CLINICAL REVIEW

Decreasing Inappropriate Use of Cardiac Telemetry

Sajan Patel, M.D.; Myung Shin Sim, DrPH; Erin Dowling, M.D.

Introduction

Telemetry, or continuous cardiac monitoring, was developed in the 1960s to monitor for arrhythmias after myocardial infarction. Since then, indications for cardiac monitoring have broadened and its use has significantly increased. Currently, telemetry is overused in hospitals and continues to be a significant source of health system waste.[1-3] It is considered a leading issue in quality initiatives, as highlighted by its presence in the top five recommendations by the Society of Hospital Medicine to the ABIM Choosing Wisely Campaign.[4]

The overuse of telemetry is likely due to physician uncertainty regarding patient trajectory, unawareness of established indications, and a misconception that telemetry implies a higher level of care.[3] Inappropriate use leads to increased costs, increased wait time for telemetry beds, unnecessary work-up of insignificant arrhythmias, and patient discomfort.[2,5-6] Multiple studies have targeted telemetry use, involving hard-wiring guidelines into the electronic health record (EHR), educational campaigns, and discontinuation protocols.[1,5,7-9]

We conducted a targeted educational study to evaluate the use of telemetry and the effect of an educational intervention on telemetry utilization among residents at a university-affiliated teaching hospital.

Methods

We studied the medicine admissions of UCLA Internal Medicine residents rotating through the Hospitalist rotation at Santa Monica/UCLA Medical Center from November 21, 2013 to May 3, 2014 (6 distinct rotation blocks were covered). Sources of admissions to the Hospitalist Service at this institution are two different UCLA emergency departments, UCLA clinics, and outside hospital transfers. Teams on the Hospitalist rotation consist one to two second or third year internal medicine residents, an attending physician, and a rotating post-call nurse practitioner (NP) who serves as the day float to carry out tasks after the resident leaves. The NP is present during post-call rounds and has no role in the admission process. The residents are on call every sixth night, and they typically staff all admissions the morning after call. Thus, the resident acting alone is responsible for the initial admission orders, including telemetry.

Three blocks of the study (November, February, and April) were dedicated to baseline data collection. The post-call NPs collected data on all admissions by the residents including admission source, telemetry status, and telemetry indication. For the other three blocks (December, January, and March), half the Hospitalist residents were randomly selected to be in the intervention arm. They received a 10-minute, standardized in-person slide-show presentation on telemetry overuse and appropriate indications based on published guidelines.[10-13] They also received a pocket reference card (Figure 1). The residents in the non-intervention arm, working in parallel to the residents in the intervention arm, were unaware of the study protocol. In addition, the attending physicians supervising either the control or intervention arm residents were unaware of the study. The study was designed to evaluate the effectiveness of the intervention for future use. The protocol was submitted to the Institutional Review Board (IRB) and was determined to not need full IRB review.

The NPs were trained on the study protocol and recorded data during rounds on admissions regarding telemetry status, telemetry indication, and telemetry appropriateness based on the list of indications (Figure 1).[10-13] Any telemetry admissions coded as "unclear" or "inappropriate" by the NPs were reviewed by the study authors, who performed chart review to determined presumed indication.

After the study, we conducted a program-wide survey of Internal Medicine residents regarding their opinions on telemetry use and comfort with indications (See Supplement 1).

Statistical Methods

A Chi-square test was used in comparing percentages and examining associations between categorical variables. Univariable and multivariable logistic regression analyses were performed using telemetry as an outcome variable. The initial multivariable model included admission source, intervention, resident, and block along with interactions between main effects. For those who were admitted to telemetry, logistic regression analysis was done using appropriate telemetry admission as an outcome variable and incorporating admission source, intervention, and resident along with interactions between main effects as covariates. The most parsimonious model was obtained thru a stepwise (backward and forward-combined) selection method using likelihood ratio tests and by comparing Akaike information criteria (AIC). All the tests were 2 sided and a p-value of less than 0.05 was considered statistically significant. All the statistical tests were performed using SAS 9.4 (Cary, NC).

Results

Data on 642 admissions were collected. Of these admissions, 52% (333/642) were put on telemetry, and 34% (112/333) of telemetry use was determined to be inappropriate based on published guidelines. With no intervention, 56% of admissions were put on telemetry, whereas with intervention, 40% were put on telemetry (p=0.0004), representing a 16% absolute reduction in telemetry use. When looking at practice of initiating telemetry and adjusting for admission source, the adjusted OR and unadjusted OR (no intervention versus intervention) were 1.87 (1.30, 2.70; P<0.001) and 1.90 (1.33,2.72 ; P<0.001), respectively. The final model, using telemetry as an outcome variable, showed that intervention (P<0.001) was significantly associated with initiating telemetry. Those who did not receive the educational intervention were 87% more likely to put patients on telemetry.

Without intervention, 63% of telemetry use was appropriate, whereas with intervention, 79% of telemetry use was appropriate (p=0.014). This represents a 16% absolute increase in appropriate telemetry use (Table 1). When looking at appropriate use, the adjusted OR (adjusting for admission source) and unadjusted OR of intervention versus no intervention were 2.08 (1.08, 4.00; P=0.029) and 2.21 (1.17, 4.19 ; P=0.015), respectively.

The final model, using appropriate telemetry as an outcome variable, shows that the educational intervention (P=0.033) was significantly associated with appropriate telemetry. Those who received this intervention were 2.03 times more likely to be appropriate in putting patients on telemetry.

Of the Internal Medicine residents who responded to the survey (74/113), 92% felt that telemetry is overused, and 72% felt that they personally overused telemetry. In addition, 89% indicated that they would be interested in learning more about telemetry guidelines and appropriate use, and most (92%) would welcome guideline integration into the EHR.

Discussion

Our study showed that the Internal Medicine residents at UCLA-Santa Monica Medical Center overused telemetry. However, a relatively simple and inexpensive educational intervention led to a significant improvement in inappropriate telemetry use. If sustained, these results could translate to a reduction in cost, waste of health system resources, and an improvement in patient experience. In addition, based on survey responses, these interventions appear to be favorably received and desired by the residents.

Previous studies have attempted to curb telemetry use with various results.[1,5,7-9] In recent literature, the most marked reduction in telemetry use was seen at Christiana Care System, which achieved this by hardwiring guidelines into their ordering system and by telemetry auto-discontinuation.[9] An educational or awareness campaign was not part of their intervention. In another recent study, the authors reduced default telemetry order duration from 72 to 48 hours. However, this led to increased telemetry re-ordering rather than actual reduction in duration.[8] Kanwar et al.[1] successfully decreased use with a combination of educational intervention and telemetry ordering restrictions. Of note, the authors of this study used admission diagnosis to judge if telemetry indication was appropriate and thus may have overstated their intervention effect.

We believe efforts to reduce telemetry at academic institutions require a multi-pronged approach. Educating residents and attending physicians on the importance of telemetry stewardship and familiarizing them with guidelines leads to a sense of personal responsibility, which could translate to sustainability. To ensure our particular intervention is long-lasting, we will be providing all housestaff with guideline pocket cards and incorporating our telemetry overuse presentation into housestaff orientations. By combining our educational intervention with EHR integration (including ordering restrictions as well as reminder and auto-discontinuation protocols), we believe we can effectively and sustainably reduce telemetry use.

Our study also identified a significant difference in the admission patterns of telemetry use depending on admission source. While outside the scope of this particular intervention, this is relevant for future studies within our institution and those that have similar operational models. It provides further evidence that clinical pathways, embedded into the EHR in combination with ongoing education, are needed to assure telemetry use is limited to clinically indicated cases.

There are several limitations to our study. It is a single-center study and thus the ability to generalize to other institutions is limited. Given that it is an educational intervention, effects will taper over time unless the intervention is regularly repeated. In addition, we did not investigate counter-balancing outcomes of decreased telemetry utilization among this cohort, including change in adverse events.

Conclusion

Reducing inappropriate telemetry use is an attainable and worthwhile goal. Prior studies have shown success with EHR integration and discontinuation protocols, while our study demonstrated the efficacy of an educational intervention. We believe sustainable telemetry reduction can be best achieved by combining these two modalities to develop a culture of telemetry stewardship among health care providers while harnessing the power of electronic health records to restrict use.

Tables and Figures

TABLE 1. Effect of Educational Intervention on Telemetry Use and Appropriateness

	Without intervention	With intervention	p-value
Admissions to telemetry	56% (266/475)	40% (67/167)	**0.0004**
Appropriate telemetry use	63% (168/266)	79% (53/67)	**0.0135**

Figure 1. Supplemental.

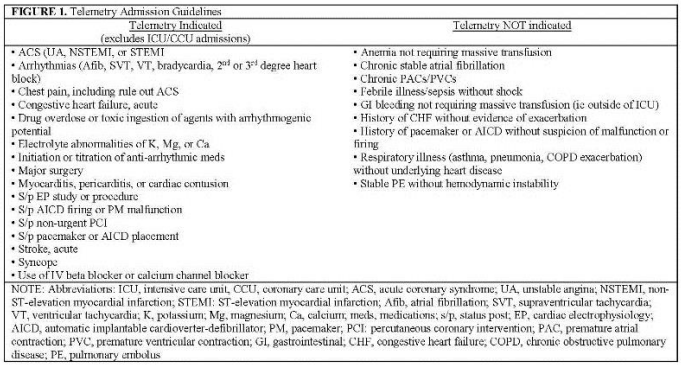
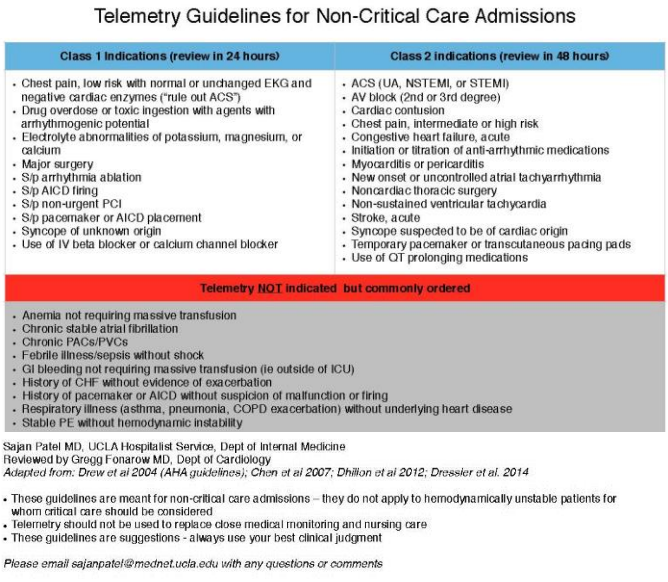


FIGURE 1. Telemetry Admission Guidelines

Telemetry Indicated (excludes ICU/CCU admissions)	Telemetry NOT indicated
• ACS (UA, NSTEMI, or STEMI • Arrhythmias (Afib, SVT, VT, bradycardia, 2nd or 3rd degree heart block) • Chest pain, including rule out ACS • Congestive heart failure, acute • Drug overdose or toxic ingestion of agents with arrhythmogenic potential • Electrolyte abnormalities of K, Mg, or Ca • Initiation or titration of anti-arrhythmic meds • Major surgery • Myocarditis, pericarditis, or cardiac contusion • S/p EP study or procedure • S/p AICD firing or PM malfunction • S/p non-urgent PCI • S/p pacemaker or AICD placement • Stroke, acute • Syncope • Use of IV beta blocker or calcium channel blocker	• Anemia not requiring massive transfusion • Chronic stable atrial fibrillation • Chronic PACs/PVCs • Febrile illness/sepsis without shock • GI bleeding not requiring massive transfusion (ie outside of ICU) • History of CHF without evidence of exacerbation • History of pacemaker or AICD without suspicion of malfunction or firing • Respiratory illness (asthma, pneumonia, COPD exacerbation) without underlying heart disease • Stable PE without hemodynamic instability

NOTE: Abbreviations: ICU, intensive care unit; CCU, coronary care unit; ACS, acute coronary syndrome; UA, unstable angina; NSTEMI, non-ST-elevation myocardial infarction; STEMI: ST-elevation myocardial infarction; Afib, atrial fibrillation; SVT, supraventricular tachycardia; VT, ventricular tachycardia; K, potassium; Mg, magnesium; Ca, calcium; meds, medications; s/p, status post; EP, cardiac electrophysiology; AICD, automatic implantable cardioverter-defibrillator; PM, pacemaker; PCI: percutaneous coronary intervention; PAC, premature atrial contraction; PVC, premature ventricular contraction; GI, gastrointestinal; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; PE, pulmonary embolus

Figure 2. Telemetry guidelines for non-critical care admissions.



Telemetry Guidelines for Non-Critical Care Admissions

Class 1 Indications (review in 24 hours)	Class 2 indications (review in 48 hours)
• Chest pain, low risk with normal or unchanged EKG and negative cardiac enzymes ("rule out ACS") • Drug overdose or toxic ingestion with agents with arrhythmogenic potential • Electrolyte abnormalities of potassium, magnesium, or calcium • Major surgery • S/p arrhythmia ablation • S/p AICD firing • S/p non-urgent PCI • S/p pacemaker or AICD placement • Syncope of unknown origin • Use of IV beta blocker or calcium channel blocker	• ACS (UA, NSTEMI, or STEMI) • AV block (2nd or 3rd degree) • Cardiac contusion • Chest pain, intermediate or high risk • Congestive heart failure, acute • Initiation or titration of anti-arrhythmic medications • Myocarditis or pericarditis • New onset or uncontrolled atrial tachyarrhythmia • Noncardiac thoracic surgery • Non-sustained ventricular tachycardia • Stroke, acute • Syncope suspected to be of cardiac origin • Temporary pacemaker or transcutaneous pacing pads • Use of QT prolonging medications

Telemetry NOT indicated but commonly ordered

- Anemia not requiring massive transfusion
- Chronic stable atrial fibrillation
- Chronic PACs/PVCs
- Febrile illness/sepsis without shock
- GI bleeding not requiring massive transfusion (ie outside of ICU)
- History of CHF without evidence of exacerbation
- History of pacemaker or AICD without suspicion of malfunction or firing
- Respiratory illness (asthma, pneumonia, COPD exacerbation) without underlying heart disease
- Stable PE without hemodynamic instability

Sajan Patel MD, UCLA Hospitalist Service, Dept of Internal Medicine
Reviewed by Gregg Fonarow MD, Dept of Cardiology
Adapted from: Drew et al 2004 (AHA guidelines); Chan et al 2007; Dhillon et al 2012; Dressler et al. 2014

- These guidelines are meant for non-critical care admissions – they do not apply to hemodynamically unstable patients for whom critical care should be considered
- Telemetry should not be used to replace close medical monitoring and nursing care
- These guidelines are suggestions - always use your best clinical judgment

Please email sajanpatel@mednet.ucla.edu with any questions or comments

References

1. **Kanwar M, Fares R, Minnick S, Rosman HS, Saravolatz L**. Inpatient cardiac telemetry monitoring: are we overdoing it? *JCOM* 2008;15(1):16-20.
2. **Henriques-Forsythe MN, Ivonye CC, Jamched U, Kamuguisha LK, Olejeme KA, Onwuanyi AE**. Is telemetry overused? Is it as helpful as thought? Cleve *Clin J Med*. 2009 Jun;76(6):368-72. doi: 10.3949/ccjm.76a.07260. Review. PubMed PMID: 19487558.
3. **Najafi N, Auerbach A**. Use and outcomes of telemetry monitoring on a medicine service. *Arch Intern Med*. 2012 Sep 24;172(17):1349-50. doi:10.1001/archinternmed.2012.3163. PubMed PMID: 22892708; PubMed Central PMCID:PMC3851315.
4. **Bulger J, Nickel W, Messler J, Goldstein J, O'Callaghan J, Auron M, Gulati M**. Choosing wisely in adult hospital medicine: five opportunities for improved healthcare value. *J Hosp Med*. 2013 Sep;8(9):486-92. doi: 10.1002/jhm.2063. Epub 2013 Aug 19. Review. PubMed PMID: 23956231.
5. **Leighton H, Kianfar H, Serynek S, Kerwin T**. Effect of an electronic ordering system on adherence to the American College of Cardiology/American Heart Association guidelines for cardiac monitoring. *Crit Pathw Cardiol*. 2013 Mar;12(1):6-8. doi: 10.1097/HPC.0b013e318270787c. PubMed PMID: 23411601.
6. **Benjamin EM, Klugman RA, Luckmann R, Fairchild DG, Abookire SA**. Impact of cardiac telemetry on patient safety and cost. *Am J Manag Care*. 2013 Jun 1;19(6):e225-32. PubMed PMID: 23844751.
7. **Lee JC, Lamb P, Rand E, Ryan C, Rubal BJ**. Optimizing telemetry utilization in an academic medical center. *JCOM* 2008;15(9):435-40.
8. **Boggan JC, Navar-Boggan AM, Patel V, Schulteis RD, Simel DL**. Reductions in telemetry order duration do not reduce telemetry utilization. J Hosp Med. 2014 Dec;9(12):795-6. doi: 10.1002/jhm.2264. Epub 2014 Sep 29. PubMed PMID: 25263661.
9. **Dressler R, Dryer MM, Coletti C, Mahoney D, Doorey AJ.** Altering overuse of cardiac telemetry in non-intensive care unit settings by hardwiring the use of American Heart Association guidelines. *JAMA Intern Med*. 2014 Nov;174(11):1852-4. doi: 10.1001/jamainternmed.2014.4491. PubMed PMID: 25243419.
10. **Drew BJ, Califf RM, Funk M, Kaufman ES, Krucoff MW, Laks MM, Macfarlane PW, Sommargren C, Swiryn S, Van Hare GF; American Heart Association; Councils on Cardiovascular Nursing, Clinical Cardiology, and Cardiovascular Disease in the Young**. 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 Oct 26;110(17):2721-46. Erratum in: Circulation. 2005 Jan 25;111(3):378. PubMed PMID:15505110.

11. **Chen EH, Hollander JE**. When do patients need admission to a telemetry bed? *J Emerg Med*. 2007 Jul;33(1):53-60. Epub 2007 May 30. Review. PubMed PMID: 17630076.
12. **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 Sep;8(3):125-6. doi: 10.1097/HPC.0b013e3181b6ef41. PubMed PMID: 19726933.
13. **Dhillon SK, Tawil J, Goldstein B, Eslava-Manchego D, Singh J, Hanon S, Schweitzer P, Bergmann SR**. Effectiveness of telemetry guidelines in predicting clinically significant arrhythmias in hospitalized patient. *Cardiology Research* 2012; 3(1):16-22.

Submitted May 31, 2016