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Clinical
Transformation
and Education

Who
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Hospital, Nieuwegein,
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Dr. J.W. Wirds, anesthesiologist

Challenge
Further reduce the number of
irrelevant ICU alarms in new ICU
facility. The starting baseline was
344 alarms per bed per day.

Solution
Philips Clinical Transformation
and Education team provided
objective monitoring data and
change management support to
help the hospital's project team
reduce non-actionable alarms
by 40%.

St. Antonius Hospital
reduces non-actionable ICU alarms by 40% to improve patient care and staff satisfaction

The ICU department at St. Antonius Hospital is no stranger to process improvements. They are continually working on projects to improve patient safety and staff satisfaction. Despite their successes in reducing irrelevant ICU alarms in their old facility, they were not satisfied with the results. When they moved to a new ICU facility, they asked Philips Clinical Transformation and Education team to help them further reduce the number of irrelevant ICU alarms. Their goal was to improve patient care and staff satisfaction by decreasing noise and distractions in the care environment significantly.

St. Antonius is a leading teaching hospital with a strong focus on research and training in Nieuwegein, The Netherlands. It offers nearly all medical specialties and is known nationally for its expertise in heart, artery, and lung treatments. The Hospital runs healthcare operations from six different locations. In July 2012, St. Antonius moved into a new ICU facility that has 24 beds with 130 nurses for ICU and 10 beds with 30 nurses for medium care.

This new facility is equipped with Philips IntelliVue patient monitoring systems. These monitors offer a number of advanced algorithms and features designed to give healthcare facilities more flexibility in setting up and managing alarms. Features, such as Smart Alarm delay SpO2, flush/blood sample detection in the invasive blood pressure measurement, and automatic alarm limit adjustment help reduce non-actionable alarms. Different alarm profiles can also be created for specific patient groups for added flexibility.

The alarm system challenge

Many devices used in patient care – ventilators, blood pressure monitors, pulse oximetry devices, cardiac monitors, etc. – produce noise. All of them have alarms. In fact, studies show that it's not uncommon for 300 alarms to sound, per bed per day.[1] Some alarms are unimportant. Some are errors. Some warn of a critical change in a patient's condition. And some are not even heard.

Alarms generate noise that may present occupational hazards or hinder patient recovery.[2,3] In fact, noise levels in most hospitals exceed the World Health Organization (WHO) recommendations of 35 decibels (dB) during daytime hours and 30 dB for nighttime hours.[4] This excessive noise, in addition to being annoying can be very dangerous. Alarm noise can keep patients from fully resting and can make them feel agitated or nervous. Nurses and physicians can become irritated, overwhelmed, and in the long run, de-sensitized to the sound of an alarm.

This state is commonly referred to as "alarm fatigue," and it can result in clinicians changing alarm settings, turning down an alarm volume, or turning it off altogether. These actions can also result in staff reacting inadequately or in an untimely fashion to an important alarm.

An issue with alarming consequences

From 2005 through 2008, the U.S. Food and Drug Administration (FDA) Manufacturer and User Facility Device Experience (MAUDE) database received 566 reports of patient deaths related to monitoring device alarms.[5] Patient monitors are the highest contributing factor to monitoring device alarms.[6]

Alarm hazards appeared in the number one spot on the Annual Top 10 Technology Hazards for 2014 list published by the ECRI Institute.[7] Hazards include modifying alarms incorrectly, modifying alarms without restoring them to their original settings, alarm fatigue, disabling or silencing alarms, and poor communication of alarms to the appropriate caregiver.

The Joint Commission has issued a National Patient Safety Goal on alarm management,[8] which requires hospitals to establish alarm system safety as a priority and spells out specific actions required of hospitals to help ensure alarm effectiveness. While this is directed to hospitals and does not include specific requirements for equipment suppliers, it establishes that improving the safety of alarm-equipped medical devices is a high priority.

Stepping up efforts to reduce alarm fatigue

In their former ICU facility, the ICU team was very aware of the many negative consequences of alarm fatigue for patients and staff. They had taken steps to reduce their irrelevant alarms and experienced fewer of them but never measured their improvement. When they moved to the new ICU facility, they equipped it with new Philips IntelliVue monitoring systems. A configuration setting was carefully chosen which led to a further reduction of alarms, but the department felt they could do more. Since the Hospital had successfully carried out other process improvement projects with Philips, they asked the Clinical Transformation and Education team to see if they could find ways to further reduce their irrelevant alarms.

Why are there so many alarms?

The issue is not that alarms on medical equipment do not work correctly. All too often they work too precisely. Some of the top reasons for too many alarms are:

- Staff are not enabled to customize alarm limits
- Alarms are not suspended during procedures on patients
- Self-correcting conditions trigger unnecessary alarms
- Staff have insufficient consumables and do not attach electrodes or sensors properly
- Long response times lead to alarms repeating
- Alarming algorithms are too rigid

"There is so much information available, but we really needed the help of the consultants at Philips who knew how to analyze the data and could help us see how to use the technology to improve our care environment"

Philips Meaningful Alarms program

Philips has a long history of working with healthcare facilities to help them improve their clinical processes and care environment. Philips Clinical Transformation and Education (CTE) group provides clinical consultative services and education to support healthcare facilities in providing better care and increasing value. Their Meaningful Alarms program is a collaborative approach based on the DMAIC (Define, Measure, Analyze, Improve, Control) methodology that. The project at Nieuwegein Hospital focuses on reducing non-actionable alarms to enhance patient safety and improve healthcare environments for patients and medical staff. The heart of the CTE approach is providing objective data and change management support to achieve sustainable transformation.

Value of an external consultant

Change is a necessity in today's fast-paced healthcare environment, but the fact is that most change management programs fail. In a survey of business executives from around the world by McKinsey & Company, only 30 percent of them considered their change programs completely or mostly successful.[9] Another study reports the number of successful change management projects are even lower at 25 percent.[10] Working with an external consultant on such projects can greatly increase the chances of success.

The team had an ambitious goal. They wanted to reduce the number of alarms per bed per day by 30% in the ICU.

You can only change what you can measure

For the Meaningful Alarms project, a team was formed with various clinical staff from St. Antonius (nurses, technologists, clinical physicist, anesthesiologist) and consultants from Philips CTE. They defined the scope of the project and set their goal. They wanted to reduce the number of alarms per bed per day by 30% in the ICU.

Getting input from various stakeholders can be very beneficial for an organizational change project. During this project, different stakeholders were interviewed, including nurses, physicians, purchasing, managers, etc., to evaluate the impact that the alarm issue has on different areas of the Hospital. This also helped increase buy-in from stakeholders for the project. The CTE team then measured the specific number of alarms generated in the ICU ward by Philips monitors during a week to establish a baseline for the project.

Objective data is key

Data was the critical factor throughout this process according to Ineke van de Pol, project champion and ICU nurse practitioner. "Every root cause we looked at, every change we made, we validated all of it with actual data. That allowed us to see the impact of what we were doing. Without that data, we could never have done this. That was a big advantage of working with Philips because they could easily collect this data for us. They knew how to read the numbers and we could then make decisions about what steps to take."

**A baseline of 344 alarms per bed per day**

The measurements showed that 344 alarms per bed per day went off in the ICU. That meant that each patient and nursing staff were disturbed every 3 or 4 minutes by an alarm. This result and the other data collected were presented to the team at the kick-off meeting for the "Alarm Week" sessions. Van de Pol says, "When we heard those numbers, we were all shocked. No one expected it to be so high. I have to admit that we all felt a bit reluctant about this program in the beginning. It's a big investment in your time and you wonder if it's really needed. It was a very motivational moment for the entire team when you saw what the actual numbers were."

"I think that many people who work with monitors all day have no idea what they can do with the data they have," says Dr. J.W. Wirds, anesthesiologist. "There is so much information available, but we really needed the help of the consultants at Philips who knew how to analyze the data and could help us see how to use the technology to improve our care environment."

"You need to have someone shake you up a bit to commit to such a project"

"The numbers made all the difference to this project. Because we had the numbers, we quickly understood how important an issue it was for our ward. That's the value of having an outside party collect the data. You need to have someone shake you up a bit to commit to such a project."

Another number that surprised the team was the number of alarms that are ignored during the day. Because the actual alarms were measured, the team could see what alarms were activated, silenced, or turned off. This identified a potential safety issue that the ICU team was unaware of. Dr. Wirds says, "I was really surprised by the number of alarms that went off, but where no action was taken. Then you realize that a certain percentage of alarms provide no added value to your clinical process."
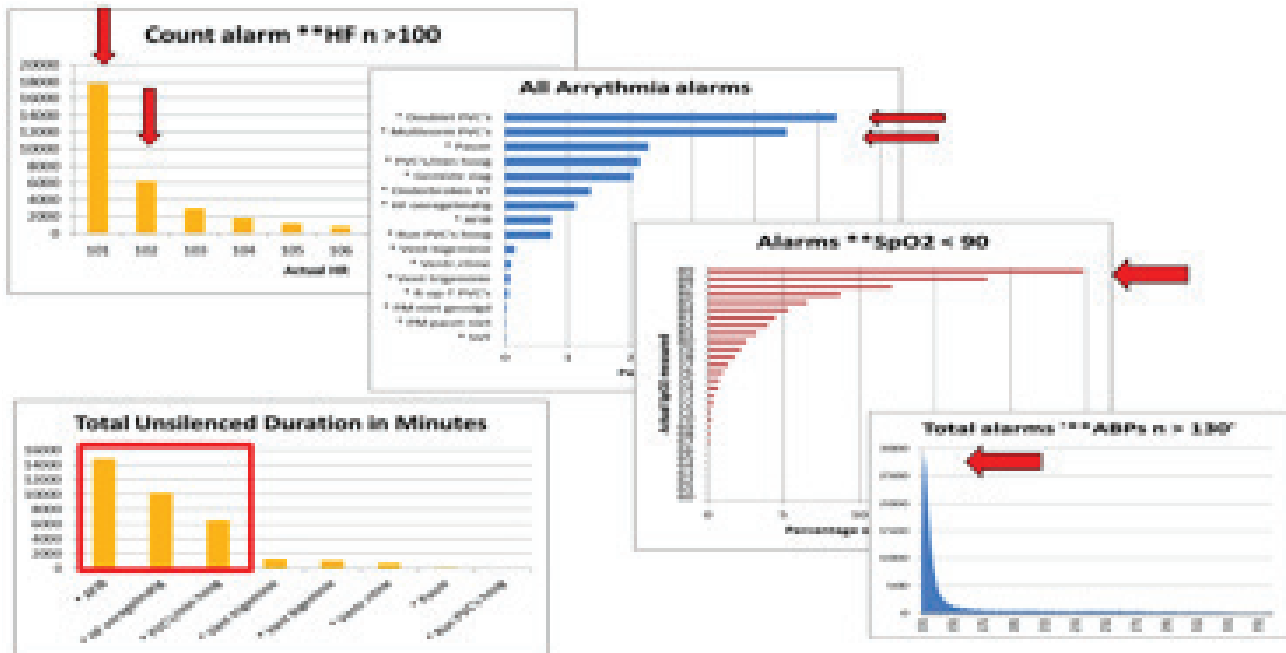
Phase 1 – from 344 to 249 alarms per bed per day

"I have to admit I was very skeptical about our ability to make a significant reduction in alarms. As a clinician you are always very cautious about changing anything that might cause risk to your patients, so I was unsure if we could really make an impact on the situation," says Dr. Wirds.

The team assessed the data and immediately identified a number of early improvements they could implement to reduce alarms. For instance, the ICU monitors were set to alarm when a patient's heart rate went above 110 (beats per minute) bpm. The data showed that many patients' heart rates would go to 111 bpm. "This was not life threatening, and by re-setting the alarm threshold to 115 we greatly reduced a number of unnecessary alarms without affecting the quality of care," says Dr. Wirds.

"When an alarm goes off you want to make sure it is **clinically relevant**"

Another early improvement was turning off the patient monitor during a procedure, such as when taking a blood sample. Two-thirds of the time the monitors were left on and this triggered alarms unnecessarily.

Van de Pol says, "When an alarm goes off you want to make sure it is clinically relevant. Our entire focus was on separating the clinically relevant alarms from non-clinically relevant alarms." To do this, the team split alarms into three categories:
· Blue for sensors/leads that have fallen off
· Yellow for a parameter that has exceeded its threshold
· Red for life threating situations

The first improvements were implemented during a four day pilot to test the new approach. After measuring the results of these changes for a few months to make sure they were sustainable, they were quickly accepted. These improvements allowed the ICU team to reduce the number of alarms by 27%, from 344 to 249 alarms per bed per day. Arrhythmia alarms were reduced by 47% and SPO$_2$ alarms were reduced by 54%.

Phase 2 – analyzing root causes and achieving further improvements

During the next phase of the project, the team focused on identifying the root causes of alarm issues. One key root cause was a lack of education and training of nursing staff on the monitoring capabilities and best practices. "For example, it's advisable to re-set your monitor profile for each patient at the beginning of your shift. Their condition may have changed, and that may influence the way you set-up your monitoring," says van de Pol. This is a practical training tip that can make a big difference in reducing alarms.

Based on the need for training, the ICU team appointed Super Users and Philips CTE organized a training program for them. This raised awareness among the staff of the importance of actively managing the settings and alarms on their monitoring systems. The ICU has now made alarm education a standard module in the training for their ICU nurses.

Before this project, the ICU used one standard alarm profile as the base setting for their monitors. After analyzing the data, the team identified the need for a second alarm profile to use for their medium care patients. This helped them further reduce unnecessary alarms.

Philips CTE also provided benchmarking from other similar facilities and information from regulatory guidelines to help the project team make fact-based decisions.

**Final results – team reduced alarms by 40% to 204 alarms per bed per day**

"After all the changes we made, we reduced our alarms by 40% – exceeding our initial goal by a quarter," says van de Pol. "We are now down to 204 alarms per bed per day. That's very motivating for all of us, to see that kind of accomplishment. It confirms that what we are doing is really making a difference. But even if we didn't have that number, we notice the difference on the ward. It's much quieter now. There is much less noise and we have a more pleasant work environment."

"In our old ward, patients complained a lot about the noise. Now it's **much quieter** and they are **more relaxed**"

Patients have noticed the difference as well says van de Pol. "In our old ward, patients complained a lot about the noise. Now it's much quieter and they are more relaxed."

Dr. Wirds adds, "One important advantage is that the staff now know that the alarms they do hear are relevant. They know they need to pay attention to them."

Alarms per day per bed by Type
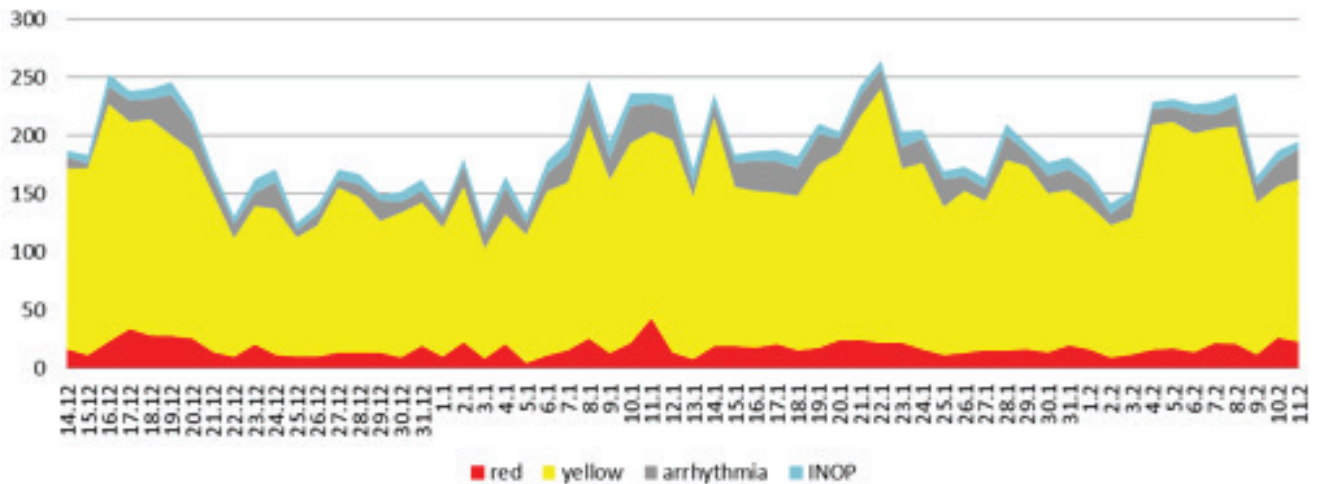
Philips CTE measurements confirmed the final results achieved at the St. Antonius ICU. The number of alarms per bed per day was reduced from 344 to 204.

"Every root cause we looked at, every change we made, we validated all of it with **actual data**."

Ineke van de Pol, project champion and ICU practitioner nurse

Advice for facilities considering such a project

Van de Pol says, "This whole process raised our consciousness about the importance of alarm management. When you are working around these signals all day long, you tend to accept it as normal. We all thought that the alarms weren't such a big issue. We didn't realize just how big the problem was or how much better we could make the situation. The Philips CTE consultants really helped us with that."

Dr. Wirds says, "It was very enjoyable working with Philips. They followed a very rigorous systematic process, and provided excellent guidance. When we thought we had gone as far as we could, they even encouraged us to take the extra step to reduce our alarms further."

"This is definitely a worthwhile project for a facility that has a lot of monitoring devices," says van de Pol. "You absolutely have to have the data to know what your actual situation is and to improve it. That also motivates everyone to make changes."

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