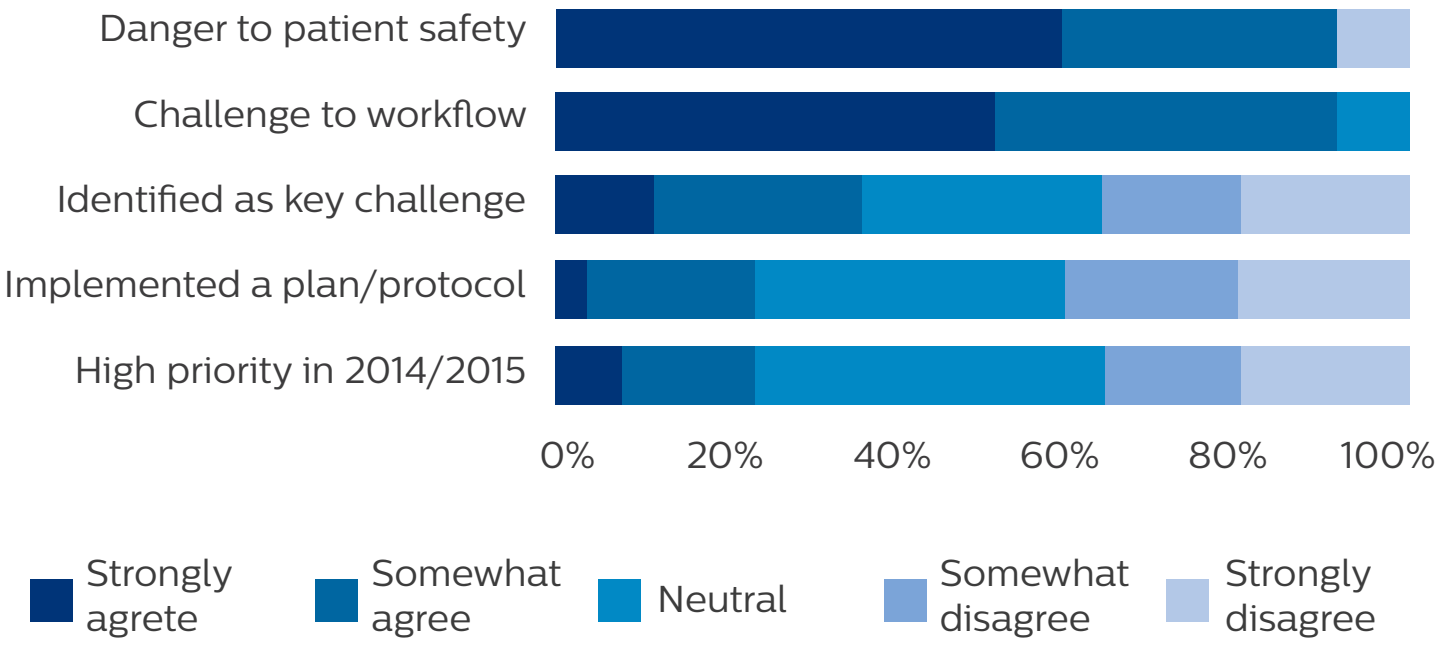
Research, surveys, and findings

Healthcare surveys

A survey done by the Physician-Patient Alliance for Health and Safety with physicians and Biomeds unveiled the following information.

1. Most people think that insufficient alarm management poses a significant danger to patient safety.
2. Very few respondents from hospitals and healthcare facilities feel that their institution has implemented a plan or protocols specific to alarm management.
3. Healthcare professionals agree that it is a difficult and complex task to improve alarm management.

A systematic approach to tackling the problem is due. This also requires a profound understanding of the root causes of excessive alarms.



Source:
http://www.ppahs.org

Research, surveys, and findings

Healthcare surveys

A survey done by the Healthcare Technology Foundation with ICU nurses revealed similar insights.

More than 80%
of the nurses feel that Nuisance alarms occur frequently, reduce trust in alarms and cause care givers to inappropriately turn alarms off at times other than during setup or procedures.

86%
of the ICU nurses agreed that “Nuisance alarms disrupt patient care.”

50%
of the respondents stated that in the previous two years their institution has experienced adverse patient events related to clinical alarm problems.

Source:
http://thehtf.org

Research, surveys, and findings

Healthcare surveys

On behalf of Philips, Junicon conducted a survey on alarm fatigue with 56 nurse managers. Here's what they found out.

More than 90%
of nurses agree or somewhat agree that an environment of continuous alarming is responsible for desensitizing clinicians to individual patient alarms.

More than 90%
nurses agree or somewhat agree that false and nuisance alarms contribute to delayed response time to truly "actionable alarms."

The survey also revealed that **more than 50%** nurses refuse or somewhat refuse to accept excessive alarms as "just part of the job."

But sadly, **most** nurses feel that there are no easy answers currently available to solve this problem.

Research, surveys, and findings

Alarm fatigue root causes

There are various factors that create excessive unnecessary alarms. They range right from technical and architectural infrastructure issues to human behavior and competencies.

Some of the factors that result in such excessive alarms are identified as the following:

Click each cause to learn more.

Consumable material defects or inadequacy

Unfavorable environment/ architecture

Suboptimal configuration

Inadequate infrastructure/ equipment

Improper workflow

Adverse organizational culture or practices

Research, surveys, and findings

Alarm fatigue root causes

There are various factors that create excessive unnecessary alarms. They range right from technical and architectural infrastructure issues to human behavior and competencies.

Some of the factors that result in such excessive alarms are identified as the following:

Click each cause to learn more.

Consumable material defects or inadequacy

- Inadequate electrodes and sensors
- Sensors beyond expiry date

Research, surveys, and findings

Alarm fatigue root causes

There are various factors that create excessive unnecessary alarms. They range right from technical and architectural infrastructure issues to human behavior and competencies.

Some of the factors that result in such excessive alarms are identified as the following:

Click each cause to learn more.

Unfavorable environment/architecture

- Unfavorable unit layout
- Many disparate medical devices

Research, surveys, and findings

Alarm fatigue root causes

There are various factors that create excessive unnecessary alarms. They range right from technical and architectural infrastructure issues to human behavior and competencies.

Some of the factors that result in such excessive alarms are identified as the following:

Click each cause to learn more.

Inadequate infrastructure/equipment

- Insufficient monitor functions
- Low monitor usability
- No central station
- No alarm forwarding to caregiver
- No integration of alarm issuing devices

Research, surveys, and findings

Alarm fatigue root causes

There are various factors that create excessive unnecessary alarms. They range right from technical and architectural infrastructure issues to human behavior and competencies.

Some of the factors that result in such excessive alarms are identified as the following:

Click each cause to learn more.

Suboptimal configuration

- No alarm-saving function used
- Inadequate defaults
- No use of patient profiles
- Overmonitoring

Research, surveys, and findings

Alarm fatigue root causes

There are various factors that create excessive unnecessary alarms. They range right from technical and architectural infrastructure issues to human behavior and competencies.

Some of the factors that result in such excessive alarms are identified as the following:

Click each cause to learn more.

Improper workflow

- No “alarm handover”
- No daily electrode change
- No tailoring of alarm limits to patient and clinical status

Research, surveys, and findings

Alarm fatigue root causes

There are various factors that create excessive unnecessary alarms. They range right from technical and architectural infrastructure issues to human behavior and competencies.

Some of the factors that result in such excessive alarms are identified as the following:

Click each cause to learn more.

Adverse organizational culture or practices

- Lack of discipline, e.g., during sensor and electrode placement
- Adverse organization or inappropriate culture
- Lack of competencies

Research, surveys, and findings

Consequences of alarm fatigue

Alarm fatigue is a global hazard, slowly becoming acknowledged as the threat it really is by healthcare professionals, patients, and their families. Though it has its roots in excessive nonactionable alarms experienced by hospital staff every day, its impact trickles down all the way to the families in case of fatalities, the well-being and occupational health of staff, and the economic setup of hospitals in cases of litigation owing to desensitization and negligence, but also due to decrease in reputation due to negative publicity.

Excessive (nonactionable) alarms cause

Extra stress and noise pollution in the hospital environment

Resultant delay in response to real clinical alarms

An increase in the number of fatalities and a fall in hospital reputation as a consequence

Philips understands alarm fatigue and has the expertise to support your organization in making necessary changes to improve your current alarm situation. Please contact your Philips representative to learn more.


PHILIPS