Table B.60: Alarm Fatigue, Risk Assessment- Single Studies

Note: Full references are available in the [Section 13.2 reference list](#Section13point2refs).

| Author, Year | Description of Patient Safety Practice | Study Design; Sample Size; Patient Population | Setting | Outcomes: Benefits | Outcomes: Harms | Implementation Themes/Findings | Risk of Bias (High, Moderate, Low) | Comments |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **AMMI, 20134** | Multidisciplinary team (patient safety experts, researchers, physicians, nurses, biomedical and human factors engineers, and information technology [IT] experts) to identify and address the challenges with patient-controlled analgesia pump. | Case study | Dartmouth-Hitchcock Medical Center. Medical-surgical orthopedic unit (36 beds). | Rescue events decreased from 3.5 per 1,000 patient days before implementation to 1.2 afterward. Intensive care unit (ICU) transfers decreased from 5.6 per 1,000 patient days to 2.9. Documented high patient and clinical acceptance of the surveillance monitoring. | Not provided | Based on results, expanded surveillance monitoring to additional adult medical-surgical units and pediatric and adolescent unit.  Team understood that implementing more advanced, IT-reliant medical equipment systems required a multidisciplinary perspective. Systems approach is a cycle of continuous improvement that includes prioritizing improvement, designing and testing change, implementing change, and continuing to measure performance. | High: case study and not peer reviewed | Pulled from Association for the Advancement of Medical Instrumentation (AAMI) Safety Innovations Series—manual search  Included in patient safety practice (PSP) 1 |
| **Alsaad et al., 201712** | Multidisciplinary team (MT) was involved in the study at varying levels. Ordering providers including attending physicians, residents, and advanced practice nurses, along with registered nurses and telemetry MT, were included in the educational sessions to familiarize them with the newly created protocols. The progressive care unit (PCU) nurse manager, nurse educator, and MT manager participated in the protocol creation and staff education. | Quality improvement (QI) study collected pre-post intervention data. Used different statistical methods to report the study results, including paired t-test, χ2, and Mann-Wilcoxon equation. | Mayo Clinic campus in Jacksonville, FL. PCU (27 beds). | Nurses reported 27% perceived decrease in alarm fatigue post-intervention.  There was a 10% reduction in cardiac telemetry assignment post-intervention.  Significant cost reduction was achieved by implementing the protocols.  No significant differences in mortality rate before and after intervention. | Not provided | Study demonstrates that a significant reduction in alarm fatigue and cost can be accomplished through a multidisciplinary team focused on identifying process gaps and closing them. | Moderate | Article was pulled from PSP 1 literature search.  Included in PSP 1 |
| **Cameron and Little, 20185** | Multidisciplinary alarm management committee was formed with representation from administration, educators, QI, risk management, biomedical engineering, plant operations, and staff nurses. Committee developed alarm policy and planned educational program for nurses on alarm management. | QI study using pre-/post-test design to evaluate the alarm management education program, and nurses’ perceptions and practices related to clinical alarms. Likert questions were analyzed using Wilcoxon signed-rank test with a confidence interval of 95%.  Participants: 417 nurses from all departments (215 completed post-test). | Florida acute care hospital (257 beds). | Significant improvements reported in 8/12 of the questions related to alarm perceptions.  Sixty-six percent of nurses who completed post-test reported they strongly agree or agree they have improved their alarm management practices.  Nurse-initiated collaborative team-based alarm practices significantly improved, including consulting a provider for individualized monitor settings and judicious use of telemetry monitoring versus unnecessary use. Results also showed significant improvement in selecting appropriate intervention. | Alarm perceptions were more negative post-test in 4 questions related to: alarms reducing attention to patients, feeling overwhelmed by alarms, alarms contributing to nurses’ stress level, and some situations requiring alarm disabling. | The findings of this QI project indicate that nurses are receptive to education on alarms, and changed their perceptions and practices based on the education program and a new policy.  Through strong leadership and a team approach, hospitals have the opportunity to improve patient safety while improving the work environment, patient care, and overall staff morale. | Moderate | Article was pulled from PSP 1 literature search  Included in PSP 1 |
| **Dandoy et al., 20148** | Multidisciplinary alarm oversight task force consisting of key stakeholders, including physicians, nurse practitioners, nursing leadership, registered nurses, patient care assistants, clinical engineering, and patient family representatives. Team reviewed the current cardiac monitor care practice, published recommendations, identified gaps between practice and evidence, and identified areas of improvement. | QI study using Model for Improvement to design, test, and implement changes. Tested hypotheses using PDSA (plan, do, study, act) measures. | Cincinnati Children’s Hospital Medical Center. Bone marrow transplant unit (24 beds). | During implementation, the median number of alarms per patient-day decreased from 180 to 40.  Median number of false alarms on the floor fell from 95% to 50%. | Not provided | Found significant decrease in the number of alarms per monitored patient with the implementation of a standardized process. Fewer false alarms allow staff to address alarms more promptly. | Moderate | Included in PSP 1 |
| **De Vaux et al., 20176** | Alarm management team (clinical engineering, Yale School of Nursing, IT, nursing management, physician leadership, and bedside staff) with the goal of meeting the requirements of The Joint Commission (TJC) National Patient Safety Goal (NPSG). Alarm management team used gap analysis assessment tool provided by the American Association of Critical-Care Nurses. | QI study using direct observation methods once pre-intervention and at three points within 6 months post.  Sample size of patients observed varied from 23 to 26 at data collection points. | Yale New Haven Hospital, York Street Campus. Two step-down units (28 beds each). | Total alarms decreased from 251 in March 2014 to 12 in February 2015. False alarms decreased from 201 in March 2014 to 12 in February 2015.  Alarm-setting customization increased from 39% pre-intervention to 87.5% post.  No adverse patient events were reported during the observational time period. | Not provided | The authors attributed increases in customization to cumulative effect of staff education and best practice interventions.  Team shared findings with leadership and, as a result, St. Raphael campus of New Haven Hospital adopted default alarm changes. | Moderate | Article was pulled from PSP 1 literature search.  Included in PSP 1 |
| **Epstein et al., 20169** | In response to TJC NPSG, an alarm management committee began in Feb 2014 and included representation from nursing leadership, education, respiratory therapy, biomed, regulatory compliance, quality, vendor, and risk management.  Goal of committee was to ensure that the data gathered from analysis of the alarm environment would find its way to frontline caregivers and managers. | Case study | NCH Healthcare System | Over 4 months, the pilot unit lowered its total number of alarm signals by 69% without a negative impact to patient safety. | Not provided | Findings highlighted the importance of having vendor representation on the committee to ensure that NCH is compliant with the alarm management goal, provide current best practice recommendations, and assist with analysis of operational reports from the device integration system. | High: case study and not peer reviewed | Pulled from AAMI Safety Innovations Series—manual search  Included in PSP 1 |
| **Graham and Cvach, 201013** | Interdisciplinary alarm management task force was created and charged with (1) evaluating excessive equipment alarms that obscure and desensitize clinicians, (2) standardizing the hospital’s approach to alarm management, (3) assessing the reliability of secondary or adjunct alarm notification devices, (4) determining the educational needs of clinicians regarding alarm management, and (5) assessing new technology and systems that may improve alarm management. | QI project. Collected baseline data and then implemented tests of change. Administered a pre- and post-intervention survey to nursing staff. | Northeastern academic medical center. Medical progressive care unit (15 beds, 30 nurses). | A 43% reduction in critical physiological monitor alarms.  Nurses perceived the unit’s overall noise level as lower after the intervention. | Not provided | Lessons learned include: (1) unit staff should analyze alarm parameters to determine if they are appropriate, (2) alarm parameters should be set to actionable levels, (3) nurses must be trained to individualize alarm parameters, and (4) institutions should establish institution-wide standards for management. | Moderate | Included in PSP 1 |
| **Ketko et al., 201511** | Multidisciplinary improvement task force (physicians, nurses, respiratory therapists, biomed engineers, IT) developed an alarm management bundle applying strategies to decrease alarm frequency. | QI study. Used control charts with many data points and conducted tests of significance. | C.S. Mott Children’s Hospital at the University of Michigan. neonatal ICU. | Modified SANS algorithm for high SpO2 delivery resulted in an immediate and sustained decrease in the escalation of high SpO2 alarms to nursing phones.  Results of the survey regarding attitudes and perceptions in alarm frequency demonstrated that most respondents felt that alarm frequency had improved and alarm fatigue was being addressed. | Not provided | Recognition that alarm management must be a collaborative effort was an important first step—cultural change transitioning from alarm frequency being a nursing concern to everyone taking responsibility was key to successfully developing strategies. | Moderate | Pulled article from manual search of reference section of Jubic, K. 2017. *Strategies for Managing Alarm Fatigue in the PICU Setting* (included in PSP 2 literature pull)  Included in PSP 1 |
| **Petersen and Costanzo, 201714** | Multidisciplinary alarm management team, including nursing, clinical staff, critical care director, respiratory therapy, biomedical, and engineering staff. Team was established as part of a series of system changes to address alarm safety. | QI study with convenience sampling to understand nurses’ perceptions of alarm fatigue and implement interventions that improve safety.  Healthcare Technology Foundation’s Clinical Alarms Committee Survey was sent to 31 nurses and 14 support staff (83.8% operational response rate). | Mary Lanning Healthcare (acute care facility). ICU and progressive care unit (29 beds total). |  | When surveyed about knowledge of Mary Lanning Healthcare’s initiatives to improvement alarm fatigue, only 15% of nurses recognized that the alarm management team was implemented to assess current needs, edit policies, decrease overall alarm numbers, and change the culture of alarm management.  Only 19% of nurses recognized that new technology had been implemented to improve clinical alarm safety. | Survey results illustrated a lack of knowledge and training in alarm management. Mary Lanning Healthcare implemented a variety of change initiatives based on assessment, current needs, nurse perception, and evidence-based practice. | Moderate | Included in PSP 1 |
| **Rayo et al., 201610** | Alarms task force (physicians, nurses, subject matter experts in IT, human factors engineering, risk management, and data analysis) was formed in response to TJC NPSG.  Task force was divided into subcommittees: executive steering, physiological monitoring oversight, platform, training and implementation, and monitoring and evaluation. | Retrospectively collected data from an institutional data warehouse for the 12-week periods before and after the intervention was implemented.  Percentages of true, false, and unnecessary alarms were collected by conducting six 2-hour observations across three different units. | Midwest tertiary care health system. Intervention was implemented in 5 hospitals, affecting 37 medical-surgical, cardiac, critical care, and hybrid units (over 1,000 beds total). | False alarm percentage decreased from 18.8% to 9.6% pre- to post-intervention. Percentage of unnecessary alarms remained consistent between the pre- (46.2%) and post-intervention (46.7%) periods.  When comparing hospital-wide data before and after implementation, average cardiac monitoring rate decreased 53.2%, weekly monitoring rate decreased 15.5%, and emergency department boarding rate decreased 36.6%. | Not provided | Results suggest that the development and communication of this new policy safely reduced the length of time that patients spent on continuous cardiac monitoring.  Factors of successful implementation include strong leadership support and widespread engagement of staff. Human factors engineers worked closely with clinicians and IT professionals from the beginning, resulting in policy and technology solutions explicitly designed to optimize usability and mitigate the risk of increased workload and other unintended consequences sometimes associated with healthcare technology.  Some subcommittees stayed intact after implementation to continue to monitor process/success of this and other alarm task force initiatives. | Moderate | Included in PSP 1 |
| **Srinivasa et al. 201715** | Alarm Fatigue Group was formed to conduct a pilot study on the state of telemetry alarms on a surgical floor. The multidisciplinary team is made up of members representing nursing, biomedical engineers, patient safety, and providers. | QI study performed using two decision analysis models: fishbone analysis and Model for Improvement framework.  Collected baseline and post-intervention alarm load and noise data. | Northeast healthcare facility, surgical telemetry unit (24 beds). | An 84% reduction in the premature ventricular contractions alarm rate, and a 54% reduction in the total alarm rate.  There was also an overall noise reduction on the surgical telemetry unit related to the cardiac telemetry alarms. Pre-intervention the average noise in decibels (dB) for the left wing and main hallway was 58.94 dB and 58.04 dB, respectively. Post-intervention it dropped to 57.84 dB and 54.43 dB, respectively. | Not provided | Factors that contributed to the success of reducing alarm load and alarm fatigue:  (1) Change was integrated into the unit with very little interruption in the flow of the unit.  (2) Stakeholder involvement and buy-in from the start.  (3) TJC Sentinel alert and subsequent establishment of NPSG on Alarm Management enabled vigorous administrative support and resources required to successfully lead this project. | Moderate | Included in PSP 1 |
| **Vockley, 20123** | Established telemetry task force that guides decisions around alarm system management. The multidisciplinary task force is made up of physicians, nurses, and clinical engineering, healthcare quality, facilities, and supply management staff. | Case study | Beth Israel Deaconess Medical Center (631 beds). | A 30% decrease in alarm signals.  Decrease in amount of time it takes to respond to an alarm. | Not provided | Resulted in a culture of taking action around auditing the standard of care and patient outcomes, and continuing to adjust alarm system parameters to meet clinical practice standards. | High: case study and not peer reviewed | Pulled from AAMI Safety Innovations Series—manual search  Included in PSP 1 |
| **Whalen et al., 20147** | BMC senior leadership convened a multidisciplinary Telemetry Task Force (TTF) in 2008 to evaluate how cardiac telemetry monitoring equipment was being used in clinical areas, identify ways to improve management and utilization, and develop consensus for a common approach to cardiac monitoring. Reconvened the TTF in 2011 to explore the issue alarm fatigue. | Two-phase study: (1) observation of nursing staff’s response to monitor alarms and (2) QI project in pilot unit to respond to largest contributors to alarm fatigue identified in Phase 1. | Boston Medical Center, medical cardiology unit (24 beds). | An 89% reduction in total number of audible alarms per week on pilot unit.  Decibel level narrowed from a range of 54-90 dB to 60-72 dB.  Percentage of nurses who assessed the noise level as acceptable increased from 0% to 64%. | Not provided | Success of QI study was the result of a multidisciplinary approach. Nurses became strong advocates of the pilot project, which resulted in sustained change and improvement. | Moderate | Included in PSP 1 |