



Alarm Management
Best Practices.

Different Thinking for
Better Healthcare.



Alarm Management Best Practices

Patient monitoring systems are a vital component to the care and safety of patients within the healthcare system. They provide real-time data and measurements, and offer notification (alarms) of changes in monitored parameters, as well as previously stored data such as trends and alarm review histories. Alarm systems are built into many medical devices with the intended goal of protecting patients.

Despite the importance of alarms, an overabundance can lead to “alarm fatigue”, defined as the desensitization that staff experience from continuous exposure to frequent, often non-actionable alarms. Ultimately, this can potentially impact patient safety.

Nihon Kohden considers alarm system management a key component in reducing alarm fatigue and improving patient safety in the healthcare setting. We have taken several steps to reduce nuisance alarms or alarms that are either false or technical alarm conditions that have no significant patient safety concern and are non-actionable. Such steps to reduce nuisance alarms include:

- Increasing the advisory alarm time from 20 seconds to 120 seconds
- Customizable escalation alarms
- SpO₂ alarm delay
- Respiratory algorithm changes and alarm delays
- Nihon Kohden’s Prefense smoothing algorithm
- Other customized settings designed to limit the number of audible non-actionable alarms

Below are some alarm management best practices that we have found will reduce false and nuisance alarms, as well as assist in establishing best practices for your organization while keeping patient safety as the highest priority. We also have included some troubleshooting tips to help reduce those false alarms and assist with delivering the highest quality, safest patient care available in today’s market.

We hope these recommendations help to serve as a guide as you continue to develop your own alarm management best practices and align your organization with The Joint Commission’s 2014 National Patient Safety Goal of alarm management.

Our team of Clinical Consultants is ready to assist you with your alarm concerns and best practice models. Each Clinical Consultant is a registered nurse with years of bedside, nursing leadership and administration experience. Our consultants are very knowledgeable in best practices for current patient safety and quality initiatives, as well as national and state regulatory requirements.

The Joint Commission (TJC) recently issued (April 2013) a Sentinel Event Alert on medical device alarm safety in hospitals www.jointcommission.org/assets/1/18/SEA_50_alarms_4_5_13_FINAL1.PDF.

TJC also subsequently issued a new National Patient Safety Goal (NPSG) for 2014 focusing on safe clinical alarm management for hospitals and critical access hospitals with a phased implementation http://www.jointcommission.org/2014_national_patient_safety_goals_slide_presentation/.

In addition to the NPSG, the FDA has also weighed in on primary vs. secondary alarm notification. Since hospitals are in the process of looking at who receives alarms and by what mechanism as well as centralized vs. decentralized monitoring models, the attached resource should be helpful as you work through this step in your monitoring policies. <http://www.aami.org/meetings/summits/alarms/Materials/PDFs/forrest-Wed-1245.pdf>.

- Educate the patient and family on the purpose for the monitoring system as well as the clinical and safety benefits of wearing the telemetry transmitter, leads and pulse oximetry probes
- Ensure that continuous monitoring occurs according to the manufacturer's recommendations for the target group of patients as per hospital policy
- Monitor all available parameters:
 - Heart rate
 - Respiratory rate
 - Pulse oximetry
 - Non-invasive blood pressure (if available)
- Ensure that finger probes remain on the patient (Consider disposable with Velcro or adhesive); Place probe on the third or fourth finger the on non-dominant hand. Remove nail polish from fingernails
- Change electrodes daily using recommended procedures; Add this to routine tasks such as baths, PM care to assure practice change (As per manufacturers recommendations)
- Change transmitter batteries as needed or per manufacturer specifications
- Assign specific tasks to trained non-licensed support staff to assist nurses (unit secretaries, nursing assistants/technicians), such as battery changes, lead/electrode placement and changes, etc.
- Customize individual patient alarms based on assessment and condition to assure alarms are valid and clinically actionable
- As an organization, determine what are clinically actionable vs. non-clinically actionable alarms and customize alarm settings accordingly
- Collaborate with physician partners to avoid keeping patients on a monitoring system longer than needed
- Provide initial and ongoing education about monitoring devices with alarms to all nurses and other members of the healthcare team on a periodic basis
- Budget for ongoing education when purchasing any monitoring system
- Establish an interdisciplinary team to define department and hospital wide alarm management strategies; Ensure key stakeholders are at the table and engaged in the alarm management process; Consider nursing leadership, clinical nursing staff and educators, physician champion, Bio-Med and IT
- Ensure there is data collection tool for the tracking and trending of adverse events and near misses related to alarm fatigue

Responding to Alarm Notifications

- Intervene to the notification in a timely manner as determined by interdisciplinary group for organization and/or facility policy
- Assess the patient when alarms occur
- Take action to correct patient problem
- Create a closed-loop communication system to assure alarms are responded to in the appropriate time frame and by the proper skill level clinician
- Assess and review trends proactively
- Adjust alarm parameters based on clinical assessment and patient stability
- Replace probe(s) and/or replace/change electrodes
- Educate patient and family members on need for continuous monitoring and reasons for the monitoring to increase patient understanding and nursing's commitment to patient safety

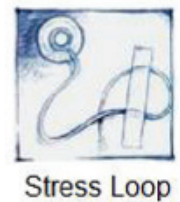
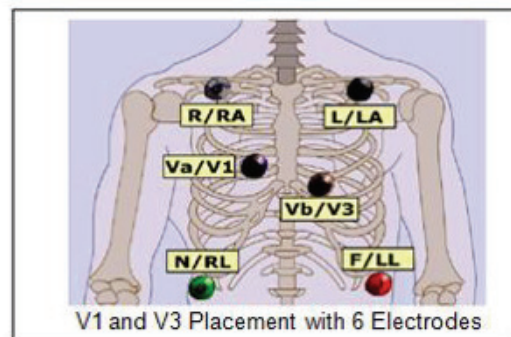
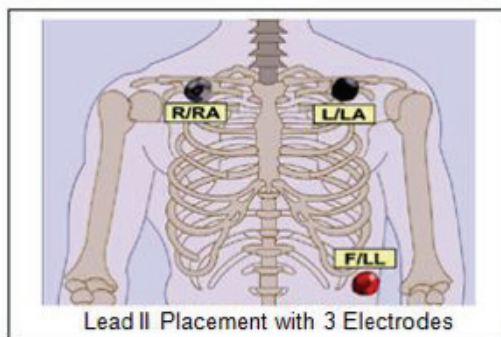
Supplies and Equipment

- Maintaining and tracking the system components
- Designate a location for transmitters, lead sets, probes, electrodes, batteries, pouches, cuffs, etc.
- Inventory, clean, and store equipment in the designated location after each patient use (as per manufacturer's recommendations)
- Replace lead wires as needed to assure proper conduction of signals (per manufacturers recommendations)
- Ensure proper inventory levels for monitoring supplies
- Plan replacement costs in operating budget to ensure consistent supply of lead wires and other monitoring materials

Skin Prep and Lead Placement

Proper skin preparation and lead placement remains the single best way to avoid many nuisance alarms.

1. Select electrode site according to electrode placement diagram
2. Clip excess hair per hospital protocol
3. Gently abrade skin with dry gauze to remove dead skin cells
4. If skin is oily, clean site with soap/water and friction and allow to dry
5. Attach lead-wire to electrode prior to placing on patient
6. Attach electrode to patient, pressing circumference of electrode to secure
7. Use stress loops to minimize artifact from movement, if necessary
8. Place transmitter in pocket or pouch and position cables to minimize movement
9. Change electrodes as needed or every 24 hours to ensure fresh conduction gel and adhesive



| 3 and 6 Electrode Cable | |
|-------------------------|--|
| Limb Lead | Position |
| White (-) | Right chest under the middle of clavicle |
| Black | Left chest under the middle of clavicle |
| Green | Right anterior-axillary line, edge of lower rib |
| Red (+) | Left anterior-axillary line at edge of lower rib. |
| Lead II | Position higher and more anterior for RESP monitoring. |
| Chest Lead | Position options for V-a and V-b electrodes |
| *V 1 (blue) | 4th Intercostal Space to the right of the sternum – best lead for arrhythmia monitoring |
| V 2 | 4th Intercostal Space to the left of the sternum |
| *V 3 (orange) | Halfway between V2 and V4 – ST monitoring |
| V 4 | 5th Intercostal Space, left mid-clavicular line |
| V 5 | Anterior axillary line at same level as V4 |
| V 6 | Mid-axillary line at same level |
| | *Recommended default V-leads |

LEAD SELECTION

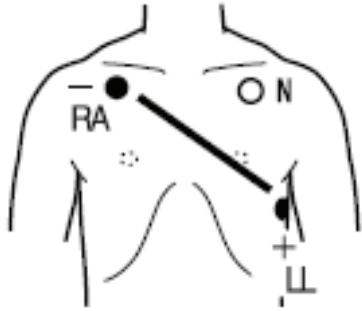
Select the best monitoring leads for arrhythmia identification; display two or more leads when possible.

| Clinical concern | Lead |
|---|---|
| Bundle branch block | V ₁ or V ₆ |
| Ischemia based on the area of infarction or site of percutaneous coronary intervention | |
| Anterior | V ₃ , V ₄ |
| Septal | V ₁ , V ₂ |
| Lateral | I, aV _L , V ₅ , V ₆ |
| Inferior | II, III, aV _F |
| Right ventricle | V ₄ |
| Junctional rhythm with retrograde P waves | II |
| Optimal view of atrial activity | I, II, or Lewis lead (positive and negative electrodes at the 2nd and 4th intercostal spaces at the right sternal border) |
| Ventricular ectopy, wide complex tachycardia | V ₁ (may use V ₆ along with V ₁) |
| Ventricular pacing | V ₁ or II |

| Problem | Possible causes | Solutions |
|-----------------------|--|---|
| False-high-rate alarm | <ul style="list-style-type: none"> Monitor interpreting large T waves as QRS complexes, which doubles the rate | <ul style="list-style-type: none"> Reposition electrodes to lead where QRS complexes are taller than T waves. Select best suitable lead for monitoring. |
| | <ul style="list-style-type: none"> Skeletal muscle activity | <ul style="list-style-type: none"> Place electrodes away from major muscle masses. |
| False-low-rate alarm | <ul style="list-style-type: none"> Shift in electrical axis from patient movement, making QRS complexes too small to register. | <ul style="list-style-type: none"> Reapply or reposition electrodes for better signal. Select best suitable lead (greater than 1mV in height) to monitor. |
| | <ul style="list-style-type: none"> Low amplitude of QRS | <ul style="list-style-type: none"> Increase sensitivity. Consider reapplying and repositioning electrodes after skin prep. Select best suitable lead (greater than 1mV in height) to monitor. |
| | <ul style="list-style-type: none"> Poor contact between electrode and skin | <ul style="list-style-type: none"> Reapply electrodes. |
| Low amplitude | <ul style="list-style-type: none"> Sensitivity set too low | <ul style="list-style-type: none"> Increase sensitivity. Select best suitable lead (greater than 1 mV in height) to monitor. Consider reapplying and repositioning electrodes after skin prep. |
| | <ul style="list-style-type: none"> Poor contact between skin and electrodes; dried gel; broken or loose lead wires; poor connection between patient and monitor; malfunctioning monitor; physiologic loss of QRS amplitude. | <ul style="list-style-type: none"> Check connections on all lead wires and monitoring cable. Replace electrodes as necessary. Re-prep skin by either clipping, debriding, cleaning. |

| Problem | Possible causes | Solutions |
|----------------------------------|--|--|
| Wandering baseline | <ul style="list-style-type: none"> ▪ Poor position or contact between electrodes and skin | <ul style="list-style-type: none"> ▪ Reposition or replace electrodes. |
| | <ul style="list-style-type: none"> ▪ Thoracic movement with respirations | <ul style="list-style-type: none"> ▪ Reposition LL electrode to the 5th intercostal space. |
| Artifact (waveform interference) | <ul style="list-style-type: none"> ▪ Patient having seizures, chills, or anxiety | <ul style="list-style-type: none"> ▪ Notify doctor and treat patient as ordered. Keep patient warm and reassure him. |
| | <ul style="list-style-type: none"> ▪ Patient movement | <ul style="list-style-type: none"> ▪ Help patient relax. Consider stress loops. |
| | <ul style="list-style-type: none"> ▪ Electrodes applied improperly | <ul style="list-style-type: none"> ▪ Check electrodes and reapply, if necessary in the correct position. |
| | <ul style="list-style-type: none"> ▪ Static electricity | <ul style="list-style-type: none"> ▪ Make sure cables don't have exposed connectors. Change patient's static-causing gown or pajamas. |
| | <ul style="list-style-type: none"> ▪ Electrical short circuit in lead wires or cable | <ul style="list-style-type: none"> ▪ Replace broken equipment. Use stress loops when applying lead wires. |
| | <ul style="list-style-type: none"> ▪ Interference from decreased room humidity | <ul style="list-style-type: none"> ▪ Regulate humidity to 40%. |
| Broken lead wires or cable | <ul style="list-style-type: none"> ▪ Stress loops not used on lead wires | <ul style="list-style-type: none"> ▪ Replace lead wires and re-tape them, using stress loops. |
| | <ul style="list-style-type: none"> ▪ Cables and lead wires cleaned with alcohol or acetone, causing brittleness | <ul style="list-style-type: none"> ▪ Clean cable and lead wires with soapy water. <i>Do not allow cable ends to become wet.</i> Replace cable as necessary. |

| Problem | Possible causes | Solutions |
|--|--|---|
| 60-cycle interference (fuzzy baseline) | <ul style="list-style-type: none"> ▪ Electrical interference from other equipment in room | <ul style="list-style-type: none"> ▪ Attach all electrical equipment to common ground. Check plugs to make sure prongs aren't loose. |
| | <ul style="list-style-type: none"> ▪ Patient's bed improperly grounded | <ul style="list-style-type: none"> ▪ Attach bed ground to the room's common ground. |
| Skin excoriation under electrode | <ul style="list-style-type: none"> ▪ Patient allergic to electrode adhesive | <ul style="list-style-type: none"> ▪ Remove electrodes and apply nonallergenic electrodes and nonallergenic tape. |
| | <ul style="list-style-type: none"> ▪ Electrode on skin too long | <ul style="list-style-type: none"> ▪ Remove electrode, clean site, reapply electrode at new site. Consider changing electrodes q 24-48 hrs or per hospital policy. |



Transmitter using 3 electrodes to detect respiration.

By placing the Left Leg (LL) electrode on the lower rib at the anterior axillary line, the lungs inflate and deflate between the RA and the LL electrodes and the system detects a good respiration signal.

As the patient breathes, the monitor detects a change in the electrical current and it displays a waveform on the screen. To improve the detection of respiration, use fresh electrodes and consider moving the LL electrode up to the 5th intercostal space if necessary.

SpO₂ - Oxygen Saturation

- It is important to instruct the patient to keep the probe in place or to replace it promptly when it is removed; When the probe is not on the patient, SpO₂ monitoring is not occurring
- It is important to change the location of the probe every 4 to 8 hours and to inspect the site for changes in the circulation due to the pressure of the probe; Place probe on non-dominant hand on the third or fourth finger
- Consider securing the probe cord lightly to the finger by the use of Velcro or tape to help ensure it doesn't fall off of the patient

Additional Resources

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The monitoring division of Nihon Kohden is empowering hospitals to radically improve their quality and economics of care. Its singular focus is on patient monitoring. Through collaboration with hospitals, Nihon Kohden helps solve today's healthcare challenges. This different mindset and business approach enables the company to deliver solutions that have an immediate clinical and financial impact. Nihon Kohden is the fastest-growing patient monitoring company in the U.S. because we offer the lowest cost of ownership and greatest value above any other monitoring solution, while improving quality of care.