

# Connecting Remote Cardiac Monitoring Issues with Care Areas

## ABSTRACT

*Patients in noncritical settings may have underlying cardiac conditions or demonstrate unexpected symptoms and condition changes that require continuous or physiologic cardiac monitoring or transfers to a higher level of care, for which appropriate treatment may be delayed due to bed unavailability. Many facilities implement remote cardiac monitoring to facilitate alarm notification. Remote cardiac monitoring of patients in noncritical care areas alerts healthcare providers about patient condition changes, which may avoid further deterioration of patient conditions and potential cardiac arrests. Remote cardiac monitoring alone does not ensure patient condition changes are successfully communicated to appropriate healthcare providers. Seventy-four percent of the 194 Incidents and Serious Events reported to the Pennsylvania Patient Safety Authority from June 2004 to December 2008 associated with remote cardiac monitoring were issues with communication or monitoring problems. Monitoring problems include the failure to monitor, the unavailability of monitors, or delay in monitoring. Healthcare providers may consider incorporating risk reduction strategies that include more effective communication between care areas, delineation of personnel responsibility, and standard protocols for alarm conditions. (Pa Patient Saf Advis 2009 Sep;6[3]:79-83.)*

Patients in noncritical settings may demonstrate unexpected symptoms and condition changes that require cardiac monitoring or transfer to a higher level of care. Remote cardiac monitoring is one of many important telemedicine applications available in today's healthcare environment. Remote cardiac monitoring provides additional surveillance for patients, typically at locations outside the care areas.<sup>1</sup> This type of cardiac monitoring generates visual and audible alarm signals based upon condition changes that exceed established alarm limits for a specific patient.<sup>2</sup>

Remote cardiac monitoring of patients in noncritical settings provides the physiological monitoring and identification of potential cardiac arrhythmias by qualified staff in a centralized remote location away from the patient care area. For example, remote cardiac monitoring observation may be performed by intensive care unit (ICU) nurses who have the added responsibility of balancing the demands of a typical caseload of critically ill patients with responding to remote arrhythmia alarms for patients in other care areas.<sup>3</sup> Remote cardiac monitoring may also be performed by technicians or monitor watchers who may be responsible for as many as 50 monitors of patients in different care areas simultaneously.<sup>1</sup> More recently,

technological advances have introduced new electronic telemonitoring methods such as the electronic ICU, the war room (a central command center for telemetry), and Tele-ICU.<sup>1-5</sup>

In remote cardiac monitoring, individuals who monitor surveillance are also responsible for capturing data and alerting staff in the appropriate care area about any changes in patient physiological conditions so that bedside assessments may be conducted and appropriate care is delivered.<sup>6</sup> Remote cardiac monitoring enhances patient safety by providing noncritical patient care areas with rapid cardiac data transmission, improves communication through use of real-time data, and reduces liability.<sup>7,8</sup> Late recognition of arrhythmias and symptoms may lead to potentially avoidable deaths.<sup>9,10</sup> Remote cardiac monitoring helps in the early identification of physiological changes, guides appropriate therapies, results in better clinical outcomes, and enhances operating efficiency.<sup>9</sup>

## Remote Cardiac Monitoring Event Data Reported to the Authority

There were 194 Incidents and Serious Events, including 12 deaths, reported to the Pennsylvania Patient Safety Authority from June 2004 to December 2008 associated with remote cardiac monitoring. The most frequently cited types of failure in these reports were as follows:

- Communication issues
- Delayed or incorrect placement
- Power failures (including disconnection of devices from their power sources and failure to replace batteries)

## Communication Issues

Of the 194 reports submitted to the Authority from June 2004 to December 2008, 74% of these events included issues with communication and delayed monitoring, or failure to place a patient on monitoring, or incorrect monitoring placement (see Table). The reports indicate breakdown in communication between the healthcare providers performing surveillance and those administering care to the monitored patients in the noncritical care areas. Seventy-three event reports indicated communication issues. The majority of the communication issues involve failures to implement remote cardiac monitoring orders and to identify arrhythmias. Examples of these events include the following:

*Patient was seen in the postanesthesia care unit, and remote telemetry was ordered [after transfer to the floor]. Patient arrived on floor [one hour later]. [Remote telemetry] orders were not communicated to floor, so a remote telemetry monitor was not reserved.*

**Table. Remote Cardiac Monitoring Events Reported to Pennsylvania Patient Safety Authority, June 2004 to December 2008**

REMOTE CARDIAC MONITORING ISSUES	NUMBER OF REPORTS	PERCENTAGE (%)
Communication	73	38%
Unavailable/delayed/not placed	69	36%
Patient condition (e.g., arrhythmia, seizure, fall)	24	12%
Battery problem or disconnection	17	8%
Wrong patient	11	6%
<b>Total</b>	<b>194</b>	<b>100%</b>

After reviewing the patient's chart, it was discovered that the patient was transferred from the ICU to [a patient care area]. Staff did not notify the [monitoring] nurse or the monitor station that the patient was ordered remote monitoring.

Patient was to have remote telemetry once admitted to the floor. The emergency department (ED) handoff communication form did not [indicate remote telemetry was] needed for the patient. The patient [was] admitted to the floor and had been transported with a monitor in use. The ED nurse who transported the patient did not know if the patient was to have remote [telemetry], and there was no handoff [communication].

Remote telemonitoring was ordered on admission. The order was signed off, but a telemetry monitor was never [secured] for the patient.

A telemetry unit was transmitting [a heart rhythm] with a full signal but with[out] patient information. The unit [where the signal was transmitting from was called] and was not aware of any admission to telemetry. [The unit staff were notified that] the transmission was coming from their unit and the monitor was found on a patient in [that unit].

A telemetry monitor was placed on a medical surgical patient, but the monitoring ICU was not aware of the need to [remotely] monitor the patient until 10 hours later.

### Delayed or Incorrect Placement

Sixty-nine of the remote cardiac monitoring reports indicated lack of monitor availability or delays in placing a patient on monitoring. The reports do not always convey why monitor placement was delayed, which may have been based on other factors unrelated to remote cardiac monitoring, such as workload. Examples include the following:

A physician ordered remote cardiac monitoring. The order was discovered [15 hours later]. The patient was placed on the monitor upon discovery of the event.

Orders to start remote telemetry were written [but not initiated for nearly 10 hours]. Intravenous Lopressor®

had been administered [four hours after the remote telemetry orders were written], which was the reason for monitoring.

A physician ordered remote monitoring but [the monitoring] nurse was not notified, resulting in a delay. The patient was placed on the monitor [16 hours later].

The remote monitor assigned to [patient A] was sent to the ED but was placed on [patient B], whose assigned remote monitor was placed on [patient A]. [This] resulted in the wrong rhythm information for both patients; [patient A] was not in an [arrhythmia as the monitor indicated] and [patient B] was [experiencing an arrhythmia] and not in [a normal sinus heart] rhythm [as the monitor indicated].

A patient on a medical/surgical unit was placed on remote telemetry monitor and monitored by nurses in the cardiac care unit (CCU). A sticker with patient's name found on the desk—indicating telemetry #4 being used for this patient—was showing a monitor pattern. Nurses later found a discontinuation notice for this same telemetry [#4] on a different patient's [chart]. When investigated, the patient whose telemetry was discontinued was still on telemetry and the CCU nurses were monitoring [the patient's] pattern for [the patient] on telemetry #4, which was never turned on. [Nine hours after arriving on the medical/surgical unit], telemetry #4 was turned on and the correct patient was being monitored. Unable to check anything in telemetry memory since [the monitor] was not turned on.

### Power Failures

Seventeen of the reports involved failures related to the remote cardiac monitors' power supplies. These included improper battery insertion or absent battery issues. Examples are as follows:

The monitoring telemetry unit called the [patient care] unit to say that they did not have a reading on a patient and [requested a battery change] because there was no signal. [The monitor was checked and it was] discovered that there were no batteries in the monitor.

A patient was admitted from the ED [to a patient care area] and ordered remote telemetry. Upon arrival to the [patient care area], the patient information was loaded into the monitor but the rhythm was not visible to the monitor technician. Upon checking the monitor, staff discovered the batteries were inserted backward.

### Clinical Guidelines

In 2004, the American Heart Association (AHA) issued a scientific statement from the Councils on Cardiovascular Nursing, Clinical Cardiology, Cardiovascular Disease in the Young, and the International Society of Computerized Electrocardiology to update and expand the scope of the best practice standards for in-hospital electrocardiographic monitoring.<sup>8</sup> These comprehensive guidelines outline the need for 24-hour human surveillance of monitors, appropriate staff levels consisting of qualified physicians and nurses in critical and noncritical care areas, and the

development of protocol and procedures for common arrhythmias for in-hospital hard-wire and telemetry cardiac rhythm monitoring systems for adults and children. A rating system was developed by the American College of Cardiology Emergency Cardiac Care Committee in 1991, which is still used today to classify common clinical conditions for cardiac monitoring. This rating system categorizes patient conditions into three classes, depending on the severity of medical indications. Class I signifies patients at significant risk of an immediate, life-threatening arrhythmia for which cardiac monitoring is indicated. Class II patients may benefit from cardiac monitoring, but it is not essential for all patients of this class type. Cardiac monitoring is not indicated in Class III patients because the risk of a serious arrhythmia or the therapeutic benefit is low with these patients.<sup>8</sup>

The AHA's scientific statement is based on expert opinions, supported by clinical experience, and indicates that regardless of the technologic advances over the last 40 years, the electrocardiogram (ECG) contains a wealth of diagnostic information and its interpretation continues to require human oversight.<sup>8</sup> Despite the more aggressive treatment methods for arrhythmias, the use of new drugs (which have the potential to cause certain arrhythmias), and the introduction of new technology, only humans can determine whether individual patients will require cardiac monitoring either remotely or in ICUs.<sup>8</sup>

## Clinical Literature

Hodgett et al. conducted a retrospective review that examined the odds of potentially avoidable cardiac arrests in non-ICU patient care areas and found that they were 5.1 times greater for these patients than those in critical care areas. In 48% of 78 cases, personnel failed to act on the clinical signs of deterioration in the 24 hours preceding the cardiac arrest. The study cited system failures, which included errors and delays in diagnosis, (eight delays in diagnosis were due to incorrect ECG interpretation; of these, six were missed myocardial infarctions), inadequate interpretation of investigations, incomplete treatment or a failure to appreciate the severity of patient conditions, and personnel inexperience. The review indicated that the majority of the non-ICU cardiac arrests are potentially avoidable and are the result of multisystem failures.<sup>10</sup>

Billinghurst et al. conducted a prospective observational study of 420 hours of observation in a nine-bed coronary respiratory care unit to determine the frequency of rhythm disturbance events among patients being remotely monitored by telemetry nurses, as well as the number of detected cardiac events and the effect of the events on telemetry nurses' workload.<sup>3</sup> There were a high number of remote telemetry warning arrhythmias, though 80.2% were artifact. Warning alarms occurred every 2.1 to 6.2 minutes, and although no malignant arrhythmias were noted during this study, telemetry nurses detected 60% to 100% of valid warning alarms. This added surveillance contributes

to the competing demands placed on telemetry nurses and has the potential to negatively affect patient safety and the nurses' caseloads. These demands may delay or impede communication between the telemetry staff and the patient care area staff. Upon detection of a potentially fatal arrhythmia by the telemetry nurse, its prompt communication to the appropriate nurse, and the quick response, assessment and treatment by the nurse in the non-ICU area may be delayed due to competing workload demands.<sup>3</sup>

A prospective observational study conducted by Tsien et al. looked at the accuracy in determining positive predictive value of routine monitoring alarms and causes for false-positive alarms.<sup>5</sup> This study assessed the effectiveness of ICU alarms in alerting personnel to significant changes in patient conditions. False alarm rates were found to be extremely high, while positive predictive values were very low. Of the 2,942 total alarms, 86% were found to be false positive, 6% were classified as clinically irrelevant true alarms, and only 8% were determined to be true alarms with clinical significance. High false-positive rates may lead to the disabling of alarms by ICU personnel, as they can be distracting and annoying. Other competing auditory sounds in the ICU may also be confusing for ICU personnel who must determine the source of the alarms, particularly if they have the added responsibility for the remote cardiac monitoring surveillance of patients in noncritical care areas.<sup>5</sup>

## Risk Reduction Strategies

Healthcare providers may use a number of strategies to facilitate communication about remote cardiac monitoring. Consider addressing the following key elements for use of remote cardiac monitoring of patients in noncritical care areas.

### Communication

Implementing effective alarm notification can provide organizations with a communication process that begins with the monitoring system and ends with appropriate assessment and care provided to the patient in the noncritical care area. This process would include developing communication protocols that identify backup coverage and ensure staff notification when the primary caregiver is unavailable.<sup>11</sup> Some communication methods include the use of smart phones, cell phones, or personal digital assistants, although there may be problems with limited memory and security concerns to consider.<sup>7,12</sup> Wireless technology may add more access points for remote cardiac monitoring, improve workflow, and decrease dead zones within the care areas, but it can be more expensive than other applications.<sup>1,9,10-14</sup> What is key in alarm notification is that the communication of the alarm signal is delivered to the surveillance person, who communicates this information to the nurse in the patient care area, not just to the device.<sup>12</sup>

### Responsibility Delineation

Organizations may consider the development of surveillance protocols for the remote cardiac monitoring

of noncritical patients and the assessment and care of the remote cardiac monitoring of noncritical patients. Consider including standing orders for placing patients on remote cardiac monitoring and verifying waveform and numerics at the monitoring station.<sup>6</sup> Ongoing education and competency skills of monitor surveillance staff may include the ability to recognize computer algorithms, to ensure proper skin preparation and accurately place monitoring electrodes, to ensure appropriate heart rate alarm settings, and to measure heart rate and intervals using ECG calipers. Ensure monitor surveillance staff are qualified to verify alarm conditions on cardiac monitors by providing regular refresher programs that include validation of arrhythmia interpretation skills and problem solving case-based scenarios.<sup>6</sup> Ensure noncritical care area nurses are qualified to respond to and assess arrhythmias by providing regular competency reviews that include the demonstration of patient care provided to simulated malignant arrhythmias.<sup>1,5,8-10,14</sup>

### Standard Protocols for Alarm Conditions

Developing alarm setting protocols that are tailored for individual patient needs that are communicated during shift change and handoff communications may minimize nuisance alarms and remove excess alarm noise.<sup>6</sup> Monitor technicians may be better equipped to filter false alarms and thereby reduce the number of false alarms that reach the monitoring nurses.<sup>1,9,12,15</sup> Organizations may consider developing policies that address regular battery replacement of cardiac monitors, as well as training and implementing reminders about battery replacement to reduce improper battery insertion in remote cardiac monitoring devices.<sup>6</sup> Technological advances include the electronic ICU, the war room (a central command center for telemetry), and Tele-ICU that enable uninterrupted care to ICU patients across multiple hospitals using remote and often intensivist-led multidisciplinary teams. These advances augment on-site care and interventions, ensure continuous care, and can provide hospitals with the ability to track outcomes of performance improvement indicators.<sup>1-5</sup>

### Conclusion

Remote cardiac monitoring enhances patient safety by providing noncritical patient care areas with rapid cardiac data interpretation, improves communication through use of real-time data, and reduces liability.<sup>7,8</sup> Remote cardiac monitoring assists in the early identification of physiological arrhythmia changes and directs appropriate assessment and treatment.<sup>9</sup> Remote cardiac monitoring results in better clinical outcomes and enhanced operating efficiency. Risk reduction strategies that healthcare providers may implement when using remote cardiac monitoring of patients in noncritical care areas include the key elements of clear communication protocols, responsibility delineation, and standard practices protocols for alarm conditions.

### Supplementary Review

A March 2008 *Pennsylvania Patient Safety Advisory* supplementary review discussed the results of a failure mode and effects analysis (FMEA) about alarm interventions during medical telemetry monitoring. Healthcare facilities can use the published results of this FMEA to understand telemetry monitoring alarm response processes and similar process failures and as an aid to develop facility-specific risk reduction strategies. The complete review, "Alarm Interventions during Medical Telemetry Monitoring: A Failure Mode and Effects Analysis," is available on the Pennsylvania Patient Safety Authority's Web site at [http://www.patientsafetyauthority.org/ADVISORIES/AdvisoryLibrary/2008/mar5\(suppl\\_rev\)/Pages/mar5\(supplrev\).aspx](http://www.patientsafetyauthority.org/ADVISORIES/AdvisoryLibrary/2008/mar5(suppl_rev)/Pages/mar5(supplrev).aspx).

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## Self-Assessment Questions

The following questions about this article may be useful for internal education and assessment. You may use the following examples or come up with your own.

1. Benefits of remote cardiac monitoring of patients in non-critical settings include all of the following EXCEPT:
  - a. Early identification of potential cardiac arrhythmias
  - b. Additional surveillance of patients typically at locations outside the patient care areas
  - c. Improved communication between healthcare providers through the use of real-time data
  - d. Assurance that remote cardiac monitoring alone provides successful communication of patient condition changes to appropriate healthcare providers
2. Problems identified with remote cardiac monitoring in the noncritical setting include all of the following EXCEPT:
  - a. Communication problems
  - b. Delayed or incorrect cardiac monitor placement
  - c. Disconnection of cardiac monitoring device from power sources
  - d. Scope of practice delineation problems
3. The American College of Cardiology Emergency Cardiac Care Committee's rating system provides which of the following guidance statements about cardiac monitoring in Class I patients?
  - a. Cardiac monitoring may benefit these patients.
  - b. Cardiac monitoring is not essential for these patients.
  - c. Cardiac monitoring is indicated for these patients who are at significant risk of an immediately life-threatening arrhythmia.
  - d. Cardiac monitoring is not indicated for these patients because the risk of serious arrhythmias is low.
4. The American College of Cardiology Emergency Cardiac Care Committee's rating system provides which of the following guidance statements about cardiac monitoring in Class III patients?
  - a. Cardiac monitoring is not indicated for these patients because the risk of serious arrhythmias is low.
  - b. Cardiac monitoring is not essential for these patients.
  - c. Cardiac monitoring is indicated for these patients who are at risk of an immediate, life-threatening arrhythmia.
  - d. Cardiac monitoring may benefit these patients.
5. Remote cardiac monitoring generates visual and audible alarm signals, based on condition changes that exceed established alarm limits for a specific patient.
  - a. True
  - b. False

# PENNSYLVANIA PATIENT SAFETY ADVISORY

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