Optimizing Telemetry Utilization in an Academic Medical Center

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Abstract

• **Objective:** To evaluate the impact of a telemetry bed management policy on utilization and hospital closure patterns.

• **Methods:** Patients admitted to non-intensive care telemetry units in an academic tertiary care medical center were studied. Baseline telemetry utilization was prospectively assessed in 167 consecutive telemetry admissions using prespecified endpoints. After a new telemetry policy was implemented, utilization was assessed in the next 1025 consecutive telemetry admissions for quality of use, safety, and impact on hospital closure.

• **Results:** Following implementation of the new policy, there was a significant improvement in telemetry utilization as measured by proper order writing (78.4% vs. 90%; \(P < 0.001\)), proper indication (76% vs. 92%; \(P < 0.001\)), and appropriate duration of monitoring (67% vs. 81%; \(P < 0.001\)). There was an increase in the 50% hospital closure threshold from 16 intensive care unit/telemetry admissions per day to 18.5, a 16% increase in admission capacity. No deaths or adverse events related to lack of telemetry use occurred.

• **Conclusion:** A multispecialty telemetry policy with dedicated enforcement by a cardiologist/nurse team improved telemetry bed utilization and decreased hospital closures without increasing beds, personnel, or sacrificing patient care and safety.

The optimal utilization of telemetry beds is poorly defined in the literature. Clinical prediction models have been proposed to optimize use of limited telemetry resources, and the majority of these focus on the triage and disposition of emergency department patients with chest pain or acute coronary syndrome [1–4]. However, telemetry monitoring is also used to monitor patients with noncardiac conditions, such as gastrointestinal bleeding, exacerbation of chronic lung disease, and traumatic injury, at an observation location other than the intensive care unit (ICU). With the significant demand for telemetry monitoring, monitored beds are often in short supply in many hospitals. A few studies have attempted to assess the impact of interventions intended to reduce inappropriate utilization of telemetry monitoring in chest pain patients [5,6]. However, none have attempted to demonstrate the efficacy and safety of a multispecialty approach to telemetry bed management in reducing hospital closure rates.

Our hospital is a tertiary care, 450-bed academic medical center with 30 ICU, 16 intermediate care, and 49 telemetry floor beds. It provides a full range of services, including interventional cardiology, vascular surgery, and cardiothoracic surgery services, and is a level 1 trauma center; hence, there is significant competition for limited telemetry resources. In recent years, a steady increase in hospital closure was seen, with lack of monitored beds accounting for 50% of hospital closures. Retrospective analysis indicated that a lack of intermediate care and telemetry floor beds was a major contributor to these closures. Closures negatively impacted our hospitals’ educational opportunities, limited procedural volume, and led to increased financial losses for the hospital. As a result, a review of bed management procedures and optimization of existing resources was directed by the hospital executive committee. We formulated this single-center study to evaluate the impact of a physician-led multispecialty strategy of telemetry bed management on our telemetry utilization and hospital closure patterns.

**Methods**

**Telemetry Policy**

A newly appointed cardiologist telemetry director oversaw the development of a new telemetry bed management policy with input from multiple specialties, including cardiology, pulmonary-critical care, neurology, general surgery/trauma, medical-surgical nursing, and utilization management. American College of Cardiology/European Society of Cardiology guidelines, InterQual level of care criteria (McKesson, San Francisco, CA), other published sources [7–9], as well as clinical judgment were used to develop the policy, which featured 3 critical elements:

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**Table 1. Indications for Telemetry Specified by Telemetry Policy**

| **Cardiac** | Known or suspected acute coronary syndrome (myocardial infarction, unstable angina) while awaiting risk stratification or diagnosis exclusion. In setting of biomarker-confirmed infarction, monitoring for 3–5 days may be considered adequate provided no significant arrhythmias are noted. In setting of complications, monitoring may be considered until clinical resolution is achieved. Patients with high-risk coronary lesions awaiting revascularization (eg, obstructive left main disease or equivalent). Status post cardiac arrest or at high risk for cardiac arrest (high-grade AV block, mobitz type II AV block, sustained VT/VF) until condition is definitely treated. Unexplained syncope or neurologic signs or symptoms that may be secondary to cardiac arrhythmia. May monitor up to 48 hours, longer course may be dictated based upon occurrence of arrhythmias. Acute phase management of patients poisoned with drugs or chemicals at doses known or suspected to have cardiac toxicity (eg, tricyclic antidepressants, phenothiazines, digitals, antiarrhythmic drugs, ethyl alcohol). |
| **Surgical/trauma** | Status post cardiac surgery, monitoring performed for up to 10 days in setting of uncomplicated recovery. Prolonged monitoring may be required in complicated postoperative courses to include postoperative atrial fibrillation, ventricular arrhythmia, postoperative bleeding, etc. Status post noncardiac surgery in patients noted to have significant rhythm or hemodynamic disturbance or event intraoperatively for 48 hours. May need further monitoring until patient is stable. Trauma involving thoracic injury or suspected cardiac contusion, monitor for 48 hours or longer if clinically indicated. |
| **Medical** | Pneumonia, severe asthma, or COPD exacerbation associated with tachycardia or significant hypoxemia, but not needing ICU level care. Monitoring may be continued during acute phase of illness. Any condition associated with severe electrolyte disturbances with cardiac sequelae to include hyper/hypokalemia, hyper/hypocalcemia, hyper/hypomagnesemia (eg, acute renal failure). Monitoring may be continued until electrolyte issues are addressed. Active or suspected bleeding with potential for hemodynamic compromise to include GI bleeding or bleeding associated with trauma. Monitoring may continue until bleeding risk is stratified, treated, or after 3 days of clinical stability. |

AV = atrioventricular; COPD = chronic obstructive pulmonary disease; GI = gastrointestinal; ICU = intensive care unit; VF = ventricular fibrillation; VT = ventricular tachycardia.

1. A comprehensive list of indications for non-ICU telemetry monitoring for all services and

The policy calls for admitting providers to provide the bed manager with an approved indication for telemetry. Providers seeking telemetry beds for indications outside of the stated policy are required to clear the admission with the telemetry director, who is authorized to approve and order transfers into and out of non-ICU telemetry units. The director acts as a liaison between physician teams and nursing to determine appropriate indications and duration for telemetry use. At any time, nursing or telemetry technicians can alert the primary physician team if it is felt that a patient has exceeded the appropriate telemetry time. If issues are not resolved to the satisfaction of both parties, the telemetry director is notified for final disposition. The telemetry director also has the authority to triage existing telemetry patients and reallocate resources if hospital closure is imminent due to lack of monitored beds.

**Assessment**

Prior to introducing the new telemetry policy, we conducted a prospective assessment of 167 consecutive non-ICU telemetry admissions using prespecified measures of quality (based on the new policy). We assessed whether

1. The telemetry order specified an indication for telemetry monitoring.
2. The order was for an indication listed in the new policy.
3. The duration of telemetry was appropriate to address the clinical concern leading to monitoring.
4. A management change occurred as a direct result of telemetry use. A change was defined as initiation or change in cardiac medication, cardioversion, implantation of pacemaker or device, or transfer to the ICU.

Following baseline assessment, the new telemetry bed management policy was distributed. Education was delivered by the telemetry director in group conferences for 2 weeks to providers at all levels. We then prospectively followed consecutive non-ICU telemetry admissions for 8 months and assessed them using the same quality measures. We calculated that a sample of at least 1000 patients would be large enough to capture infrequent complications. After 8 months/1000 patients...
telemetry admissions, the enrolled patients were followed to discharge and no further enrollments were pursued.

To assess for an impact on hospital closures due to lack of monitored beds, we compared the daily admission census to the ICU and telemetry wards with the daily hospital closure records. Hospital closure and admission numbers were prospectively tracked during the 8-month study period.

To assess safety of the new policy, we conducted a retrospective chart review for all “code blues” and deaths in the hospital during the study period to assess whether any were related to lack of telemetry use. Two study physicians reviewed the relevant inpatient medical records independently; the telemetry director was consulted if the assessments were not in accord.

All patients on telemetry had their telemetry records reviewed by a study physician every 24 hours to document rhythm findings independent of the managing physician team. Chart review was then performed at discharge to assess for changes to management and whether the indication and duration of monitoring was appropriate. Admissions to the telemetry units included transfers from higher levels of care and from nontelemetry units as well as direct admissions from clinics and the emergency department.

Continued reinforcement of the telemetry policy at the individual level was performed on a daily basis and orientation of new nursing supervisors performed with personnel changes throughout the duration of the study period.

This study was reviewed and approved as an expedited protocol by the department of clinical investigations, Brooke Army Medical Center, as a prospective performance improvement project.

### Statistical Analysis

Statistical calculations were performed using SPSS version 11.5 (Chicago, IL), and plots were generated using SigmaPlot version 9.0 (Systat Software, San Jose, CA). Means were compared using a t test, and a contingency test was employed for comparing nominal data. Statistical significance was defined as a P value < 0.05. The probability of hospital closure was modeled using a 3-variable logistic function plotting the likelihood of hospital closure versus the daily ICU and telemetry admission rate in the preimplementation period versus the postimplementation period looking for a change in the 50% probability of hospital closure threshold.

### Results

Implementation of the new hospital telemetry management policy significantly improved telemetry utilization in our facility (Table 2). Significant increases in telemetry order writing compliance, appropriate admissions to telemetry units, and appropriate duration of telemetry monitoring were seen. Hospital closure was highly predicted by the daily volume of patients admitted to the hospital ICU, step-down, and telemetry floors (Figure). Implementation of the new telemetry management policy led to an increase in the 50% closure threshold from 16 ICU/telemetry admissions per day to 18.5 admissions, reflecting a 16% increase in admission capacity without an increase in beds, personnel, or compromise of patient safety.

Four deaths occurred on the telemetry floor; none were attributed to inappropriate telemetry utilization. 150 patients (14.7%) spent time in the ICU during their hospitalization, and 141 patients (13.8%) were discontinued from telemetry monitoring prior to hospital discharge, for a mean of 4.2 days (range, 1–29 days) spent off monitor. No adverse events resulted from telemetry discontinuation prior to discharge. Review of code blue events and deaths attributed no events to misuse of telemetry resources during the study period.

Patients were admitted to telemetry beds for a variety of conditions, with cardiovascular indications accounting for over 50% of admissions (Table 3). 86% of patients were admitted in sinus rhythm, 7.7% in atrial fibrillation/flutter, 4.4% paced rhythm, and 1.5% other rhythms. Significant rhythm disturbances were detected on an infrequent basis, with ventricular fibrillation/pulseless ventricular tachycardia occurring in only 1 patient (0.1%). Symptomatic bradyarrhythmias were captured in 24 patients (2.3%), symptomatic tachycardia in 102 patients (10%), new atrial fibrillation/flutter diagnosed in 24 patients (2.3%), and nonsustained ventricular tachycardia in 117 patients (11.4%). Management changes were noted in 110 patients (10.7%) as a result of telemetry findings, with 65 patients undergoing medication changes, 14 permanent pacemaker implantations, 12 ICU transfers, and 4 cardioversions among others. The mean time of telemetry monitoring per admission did not change significantly following implementation of the telemetry policy (68.1 hrs preimplementation vs. 61.5 hrs postimplementation; P = 0.282).

On subgroup analysis by service, the department of medicine was the major user of telemetry resources, with 81.3% of non-ICU telemetry admissions (department of surgery, 18.7%). Significant improvements in proper order writing were seen in both departments (medicine 88.1% to 95.4%; P = 0.002, surgery 67% to 81%; P = 0.001).

### Table 2. Telemetry Use Before and After Implementation of New Telemetry Policy

<table>
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<th>Preimplementation</th>
<th>Postimplementation</th>
<th>P Value</th>
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<tbody>
<tr>
<td>Order written</td>
<td>78.4% (n = 167)</td>
<td>90% (n = 1025)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Appropriate indication</td>
<td>76% (n = 167)</td>
<td>92% (n = 1025)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Appropriate duration</td>
<td>67% (n = 167)</td>
<td>81% (n = 1025)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Management change</td>
<td>10.5% (n = 167)</td>
<td>10.7% (n = 1025)</td>
<td>NS</td>
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Optimizing Telemetry Utilization

Surgery 32.1% to 65.5%; \( P = 0.001 \). However, only the department of medicine demonstrated improvement for proper admission criteria (78.4% to 95.9%; \( P < 0.001 \)) and proper duration of telemetry use (71.6% to 87.4%; \( P < 0.001 \)). There was no significant change in frequency of management changes as a result of the new telemetry policy in either department.

Discussion

We found that the initiation of dedicated physician management of non-ICU telemetry resources was associated with improved provider adherence to ordering guidelines as well as a reduction in hospital closures. Rather than using a novel clinical prediction model to guide disposition, our hospital used published guidelines and clinical judgment to create a consensus telemetry policy that was then enforced by a cardiologist/nurse team. The implementation of this change came without change in the number of beds, increase in personnel, or compromise of patient care and safety. From the economic perspective of increased productivity from the increased admission capacity, a conservative estimate of $4.5 million annual gain for our hospital system is estimated using current reimbursement schedules.

Cardiac telemetry monitoring has rapidly expanded in the past 40 years from its original use in coronary care units for patients at high risk for life-threatening arrhythmic events to evaluation of lower-risk chest pain patients. Currently, non-ICU telemetry is also utilized for a broad range of noncardiac diagnoses, including pulmonary embolism, bleeding, trauma, and neurologic injuries. Studies evaluating the utility of telemetry outside of critical care units suggest that significant arrhythmic events occur infrequently, leading some to question the benefit of telemetry monitoring in patient outcomes [3,4,10–13].

Other studies have examined approaches to reducing inappropriate utilization. Silverstein and Silverman [5] demonstrated that a telemetry guideline intervention targeting internal medicine house staff can lead to more appropriate utilization of resources. In a study by Gross et al [6], a hospital intervention in which an advanced practice nurse was utilized to monitor telemetry use and intervene if guidelines were not being followed improved the efficiency of telemetry use. Our study differs from these studies as we report the impact on hospital closures as well as assess the safety outcomes for all patients admitted to the hospital throughout their hospital stay.

Our system utilizes a telemetry director who has the

Figure. Relationship between daily intensive care unit (ICU) and telemetry admissions and the probability of subsequent hospital closure. Hospital closure is highly predicted by the daily admission rates. In the preimplementation period, after 16 ICU or telemetry admissions in a given day, the hospital had a 50% likelihood of closure. After policy implementation, this increased to 18.5 admissions, reflecting a 16% increase in the hospital’s ability to handle ICU and telemetry admissions.
final decision regarding telemetry bed use rather than an individual who acts to remind clinicians but has limited enforcement capability. Our telemetry director interfaced very closely with the nursing bed manager to ensure the guidelines were properly enforced, which proved to be a critical feature in our success. The importance of physician involvement in bed utilization decisions cannot be understated. Physician-to-physician communication allows for communication of subjective findings and clinical concerns regarding the need for telemetry monitoring and preserves clinical judgment in patient disposition matters. A system run purely on objective criteria outlined in standard utilization management guidelines alone would not be acceptable to physicians due to lack of clinical autonomy regarding unique patient management issues. During our study, when discussion between physicians was accomplished, satisfaction of both parties was always achieved.

The benefits of a universal non-ICU telemetry use policy will likely have the greatest impact in socialized or governmental medical centers where care is delivered without significant concern for specific cost to the patient or insurance reimbursement. The military health care system in the United States closely resembles the socialized health care systems seen in other nations. Often telemetry monitoring is requested due to physician concern that a higher level of monitoring is required without identifying a specific clinical concern. There exists the perception of higher level of care on the telemetry floor because a technician is continuously monitoring all patient telemetry tracings, despite equivalent nurse:patient ratios on nontelemetry floors. However, given technical difficulties with equipment, removal of monitors for transport or bathing, this perception is not entirely true. Requiring identification of a specific clinical concern helps physicians truly identify the underlying risk and allows for better nursing care to be provided rather than just telemetry monitoring.

The single-center nature of this study limits the applicability to all hospital organizations given that every hospital has a unique composition of resources, personnel, and patients. However, there are common aspects to health care delivery with respect to non-ICU telemetry utilization, and lessons applicable to all facilities can be learned from this study. The military health care system also allows for rapid centralization of authority, which may not be easily accomplished in other facilities. Further prospective confirmation of the success of these findings in long-term evaluation would be useful. The conduct of this study reinforced the importance of continued education and monitoring to support a sustained benefit in telemetry utilization as the less efficient methods of bed utilization could return otherwise.

**Conclusion**

A multispecialty telemetry policy with dedicated enforcement by a physician/nurse team improved telemetry bed utilization and decreased hospital closure without increasing resources, personnel, or sacrificing patient care and safety. This has significant implications for academic medical centers that experience hospital closure due to lack of monitored beds.

<table>
<thead>
<tr>
<th>Indication</th>
<th>No. of Pts (%)</th>
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<tr>
<td>Chest pain (rule out ACS)</td>
<td>380 (37.1)</td>
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<tr>
<td>Myocardial infarction</td>
<td>44 (4.3)</td>
</tr>
<tr>
<td>Syncope</td>
<td>67 (6.5)</td>
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<tr>
<td>Arrhythmia management</td>
<td>107 (10.4)</td>
</tr>
<tr>
<td>Hemorrhage</td>
<td>50 (5.9)</td>
</tr>
<tr>
<td>COPD/respiratory monitoring</td>
<td>46 (4.5)</td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td>32 (3.1)</td>
</tr>
<tr>
<td>Electrolyte disturbance</td>
<td>24 (2.3)</td>
</tr>
<tr>
<td>Trauma</td>
<td>39 (3.8)</td>
</tr>
<tr>
<td>SIRS/infection</td>
<td>34 (3.3)</td>
</tr>
<tr>
<td>Other</td>
<td>192 (18.8)</td>
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</tbody>
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ACS = acute coronary syndrome; COPD = chronic obstructive pulmonary disease; SIRS = systemic inflammatory response syndrome.

Note: The opinions or assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the Department of the Army or the Department of Defense.

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**References**