

# Effect of a Nurse-Managed Telemetry Discontinuation Protocol on Monitoring Duration, Alarm Frequency, and Adverse Patient Events

**Keisha Perrin, BSN, RN; Neysa Ernst, MSN, RN;  
Terry Nelson, MSN, RN, NEA-BC;  
Melinda Sawyer, MSN, RN, CNS-BC;  
Elizabeth Pfoh, PhD, MPH; Maria Cvach, DNP, RN, FAAN**

Telemetry monitoring is a limited resource. This quality improvement project describes a nurse-managed telemetry discontinuation protocol aimed at stopping telemetry monitoring when it is no longer indicated. After implementing the protocol, data were collected for 6 months and compared with a preintervention time frame. There was a mean decrease in telemetry monitor usage and a decreased likelihood of remaining on a telemetry monitor until discharge. A nurse-managed telemetry discontinuation protocol was effective in decreasing overmonitoring and ensuring telemetry availability. **Key words:** *alarm fatigue, alarms, cardiac monitoring, physiologic monitoring, telemetry, telemetry discontinuation protocol*

---

**Author Affiliations:** *The Johns Hopkins Hospital (Mss Perrin, Ernst, and Nelson), Johns Hopkins, Armstrong Institute for Patient Safety and Quality (Ms Sawyer and Dr Cvach), Division of General Internal Medicine, Johns Hopkins University (Dr Pfoh), and Johns Hopkins Health System (Dr Cvach), Baltimore, Maryland.*

*The authors acknowledge Y.-J. Cheng, C. Denver-Fowler, MPH, BSN, RN; S. Desai, MD, FACP; and R. Hasan, MD, MHS, for their consultation on the conduct of this project.*

*The authors declare no conflict of interest.*

*Supplemental digital content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's Web site ([www.jncqjournal.com](http://www.jncqjournal.com)).*

**Correspondence:** *Maria Cvach, DNP, RN, FAAN, Johns Hopkins Health System, Room 631, 1830 E. Monument St, Baltimore, MD 21287 ([mcvach@jbmi.edu](mailto:mcvach@jbmi.edu)).*

*Accepted for publication: June 16, 2016*

*Published ahead of print:*

*DOI: 10.1097/NCQ.0000000000000230*

**T**ELEMETRY MONITORS on hospital units sound alarms 24 hours a day, often for nonactionable reasons that, nevertheless, cause a considerable work burden for staff. There are a substantial number of alarms per monitored bed each day<sup>1-3</sup> that siphon away time and resources that might otherwise be spent caring for patients. Overmonitoring has become a significant problem that distracts from clinical care and leads to desensitization from clinically important alarms. In addition, overmonitoring leads to unnecessary medical interventions, increased health care costs, increased unit noise, increased patient discomfort from being attached to monitoring equipment, and delayed inpatient admissions.<sup>4-7</sup> In hospitals where telemetry monitoring is limited and patient demand outpaces available resources, there must be an efficient and safe way to assess when monitoring is unnecessary and may be discontinued.

The objective of this quality improvement project was to develop and implement an efficient, safe method to discontinue telemetry monitoring when it is no longer indicated. Without initiation and discontinuation criteria, patients remain unnecessarily monitored, often for the duration of their hospitalization. This objective was met by reviewing the literature and then developing and implementing a nurse-managed telemetry discontinuation protocol over a 6-month period on a non-intensive care/non-intermediate care medical unit. Using a pre-post study design, we report on whether the protocol (1) reduces the proportion of patients who remain on a telemetry monitor until discharge, (2) reduces the total number of hours patients remain on a telemetry monitor, (3) impacts clinically significant events (ie, rapid response team [RRT]/code calls) (4) decreases the quantity of alarms per monitored bed, and (5) is acceptable to nurses and physicians as a method for discontinuing telemetry monitoring.

## LITERATURE REVIEW

In 2004, the American Heart Association (AHA) published ECG (electrocardiographic) Monitoring Practice Standards for hospital settings. A rating system devised by the American College of Cardiology Emergency Care was used to describe monitoring recommendations, which included 3 categories: class I (cardiac monitoring is indicated in most, if not all patients); class II (cardiac monitoring may be of benefit in some patients but is not considered essential for all patients); and class III (cardiac monitoring is not indicated because a patient's risk of serious event is low and monitoring is not beneficial).<sup>8</sup> Despite availability of AHA practice standards, unnecessary monitoring continues today.<sup>6,9,10</sup> The most commonly reported misused diagnoses with telemetry monitor orders were gastrointestinal bleeding, malignancy, sepsis, acute renal failure, sickle cell, deep vein thrombosis, chronic obstructive pulmonary disease, alcohol withdrawal, pneumonia, and cirrhosis.<sup>9</sup> Studies have reported cost and time sav-

ings associated with limiting telemetry use while maintaining and potentially increasing patient safety.<sup>11-13</sup> This can be done safely using proactive telemetry screening or through the use of telemetry inclusion and exclusion criteria/protocols.<sup>14-17</sup>

On the basis of our literature review, the best available evidence indicates that telemetry monitoring is used beyond recommended time frames, and proactive screening using a nurse-managed telemetry discontinuation protocol may be effective in decreasing telemetry usage, increasing telemetry monitoring availability, and improving allocation of telemetry monitors without increasing clinically significant events. This review illustrated the gap in knowledge about the decision to monitor and when monitoring is no longer indicated. This study demonstrates how a nurse-managed telemetry discontinuation protocol, developed using the AHA ECG Monitoring Practice Standards<sup>8</sup> and expert opinion, can be used to classify telemetry patients and safely discontinue telemetry monitoring when it is no longer indicated.

## METHODS

This pre-post study was conducted in a 15-bed medical acute care unit with a maximum telemetry monitor capacity of 8 patients and was a representative sample of other medical telemetry units in The Johns Hopkins Hospital, Department of Medicine (DOM). All patients who were admitted to the unit and had a telemetry monitor ordered at any point during their stay on the unit were included in the study. Six months of preintervention data (April 2013 to September 2013) were compared with 6 months of data collected during the intervention phase (April 2014 to September 2014). Before beginning this project, the DOM did not have specific telemetry initiation or discontinuation criteria. Physicians based their decision to initiate or discontinue telemetry monitoring on patient assessment and clinical judgment, resulting in unnecessary monitoring. The project was

approved by the hospital's institutional review board.

### **Telemetry discontinuation intervention**

The nurse-managed telemetry discontinuation protocol was developed by a DOM project team using the AHA Monitoring Practice Standards<sup>8</sup> and in consultation with Johns Hopkins Cardiology and Hospitalists to determine who should be monitored along with recommended monitoring duration time (see Supplemental Digital Content, Figure, available at: <http://links.lww.com/JNCQ/A301>). We used the hospital's Intra-Facility Transport policy to guide the decision about the type of monitoring required during transports. The protocol was divided into 3 categories: type I (eg, telemetry monitoring, which requires continuous monitoring including specialized staff and equipment while off the unit for tests or procedures); type II (eg, intermittent telemetry monitoring, which could be temporarily suspended while traveling off the unit for tests or procedures); and acute illness (eg, non-AHA diagnoses determined by the DOM project team as potentially helpful in guiding treatment and not requiring specialized staff or telemetry monitoring while traveling off the unit). The Supplemental Digital Content, Figure (available at: <http://links.lww.com/JNCQ/A301>), lists the types of diagnoses included under each category and the recommended monitoring duration times.

### **Nurse-managed telemetry discontinuation workflow**

Daily (between 4 AM-6 AM) a nurse on the unit reviewed the telemetry discontinuation criteria, using a paper form, to determine whether a patient was eligible for discontinuation. The process included a nurse assessment of each patient's cardiac rhythm and 24-hour monitor history. If telemetry discontinuation criteria were met (eg, no hemodynamically significant arrhythmia; heart rate 60-100), the nurses made their recommendation during multidisciplinary rounds and a collaborative decision was made to maintain or discontinue telemetry. If physicians chose to

continue telemetry, they were asked to select one of the following reasons for monitor continuation: (1) detect clinical deterioration early; (2) allow a higher level of nursing care; (3) monitor a patient with an abnormal electrocardiogram; (4) concern for development of an arrhythmia; or (5) other.

To evaluate the effectiveness of this workflow, the study team developed a short survey, which included 7 questions about the usage and support of the nurse-managed telemetry discontinuation protocol. A paper form of the survey was provided to the nursing staff who were asked to place anonymously completed forms in the project team leader's mailbox. Two months post-protocol implementation, DOM physician house staff received the survey electronically using an online survey tool.

### **Nurse-managed telemetry discontinuation education plan**

The project team leader, who worked on the study unit, developed an educational plan. Education was provided to both the nursing and physician staff over a 1-month time frame. Nurse education included a one-to-one nurse review of the unit's monitoring system and full disclosure logs, an in-service on alarm fatigue, the importance of alarm customization, and a primer on how to use the nurse-managed telemetry discontinuation protocol. Physicians were introduced to the discontinuation protocol at a house staff meeting and were advised a nurse would follow this protocol to determine when patients met telemetry discontinuation criteria. Physicians also were informed that they could override criteria and continue telemetry monitoring but would be requested to specify a reason for monitor continuation. Physicians and the study unit staff were provided with fact sheets and reminders regarding protocol implementation.

### **Telemetry usage, alarm, and RRT/code data**

Telemetry usage and length-of-stay data were collected from the electronic provider order entry system for all patients who had an order for telemetry monitoring on the study

unit during the project time frame. Patients were dichotomized into having a telemetry monitor order in place or not. For patients who had more than 1 encounter to the study unit within the same admission, only the final encounters that resulted in discharge were included in this dichotomized measure.

Clinical Engineering collected weekly monitor alarm data and provided the project team with the unit's average total number of patients monitored daily, average total monitor alarms per week, and average daily alarms per monitored bed from January to September 2014. Three months of preintervention data (January 2014 to March 2014) were used as our comparison time frame for this analysis. To ensure that there were no additional RRT or cardiac and/or respiratory arrest (code) events during the intervention as compared with the preintervention period, we report the number of events among all patients on the study unit regardless of whether they were on a telemetry monitor.

### Statistical analysis

All analyses were conducted at the monitor encounter level. We conducted descriptive analyses to identify whether there were any differences in age, sex, race, and the number of encounters per admission to the unit (see Supplemental Digital Content, Table, available at: <http://links.lww.com/JNCQ/A302>). Continuous variables are reported as means with standard deviations, and categorical variables are reported as counts with percentages; *t* tests were used to compare differences between the preintervention (control) period and the intervention period for continuous variables, whereas  $\chi^2$  tests were used to compare differences with categorical variables. We used multilevel regression models to determine the impact of the telemetry discontinuation protocol on our outcomes; a logistic model was used to evaluate the impact on cardiac monitoring until discharge, and a linear model was used to evaluate the impact on the number of hours on cardiac monitor. Since a person could have more than 1 monitor encounter, both the unadjusted and adjusted regression models used

multilevel modeling to account for within-patient correlations across multiple encounters. The adjusted regression analysis controlled for age, sex, race, and length of stay.

## RESULTS

Demographic and other relevant information for the project time frame is presented in Supplemental Digital Content, Table (available at: <http://links.lww.com/JNCQ/A302>). There were no significant differences in patient sex and age during the preintervention and intervention time frames. There were a significantly higher proportion of blacks in the intervention period than those in the preintervention period. There were more single monitor encounters during the intervention period but fewer patients with multiple encounters. Individuals in the preintervention period had a longer mean length of stay than those in the intervention period (242 hours compared with 190 hours), although this difference was marginally significant ( $P = .046$ ). The average number of hours per monitor encounter was 107 in the preintervention group as compared with 74 in the intervention group ( $P < .01$ ).

Table 1 demonstrates patient-days, defined as the total number of all patient-days during the study time frame, the number of admissions to the study unit, the number of monitor encounters, and the number of discharges

**Table 1.** Patient Encounter Demographic Details

| Time Frame                      | Preintervention<br>Apr 1, 2013-<br>Sep 30, 2013 | Intervention<br>Apr 1, 2014-<br>Sep 30, 2014 |
|---------------------------------|---|--|
| Patient-days                    | 2168  | 2243   |
| Admissions                      | 317   | 288  |
| Monitor encounters <sup>a</sup> | 186   | 221  |
| Discharges                      | 416   | 451  |

<sup>a</sup>Monitor encounter is any stay on the study unit that includes telemetry order. Also includes both multiple admissions and transfers to/from other units during same admission.

from the study unit. There were more patient-days, monitor encounters, and discharges during the intervention period.

#### Telemetry monitor duration

Table 2 denotes the unadjusted and adjusted average hours on telemetry monitoring for the preintervention and intervention periods, as well as the odds of having a telemetry monitor at the time of discharge. After adjusting for age, sex, race, and length of stay, there was a 75% decreased likelihood of remaining on a telemetry monitor until discharge among monitor encounters in the intervention group compared with monitor encounters in the preintervention group (odds ratio = 0.25;  $P < .001$ ; 95% confidence interval [CI], 0.13-0.48). Monitor encounters in the intervention group had a mean decrease of 25 hours of telemetry monitor use compared with monitor encounters in the preintervention group ( $P < .005$ ; 95% CI, 8.1-41.5).

#### Telemetry monitor alarm frequency and RRT/code call results

On average, 6 patients per day were monitored using telemetry in both the pre- and postintervention periods. Although a slight downward trend in daily average monitor alarms per bed (Figure) was noted upon initiation of the intervention (April 2014), alarm frequency increased again in May and remained relatively unchanged compared with the preintervention time frame. During the 6-month preintervention time frame, there

were 7 RRT calls and 1 code call for 2168 patient-days. During the 6-month intervention time frame, there were 9 RRT calls and 1 code call for 2243 patient-days.

#### Nurse and physician survey results

Two months postimplementation, 14 nurses on the pilot unit completed the nursing satisfaction survey about the use of the nurse-managed telemetry discontinuation protocol. Eighty-six percent of the nursing staff ( $n = 12$ ) agreed or strongly agreed that they would support using this protocol. Seventy-one percent of nurses ( $n = 10$ ) believed that the protocol was beneficial to improve patient satisfaction and they were more knowledgeable about telemetry and the unit's monitor system as a result of this project. Most physicians (83%;  $n = 39$ ) reported that they would support a nurse-managed telemetry discontinuation protocol.

#### DISCUSSION

Telemetry monitoring is a scarce resource in hospitals; judicious use addresses this concern. In our pre-post study on a single unit, we found that a nurse-managed telemetry discontinuation protocol resulted in significantly reduced odds of being on a telemetry monitor at discharge. The Johns Hopkins Nurse-Managed Telemetry Discontinuation Protocol (see Supplemental Digital Content, Figure, available at: <http://links.lww.com/JNCQ/A301>) is a useful tool for deciding when telemetry is no longer

**Table 2.** Results of Unadjusted and Adjusted Logistic and Linear Regression of Being on Telemetry by Monitor Encounter<sup>a</sup>

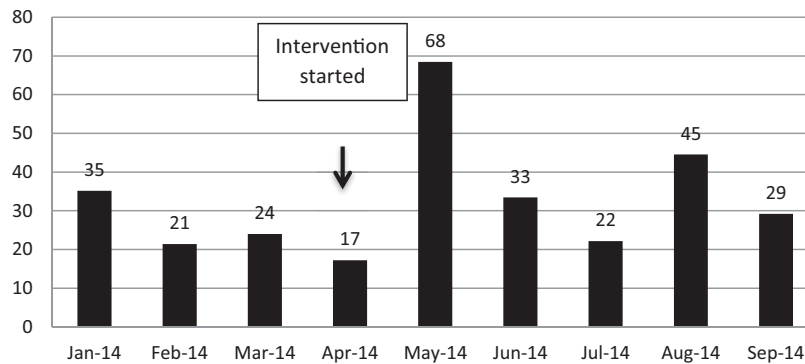
|  | Unadjusted       | Adjusted         |
|--|------------------|------------------|
| Telemetry until discharge, OR <sup>b</sup> (95% CI)      | 0.30 (0.16-0.54) | 0.25 (0.13-0.48) |
| Change in hours on telemetry, mean <sup>c</sup> (95% CI) | 33 (14.0-51.4)   | 25 (8.1-41.5)    |

Abbreviations: CI, confidence interval; OR, odds ratio.

<sup>a</sup>A monitor encounter is any stay on the study unit that includes a telemetry order. This also includes both multiple admissions and transfers to/from other units during the same admission.

<sup>b</sup>Multilevel multivariate logistic regression adjusting for age, gender, race, length of stay, and within-patient clustering.

<sup>c</sup>Multilevel multivariate linear regression adjusting for age, gender, race, length of stay, and within-patient clustering.



**Figure.** Average number of alarms per monitored bed each day (pre/postintervention).

indicated and reducing the amount of time a patient is ordered for telemetry monitoring. Our results indicate that nurses and physicians working collaboratively can use a nurse-managed telemetry discontinuation protocol to significantly decrease the number of patients who remain on telemetry until discharge without compromising patient safety as indicated by no difference in our code/RRT data. Decreasing telemetry monitoring time by an average of 25 hours in the intervention group compared with the control group increases telemetry monitor availability, which facilitates patient throughput, especially in high demand areas (eg, emergency department, postprocedure areas) where patients may be awaiting admission to a monitored bed.

The number of monitor alarms per telemetry bed remained the same despite the use of this protocol. These findings are consistent with a study conducted by Rayo et al,<sup>18</sup> in which the percentage of unnecessary alarms remained unchanged despite the use of a telemetry discontinuation protocol. Our hospital had instituted measures to decrease unnecessary monitor alarms before starting this project; thus, our preintervention quantity of monitor alarms was already low. We expected that the average number of patients on telemetry monitoring would decrease during the intervention period; however, it remained steady at 6 patients per day, indicating that when a patient was discharged from telemetry, a new patient requiring monitor-

ing was quickly admitted. The increased incidence of monitor alarms in May 2014 could be explained by patient noncompliance with wearing the telemetry monitor. For example, in 1 week during May, there were 4650 monitor “lead off” alarms of which 1 patient caused 4520 of these alarms. When a patient is noncompliant with wearing telemetry, the physician needs to be notified and telemetry orders reevaluated. Allowing alarms to continue for patient noncompliance creates noise (false alarms) and masks important alarm signals (true alarms), creating an opportunity for missed alarms. Additional education of the staff about alarm fatigue and alarm customization was provided to the study unit during the intervention period. We concluded that the staff need continual reminders about alarm customization to minimize alarm fatigue.

Our project results are consistent with the results that others have experienced, indicating that telemetry is ordered on medical patients for noncardiac reasons.<sup>9,10</sup> When physicians were provided with a list of recommended AHA diagnoses to choose from to continue telemetry monitoring, they frequently chose the “other” option. Gastrointestinal bleeding was the most common non-AHA reason selected for continuation of monitoring. Nurses on the study unit expressed a high degree of approval for the use of the protocol, although they felt inconvenienced using paper-based criteria on a unit where all medical record documentation is electronic. To improve workflow, the team

recommended incorporation of the telemetry discontinuation protocol into the electronic provider order entry system. Despite education, physicians indicated in the survey that they did not remember the protocol but supported its use. This may have occurred because the nurse was following the protocol and the physician did not have an opportunity to see the paper-based protocol form that was being used. Future work will incorporate health information technology as a way to encourage appropriate initiation of telemetry monitoring.

### Limitations

This study was conducted as a quality improvement project and was implemented on 1 medical telemetry unit; therefore, generalizability may be limited. Our study focused on telemetry discontinuation and not telemetry initiation; therefore, we cannot comment on whether patients were inappropriately initiated on telemetry. In addition, we were only able to obtain telemetry alarm data for the 3 months prior to our intervention, limiting our ability to make comparisons in this analysis. However, we were able to compare the same 6-month time periods a year apart for the telemetry duration analysis, as well as control for patient characteristics; this strengthens our confidence that our protocol did decrease the duration of telemetry monitoring.

We believe that our statistically significant demographic differences in race and the number of monitor encounters can be explained by a change in the study unit's admission practices between 2013 and 2014. In 2014, the subspecialty of the study unit shifted from a primarily white, female demographic, hospitalized for gastrointestinal motility diagnoses with frequent hospital encounters (admissions) to a medically complex demographic with fewer encounters (admissions) and more intrahospital transfers. This change in patient demographic occurred because patients who were previously treated on the study unit during the preintervention time frame were sent to another hospital within our health system during the intervention time frame.

### CONCLUSIONS

A nurse-managed telemetry discontinuation protocol is an effective way of decreasing the length of time patients remain on a monitor and increasing telemetry monitor bed availability for patients who need it the most. Our results indicated that the nurse-managed telemetry discontinuation protocol resulted in a decreased likelihood of remaining on a telemetry monitor until discharge and a mean decrease in the number of hours of telemetry monitor usage on the study unit without increasing adverse patient outcomes.

### REFERENCES

1. Graham KC, Cvach M. Monitor alarm fatigue: standardizing use of physiological monitors and decreasing nuisance alarms. *Am J Crit Care*. 2010;19(1):28-34; quiz 35.
2. Drew BJ, Harris P, Zegre-Hemsey JK, et al. Insights into the problem of alarm fatigue with physiologic monitor devices: a comprehensive observational study of consecutive intensive care unit patients. *PLoS One*. 2014;9(10):e110274.
3. Sendelbach S, Wahl S, Anthony A, Shotts P. Stop the noise: a quality improvement project to decrease electrocardiographic nuisance alarms. *Crit Care Nurse*. 2015;35(4):15-22.
4. Feder S, Funk M. Over-monitoring and alarm fatigue: for whom do the bells toll? *Heart Lung*. 2013;42(6):395-396.
5. Funk M, Stephens K, May J, Fennie K, Feder S, Drew B. An alarming rate of unnecessary monitoring in the practical use of the latest standards of electrocardiography (PULSE) trial. *J Am Coll Cardiol*. 2013;61(10\_S):A370.
6. Funk M, Winkler CG, May JL, et al. Unnecessary arrhythmia monitoring and underutilization of ischemia and QT interval monitoring in current clinical practice: baseline results of the practical use of the latest standards for electrocardiography trial. *J Electrocardiol*. 2010;43(6):542-547.

7. Chen EH, Hollander JE. When do patients need admission to a telemetry bed? *J Emerg Med.* 2007;33(1):53-60.
8. Drew BJ, Califf RM, Funk M, et al. Practice standards for electrocardiographic monitoring in hospital settings: an American Heart Association scientific statement from the councils on cardiovascular nursing, clinical cardiology, and cardiovascular disease in the young: endorsed by the international society of computerized electrocardiology and the American Association of Critical-Care Nurses. *Circulation.* 2004;110(17):2721-2746.
9. Sabharwal A, Mason M, Lipin R. Cardiac telemetry guidelines improve bed utilization and resources. *Patient Saf Qual Healthc.* 2008;11:1-7.
10. Najafi N, Auerbach A. Use and outcomes of telemetry monitoring on a medicine service. *Arch Intern Med.* 2012;172(17):1349-1350.
11. Benjamin EM, Klugman RA, Luckman R, Fairchild DG, Abookire SA. Impact of cardiac telemetry on patient safety and cost. *Am J Managed Care.* 2013;19(6):e225-e232.
12. Kansara P, Jackson K, Dressler R, et al. Potential of missing life-threatening arrhythmias after limiting the use of cardiac telemetry. *JAMA Intern Med.* 2015;175(8):1416-1418.
13. Bulger J, Nickel W, Messler J, et al. Choosing wisely in adult hospital medicine: five opportunities for improved healthcare value. *J Hosp Med.* 2013;8(9):486-492.
14. Reilly T, Humbrecht D. Fostering synergy: a nurse-managed remote telemetry model. *Crit Care Nurse.* 2007;27(3):22-26, 29-33; quiz 34.
15. Dhillon SK, Rachko M, Hanon S, Schweitzer P, Bergmann SR. Telemetry monitoring guidelines for efficient and safe delivery of cardiac rhythm monitoring to noncritical hospital inpatients. *Crit Pathw Cardiol.* 2009;8(3):125-126.
16. Bubb C. A timely practice; a nurse-driven telemetry discontinuation protocol. *Pa Nurse.* 2011;66(4):6-10; quiz 10.
17. Clement J, Oribello R. EB83: improved telemetry utilization through a nurse-driven screening protocol at a public teaching hospital. *Crit Care Nurse.* 2011;31(2):e29-e30.
18. Rayo MF, Mansfield J, Eiferman D, Mignery T, White S, Moffatt-Bruce SD. Implementing an institution-wide quality improvement policy to ensure appropriate use of continuous cardiac monitoring: a mixed-methods retrospective data analysis and direct observation study [published online ahead of print November 13, 2015]. *BMJ Qual Saf.* doi:10.1136/bmjqs-2015-004137.