A Quality Improvement Project to Reduce Inappropriate Telemetry Utilization in Nephrology Inpatients at an Academic Hospital

Meherzad Kutky, MD, MSc*, Seychelle Yohanna, MD, MSc*

Department of Medicine, Division of Nephrology, St. Joseph's Healthcare Hamilton, McMaster University, Hamilton, ON, Canada

Corresponding Author: Meherzad Kutky: meherzad.kutky@medportal.ca

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Abstract

Background: Cardiac telemetry plays a key role in diagnosing and monitoring arrhythmias in hospitalized patients. The American Heart Association (AHA) provides recommendations on the use of telemetry outside the intensive care unit (ICU). These can be stratified into three categories; telemetry is indicated (Class I), telemetry may provide benefit (Class II) or telemetry is unlikely to be of benefit or may cause harm (Class III). The AHA and Choosing Wisely Canada suggest that telemetry use should be guideline-based and should not be used outside the ICU without a plan for discontinuation. In the United States, interventions that modify the Electronic Medical Record (EMR) have been shown to improve telemetry utilization. Patients admitted to our nephrology ward are often prescribed telemetry inappropriately, which impacts patients and providers, and increases healthcare costs.

Methods: We used the Model for Improvement framework to conduct a quality improvement project with the aim of reducing inappropriate telemetry utilization (ordered for a Class III indication). We employed an interrupted time series design to evaluate telemetry utilization from January 2018 to September 2019 (pre-intervention period, which was retrospective) and September 2019 to September 2020 (postintervention period, which was prospective). We implemented a modification to our electronic health record (EMR) that forced prescribers to choose an appropriate telemetry indication.

Results: There was a reduction of Class III telemetry utilization from 56 to 22%. This reduction was sustained for 12 months following implementation. We piloted a nursing-led discontinuation protocol which resulted in 35% of telemetry orders being discontinued prior to the 48-hour prescribed period.

Interpretation: Our study shows that interventions to enhance the EMR in a way that supports better utilization of telemetry can be successful at Canadian institutions. Our next steps will be to implement a permanent nursing-led discontinuation protocol to reduce the duration of telemetry utilization.

* Both authors contributed equally to the writing and editing of the manuscript.
Introduction

Cardiac telemetry monitoring plays a key role during acute hospitalizations to assist with the diagnosis and monitoring of arrhythmias and myocardial ischemia. The American Heart Association's (AHA) published guideline and subsequent update from 2017 provide recommendations on the use of telemetry outside the intensive care unit (ICU). These can be stratified into three categories: telemetry is indicated (Class I), telemetry may provide benefit (Class II) or telemetry is unlikely to be of benefit or may cause harm (Class III). Clinicians often order telemetry with the intention of being safe and often are not familiar with the AHA guidelines, however, this increased use does not appear to improve patient outcomes.

Findings from numerous studies in the United States indicate that telemetry is often overused in non-ICU settings. Studies by Benjamin et al. and Dressler et al. assessed utilization at major centers in the United States and found that 33% of telemetry was not indicated. The consequences of inappropriate telemetry utilization include decreased patient mobility, unnecessary investigations for patients and nursing fatigue. Interventions to reduce inappropriate telemetry use in the United States have been shown to decrease telemetry use and duration by as much as 70 and 47%, respectively. This reduction in telemetry led to significant cost savings and reduced nursing workload without any increase in adverse events. In Canada, the Choosing Wisely campaign has identified telemetry utilization as a target for reduction and has advocated that non-ICU telemetry should only be used when indicated with systems in place for timely discontinuation.

We hypothesized that because of the cardiovascular complications related to chronic kidney disease,
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admitted patients in our ward were often ordered telemetry, with some of these uses being inappropriate. In July 2019, we conducted a 1-month audit of telemetry utilization on our nephrology ward. This audit confirmed that over half (53%) of the patients on the nephrology ward were ordered telemetry for a Class III indication. With this understanding of the quality problem, we established a multidisciplinary team of key stakeholders to undertake a quality improvement project with the aim of reducing inappropriate telemetry utilization.

Methods

Setting
The nephrology service at St. Joseph’s Healthcare Hamilton is an admitting service for all patients on maintenance hemodialysis, patients with advanced chronic kidney disease, and patients with a kidney transplant including those patients being admitted for kidney transplant surgery (living and deceased). Many of these admissions are for cardiac complications (e.g., acute coronary syndrome, arrhythmias, and heart failure exacerbations). St. Joseph’s Healthcare Hamilton is a 400-bed academic teaching hospital that uses an EPIC® based Electronic Medical Record (EMR) for physician computerized order entry. Our teams consisted of a nephrologist, nephrology fellow, internal medicine residents, and medical students. Most of the admissions to our service occur in the evening and are seen by internal medicine residents. Telemetry orders are entered in the EMR with a chosen indication and duration (e.g., 24 or 48 hours). Telemetry is monitored centrally in the Cardiac Care Unit by registered nurses with dedicated training in telemetry monitoring. If any alarms or issues with telemetry are identified, telemetry nurses will communicate with the patient’s bedside nurse to inform them. Given the volume of patients, the workload associated with monitoring telemetry is significant when considering the total volume of calls required for patients across all medical and surgical wards in the hospital. When the specified duration is complete, telemetry is not automatically discontinued (as this is not regarded as a physician order to stop telemetry). Our project team included key stakeholders from internal medicine, cardiology, critical care, clinical informatics, and nursing.

Patients
We included all patients admitted to the nephrology ward who had telemetry ordered at any time during their admission. This included patients from the emergency department, transfers from other wards and postoperative transplant patients. If a patient was transferred to the intensive care or cardiac care unit, we did not assess telemetry utilization during that portion of their admission. Patients not on telemetry were not followed up.

Study design
We employed an interrupted time series design to evaluate telemetry utilization in the preintervention period from January 2018 to September 2019 and the 12-month postintervention period from September 2019 to September 2020. Charts for all patients in the study (n = 179) who were ordered telemetry were reviewed retrospectively every 2 months. We recorded the indication for telemetry ordering, the duration ordered, and the actual duration. We then compared the ordering indication with AHA guidelines and confirmed that the ordering indication was correct for that patient. We used the Model for Improvement’s Plan-Do-Study-Act (PDSA) framework. Our project aim was to reduce inappropriate telemetry utilization by 20% (baseline audit rate of 53%) over 12 months.

Understanding the problem
We completed a baseline audit of telemetry utilization from July 2019 to September 2019. Our audit showed that 53% of telemetry was ordered for a Class III indication, and the median duration was 48 hours, with 25% of patients being on telemetry for more than 48 hours. We then completed a process map of telemetry ordering which is displayed in Figure 1. Briefly, a physician orders telemetry which includes an indication and duration. Telemetry is monitored centrally in the cardiac care unit by telemetry nurses. If any alarms or issues with telemetry are identified, telemetry nurses will communicate with the patient’s bedside nurse to inform them. Calls from the telemetry nurses were also monitored over a 6-week period.

PDSA Cycle 1: Revising EMR indications
We performed a retrospective chart review over an 18-month period to understand the reasons as to why telemetry was being ordered inappropriately and found that our EMR indications incorrectly included many Class III indications. To assess resident comfort with telemetry ordering, we conducted a survey of resident physicians (n=15). Residents were asked if they used any guidelines when ordering telemetry and whether they were aware of the AHA telemetry guidelines. This data helped us identify a knowledge gap and helped to guide where to target our intervention. With this
knowledge, our first intervention was a modification to the
telemetry indications in our EMR to align more closely with
the AHA recommendations (e.g., sepsis, a Class III indica-
tion was removed). Our main outcome measure was the per-
centage of telemetry ordered for a Class III indication.

**PDSA Cycle 2: Decreasing the duration of telemetry**

Residents were also surveyed to understand how likely they
would be to discontinue telemetry on call (Likert scale from
1 to 5; 1 - would not discontinue, 2 - not likely to discon-
tinue, 3 - may or may not discontinue, 4 - likely to discon-
tinue, 5 - would discontinue). To reduce the duration of
telemetry, our second intervention was to develop a nurs-
ing-led discontinuation protocol. This was done in consul-
tation with telemetry nurses, physicians, and administrative
staff across the organization. Previous data have shown that
nursing-led medical directives have been successful at lim-
iting the time patients spend on telemetry.\textsuperscript{10} For each of the
four most common indications (tachy-arrhythmia, brady-ar-
rhythmia, acute coronary syndrome, and syncope), a clear
protocol was provided that enabled telemetry nurses to
consider automatic discontinuation of telemetry (Table 1).
Telemetry nurses were provided with written and verbal
instructions on how to implement the protocol and had the

![Outline of the telemetry ordering process at our institution](image-url)

**Figure 1. Outline of the telemetry ordering process at our institution**

<table>
<thead>
<tr>
<th>Indication</th>
<th>Sub-indication and timeline to consider discontinuation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>24hr</td>
</tr>
<tr>
<td></td>
<td>48hr</td>
</tr>
<tr>
<td></td>
<td>Other</td>
</tr>
<tr>
<td>Acute Coronary Syndrome</td>
<td>- discontinue if no sustained arrhythmia</td>
</tr>
<tr>
<td>Tachy-arrhythmia or risk</td>
<td>- discontinue for atrial fibrillation or atrial flutter</td>
</tr>
<tr>
<td></td>
<td>- discontinue for atrioventricular node reentrant tachycardia or atrioventricular reentrant tachycardia</td>
</tr>
<tr>
<td></td>
<td>- discontinue for non-sustained ventricular tachycardia (VT) as long as no VT runs &gt;3 consecutive beats in last 24hrs</td>
</tr>
<tr>
<td></td>
<td>- continue telemetry for sustained VT until discontinued by physician</td>
</tr>
<tr>
<td>Brady-arrhythmia or risk</td>
<td>- discontinue for sinus bradycardia</td>
</tr>
<tr>
<td></td>
<td>- discontinue for first degree heart block</td>
</tr>
<tr>
<td></td>
<td>- discontinue for second degree (Mobitz type 1) heart block</td>
</tr>
<tr>
<td></td>
<td>- continue telemetry for second degree (Mobitz type 2, 1:1, or 2:1) or third degree (complete heart block) until discontinued by physician</td>
</tr>
<tr>
<td>Syncope</td>
<td>- discontinue if no arrhythmia noted on telemetry</td>
</tr>
<tr>
<td></td>
<td>- discontinue telemetry for risk of myocardial injury post non-cardiac surgery</td>
</tr>
<tr>
<td></td>
<td>- discontinue if patient is made palliative</td>
</tr>
<tr>
<td></td>
<td>- discontinue once patient leaves recovery unit for those patients who had telemetry ordered post operatively</td>
</tr>
</tbody>
</table>

**Table 1. Summary table of nursing medical directive outlining common indications for telemetry, timeline for assessment, and suggested action**
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Related to telemetry error (pack is off patient, lead failure), 24% of calls were for an arrhythmia, and 5% of the calls were to suggest discontinuing telemetry. Thus, 74% of the calls were clinically irrelevant. Additionally, 48% of the calls were in the evening to an on-call resident.

Resident comfort with telemetry
To assess resident comfort with telemetry ordering, we conducted a survey of resident physicians (n = 15). Residents were asked if they used any guidelines when ordering telemetry and whether they were aware of the AHA telemetry guidelines. Most residents (n = 13, 87%) did not use any guidelines and were not aware of the AHA guidelines. Residents were also surveyed to understand how likely they would be to discontinue telemetry on call (Likert scale from 1-5; 1 - would not discontinue, 2 - not likely to discontinue, 3 - may or may not discontinue, 4 - likely to discontinue, 5 - would discontinue). Thirteen of the 15 residents (87%) rated their likelihood of discontinuing telemetry as 1–3, 2 (13%) residents rated their likelihood as 4, and no residents said they would discontinue telemetry on call. Most residents (n = 8, 53%) rated their likelihood as 2, suggesting that they were not likely to discontinue telemetry on call.

Intervention 1
Based on the audit data, an intervention to modify the indications for telemetry was completed, and the results were tracked for 12 months. Figure 2 shows the run chart for the pre- and postintervention period. The median percentage of Class III telemetry utilization decreased from 56 (in the pre-intervention period) to 22%, and this decrease was sustained for 12 months. The median duration of telemetry remained unchanged at 48 hours. The four most common indications chosen were tachy-arrhythmia, brady-arrhythmia, acute coronary syndrome, and syncope. We also conducted a chart review to ensure the indications chosen were accurate for each patient and found that 15% of patients did not have the correct telemetry indication chosen, which did not change when we modified the EMR. There were a total of 103 telemetry orders in the preintervention period (18 months) and 76 in the 12-month postintervention period.

Intervention 2
To decrease duration of telemetry, we created a nursing-led discontinuation protocol to discontinue telemetry for the four most common indications once specific parameters were met. A condensed version of the protocol is outlined in Table 1. Full instructions were also provided in writing.
and verbally to the telemetry nurses. A pilot of this protocol \((n = 43)\) resulted in 35% \((n = 13)\) of patients having their telemetry correctly discontinued prior to 48 hours, and no patients had their telemetry discontinued in error. One patient had their telemetry incorrectly continued. All patients charts were reviewed to assess for any adverse events (e.g., syncope, life threatening tachycardia/bradycardia, or re-order of telemetry), and no adverse events were noted.

**Discussion**

Inappropriate telemetry utilization has significant impacts on patients by reducing mobility and increasing anxiety, on providers by increasing workload, and to the healthcare system through added costs. To our knowledge this is the first Canadian study demonstrating a reduction in inappropriate telemetry utilization through EMR modifications that support clinicians making more informed decisions. Results from this modification showed a sustained decrease in the percentage of Class III telemetry from 56 to 22%. In addition, we created and piloted a nursing-led discontinuation protocol for telemetry nurses to discontinue telemetry and showed that it can be effective at reducing the duration of telemetry without any documented adverse events.

These findings are in keeping with larger studies from the United States which use EMR-based interventions and show a reduction in inappropriate telemetry without compromising patient safety.\(^{6,7,15,16}\) Our intervention was chosen based on the literature which showed that EMR-based systems could alter telemetry ordering and was modified for our local context.\(^{6,7,16}\) Stoltzfus et al. also showed that EMR-based interventions were more successful than nursing huddles or education-based interventions. While education models and feedback showed benefit, they lacked efficacy over time. Similarly, Chakrawarthy et al. also noted that education and feedback did not significantly impact telemetry utilization and ordering in their study. Nursing-based medical directives have been successful at limiting the time patients spend on telemetry.\(^{10,17}\) Duffy et al. showed that a nursing-based medical directive resulted in a sustained decrease in the duration of telemetry.\(^{18}\) We piloted a nursing-based discontinuation protocol, and its application led to 35% of patients having telemetry discontinued early, with no adverse events. If this protocol was implemented, it would lead to a significant reduction in the duration of telemetry.

The strengths of our study include use of the Model for Improvement quality improvement framework, which results in a thorough understanding of the quality problem and an iterative approach to improvement. We directly observed the effects of telemetry on nursing staff and appreciated the uncertainties that medical residents have with ordering and discontinuing telemetry. This knowledge helped us to refine the theory behind why our interventions were expected to produce the anticipated effect. We found that resident familiarity with telemetry guidelines was low. We did consider
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an education-based intervention as there is evidence from our institution that this is feasible for changing prescribing habits, but there are conflicting data in the literature regarding the efficacy and sustainability of education alone as an intervention for quality improvement.\textsuperscript{17,19} We chose an EMR-based intervention as it allows for efficient capturing of hazardous events, allows us to capture all residents or users, and to change behavior in a more passive manner over time.\textsuperscript{20}

In addition, by using an EMR to monitor telemetry utilization, we can be confident that we have accurately captured all patients who were ordered telemetry during their admission. Limitations deserve mention. Our first PDSA cycle to modify the EMR telemetry indications led to a reduction in the percentage of Class III telemetry but did not change the duration. Additionally, our nursing-led discontinuation protocol was tested on a small sample of nephrology patients, and further testing would be required across different wards in the hospital (e.g., surgical ward). Given the positive results of our pilot, senior leadership at our hospital have endorsed the implementation, and we have begun advancing the directive to the appropriate committees. Next steps will include implementing and expanding the medical directive across multiple services within the hospital.

In conclusion, our study showed that modifications to the EMR support clinicians ordering telemetry more effectively, and that the implementation of a nursing-led discontinuation protocol can be successful at reducing the duration of inappropriate telemetry at a Canadian academic tertiary care hospital. These findings will be increasingly relevant as more hospitals transition to full EMR-based systems with computerized physician order entry where efforts to improve resource utilization while keeping patients safe are paramount.

Ethical Considerations

This study was deemed exempt from oversight by our Institutional Review Board. Patient consent was not required. There was no external funding for this project.

References


12. CSIM has developed a list of 11 things physicians & patients should question in internal medicine. Choosing Wisely Canada. [cited 2021 Apr 25–4]. Available from: https://choos-ingwiselycanada.org/internal-medicine/


