

## ORIGINAL ARTICLE

# Physician awareness of patient cardiac telemetry monitoring

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## ABSTRACT

Overuse of cardiac telemetry monitoring in the inpatient setting is widespread, contributes to alarm fatigue, and is costly for health systems. We sought to quantify the rates of provider unawareness of ongoing telemetry use and to quantify the rate of appropriate monitoring compared to American Heart Association (AHA) guidelines using a survey design. Inpatient medical providers were questioned about the presence of telemetry for each of their patients. In the 870 inquiries, 47% of patients were receiving telemetry. Providers' awareness of whether their patient was receiving telemetry was inaccurate in 26% of assessments. A guideline-appropriate indication for telemetry use was provided in only 58% of assessments. Providers are often unaware of ongoing cardiac telemetry use in their patients, and may continue use despite the lack of a guideline-appropriate indication.

**Key Words:** Cardiac monitoring, Telemetry, Guidelines

## 1. INTRODUCTION

Overuse of continuous cardiac telemetry monitoring for medical inpatients is a threat to high value care and has impacts on patient safety. Inappropriate use of telemetry contributes to bed limitations, leading in turn to increased boarding time in the emergency rooms and ambulance diversions. Also, like any test, false positive findings can result in unnecessary testing or procedures that have their own associated risks and costs. There are also operational costs needed to maintain the required staffing with specialized training as well as costs associated with mitigating the effects on bed flow, hospital throughput, and transport. Moreover, the proliferation of telemetry use has led to unintended consequences including alarm fatigue, which has been increasingly recognized as a risk to patient safety. Cardiac monitoring has even been tied to sentinel events, including death, related to alarm fatigue.

As such, the Joint Commission released a sentinel event alert in 2013 and adopted alarm management as a National Patient Safety Goal for 2014.<sup>[1]</sup> Additionally, appropriate telemetry use was included as one of the Society of Hospital Medicine's Choosing Wisely recommendations.<sup>[2]</sup>

Identifying the factors that contribute to the overuse of telemetry monitoring will be key in developing successful solutions to optimize use. Prior research has shown physicians are often unaware of the presence of urinary catheters and central lines.<sup>[3,4]</sup> We hypothesized that providers are also often unaware of ongoing telemetry monitoring, which may contribute to continuation of unnecessary use. Furthermore, we hypothesized that providers were unfamiliar with the appropriate indications for cardiac monitoring. In this study we sought to quantify provider awareness of active cardiac monitoring and to assess provider understanding of

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the indications for telemetry use.

## 2. METHODS

### 2.1 Patients and study design

This study was conducted at a 369 bed, community-based hospital in the Duke University Health System with a medical inpatient service of approximately 90-100 patients that are managed by hospital medicine physicians. This site also serves as a teaching center for residents, medical students and physician assistant students. Medical inpatients are managed by either a hospitalist alone or by teaching teams which include an attending physician supervising a resident, intern and students. "Providers" in our study were defined as hospital medicine physicians, physician assistants (PA's), medical residents, medical students, or physician assistant students. Hospitalists who are not on a teaching team may be assigned a geographic location. Hospitalists assigned a geographic location generally have the majority of their patients concentrated on one of three medical units. This geographic assignment facilitates communication between the staff and physician caring for the patients on the unit. Hospitalists without a geographic assignment do not necessarily have patients concentrated on any unit and see patients on all three medical inpatient units. All medical inpatient units have the capability for cardiac telemetry monitoring, and telemetry orders on all units are written through the same electronic health record computerized order entry pathway. Cardiologists were not the primary attending on any of the patients on the medical inpatient service included in this study, but did serve as consultants on some of the patients. In general, telemetry orders are the responsibility and purview of the primary team, not the cardiology consultant.

Providers were interviewed on 8 separate days in January and February 2014 to gauge awareness of ongoing telemetry use and to assess knowledge of indications for telemetry. Initiation and discontinuation of telemetry for this patient population requires a provider order. Providers were asked in-person by a physician interviewer to comment on telemetry use only for patients for whom they had cared for at least 1 day. All providers rounding on the medical inpatient service were included; we excluded providers rounding in the intensive care unit. Providers were asked to indicate which of their patients were receiving active telemetry monitoring. Providers were asked not to refer to the electronic health record or the telemetry monitor prior to answering, but they could refer to their handwritten notes. Interviews were conducted in work areas away from cues by central telemetry monitors and patients. If the provider said that a patient was on telemetry, they were asked to give the indication. Participation in the study was voluntary, but no provider declined

participation. Provider role (hospitalist, teaching attending, PA, resident, or student) and assigned geographic unit (if applicable) were recorded. One of the geographic units is a cardiac unit with a higher prevalence of patients on telemetry. We wanted to assess whether this was a confounding variable. Providers could be interviewed on multiple days.

On each interview day, study investigators then reviewed the telemetry monitors within one hour to compare provider responses to actual telemetry use to determine provider accuracy. Provider responses for telemetry indications were compared to the American Heart Association (AHA) guideline on telemetry monitoring<sup>[5]</sup> to determine appropriateness. Two reviewers independently graded each response as either consistent or inconsistent with guidelines. A third reviewer judged discordant responses to make the final determination in cases where the first two reviewers did not agree. The protocol was deemed exempt by the Duke University Medical Center IRB.

### 2.2 Statistical methods

A provider assessment was considered correct if the provider stated that the patient had telemetry and the patient had an active monitor or if the provider stated that the patient did not have telemetry and the patient did not have an active monitor. Rates of correct assessments were calculated as the number of correct assessments over the total number of assessments. Rates were compared across roles (hospitalist, intern, PA, resident, teaching attending, or student) and across geographic assignment (unassigned, unit 5-1, unit 5-2, or unit 5-3) for hospitalist teams using the Chi-Squared test.

If the provider indicated that the patient was on telemetry, they were asked to provide the indication for use. The rate of appropriate use was calculated as the number of assessments with a guideline-indicated use as determined by the reviewers divided by the total number of assessments in which the provider indicated that the patient was on telemetry. Patients who the provider indicated were not on telemetry were not included in the appropriate use analysis. The rate of appropriate use was also compared across roles using the Chi-Squared test.

A logistic model was used to examine the association of role with the probability of making a correct assessment. This model was adjusted for date of assessment in order to account for possible changes over time.

The Kappa coefficient was used to estimate the agreement between the two independent reviewers. A two-sided significance level of 0.05 was used for all statistical tests. All statistical analyses were conducted using SAS version 9.4 (SAS Institute, Cary, NC).

### 3. RESULTS

A total of 870 assessments were obtained from the 8 interview days. 414 responses (47.6%) were from hospitalists rounding alone, 82 responses (9.4%) were from attending physicians on the teaching service, 43 responses (4.9%) were from PA's, 156 responses (17.9%) were from residents, 103 (11.8%) responses were from interns and 72 responses (8.3%) were from students. Of the 870 responses, 417 (47.9%) were receiving telemetry monitoring. Overall, providers made

an accurate assessment of telemetry use in 700 of the 870 assessments (80%). When telemetry was present, providers correctly identified telemetry use in 73.6% (307/417) of assessments; when absent, providers correctly identified absence of use in 86.8% (393/453) of assessments. Providers were unaware of telemetry use when present in 26.4% of assessments (110/417). Similarly, providers thought telemetry use was ongoing in 13.2% of assessments (60/453) when it was not (see Table 1).

**Table 1.** Provider awareness of telemetry use

	Provider believes telemetry present	Provider believes telemetry not present	Total
Telemetry present	307	110	417
Telemetry not present	60	393	453
Total	367	503	

**Table 2.** Rates of accurate knowledge of telemetry use by provider type

	All Providers	Role of Provider						p-value
		Hospitalist	Intern	Physician's Assistant	Resident	Teaching Attending	Student	
Number of Assessments (% of total)	870 (100%)	414 (48%)	103 (12%)	43 (5%)	156 (18%)	82 (9%)	72 (8%)	
Accurate Assessments	700 (80%)	349 (84%)	82 (80%)	31 (72%)	127 (81%)	59 (72%)	52 (72%)	.025
Patients Actually on Telemetry	417 (48%)	195 (47%)	53 (51%)	29 (67%)	73 (47%)	31 (38%)	36 (50%)	.056
Provider Unaware of Telemetry Use <sup>#</sup>	110 (26%)	39 (20%)	14 (26%)	8 (28%)	23 (32%)	10 (32%)	16 (44%)	.039
Rate of Identifying Appropriate Indication for Telemetry*	214 (58%)	106 (58%)	24 (52%)	18 (72%)	38 (68%)	17 (50%)	11 (46%)	.115

<sup>#</sup> Denominator reflects the number of patients on telemetry; \*Out of the observations where provider gave indication for use

There were significant differences in the accuracy rate among the roles ( $p = .025$ ) (see Table 2). Hospitalists rounding alone had the highest rate of accurate assessments. The logistic model showed an overall association of role with making an accurate assessment ( $p = .028$ ). Compared to hospitalists, physician's assistants, teaching attendings, and students were each 52% less likely to make a correct assessment (OR = 0.481 and 95% CI= [0.235, 0.986], OR = 0.478 and 95% CI = [0.276, 0.829], and OR = 0.484 and 95% CI = [0.270, 0.866] respectively).

An examination of the geographic assignment of the hospitalist-only subset of the data did not show geographic assignment to have a significant effect.

#### Appropriateness of telemetry monitoring

When the indications given by providers were reviewed for appropriateness in comparison to guideline indications for telemetry there was substantial agreement between the two reviewers ( $\kappa = 0.76$ , 95% CI = [0.69, 0.83]).

Providers provided an indication for telemetry for 367 responses. Of these, 58% (214/367) were found to have an appropriate indication for use. No differences in the rate

of identifying an appropriate use was seen among roles ( $p = .115$ ) (see Table 2).

Common reasons providers gave for telemetry use that did not meet guideline criteria included bleeding, end-stage renal disease (ESRD), chronic obstructive pulmonary disease (COPD), and hypoxia. In 13 assessments, providers indicated that the patient had no active indication for telemetry.

### 4. DISCUSSION

This study demonstrates that providers are unaware of telemetry use in a quarter of the patients who have active cardiac monitoring. Moreover, providers did not give an appropriate indication for telemetry in 42% of patients receiving it. These findings suggest that increased provider awareness of telemetry monitoring and increased provider education of the appropriate indications may help to optimize use. Lack of provider awareness has also been found in other spheres where overuse has been demonstrated, such as urinary catheter and central line use.<sup>[3,4]</sup> Lessons learned from implementation of other line and catheter removal strategies are likely to also be applicable here. Contributing factors to unawareness likely include multiple handoffs, complex pa-

tient care decisions which demand providers' attention, and lack of institutional focus on cardiac monitoring. Another contributor to overuse is clinical inertia. Clinical inertia is often described as a factor to explain failure to appropriately escalate therapy, but also can be to blame when there is a failure to appropriately de-escalate therapy. Many patients may have a diagnosis indicating telemetry is indicated at presentation, but this indication may not continue through discharge.

The incremental cost of telemetry monitoring has been estimated to be in the range of \$39-\$82 per patient, per day.<sup>[6-8]</sup> These estimates were generally made by authors using cost-accounting data, including equipment costs and personnel/labor costs for telemetry monitoring. They do not include indirect costs such as the cost of delays while patients wait in the emergency department (ED) for telemetry beds to become available, or the costs of additional testing or prolonged length of stay prompted by telemetry findings. In our study, excess cost estimates could not be directly calculated because each provider assessment did not correspond to a single, discrete patient (some patients were represented by multiple provider assessments from different members of the care teams). However, with over 9,000 medicine admissions annually at our institution, overuse of telemetry in even a small fraction of patients can lead to substantial excess costs over time.

The goal of optimization of use does not solely mean a reduction in overall telemetry use, but rather an increase in the rate of appropriate use. While awareness of use was impacted by provider role, appropriateness of use was not. This underscores the need for increased education of all providers about appropriate use of telemetry. A recent multi-pronged effort by hospitalists to reduce excess telemetry use which included efforts to increase awareness and an educational component to address appropriateness showed a significant reduction in telemetry length of stay.<sup>[9]</sup> A more clear understanding of which factors are driving persistent overuse will help tailor and streamline future such efforts. Our study suggests that

awareness and lack of knowledge of appropriate indications are key factors in excess use and addressing these factors is going to be key in any successful intervention to optimize telemetry use.

The results of our study should be interpreted in the context of several limitations. First, some respondents were interviewed on more than one day over the course of the interview period. This could have impacted their use and awareness of telemetry later in the study period. The lack of change noted over the course of the study period suggests this was not a marked effect. Similarly, some patients were represented in the data set multiple times as they were in the hospital on multiple interview days. Patients may have also been cared for by multiple interviewed providers (both the teaching attending and the resident, for example). However, we felt that this would not meaningfully alter the question of whether providers are aware of a patients' cardiac monitoring. Another limitation was the use of provider responses to determine the indication for telemetry. It is possible that a more in-depth chart review would have changed the classification of some patients from not having an indication for telemetry to actually having an indication or vice-versa. Finally, the study group was confined to internal medicine providers in one hospital. Further study at other sites may be considered in the future to validate our results.

## 5. CONCLUSION

Health care providers are frequently unaware of ongoing telemetry use and are often using telemetry inappropriately. As a result, inappropriate telemetry utilization results in increased health care costs and risks to patient safety. Improving provider education, decision support in electronic health record systems, and the development of hospital processes to increase awareness are the first steps to reduce unnecessary telemetry monitoring. Understanding the factors that drive unnecessary telemetry use is critical to the development of sustainable solutions that will ensure patient safety, reduce costs, and promote high-value, cost-conscious care.

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