

CHOOSING WISELY[®]: NEXT STEPS IN IMPROVING HEALTHCARE VALUE

Hospitalist Intervention for Appropriate Use of Telemetry Reduces Length of Stay and Cost

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BACKGROUND: Telemetry monitoring is a widely used, labor-intensive, and often-limited resource. Little is known of the effectiveness of methods to guide appropriate use.

OBJECTIVE: Our intervention for appropriate use included: (1) a hospitalist-led, daily review of bed utilization, (2) hospitalist-driven education module for trainees, (3) quarterly feedback of telemetry usage, and (4) financial incentives.

DESIGN/METHODS: Hospitalists were encouraged to discuss daily telemetry utilization on rounds. A module on appropriate telemetry usage was taught by hospitalists during the intervention period (January 2013–August 2013) on medicine wards. Pre- and post-evaluations measured changes regarding telemetry use. We compared hospital bed–use data between the baseline period (January 2012–December 2012), intervention period, and extension period (September 2014–March 2015). During the intervention period, hospital bed–use data were sent to the hospitalist group quarterly. Financial incentives were provided after a decrease in hospitalist telemetry utilization.

SETTING: Stanford Hospital, a 444-bed, academic medical center in Stanford, California.

RESULTS: Hospitalists saw reductions for both length of stay (LOS) (2.75 vs 2.13 days, $P = 0.005$) and total cost (22.5% reduction) for telemetry bed utilization in the intervention period. Nonhospitalist telemetry bed utilization remained unchanged. We saw significant improvements in trainee knowledge of the most cost-saving action ($P = 0.002$) and the least cost-saving action ($P = 0.003$) in the pre- and post-evaluation analyses. Results were sustained in the hospitalist group, with telemetry LOS of 1.93 days in the extension period.

CONCLUSIONS: A multipronged, hospitalist-driven intervention to improve appropriate use of telemetry reduces LOS and cost, and increases knowledge of cost-saving actions among trainees. *Journal of Hospital Medicine* 2015;10:627–632. © 2015 Society of Hospital Medicine

Inpatient hospital services are a major component of total US civilian noninstitutionalized healthcare expenses, accounting for 29.3% of spending in 2009¹ when the average cost per stay was \$9700.² Telemetry monitoring, a widely used resource for the identification of life-threatening arrhythmias, contributes to these costs. In 1998, Sivaram et al. estimated the cost per patient at \$683; in 2010, Ivonye et al. published the cost difference between a telemetry bed and a nonmonitored bed in their inner-city public teaching facility reached \$800.^{3,4}

In 1991, the American College of Cardiology published guidelines for telemetry use, which were later revised by the American Heart Association in 2004.^{5,6} Notably, the guidelines are based on expert opinion and on research data in electrocardiography.⁷ The guidelines divide patients into 3 classes based on clinical

condition: recommending telemetry monitoring for almost all class I patients, stating possible benefit in class II patients, and discouraging cardiac monitoring for the low-risk class III patients.^{5,6} The Choosing Wisely campaign, an initiative of the American Board of Internal Medicine and the Society of Hospital Medicine, highlights telemetry monitoring as 1 of the top 5 interventions that physicians and patients should question when determining tests and procedures.⁸ Choosing Wisely suggests using a protocol to govern continuation of telemetry outside of the intensive care unit (ICU), as inappropriate monitoring increases care costs and may result in patient harm.⁸ The Joint Commission 2014 National Patient Safety Goals notes that “numerous alarm signals and the resulting noise and displayed information tends to desensitize staff and cause them to miss or ignore alarm signals or even disable them.”⁹

Few studies have examined implementation methods for improved telemetry bed utilization. One study evaluated the impact of a multispecialty telemetry policy with enforcement by an outside cardiologist and nurse team, noting improved cardiac monitoring bed utilization and decreased academic hospital closure, which previously resulted in inability to accept new patients or procedure cancellation.¹⁰ Another study provided an orientation handout discussed by the

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chief resident and telemetry indication reviews during multidisciplinary rounds 3 times a week.¹¹

Our study is one the first to demonstrate a model for a hospitalist-led approach to guide appropriate telemetry use. We investigated the impact of a multipronged approach to guide telemetry usage: (1) a hospitalist-led, daily review of bed utilization during attending rounds, (2) a hospitalist attending-driven, trainee-focused education module on telemetry utilization, (3) quarterly feedback on telemetry bed utilization rates, and (4) financial incentives. We analyzed pre- and post-evaluation results from the education module to measure impact on knowledge, skills, and attitudes. Additionally, we evaluated the effect of the intervention on length of stay (LOS) and bed utilization costs, while monitoring case mix index (CMI) and overall mortality.

METHODS

Setting

This study took place at Stanford Hospital and Clinics, a teaching academic center in Stanford, California. Stanford Hospital is a 444-bed, urban medical center with 114 telemetry intermediate ICU beds, and 66 ICU beds. The 264 medical–surgical beds lack telemetry monitoring, which can only be completed in the intermediate and full ICU. All patients on telemetry units receive both cardiac monitoring and increased nursing ratios. Transfer orders are placed in the electronic medical record to shift patients between care levels. Bed control attempts to transfer patients as soon as an open bed in the appropriate care level exists.

The study included all 5 housestaff inpatient general internal medicine wards teams (which excludes cardiology, pulmonary hypertension, hematology, oncology, and post-transplant patients). Hospitalists and nonhospitalists attend on the wards for 1- to 2-week blocks. Teaching teams are staffed by 1 to 2 medical students, 2 interns, 1 resident, and 1 attending. The university institutional review board notice of determination waived review for this study because it was classified as quality improvement.

Participants

Ten full- and part-time hospitalist physicians participated in the standardized telemetry teaching. Fifty-six of the approximately 80 medical students and housestaff on hospitalists' teams completed the educational evaluation. Both hospitalist and nonhospitalist teams participated in daily multidisciplinary rounds, focusing on barriers to discharge including telemetry use. Twelve nonhospitalists served on the wards during the intervention period. Hospitalists covered 72% of the internal medicine wards during the intervention period.

Study Design

We investigated the impact of a multipronged approach to guide telemetry usage from January 2013 to August 2013 (intervention period).

Hospitalist-Led Daily Review of Bed Utilization

Hospitalists were encouraged to discuss the need of telemetry on daily attending rounds and review indications for telemetry while on service. Prior to starting a ward block, attendings were emailed the teaching module with a reminder to discuss the need for telemetry on attending rounds. Reminders to discuss telemetry utilization were also provided during every-other-week hospitalist meetings. Compliance of daily discussion was not tracked.

Hospitalist-Driven, Trainee-Focused, Education Module on Telemetry Utilization

The educational module was taught during teaching sessions only by the hospitalists. Trainees on nonhospitalist teams did not receive dedicated teaching about telemetry usage. The module was given to learners only once. The module was a 10-slide, Microsoft PowerPoint (Microsoft Corp., Redmond, WA) presentation that reviewed the history of telemetry, the American College of Cardiology and the American Heart Association guidelines, the cost difference between telemetry and nonmonitored beds, and the perceived barriers to discontinuation. The presentation was accompanied by a pre- and post-evaluation to elicit knowledge, skills, and attitudes of telemetry use (see Supporting Information, Appendix A, in the online version of this article). The pre- and post-evaluations were created through consensus with a multidisciplinary, expert panel after reviewing the evidence-based literature.

Quarterly Feedback on Telemetry Bed Utilization Rates

Hospital bed–use and CMI data were obtained from the Stanford finance department for the intervention period and for the baseline period, which was the year prior to the study, January 1, 2012 to December 31, 2012. Hospital bed–use data included the number of days patients were on telemetry units versus medical–surgical units (nontelemetry units), differentiated by hospitalists and nonhospitalists. Cost savings were calculated by the Stanford finance department that used Stanford-specific, internal cost accounting data to determine the impact of the intervention. These data were reviewed at hospitalist meetings on a quarterly basis. We also obtained the University Healthsystem Consortium mortality index (observed to expected) for the general internal medicine service during the baseline and intervention periods.

To measure sustainment of telemetry reduction in the postintervention period, we measured telemetry LOS from September 2014 to March 2015 (extension period).

TABLE 1. Bed Utilization Over Baseline, Intervention, and Extension Time Periods for Hospitalists and Nonhospitalists

	Baseline Period	Intervention Period	P Value	Extension Period	P Value
Length of stay					
Hospitalists					
Telemetry beds	2.75	2.13	0.005	1.93	0.09
Nontelemetry beds	2.84	2.72	0.324	2.44	0.21
Nonhospitalists					
Telemetry beds	2.75	2.46	0.331	2.22	0.43
Nontelemetry beds	2.64	2.89	0.261	2.26	0.05
Case mix index					
Hospitalists					
	1.44	1.45	0.68	1.40	0.21
Nonhospitalists					
	1.46	1.40	0.53	1.53	0.18

NOTE: Length of stay (LOS) for telemetry beds was significantly reduced over the intervention period (2.75 days vs 2.13 days, $P = 0.005$) for hospitalists. Nonhospitalists demonstrated no difference in mean LOS for telemetry beds between baseline and intervention periods (2.75 days vs 2.46 days, $P = 0.33$). The results were sustained in the hospitalist group, with a telemetry LOS of 1.93 in the extension period. The mean case mix index managed by the hospitalist and nonhospitalist groups remained unchanged.

Financial Incentives

Hospitalists were provided a \$2000 bonus at the end of fiscal year 2013 if the group showed a decrease in telemetry bed use in comparison to the baseline period.

Statistical Analysis of Clinical Outcome Measures

Continuous outcomes were tested using 2-tailed t tests. Comparison of continuous outcome included differences in telemetry and nontelemetry LOS and CMI. Pairwise comparisons were made for various time periods. A P value of <0.05 was considered statistically significant. Statistical analyses were performed using Stata 12.0 software (StataCorp, College Station, TX).

RESULTS

Clinical and Value Outcomes

Baseline (January 2012–December 2012) Versus Intervention Period (January 2013–August 2013)

LOS for telemetry beds was significantly reduced over the intervention period (2.75 days vs 2.13 days, $P = 0.005$) for hospitalists. Notably, there was no significant difference in mean LOS between baseline and intervention periods for nontelemetry beds (2.84 days vs 2.72 days, $P = 0.32$) for hospitalists. In comparison, for nonhospitalists, there was no difference in mean LOS for telemetry beds between baseline and intervention periods (2.75 days vs 2.46 days, $P = 0.33$) and nontelemetry beds (2.64 days vs 2.89 days, $P = 0.26$) (Table 1).

Costs of hospital stay were also reduced in the multipronged, hospitalist-driven intervention group. Expenditures for telemetry beds were reduced by -22.5% over the intervention period for hospitalists (Table 2).

The mean CMI of the patient cohort managed by the hospitalists in the baseline and intervention

TABLE 2. Percent Change in Accommodation Costs Over Baseline to Intervention and Intervention to Extension Periods

	Baseline to Intervention Period	Intervention to Extension Period
Hospitalists		
Telemetry beds	-22.55%	-9.55%
Nontelemetry beds	-4.23%	-10.14%
Nonhospitalists		
Telemetry beds	-10.55%	-9.89%
Nontelemetry beds	9.47%	-21.84%

NOTE: Accommodation costs were reduced in the hospitalist group. Expenditures for telemetry beds were reduced by -22.5% over the intervention period for hospitalists.

periods was not significantly different (1.44 vs 1.45, $P = 0.68$). The mean CMI of the patients managed by the nonhospitalists in the baseline and intervention periods was also not significantly different (1.46 vs 1.40, $P = 0.53$) (Table 1). Mortality index during the baseline and intervention periods was not significantly different (0.77 ± 0.22 vs 0.66 ± 0.23 , $P = 0.54$), as during the intervention and extension periods (0.66 ± 0.23 vs 0.65 ± 0.15 , $P = 0.95$).

Intervention Period (January 2013–August 2013)

Versus Extension Period (September 2014–March 2015)

The decreased telemetry LOS for hospitalists was sustained from the intervention period to the extension period, from 2.13 to 1.93 ($P = 0.09$). There was no significant change in the nontelemetry LOS in the intervention period compared to the extension period (2.72 vs 2.44, $P = 0.21$). There was no change in the telemetry LOS for nonhospitalists from the intervention period to the extension period (2.46 vs 2.22, $P = 0.43$).

The mean CMI in the hospitalist group was not significantly different in the intervention period compared to the extension period (1.45 to 1.40, $P = 0.21$). The mean CMI in the nonhospitalist group did not change from the intervention period to the extension period (1.40 vs 1.53, $P = 0.18$) (Table 1).

Education Outcomes

Out of the 56 participants completing the education module and survey, 28.6% were medical students, 53.6% were interns, 12.5% were second-year residents, and 5.4% were third-year residents. Several findings were seen at baseline via pretest. In evaluating patterns of current telemetry use, 32.2% of participants reported evaluating the necessity of telemetry for patients on admission only, 26.3% during transitions of care, 5.1% after discharge plans were cemented, 33.1% on a daily basis, and 3.4% rarely. When asked which member of the care team was most likely to encourage use of appropriate telemetry, 20.8% identified another resident, 13.9% nursing,

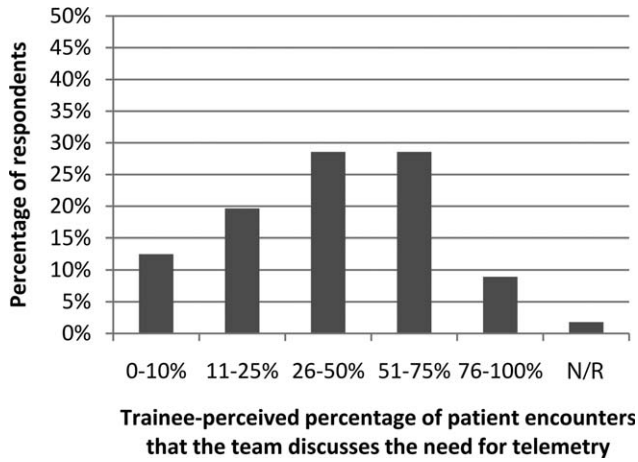


FIG. 1. Premodule, trainee-perceived percentage of patient encounters for which the team discussed a patient’s need for telemetry; N/R, no response.

37.5% attending physician, 20.8% self, 4.2% the team as a whole, and 2.8% as not any.

Figure 1 shows premodule results regarding the trainees’ perceived percentage of patient encounters during which a participant’s team discussed their patient’s need for telemetry.

In assessing perception of current telemetry utilization, 1.8% of participants thought 0% to 10% of patients were currently on telemetry, 19.6% thought 11% to 20%, 42.9% thought 21% to 31%, 30.4% thought 31% to 40%, and 3.6% thought 41% to 50%.

Two areas were assessed at both baseline and after the intervention: knowledge of indications of telemetry use and cost related to telemetry use. We saw increased awareness of cost-saving actions. To assess current knowledge of the indications of proper telemetry use according to American Heart Association guidelines, participants were presented with a list of 5 patients with different clinical indications for telemetry use and asked which patient required telemetry the most. Of the participants, 54.5% identified the correct answer in the pretest and 61.8% identified the correct answer in the post-test. To assess knowledge of the costs of telemetry relative to other patient care, participants were presented with a patient case and asked to identify the most and least cost-saving actions to safely care for the patient. When asked to identify the most cost-saving action, 20.3% identified the correct answer in the pretest and 61.0% identified the correct answer in the post-test. Of those who answered incorrectly in the pretest, 51.1% answered correctly in the post-test ($P = 0.002$). When asked to identify the least cost-saving action, 23.7% identified the correct answer in the pretest and 50.9% identified the correct answer in the posttest. Of those who answered incorrectly in the pretest, 60.0% answered correctly in the post-test ($P = 0.003$).

In the post-test, when asked about the importance of appropriate telemetry usage in providing cost-conscious care and assuring appropriate hospital resource man-

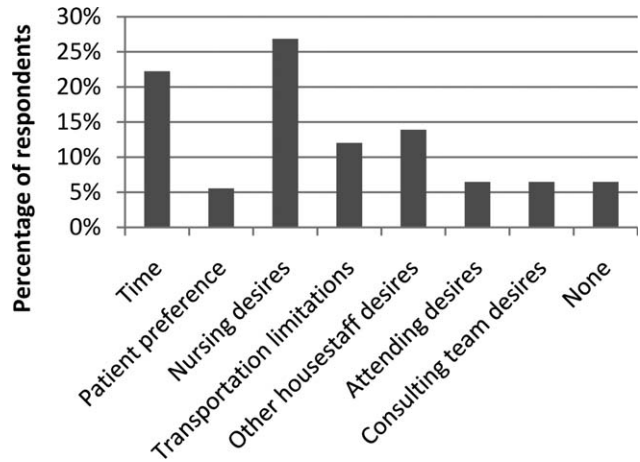


FIG. 2. Postmodule, trainee-perceived barriers to discontinuation of telemetry.

agement, 76.8% of participants found the need very important, 21.4% somewhat important, and 1.8% as not applicable. The most commonly perceived barriers impeding discontinuation of telemetry, as reported by participants via post-test, were nursing desires and time. Figure 2 shows all perceived barriers.

DISCUSSION

Our study is one of the first to our knowledge to demonstrate reductions in telemetry LOS by a hospitalist intervention for telemetry utilization. Others^{10,11} have studied the impact of an orientation handout by chief residents or a multispecialty telemetry policy with enforcement by an outside cardiologist and nurse team. Dressler et al. later sustained a “70% reduction in telemetry use without adversely affecting patient safety,” as assessed through numbers of rapid response activations, codes, and deaths, through integrating the AHA guidelines into their electronic ordering system.¹² However, our study has the advantage of the primary team, who knows the patient and clinical scenario best, driving the change during attending rounds. In an era where cost consciousness intersects the practice of medicine, any intervention in patient care that demonstrates cost savings without an adverse impact on patient care and resource utilization must be emphasized. This is particularly important in academic institutions, where residents and medical students are learning to integrate the principles of patient safety and quality improvement into their clinical practice.¹³ We actually showed sustained telemetry LOS reductions into the extension period after our intervention. We believe this may be due to telemetry triage being integrated into our attending and resident rounding practices. Future work should include integration of telemetry triage into clinical decision support in the electronic medical record and multidisciplinary rounds to disseminate telemetry triage hospital-wide in both the academic and community settings.

Our study also revealed that nearly half of participants were not aware of the criteria for appropriate utilization of telemetry before our intervention; in the preintervention period, there were many anecdotal and objective findings of inappropriate utilization of telemetry as well as prolonged continuation beyond the clinical needs in both the hospitalist and nonhospitalist group. For the hospitalist group (ie, the group receiving guideline-based education on appropriate indications for telemetry utilization), there was an assessment of both appropriate usage and timely discontinuation of telemetry in the postintervention period, which we attribute in large part to adherence to the education provided to this group.

We were able to show increased knowledge of cost-saving actions among trainees with our educational module. We believe it is imperative to educate our providers (physicians, nurses, case managers, and students within these disciplines) on the appropriate indications for telemetry use, not only to help with cost savings and resource availability (ie, allowing telemetry beds to be available for patients who need them most), but also to instill consistent expectations among our patients. For the hospitalist group (ie, the group receiving guideline-based education on appropriate indications for telemetry utilization), there was an assessment of both appropriate usage and timely discontinuation of telemetry in the postintervention period, which we attribute in large part to adherence to the education provided to this group.

Additionally, we feel it is important to consider the impacts of inappropriate use of telemetry from a patient's perspective: it is physically restrictive/inconvenient, alarms are disruptive, it can be a barrier for other treatments such as physical therapy, it may increase the time it takes for imaging studies, a nurse may be required to accompany patients on telemetry, and poses additional costs to their medical bill.

We believe our success is due to several strategies. First, at the start of the fiscal year when quality improvement metrics are established, this particular metric (improving the appropriate utilization and timely discontinuation of telemetry) was deemed important by all hospitalists, engendering group buy-in prior to the intervention. Our hospitalists received a detailed and interactive tutorial session in person at the beginning of the study. This tutorial provided the hospitalists with a comprehensive understanding of the appropriate (and inappropriate) indications for telemetry monitoring, hence facilitating guideline-directed utilization. Email reminders and the tutorial tool were provided each time a hospitalist attended on the wards, and hospitalists received a small financial incentive to comply with appropriate telemetry utilization.

Our study has several strengths. First, the time frame of our study was long enough (8 months) to allow consistent trends to emerge and to optimize exposure of housestaff and medical students to this quality-improvement initiative. Second, our cost savings came from 2 factors, direct reduction of inappro-

priate telemetry use and reduction in length of stay, highlighting the dual impact of appropriate telemetry utilization on cost. The overall reductions in telemetry utilization for the intervention group were a result of both reductions in initial placement on telemetry for patients who did not meet criteria for such monitoring as well as timely discontinuation of telemetry during the patient's hospitalization. Third, our study demonstrates that physicians can be effective in driving appropriate telemetry usage by participating in the clinical decision making regarding necessity and educating providers, trainees/students, and patients on appropriate indications. Finally, we show sustainment of our intervention in the extension period, suggesting telemetry triage integration into rounding practice.

Our study has limitations as well. First, our sample size is relatively small at a single academic center. Second, due to complexities in our faculty scheduling, we were unable to completely randomize patients to a hospitalist versus nonhospitalist team. However, we believe that despite the inability to randomize, our study does show the benefit of a hospitalist attending to reduce telemetry LOS given there was no change in nonhospitalist telemetry LOS despite all of the other hospital-wide interventions (multidisciplinary rounds, similar housestaff). Third, our study was limited in that the CMI was used as a proxy for patient complexity, and the mortality index was used as the overall marker of safety. Further studies should monitor frequency and outcomes of arrhythmic events of patients transferred from telemetry monitoring to medical-surgical beds. Finally, as the intervention was multipronged, we are unable to determine which component led to the reductions in telemetry utilization. Each component, however, remains easily transferrable to outside institutions. We demonstrated both a reduction in initiation of telemetry as well as timely discontinuation; however, due to the complexity in capturing this accurately, we were unable to numerically quantify these individual outcomes.

Additionally, there were approximately 10 nonhospitalist attendings who also staffed the wards during the intervention time period of our study; these attendings did not undergo the telemetry tutorial/orientation. This difference, along with the Hawthorne effect for the hospitalist attendings, also likely contributed to the difference in outcomes between the 2 attending cohorts in the intervention period.

CONCLUSIONS

Our results demonstrate that a multipronged hospitalist-driven intervention to improve appropriate use of telemetry reduces telemetry LOS and cost. Hence, we believe that targeted, education-driven interventions with monitoring of progress can have demonstrable impacts on changing practice. Physicians will need to make trade-offs in clinical practice to balance efficient resource utilization with the patient's evolving condition in the inpatient setting, the

complexities of clinical workflow, and the patient's expectations.¹⁴ Appropriate telemetry utilization is a prime example of what needs to be done well in the future for high-value care.

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