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Cost-Saving Opportunities with Appropriate Utilization of Cardiac Telemetry

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ABSTRACT

A third of healthcare spending in the United States is considered waste, and costs are growing at an unsustainable rate. Reducing unnecessary cardiac telemetry, a costly intervention with a high potential for overuse, may be an opportunity to reduce waste. We performed a review of 250 consecutive patients admitted to telemetry capable beds on the general medical-surgical, noncritical care units. Based on the American Heart Association Practice Standards for Electrocardiographic Monitoring in Hospital Settings, appropriateness of telemetric monitoring during each inpatient day was assessed, with identification of significant new arrhythmias, code calls, and clinical decisions resulting from telemetry. Cost of a telemetry day was calculated

using a time-driven activity-based cost model. Patients (63±19 years, 54% male) spent a total of 1640 days hospitalized, 1399 (85%) of which were on telemetry. Average length of stay was 6.6 days, and average telemetry time was 5.6 days. Only 334 (24%) telemetry days were deemed appropriate based on Practice Standards. During telemetric monitoring, 16 new significant arrhythmias were detected, 4 code calls were made, and 19 significant clinical decisions were prompted by telemetry. No cardiac code call occurred on a nontelemetry day. The cost of telemetry was calculated as $34.28 more per day than a nontelemetry hospital day. Elimination of inappropriate telemetry days would result in a minimum estimated savings of $37,007 in these 250 patients, and an annual savings of $528,241 overall. Telemetric monitoring is frequently overused. In conclusion, our findings propose that a reduction in inappropriate telemetry days in accordance with the American Heart Association Practice Standards could result in significant cost savings.

Key Words: cardiac telemetry, quality improvement, time-driven activity based costing

Healthcare costs in the United States now account for 18% of the gross domestic product, and per capita spending is approximately twice that of other major industrialized nations without demonstrating better health outcomes.[1] A significant opportunity for reducing healthcare costs is reducing waste, accounting for up to one-third of healthcare expenditures.[1] Cardiac telemetry is widely used in hospitals to detect clinically significant arrhythmias.[2] Its use has increased substantially since its invention, especially in noncritical care settings, due to increased availability and portability of telemetry monitoring systems.[2] Practice standards for the use of telemetry were published in 1991 by the American College of Cardiology due to concerns of overuse and most recently updated by the American Heart Association in 2004.[3,4] Previous

observational investigations of appropriate use of telemetry appraised cost of telemetry at between $53 and $1400 per day.[2,5,6,7] Previous cost models for daily telemetry usage focused on nursing full-time equivalents associated with telemetry monitoring, equipment costs and/or downstream costs with associated flow bottlenecks and backups.[5] Our study evaluated the appropriateness of telemetry use at a tertiary care hospital, and used a time-driven activity-based costing model to estimate the potential cost savings that could be realized through optimal use of telemetry.

Methods

This study was approved by the Ochsner Clinic Foundation Internal Review Board. A query of our 432-bed tertiary care hospital's electronic medical record identified 250 sequential inpatients monitored using cardiac telemetry during their stay. Patients in intensive care and coronary care units were excluded as they undergo telemetric monitoring based on mandates from the Joint Commission. General cardiology units were also excluded because a majority of these patients are admitted for conditions that are indications for telemetry based on the 2004 American Heart Association guidelines.[4] The cardiothoracic step-down unit was also excluded, as recent major cardiac surgery is an indication for telemetry, again based on the 2004 guidelines.

Two physicians performed a retrospective chart review of all 250 admissions. Appropriateness or inappropriateness of telemetry initiation was assessed based on the admitting teams progress note from the day that telemetry was initiated. Duration of telemetry was deemed appropriate or inappropriate based on continuance or resolution of the indications for telemetry (see *Table 1*), based on progress notes, associated diagnoses and diagnostic studies. All "rapid-response" and code calls were identified from standardized rapid-response and code

documentation. Clinical decisions motivated by telemetry findings were identified as therapeutic decisions (*e.g*., medication initiation or changes, cardiology consults, or procedures) documented in provider notes.

The primary end point was appropriateness of telemetric monitoring for each day of telemetry use. Secondary end-points were treatment changes that were made based on telemetric data, and the initiation of rapid response/code calls (and whether these occurred on appropriate telemetry days or inappropriate telemetry days).

Using a time-driven activity-based costing model, we estimated the incremental cost of a telemetry day based on a number of fixed costs and variable costs. Time-driven activity-based costing analysis is a method of assigning cost rates to various resources consumed by proving insight into processes and costs that conventional healthcare costing systems are unable to estimate.[8,9] This is accomplished by mapping the processes related to an activity and identifying the resources involved at each step. Time required is estimated for each process step, and the associated cost is estimated by determining the amount of time the total process takes and the cost of the resources (personnel and/or equipment) involved in the processes.

For our study, we calculated the cost of each significant telemetry event by determining the process by which a telemetry event is investigated and reported, along with all of the personnel associated with each event. The time required for each step in the process was determined by direct observation of clinicians involved in the investigation and reporting of a telemetry event. The total time required for each employee was recorded over 50 telemetry events. The estimated incremental cost of unnecessary telemetric monitoring was derived from this result – first for these 250 patients and then extrapolated to the entire hospital for an entire year. Thus, telemetry cost per day was calculated as summarized in Figure 1.

Results

We reviewed 250 admissions. Patient characteristics are summarized in *Table 2*. Patients were admitted for a total of 1640 hospital days (median 4 days [interquartile range: 3-6 days]) with cardiac telemetry used on 1399 (85%) days (median 3 days [interquartile range: 2-5 days]).

The appropriateness of telemetric monitoring based on guidelines, and the associated outcomes, are summarized in *Table 3*. Of the 16 significant arrhythmias detected, all were recorded during appropriate telemetry days, while none was recorded on an inappropriate telemetry day. All 5 code calls were due to respiratory arrest with 4 being on appropriate telemetry days and 1 on an inappropriate telemetry day. There were 18 significant clinical decisions motivated by telemetry findings during appropriate telemetry days, with only 1 such decision made on an inappropriate telemetry day.

There were 7 days during which a patient had guideline-based indication(s) for telemetry but telemetric monitoring was either not initiated or had been removed prematurely. No critical event or significant clinical decision occurred on these non-telemetry days.

Based on our time-driven activity-based costing model (Figure 2) and a standard linear depreciation model for central and portable telemetry monitoring equipment, the calculated cost of a telemetry day was $34.31 more than a non-telemetry day. The calculation equation and cost bases are shown in Figure 1 and are unique to our institution.

Elimination of inappropriate telemetry days could have resulted in a conservatively-estimated savings of $36,540 for these 250 patients, and for the entire hospital population an annual savings of $528,648.

Discussion

Our study has several important findings. First, the majority of cardiac telemetry monitoring at our institution is inappropriate based on the 2004 American Heart Association (AHA)/ American College of Cardiology (ACC) guidelines. In addition, there is little benefit to telemetry overuse, as no clinically significant arrhythmia nor code call occurred on inappropriate telemetry days. Finally, optimization of telemetry utilization, primarily through reduction in inappropriate use, could result in significant cost savings.

Cardiac telemetry, when used in the correct setting, is a useful tool for identifying clinically significant arrhythmias. Our study shows that the majority of telemetry days at our hospital are inappropriate based on the 2004 AHA/ACC guidelines for inpatient cardiac telemetry monitoring, which are the most recent guidelines despite being more than a decade old at the time of our study. This proportion of inappropriate telemetry days far exceeded that of a similar study performed by Benjamin et al.[5] Potential reasons for telemetry overuse include lack of awareness of the AHA/ACC guidelines, non-adherence to these guidelines, lack of provider awareness of ongoing telemetry use and a lack of telemetry auditing. These causes have been described in previous studies and should be a target for future study and intervention.[2,5,6,7,10]

Our analysis of inappropriate telemetry days found that monitoring on inappropriate days provided little clinical information and resulted in few if any significant clinical decisions. There was no code call of cardiac origin on an inappropriate telemetry day. Therefore, on inappropriate telemetry days, if telemetry were not used, no adverse events would have been missed.

In addition, there were a number of days during which patients “should” have been on telemetry based on guideline-directed indications, but telemetry was not used or had been prematurely discontinued. Fortunately, no adverse events occurred on these days. Thus, in

addition to inappropriate/wasteful telemetry use for patients who did not require monitoring, there was failure to identify patients with guideline-directed indications for telemetry monitoring.

There is evidence that up to one-third of money spent on medical care in the US is waste.[1] If we are to continue to provide a financially tenable health system, it is incumbent upon us to reduce waste. Based on our conservative estimate of $528,241 saved per year via reduction of inappropriate telemetry at our hospital, similar waste reduction at a medium-sized community hospital with 175 telemetry-capable beds could translate to annual cost savings of $213,986. Due to the immense opportunity for substantial cost savings, all hospitals, regardless of size and capability, should make a concerted effort to reduce inappropriate telemetry use. Tools for such optimization could include clinician education regarding practice standards for cardiac telemetry monitoring, clinical decision support tools embedded within the electronic medical record, and electronic medical record-based protocolization of telemetry monitoring.[7]

Since this was a retrospective chart review, the quality of our data relies on the quality of documentation by the provider teams. Diagnostic studies (such as ECGs and labs) and associated diagnoses were analyzed to further determine if telemetry was indeed appropriate. Additionally, our daily telemetry cost calculation likely underestimates the true cost of telemetry, since downstream effects, such as decreased emergency department throughput due to reduced availability of inpatient telemetry beds, the cost of unnecessary consultations from telemetry overuse, and other unaccounted effects, were not included. Due to wide variation in provider salaries (trainees *vs*. medical staff *vs*. mid-level providers), cost related to their work time was not incorporated into our time-driven activity-based costing model (further underestimating cost). Further prospective studies with protocolization of telemetry and robust cost data are

needed to provide greater insight into the exact magnitude of cost savings that would result from optimized telemetry use.

Telemetric monitoring is frequently overused among patients admitted to non-cardiac, non-critical care services. A reduction in inappropriate telemetry days in accordance with the American Heart Association Practice Standards would result in significant savings without missing clinically significant events.

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Figure 1: Telemetry cost per day calculation equation and cost bases for calculation
Figure 2: Telemetry event reporting workflow
Table 1: Indications for Cardiac Telemetry Adapted from 2004 AHA Practice Standards and 1991 ACC Guidelines.[3,4]

	Indication for Monitoring	Suggested Time Frame
1.	Patients with chest pain syndromes	12-24 hours or negative biomarkers
2.	Patients receiving anti-arrhythmics or medication adjustments for rate control of chronic atrial tachyarrhythmia	24 hours or until definitive management
3.	Patients being evaluated for syncope	24-48 h
4.	DNR Patients with symptomatic arrhythmias	Until optimal rhythm management is achieved
5.	Assessment, monitoring and control of significant arrhythmias (Supraventricular or ventricular tachycardia, bradycardia) that require medical therapy	72 hours
6.	New onset atrial fibrillation with or without rapid ventricular response	Until optimal rate/rhythm management or 24h after successful cardioversion
7.	Patient started on drug known to cause torsades de pointes	72 hours, stable dosage or until drug is discontinued
8.	Patients who have severe electrolyte abnormalities	24 hours or until stabilization of electrolyte derangement and no QT related arrhythmias

9. Assessment and monitoring of patients with drug or chemical toxicity known to cause cardiac arrhythmias	Until drug is excreted/metabolized and late effects have resolved
10. Newly diagnosed stroke	24 hours
11. Patients with other acute neurological events	24 hours or until hemodynamically stable
12. Patients with significant cardiovascular disease history admitted with pneumonia, severe asthma or COPD exacerbation associated with tachycardia or significant hypoxemia not requiring ICU level care	During acute phase of illness
13. Variceal bleeding treated with endoscopy, sclerotherapy and intravenous vasopressin	Until bleeding risk is stratified and treated or after 3 days of clinical stability
14. Major non-cardiac surgery with prior CAD or CAD risk factors	24 hours or until hemodynamically stable
15. Following sedation or anesthesia for procedures	Until patient is awake, alert and hemodynamically stable
16. Drug overdose or active alcohol withdrawal	24 hours

Table 2: Patient Characteristics (n=250)

Mean Age (Years)	62.6
Men	54.0
Average LOS (days)	6.6
Average Days on Telemetry	5.6
Prior Coronary Artery Disease	26.0%
Prior Congestive Heart Failure	25.2%
Type 2 Diabetes Mellitus	29.6%
Atrial Fibrillation	17.2%
Most Common Admitting Diagnoses	
Pneumonia	23%
Sepsis	18%
Stroke	14%

Table 3: Telemetry Monitoring Appropriateness and Significant Clinical Events

Appropriate Telemetry Days	334 (23.8%)
Inappropriate Telemetry Days	1065 (76.5%)
Arrhythmias on Appropriate Telemetry Day	16 (100%)
Arrhythmias on Inappropriate Telemetry Day	0 (0%)
Code Calls on Appropriate Telemetry Day	4 (80%)
Code Calls on Inappropriate Telemetry Day	1 (20%)
Clinical Decisions on Appropriate Telemetry Day	18 (94.7%)
Clinical Decisions on Inappropriate Telemetry Day	1 (5.3%)