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Joseph Paul Urbanski
Grand Valley State University

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Evidence-Based Cardiac Monitoring: A Practice Change

Joseph Paul Urbanski RN, BSN

Kirkhof College of Nursing

Grand Valley State University

Advisor: Dianne Conrad DNP, RN, FNP-BC

Advisory Team: Katherine Moran DNP, RN, CDE, FAADE

Site Mentor: Amy Kyes RN, MSN, CRNI, APRN, AG-CNS BC

Abstract

Background: Overuse of cardiac monitoring (CM) in acute care settings contributes to increased healthcare spending and cost of services for patients. Additionally, inappropriate use of CM can contribute to wastefulness of healthcare resources, increases in hospital staff workloads, and can be improved with best evidence-based practice recommendations. A Midwest acute care hospital lacked an evidence-based, systematic method to define care for patients requiring CM.

Objective: The purpose of the project was to pilot an evidence-based CM change initiative, determine feasibility for sustainment, and propose next steps for adoption of the change initiative across non-emergency department, non-intensive care inpatient CM units at a Midwest, acute care hospital.

Method: The project involved piloting an evidence-based practice change that focused on the appropriate use of CM. The practice change consisted of education for ordering providers and nurses on the current American Heart Association's (AHA) and American College of Cardiology's (ACC) CM guidelines (2017), nurse/provider communication, and utilization of a CM clinical tool in daily practice. Data was collected regarding appropriate CM orders, duration of time patients were maintained on CM, and the number of patients maintained on CM until discharge from the hospital over a two-week pre-implementation period and a six-week post-implementation period for comparison. The results of the study were then used to develop evidence-based recommendations for implementing a hospital-wide, CM practice change.

Results: There was a significant decrease in the number of inappropriate CM orders over the duration of the project. Inappropriate CM orders were reduced from 35.0% to 12.1% ($p = 0.0019$). Additionally, there was a significant decrease in the number of patients maintained on monitoring until the time of discharge, 95.0% to 66.7% ($p = 0.0121$). The approximate cost

savings for delivering CM services to patients over the duration of the project was $11,222.40

and $97,528.00 over a year. Estimated cost of services included patient monitoring, CM

equipment, and upkeep of equipment. Approximate cost savings for RN wages over the duration

of the project was $2,394.00 and $20,805.00 over a year.

Conclusions: Implementation of an evidence-based practice change significantly decreased the

number of inappropriate CM orders as well as the number of patients maintained on CM at the

time of discharge from the hospital. Recommendations for sustainability of the practice change

include incorporating the use of the AHA/ACC's CM guideline in the electronic ordering system

(EOS), use of evidence-based CM guidelines in daily practice, discussion of CM in daily

interdisciplinary rounds, continued education for staff on AHA/ACC CM guidelines, and

utilization of unit charge nurses to replicate the pilot study findings throughout the organization.

Key words: Telemetry, utilization, and cardiac monitoring.

Evidence-Based Cardiac Monitoring: A Practice Change

Cardiac monitoring (CM) is a clinical tool that is used to identify deteriorating health conditions, life-threatening heart arrhythmias, sudden cardiac arrest, and other potential causes of cardiac related symptoms (Sandau, Funk, Auerbach, et al., 2017). The goal of CM is to provide healthcare providers with timely information regarding the health status of a patient in order to decrease adverse cardiovascular related events (Piccini, 2012). Due to the clinical significance of CM use in hospital settings, there has been an overall increase in monitor utilization (Chung-Yik et al., 2018).

Increases in CM use led to the first evidence-based CM guideline published in 1991 by the American College of Cardiology (ACC) and American Heart Association (AHA, 1991). This practice guideline was initially published as a response to rising concern for the costs associated with CM use (Chung-Yik et al., 2018). The most recent AHA/ACC CM guideline (2017) (Appendix A) includes recommendations for appropriate diagnoses, indications, and duration of use for CM. The AHA/ACC guideline outlines how well each recommendation is supported by evidence in literature (Sandau, Funk, Auerbach, et al., 2017).

Misuse of CM contributes to increased healthcare costs for patients and healthcare organizations as well as wastefulness of healthcare resources (Rizvi, Munguti, Mehta, et al., 2017). Recent research and appraisals of daily CM use estimate the total daily cost of providing CM services per patient is approximately $53.44 per day in non-intensive care unit settings (Dressler, Dryer, Coletti, et al., 2014). Direct and indirect CM associated costs include, CM equipment, upkeep of that equipment, and wages paid to those managing CM services. Nurses spend approximately 90 minutes per patient assignment each day managing CM related tasks

(Benjamin et al., 2013; Saley & Chatriwalla, 2015). Staff time is spent managing equipment, answering alarms, analyzing cardiac rhythms, and communicating about CM related findings.

Findings in current literature also revealed that as many as 35% of patients placed on CM do not meet the proper clinical indications for CM in acute care settings (Benjamin, Klugman, Luckmann, Fairchild, & Abookire, 2013). Common gaps in care related to CM include a lack of evidence-based ordering practices, inconsistent communication regarding the use of CM amongst healthcare staff, and lack of a policy/procedure for continual reassessment of a patients need for CM (Dressler et al., 2014; Leighton et al., 2013; Ramkumar et al., 2017; Svec et al., 2013). Three interventions were identified to improve CM appropriateness: 1) Implementation of the AHA/ACC guideline into daily practice, 2) education on AHA/ACC guidelines and CM appropriateness for hospital staff, specifically ordering providers and nurses, and 3) communication between ordering providers and nursing staff regarding patients on CM (Dressler et al., 2014; Leighton et al., 2013; Ramkumar et al., 2017; Svec et al., 2013).

The purpose of the Doctor of Nursing Practice (DNP) project was to pilot an evidence-based practice change to improve CM appropriateness on a 33-bed, inpatient, cardiac unit that could eventually be implemented throughout the entire 336-inpatient bed, Midwest hospital. By addressing this issue, the goal of the DNP project was to provide patients with quality, cost-effective, evidence-based care.

Methods

Context

The DNP project took place at a 336-inpatient bed, Midwestern hospital, with a 33-bed cardiac inpatient unit. To examine the current state of practice surrounding CM, an organizational assessment (OA) was conducted using the Burke-Litwin Model of Organizational

Performance and Change (Burke & Litwin, 1992) (Appendix B). This model identifies variables within an organization that should be considered when implementing a change process. Additionally, a strength, weakness, opportunity, and threat analysis or SWOT was completed as a part of the assessment (Appendix C).

Currently, the organization does not have a process in place for continued assessment of a patient's need to remain on CM. Ordering providers determine the initial need for CM and nursing staff oversee the care of patients being monitored. Patients on CM are assessed daily by providers and nurses but there is no formal evidence-based process to determine if a patient should remain on CM. In 2018, the organization had collected data to better understand the current practice state of CM and determined that there were several issues.

Baseline data was collected over 30 days and revealed that 1) patients are placed on CM outside of evidence-based recommendations, 2) providers fail to select or select an inappropriate indication for CM, 3) patients are maintained on CM for durations of time outside those defined within the AHA/ACC CM guideline, 4) patients are maintained on CM up until discharge from the hospital, and 5) patients are placed on CM without an active order. To bridge these existing gaps in care, a project including multi-faceted, evidence-based interventions was conducted. Interventions included: 1) educational sessions for unit nursing staff, hospitalists, internal medicine providers, and family medicine providers, 2) development of a data collection tool, CM assessment tool, and data dashboards (Appendix D and E), and 4) changes in workflow processes in order to improve CM appropriateness, decrease CM related healthcare costs, and provide best-evidence based practice for patients.

The pilot study was conducted to inform further CM recommendations for the entire organization. The evidence-based project was designed to address the clinical question: Does the

implementation of a multi-faceted, evidence-based practice change incorporating a clinical

decision tool supported by the ACC/AHA CM guideline (2017), improve appropriate use of

cardiac monitoring on a cardiac-based 33-bed inpatient unit?

Intervention

The Promoting Action on Research Implementation in Health Services (PARiHS)

framework (Appendix F) and Melnyk's (2005) five sequential steps to evidence-based practice

(Appendix G) were used to guide the implementation of the project (Fineout-Overholt, Melnyk

& Schultz, 2005; Kitson, Harvey & McCormack, 2011). Key project stakeholders included,

patients, healthcare providers (physicians, nurse practitioners, physician assistants, clinical nurse

specialist), RNs, organizational leadership (managers, supervisors, directors), supporting staff

(patient care assistants and technicians), and clinical nurse leaders.

Educational sessions were held for registered nurses (RNs), hospitalists, family medicine

providers, and internal medicine providers. A Power-Point presentation was created and included

common misconceptions surrounding CM, how the misuse of CM can negatively affect patients,

cost implications for CM services, information on the CM clinical tool, and the roles of

stakeholders involved in the project.

Educational sessions took place at four mandatory staff meetings and lasted

approximately 15-20 minutes. Additional educational opportunities were available to unit staff

on data collection days via one on one conversation. Project flyers (Appendix H) were created

and placed in the pilot unit workroom to facilitate awareness of the project for those who were

not included in the educational sessions. The project flyer included the project implementation

date, information regarding CM appropriateness, how misuse of CM can negatively impact

patients and hospital staff, and the identified practice changes for improving CM appropriateness.

The clinical tool used throughout the project was adapted from a CM screening tool previously used by the project organization and utilizes the AHA/ACC guidelines (2017) as supporting evidence (Appendix E). The tool included: basic instructions of intended use for the registered nurse (RN), indications and categories for CM and the AHA/ACC classifications, recommended duration for CM based on indication and class, and a communication prompt for nurses reaching out to providers.

Data dashboards were used to display changes seen over the duration of the project in the number of inappropriate CM orders as well as the number of patients maintained on CM. Three data dashboards in total were posted in the pilot unit workroom. The dashboards were used to facilitate awareness of the project as unit staff were able to visualize the progress of the project and continually see how their work was affecting CM practice.

Approach

The project took place from March 13th of 2019 through July 9th, 2019. The pre-implementation period (two-weeks) began after gaining institutional review board (IRB) approval (Appendix I) from the organization. During those two weeks, the project facilitator finalized development of the clinical tool used throughout the project, collected pre-implementation data, and completed educational sessions. The post-implementation period of the project included an additional six-weeks of data collection and continued education for staff. Once the data collection was completed, analyzed, and reviewed, the project facilitator began next step planning for sustainability of the CM practice change, organization of the information

obtained during the project, and planning for dissemination of the project results and hospital

wide adoption of the practice change on all non-emergency department, non-intensive care units.

The CM clinical tool was distributed to RNs by the hospital unit clerk (HUC) each

morning. The tool prompted nursing staff to review orders for CM on patients under their care

and determine if each patient met AHA/ACC criteria for monitoring. If the RN determined that

the patient did not meet criteria for monitoring, they were prompted to reach out to the ordering

provider caring for the patient. The RN and provider were then be able to discuss if CM was still

necessary for each individual patient. The provider was ultimately responsible for the

continuation or discontinuation of CM. Providers were expected to communicate any change in

orders to nursing staff.

Data was collected by auditing charts of patients who had discharged from the hospital on

the Monday and Tuesday of each data collection week and on succeeding days of the week until

at least 10 applicable charts had been reviewed. If more than 10 applicable charts were

identified on the Monday and Tuesday of any given data collection week, they were included in

the data collection. Collecting data in this manner ensured a minimum of 80 data points for each

data variable. The data variables and collection methods can be found in Appendix D.

Measures

The number of inappropriate CM orders, duration of time that patients were maintained

on CM, and number of patients maintained on CM until discharge from the hospital were

examined. This information was also used to determine potential cost savings for CM services

and RN wages over the duration of the project. All data collected during the completion of the

project was de-identified to meet healthcare privacy standards. Data was saved on a protected,

organization-approved storage device.

Analysis

Quantitative project data consisted of (a) admitting diagnosis, (b) AHA classification, (c) indication for monitoring, (d) initial CM order date/time, (e) CM order discontinuation date/time, (f) duration of maintained on CM, and (g) if the patient was maintained on monitoring until discharge. Qualitative data included conversations with stakeholders regarding the process change.

A Fisher's Exact Test was used to calculate changes seen in CM order appropriateness. A Wilcoxon Ranked Sum test was used to evaluate the differences in medians for the duration of time patients spent on CM. A Chi-Square Test was utilized to calculate change in the number of patients who were maintained on CM up until discharge from the hospital. Lastly, cost savings for CM services and RN wages were calculated using the completed data collection results.

Potential costs savings for CM services and RN wages were calculated by using the average census of the project unit (29 patients), percentage of patients who were found to be on CM during data collection, previously identified cost of daily CM ($53.44), and change in the number of inappropriate CM orders from pre- to post-implementation (Dressler, et al. 2014). Cost savings for RN wages were calculated using the average salary of RN wages in the project area and the expected duration of time RNs spent managing CM related tasks per shift (Appendix N).

Diagnoses were categorized by international classification of disease (ICD) codes, then placed into categories that most closely represented the assigned ICD code for ease of interpretation (Appendix J). Patients were also categorized by AHA classifications I through III, which separates the classes by level of supporting evidence and indication for CM (Appendix K

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and L). Cardiac monitoring appropriateness was determined by reviewing each CM order,

indication for monitoring, and AHA/ACC classification.

Results

Data Characteristics

A total of 86 charts were identified during the project time period that met criteria of

patients aged 17 or older who required CM services on the pilot unit. Pre-implementation data

was obtained from 20 patient chart audits (n=20), post-implementation data was obtained from

66 patient chart audits (n=66).

Data Results

Analysis of the data was completed using statistical analysis system software (SAS,

2018). Pre-implementation, 35.0% (7 of 20) of patients on CM did not have an inappropriate

order. Post-implementation the number of inappropriate CM orders was reduced to 12.1% (8 of

66), ($p = 0.0019$) (Appendix M). The median amount of time patients were maintained on CM

pre-implementation was 66:31 hours and 42:59 hours post-implementation ($p = 0.2186$)

(Appendix M). Pre-implementation, 95.0% (19 of 20) of patients were still on CM at the time of

discharge. This was reduced to 66.7% (44 of 66) post-implementation, ($p = 0.0121$; 95% CI

[0.1348 to 0.4319]) (Appendix M).

Potential cost savings for CM services were calculated using the average unit census (29

patients), the average amount of patients on CM daily (21 of 29), the percentage change for

inappropriate CM orders pre- to post-implementation (22.9% or 5 patients), and the average

daily cost of CM services per patient of $53.44 in a non-intensive care unit setting as determined

by Dressler et al., (2014). If CM services was reduced for five patients the approximate cost

savings per day would be $267.20, which totals $11,222.40 for the six-week post-implementation period of the project and $97,528.00 over an entire year.

Potential cost savings for nurse wages were calculated by average patient assignment (4), average RN salary ($30.40), and reduction in time spent by nurses on CM related tasks (112.5 minutes). Using these variables, the average nurse time spent managing CM related tasks was reduced by 78 hours and 45 minutes, for a potential cost savings of $2,394.00 over the duration of the project and $20,805.00 over an entire year. The estimated cost of operation for the project and return on investment (ROI) is presented in Appendix N).

Workflow and Process Changes

There were three workflow modifications made during the project. The first modification involved distribution of the CM tool to nursing staff. Initially, multiple copies of the clinical tool were handed out to RN staff; one for each patient on CM. Nurses reported feeling overwhelmed by the excess number of handouts. As a result, the process was changed so that each RN with one or more patients on CM only received one copy of the CM tool to use as a reference each day.

The two additional changes involved project modifications by the addition of another data variable and change in data collection process. The organization deemed it advantageous to collect data regarding CM and patient discharge. The added variable was used to determine if the use of the project interventions had any effect on the number of patients maintained on CM until the time of discharge. As a result, a data collection modification was needed. Rather than attempting to collect CM data in "real time", data collection was completed by auditing charts of patients who had recently been discharged from the pilot unit. This change allowed the facilitator

to provide accurate reporting of CM orders at the time of discharge as well as the total duration of time a patient spent on monitoring.

Themes from the Qualitative Data Collection

Nursing staff and ordering providers verbalized that the project educational interventions were engaging and informative. Individuals from both groups stated that the length of the educational PowerPoint was appropriate, and that the intent of the project was clearly understood. Nurses reported that the data dashboards were easy to understand and provided appropriate information about the progression of the project. Additionally, nurses and providers reported that they had utilized the clinical tool successfully and were actively engaged in the process changes.

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Discussion

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Two statistically significant outcomes were identified upon completion of data analysis. There was a significant reduction in the overall occurrence of inappropriate CM orders and the number of patients maintained on CM until discharge throughout the duration of the project. These outcomes were obtained using three evidence-based interventions for improvement of CM appropriateness, including the incorporation of the AHA/ACC CM guideline (2017) as a clinical tool, RN and provider education on CM appropriateness, and RN and provider communication regarding patients on CM (Dressler et al., 2014; Leighton et al., 2013; Ramkumar et al., 2017; Svec et al., 2013). Additionally, patients spent approximately 23:31 less hours on CM when comparing pre- and post-implementation data. This data result was not statistically significant but was potentially clinically significant about conservation of resources as the median reduction in CM hours was quite large.

The facilitator used tools and resources such as flyers, a daily clinical tool, data collection tool, return on investment (ROI) calculations and data dashboards to facilitate the pilot study (Fineout-Overholt et al, 2005). These tools allowed project unit staff to obtain knowledge about the project and view the progression of the project further promoting project engagement (Kitson et al., 2011). While some of these tools and resources are most likely not sustainable as a future strategy for continuing this practice change, the project organization should consider using advanced nursing practice staff to sustain efforts such as this and/or to implement other practice changes throughout the organization. The cost of utilizing organizational resources to implement a practice changes can be captured in the ROI, which in the case of this short-term project showed that such efforts from advanced nursing practice staff can prove to be beneficial to an organization for quality improvement and decreased spending.

Pilot unit staff reported being regularly engaged in the CM process change. Providers and nurses frequently voiced their own personal experiences working as a team, assessing patients for CM appropriateness, and utilizing the CM clinical tool successfully. When staff is engaged with a practice change and can perceive how that practice change will positively affect their work on a day-to-day basis, that practice change is more likely to be successful (Fineout-Overholt et al, 2005). There was no reported barriers regarding the daily use of the CM clinical tool. No adverse events were reported over the duration of the project.

Limitations

There were several limitations identified throughout the project. There is a limited amount of high level of evidence literature that exists regarding interventions to improve appropriate use of CM in non-ICU and non-ED settings. The majority of studies identified in the literature review were purely observational or were conducted in settings that did not meet

inclusion criteria for this project, limiting the number of possible interventions for improving CM appropriateness.

Completing more pre-implementation chart audits would have offered more robust baseline data. Additionally, it would have been helpful to collect data regarding the date and time each patient was admitted and discharged from the pilot unit. Patients placed on CM at the time of admission to a hospital will often no longer require CM after 48 hours (Ramkumar et al., 2017; Rizvi et al., 2017; Sandau et al., 2017). Collection of these additional variables could help determine if it was within AHA/ACC criteria to maintain a patient on CM until discharge.

A third limitation involved the inability to use a high-level of evidence intervention for improving CM appropriateness. Alteration and/or incorporation of the AHA/ACC CM guideline in the electronic ordering system (EOS) was found to be a highly effective intervention for improving CM appropriateness (Dressler et al., 2014; Leighton et al., 2013; Ramkumar et al., 2017). Timing for incorporation of a clinical decision support for the AHA/ACC CM guidelines for providers and nursing staff into the EHR/EOS was not possible during the timeframe of the project as the organization is planning an upcoming change to the EOS and EHR.

The fourth limitation was that education was not provided for all groups of ordering providers. Because there are so many different specialty services and therefore specialty providers throughout the hospital, face-to-face education for all was not possible for the pilot project. Lastly, the calculation for potential cost savings was completed using information obtained from previous studies. The studies provided the cost for CM services in urban areas and examined potential costs savings for CM services in hospitals that ranged from approximately 400 inpatient beds up to 1100 beds (Benjamin et al., 2013; Dressler et al., 2014). Information regarding the cost of CM services within the project organization was not available. The cost of

CM services is institutionally specific, as a result the calculations cannot account for unknown direct or in-direct CM costs specific to the organization.

Sustainability and Implications for Practice

Four recommendations were identified for adopting the CM practice change on all non-emergency department and non-intensive care units. The first recommendation is to ensure the organization utilizes the upcoming EOS/EHR change to incorporate a CM clinical support system (Dressler et al., 2014; Leighton et al., 2013; Ramkumar et al., 2017). This electronic ordering system (EOS) modification would notify a provider once a CM order had been active for 48 hours to help ensure that each patient chart would be reviewed to determine if CM is still a necessary intervention.

The second recommendation is to continually educate staff on the most current AHA/ACC CM guidelines and use of the CM tool in everyday practice. The organization could incorporate education for providers and nurses through mandatory annual on-line learning modules, currently used for most staff education. Additionally, education on CM and use of a CM clinical tool could be incorporated into new RN orientation for nurses assigned to work on cardiac-based inpatient units.

Recommendations three and four involve workflow and RN/provider communication. Cardiac monitoring should be discussed in daily, multi-disciplinary rounds that includes advance nursing practice staff. Discussing CM during patient rounds allows for an entire team of individuals to help facilitate CM appropriateness. The last recommendation is to create a workflow change for unit nursing staff and charge nurses (CN). The CN and unit nurses should work together in reviewing CM orders during patient updates. Patient updates occur each shift and are documented in the EHR. It would be appropriate for the RNs to review CM orders during

this time to determine if missing or inappropriate CM orders are present. If identified, the nurses could then determine the next appropriate actions. These recommendations will be communicated to the organizational leadership, providers and unit staff to promote the adoption of the CM practice change throughout the hospital.

Conclusion

Three interventions were used to significantly improve CM appropriateness in a non-intensive care unit, non-emergency department, acute care setting that included: 1) use of the American Heart Association and American College of Cardiology cardiac monitoring guidelines as a clinical tool in daily practice, 2) education on those guidelines for ordering providers and nursing staff, and 3) improved communication regarding cardiac monitoring between nurses and providers. The project resulted in statistically significant decreases in the number of inappropriate cardiac monitoring orders and number of patients maintained on cardiac monitoring until discharge. Recommendations for sustaining the results of this pilot study within this organization include incorporating evidence-based cardiac monitoring guidelines into the electronic ordering system, continued use of a cardiac monitoring clinical tool, continued education or nursing staff and ordering providers on cardiac monitoring guidelines, discussing cardiac monitoring in daily rounding that include advance nursing practice staff, and the use of charge nurses as facilitators of change.

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Appendix A
American Heart Association and American College of Cardiology Guideline (2017)

Patient Population/Indication	Arrhythmia Monitoring Recommendations	Continuous ST-Segment Ischemia Monitoring Recommendations	QTc*
Major cardiac interventions Continued			
Transcatheter structural interventions		Not indicated unless ischemic origin is suspected; then follow indications and duration per ischemia criteria	
After TAVR, particularly with periprocedural conduction abnormalities	≥3 d after procedure (*Class I; Level of Evidence C*) and after day 3 (*Class IIa; Level of Evidence C*)		
Other transcatheter interventions (eg, VSD, ASD, valvuloplasty)	Duration of monitoring varies with procedure, device, and patient factors (*Class I; Level of Evidence C*)		
Arrhythmias			
VTs; postresuscitation from VT/VF cardiac arrest or hemodynamically unstable VT	Until ICD implanted or underlying problem resolved (*Class I; Level of Evidence C*)	For all arrhythmias, add ST-segment monitoring only if ischemic origin is suspected; then follow indications and duration per ischemia criteria	
Nonsustained VT	*Class IIb; Level of Evidence C*		
Atrial tachyarrhythmias			
New or recurrent AF: monitor until treatment strategy determined	*Class I; Level of Evidence C*		
Hemodynamically unstable or symptomatic AF	*Class I; Level of Evidence C*		
Ongoing rate control management	*Class I; Level of Evidence C*		
Initiation of new antiarrhythmic agent†	See text; QTc monitoring may be indicated for hospitalized patients		*
Chronic AF			
If admitted for reason other than arrhythmia or rate and patient are hemodynamically stable	*Class III: No Benefit; Level of Evidence C*		
If medical condition affects ventricular rate or patient is unstable	*Class IIa; Level of Evidence C*		
Sinus bradycardias			
Symptomatic	*Class I; Level of Evidence C*		
Asymptomatic, significant bradycardia with negative chronotropic medications initiated	*Class IIa; Level of Evidence C*		
Asymptomatic, hemodynamically stable, admitted for other indication	*Class III: No Benefit; Level of Evidence C*		
Atrioventricular block			
Symptomatic second- or third-degree atrioventricular block of any anatomic origin	*Class I; Level of Evidence C*		
Asymptomatic second- or third-degree block caused by distal conduction system disease	*Class I; Level of Evidence C*		
Third-degree atrioventricular block caused by intranodal disease	*Class I; Level of Evidence C*		
Asymptomatic Wenckebach or transient atrioventricular block of vagal origin	*Class III: No Benefit; Level of Evidence C*		
Congenital or genetic arrhythmic syndromes (eg, WPW, Brugada, LQTS)			
Hemodynamically unstable, recurrent syncope, increased arrhythmia susceptibility	Until appropriate therapy is delivered (*Class I; Level of Evidence C*)		
WPW with rapid conduction via accessory pathway during atrial arrhythmia	Until therapy such as antiarrhythmic medication or ablation is delivered (*Class I; Level of Evidence C*)		
Congenital long QT with unstable ventricular arrhythmias or further QT prolongation induced medically or metabolically	Until stable, exacerbating cause reversed, QTc returned to baseline (*Class I; Level of Evidence C*)		*

(*Continued*)

CARDIAC MONITORING

Table 7. Continued

Patient Population/Indication	Arrhythmia Monitoring Recommendations	Continuous ST-Segment Ischemia Monitoring Recommendations	QTc*
Syncope of suspected cardiac origin			
Meeting admission criteria for syncope, cause of syncope suspected to be cardiac	Monitor ≥24 h; until cause and treatment identified; then follow indications and durations per criteria in these practice standards (*Class I; Level of Evidence B*)	Not indicated unless ischemic cause is suspected; then follow indications and duration per ischemia criteria	
After electrophysiology procedures/ablations			
Uncomplicated SVT ablation	Can be discontinued after immediate postprocedure area (*Class IIb; Level of Evidence C*)	For signs and symptoms of ischemia, follow indications and duration per ischemia criteria	
Complex ablation (pulmonary vein isolation) or serious comorbidities (eg, heart failure)	Monitor for 12–24 h (duration of monitoring varies with procedure, vascular access, and patient factors) (*Class I; Level of Evidence C*)		
Atrioventricular nodal ablation after incessant tachycardia and after chronic AF with concomitant pacemaker implantation	Monitor for 12–24 h (*Class I; Level of Evidence C*)		
After pacemaker or ICD implantation procedures			
Transcutaneous pacing pads	Monitor until pacing is no longer necessary and the device is removed or replaced with a permanent device (*Class I; Level of Evidence C*)	*Class III: Harm; Level of Evidence C*	
Standard temporary transvenous pacing wires	Monitor until pacing is no longer necessary and the device is removed or replaced with a permanent device (*Class I; Level of Evidence C*)		
Semipermanent transvenous pacing			
Day 1	*Class IIa; Level of Evidence C*		
After day 1	*Class IIb; Level of Evidence C*		
Permanent pacemaker or ICD			
Pacemaker dependent	For 12–24 h (*Class I; Level of Evidence C*)		
Not pacemaker dependent	For 12–24 h (*Class IIb; Level of Evidence C*)		
Generator change	In immediate postprocedure period (*Class IIb; Level of Evidence C*)		
Preexisting rhythm devices			
ICD shocks, requiring hospital admission	For duration of related hospitalization until precipitating event treated (*Class I; Level of Evidence C*)	*Class III: No Benefit; Level of Evidence C*	
ICD or pacemaker, admission for unrelated indication	*Class III: No Benefit; Level of Evidence C*		
Stable with wearable defibrillator, admission for unrelated indication	*Class III: No Benefit; Level of Evidence C*		
Other cardiac conditions			
Acute decompensated heart failure	Until precipitating event (eg, volume overload; ischemia; anemia; progressive ventricular, respiratory, or renal failure; hypertension; exacerbation of comorbidities; new-onset AF; or infection) is successfully treated (*Class I; Level of Evidence B*)	Only if possible ischemic origin and in the setting of evaluable ST segments (*Class IIb; Level of Evidence C*)	
Infective endocarditis	Until clinically stable (*Class IIa; Level of Evidence C*)	*Class III: No Benefit; Level of Evidence C*	
Noncardiac conditions			
Postconscious sedation	May be of benefit until patients are breathing per baseline and hemodynamically stable; consider that monitoring other than ECG may be more appropriate (eg, oximetry, end-tidal CO_2) (*Class IIb; Level of Evidence C*)	Decision based on preoperative cardiac risk assessment	

(*Continued*)

CARDIAC MONITORING

Patient Population/Indication	Arrhythmia Monitoring Recommendations	Continuous ST-Segment Ischemia Monitoring Recommendations	QTc*
Noncardiac conditions Continued			
Noncardiac surgery	Not indicated among asymptomatic postoperative patients; postoperative patients with angina equivalent symptoms or rhythm changes should be treated according to chest pain/coronary artery disease standards above (*Class III: No Benefit; Level of Evidence C*)	Only if specific practice standard met (*Class III: No Benefit; Level of Evidence C*)	
Noncardiac major thoracic surgery	After noncardiac major thoracic surgery such as pulmonary resection to identify AF through postoperative day 2–3 and may be helpful until discharge from acute care (*Class IIa; Level of Evidence B*)		
Medical conditions			
Stroke	Monitor 24–48 h (*Class I; Level of Evidence B*) Monitor longer if cryptogenic stroke (to assess for intermittent AF and asymptomatic rapid ventricular response) (*Class IIa; Level of Evidence B*)	ST-segment monitoring should be considered only in patients with acute stroke at increased risk for cardiac events with evaluable ST-segments (24–48 h) (*Class IIb; Level of Evidence C*)	
Moderate to severe imbalance of potassium or magnesium	Until normalization of electrolytes (*Class I; Level of Evidence B*) In less severe electrolyte abnormalities, if 12-lead ECG at time of abnormal laboratory result demonstrates electric abnormalities, consider continuous electrocardiographic monitoring	*Class III: No Benefit; Level of Evidence C*	*
Drug overdose	Monitor until free of the influence of the drug(s) and clinically stable (*Class I; Level of Evidence B*) (see specific recommendations for QTc monitoring in Table 6)	*Class III: No Benefit; Level of Evidence C*	*
Hemodialysis	Efficacy is not well established for most patients receiving chronic hemodialysis unless they have another indication (eg, hyperkalemia, arrhythmia) (*Class IIb; Level of Evidence B*) (see specific recommendations for QTc monitoring in Table 6)	*Class III: No Benefit; Level of Evidence C*	*
DNR/DNI			
When data gained from monitoring would trigger interventions consistent with patient wishes (eg, rate control if symptomatic)	Follow practice standards for related conditions	Follow practice standards for related conditions	
When data will not be acted on and comfort-focused care is the goal	*Class III: Harm; Level of Evidence C*	*Class III: Harm; Level of Evidence C*	

Need for continuous electrocardiographic monitoring should be reevaluated at least every 24 to 48 hours.

Patients in an intensive care unit and immediate postprocedure area (eg, catheterization laboratory) will have continuous electrocardiographic monitoring.

Patients with Class I indications for arrhythmia monitoring who need to be transported off the unit should have continuous electrocardiographic monitoring via a portable monitor–defibrillator/pacemaker with a healthcare provider skilled in use of the equipment and in electrocardiographic interpretation.

For chest pain/coronary artery disease, complications such as cardiogenic shock or recurrent angina or angina-equivalent syndromes require continued arrhythmia monitoring beyond 24 to 48 hours.

For chest pain/coronary artery disease, reapplication of ischemia monitoring should be considered in previously stable patients who experience recurrent signs/symptoms of ischemia.

For continuous ST-segment monitoring, monitor all 12 leads in the setting of a nursing unit with technology, education, and protocols that facilitate reduction of false and nonactionable alarm signals; not appropriate for patients with uninterpretable ECG (ST segments).

ACS indicates acute coronary syndrome; AF, atrial fibrillation; ASD, atrial septal defect; DNR/DNI, do not resuscitate/do not intubate; ICD, implantable cardioverter-defibrillator; LQTS, long-QT syndrome; MI, myocardial infarction; NSTE-ACS, non–ST-segment–elevation acute coronary syndrome; PCI, percutaneous coronary intervention; STEMI, ST-segment–elevation myocardial infarction; SVT, supraventricular tachycardia; TAVR, transcatheter aortic valve replacement; VF, ventricular fibrillation; VSD, ventricular septal defect; VT, ventricular tachycardia; and WPW, Wolff-Parkinson-White.

*QTc monitoring indicated: see comprehensive QTc monitoring recommendations in Table 6.

Figure 1. AHA/ACC Cardiac Monitor Guidelines: Sandau, K. E., Funk, M., Auerbach, A. Barsness, G. W. & Wang, P. J. (2017). Update to Practice Standards for Electrocardiographic Monitoring in Hospital Settings: A Scientific Statement from the American Heart Association. doi:https://doi.org/10.1161/CIR.0000000000000527

Appendix B
The Burke-Litwin Model of Organizational Performance and Change
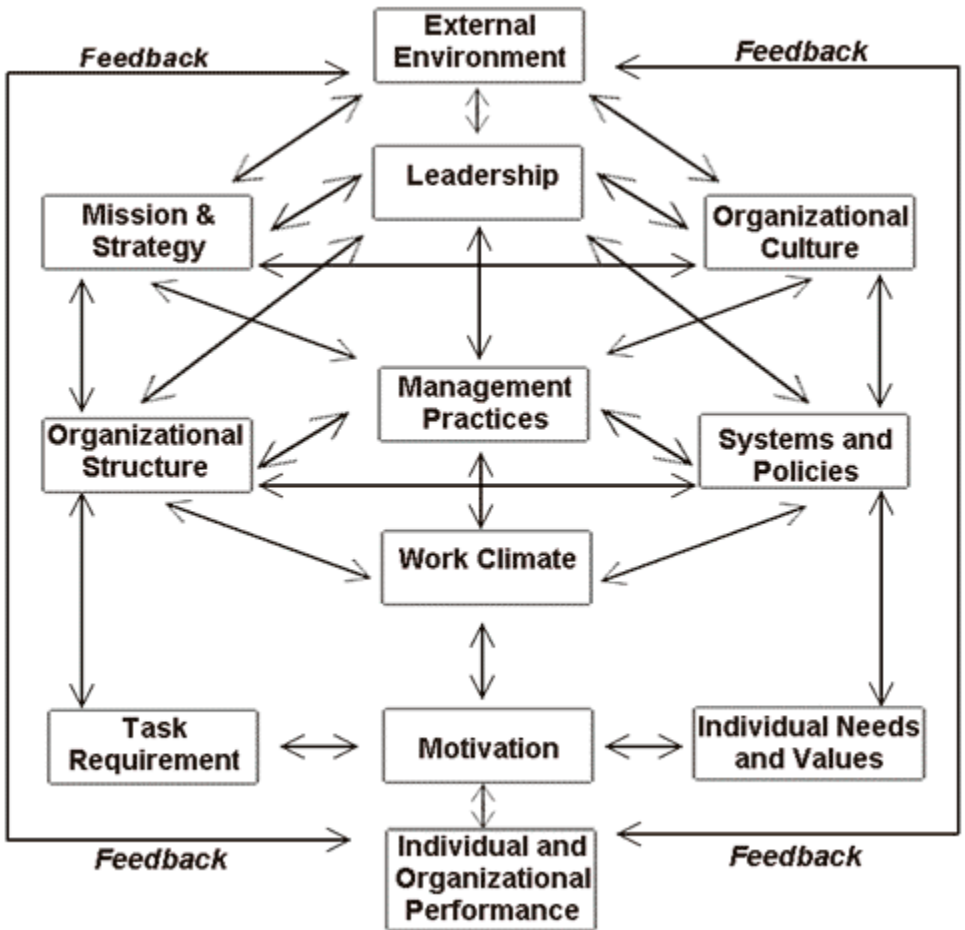
Figure 2. A model of organizational performance and change. Reprinted from "A Causal Model

of Organizational Performance and Change, "by W. W. Burke and G. H. Litwin, 1992, *Journal*

of Management, 18, 528. Copyright 1992 by Southern Management Association.

CARDIAC MONITORING

Appendix C
SWOT Analysis of Inpatient Cardiac Unit

Strengths	Weaknesses
- Cardiac monitor unit. Staff who primarily work on this unit receive specialty training. - Teaching based hospital. Adaptable to learning and accepting of change. - Clinical nurse specialist and leaders (CNS/CNL) on each unit. Graduate prepared nurses employed specifically to understand and implement change. - Motivated management and supportive staff with positive attitudes towards change.	- Open unit: frequent float staff from other units who may not knowledgeable to care for patients on cardiac monitoring. - Staff turnover and lack of experience. Many newly graduated nurses. - No current guidelines in place for monitoring appropriateness - No required annual educated for cardiac monitoring - Three different general medicine provider services.
Opportunities	**Threats**
- Implement a process that follows evidence-based guidelines. - Establish appropriate telemetry use education for staff. - Decrease staff workload regarding cardiac monitoring. - Enhance quality of patient care. - Utilize previously explored organizational information regarding cardiac monitoring. - Decrease costs of care.	- Staff and providers willingness and acceptance of change processes. - Ensuring appropriateness of care for all patient populations who may require cardiac monitoring.

Table 1. SWOT analysis of organization.

Appendix D
Data Collection Table

Variable	Measurement	Data Location	Collection Method	Data Collector	Data Collection Time Intervals
Admitting Category	Based on ICD-10 Diagnosis	Pre/Post data collection excel spreadsheet	Retrieved from EHR (de-identified)	DNP Student	Pre- and Post- Intervention (Weekly)
AHA Classification	Class I, II, III, or none	Pre/Post data collection excel spreadsheet	Retrieved from EHR (de-identified)	DNP Student	Pre- and Post- Intervention (Weekly)
Indication(s) for Cardiac Monitoring	Provider selected indication for cardiac monitoring	Pre/Post data collection excel spreadsheet	Retrieved from EHR (de-identified)	DNP Student	Pre- and Post- Intervention (Weekly)
Cardiac Monitor Order (Initial Order and Discontinuation Order)	Date/Time of Initial Cardiac Monitor order, Date/Time of Discontinued Order, Total Duration of Cardiac Monitor Order	Pre/Post data collection excel spreadsheet	Retrieved through EHR audit (de-identified)	DNP Student	Pre- and Post- Intervention (Weekly)
Cardiac Monitoring Appropriateness	Yes/No Based on order, class, and indication	Pre/Post data collection excel spreadsheet	EHR Audit (de-identified)	DNP Student	Pre- and Post- Intervention (Weekly)
Record of Patients on Cardiac Monitoring at the Time of Discharge	Yes/No	Pre/Post data collection excel spreadsheet	EHR Audit (de-identified)	DNP Student	Pre- and Post- Intervention (Weekly)

Table 2. Data collection table and variable definitions.

Appendix E
Cardiac Monitoring Clinical Tool

**Screening Tool for Cardiac Monitoring
Appropriateness (for non-ICU/non-ED patients)**

Based on AHA/ACC guidelines, see reference at:
www.ahajournals.org/doi/full/10.1162/CIR.0000000000000527

Instructions:
1. The intent of this form is to help the RN identify appropriate criteria for the use of cardiac monitoring. The decision to continue or discontinue cardiac monitoring is determined by ordering providers **ONLY**.
2. Contact ordering provider if patient does not meet class I or II indications or when:
   - No significant arrhythmias for 48 hours
   - Rate controlled atrial fibrillation
   - Resolution of initial diagnosis or cardiac diagnoses have been ruled out
   - Anticipated discharge within 24 hours

Class I Indications: Indications for cardiac monitoring (review after 48 hours)

	Critical care status or hemodynamic instability
	Early phase acute coronary syndromes (ST-Elevation and Non-ST-Elevation MI)
	Unstable coronary syndromes and newly diagnosed high-risk coronary lesions
	Post percutaneous coronary intervention
	Implantation of defibrillator or pacemaker or considered pace maker dependent
	Acute heart failure and/or pulmonary edema
	Prolonged QT/QTc (> 460msec in women, >450msec in men)
	Any hemodynamically unstable arrhythmia (SB, ST, uncontrolled a-fib, heart-blocks)
	Wolff Parkinson White Syndrome with complicating arrythmias

Class II Indications: Monitoring may be beneficial but not essential for all patients (review after 24-48 hours)

	Post-acute MI (greater than 24 hours)
	Chest pain syndromes or chest pain "rule out" (MI, unstable angina, myocarditis, pericarditis)
	Uncomplicated percutaneous PCI, angiography, or ablation
	Implantation of pacemaker but not pacemaker dependent
	Subacute/chronic heart failure
	Syncope
	Administration/initiation/adjustment of an antiarrhythmic drug
	Initiation or adjustment of medications known to cause arrhythmias

Other Indications:

	Stroke protocol / cerebral vascular disease evaluation
	Vasoactive medication drips
	Severe anemia or electrolyte abnormalities

Date_____**Time**_____

Physician Notified (Y/N) _____

Cardiac Monitoring Discontinued (Y/N) _____

Figure 3. Cardiac monitoring clinical tool for daily use.

Appendix F
PARIHS Model
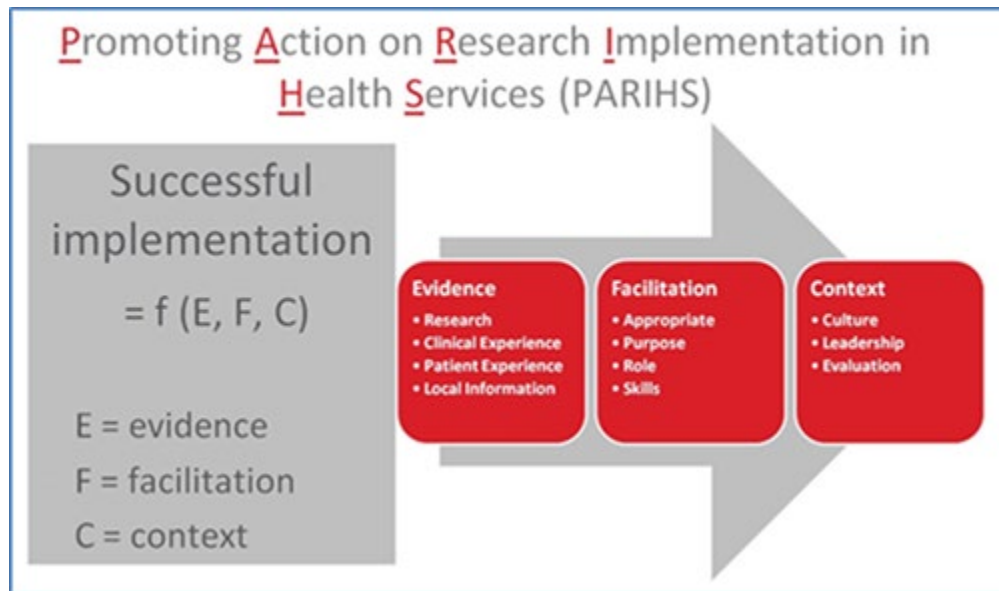
Figure 4. Adapted from "Enabling the implementation of evidence-based practice: a conceptual

framework," by A. Kitson, G. Harvey, and B. McCormack. Copyright 2011 by University of

Maryland School of Nursing.

CARDIAC MONITORING

Appendix G
Evidence Based Practice Model
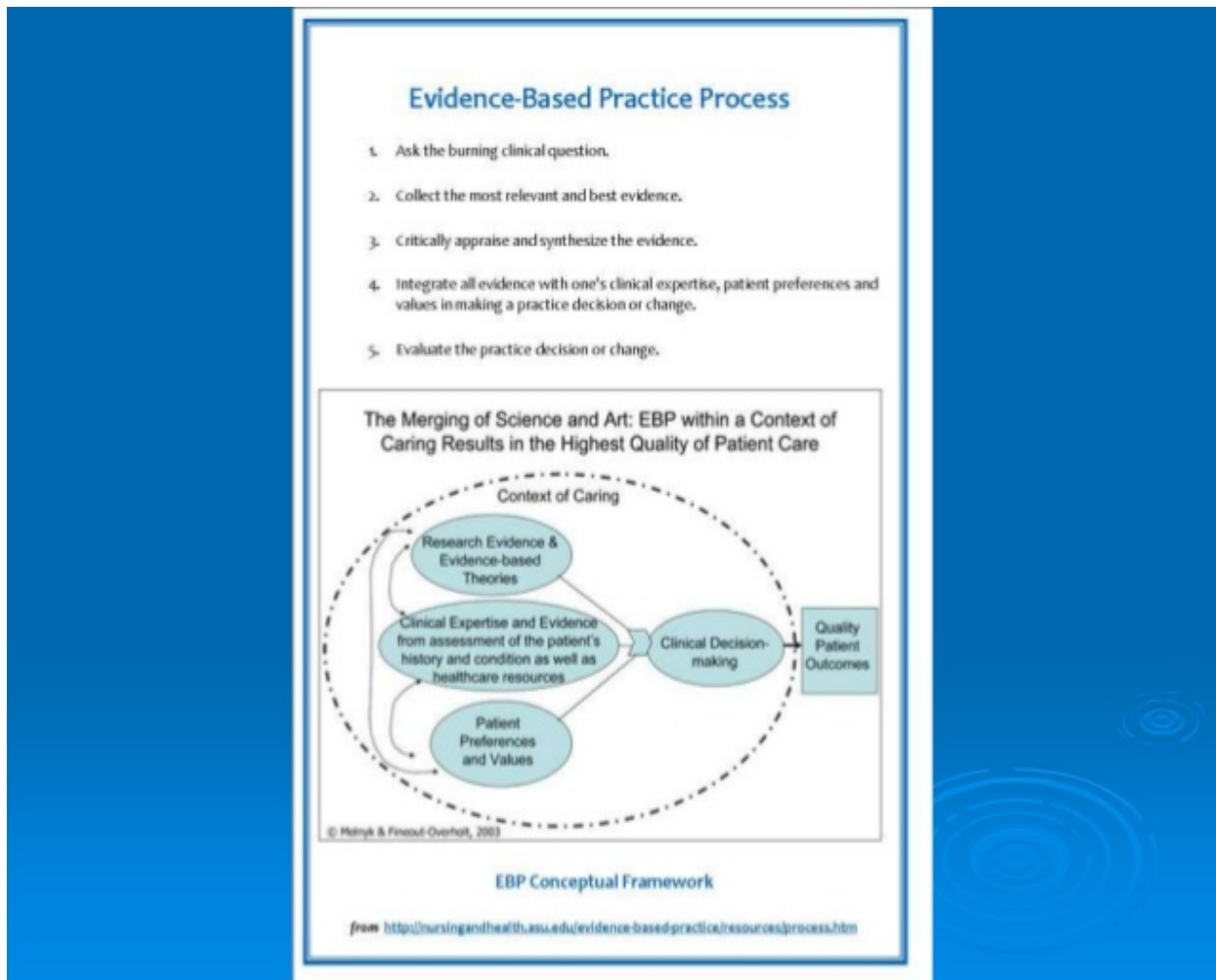
Figure 5. Adapted from "Transforming Health Care from the Inside Out: Advancing Evidence-Based Practice in the 21st Century." by Fineout-Overholt, E., Melnyk, B. M., & Schultz, A. Copyright 2005 by Elsevier Inc.

CARDIAC MONITORING

Appendix H
Project Flyer

Quality Care: is committed to providing quality, evidenced-based care.

What is cardiac monitoring appropriateness?
- Ensuring a patient has the correct order for cardiac monitoring.
- Use of an evidence-based guideline for use of cardiac monitoring.
- Discontinuation of monitoring when it is no longer necessary for a patient or when the use of monitoring is no longer supported by evidence.

How does cardiac monitoring impact patients and staff?
- Excessive monitoring is costly to both the organization and to patients.
- Alarms associated with cardiac monitoring interfere with a calm and healing environment.
- Delays in care can occur due to limited cardiac monitoring capable beds.
- Extra time from physicians, nursing, and supportive staff is required to manage phone calls, pages, and doc-halos regarding cardiac monitoring as well as charting and equipment upkeep.

Recommendations for facilitating appropriate use of cardiac monitoring:
- XXXX has partnered with Grand Valley State University (GVSU) to take on a Doctor of Nursing Practice (DNP) scholarly project to improve cardiac monitoring appropriateness on XXXXX
- The project will incorporate the American Heart Association cardiac monitoring guidelines to decrease overutilization of cardiac monitoring.
- Providers and nurses will work together in an effort to make timely and appropriate care plan decisions regarding patient cardiac monitoring.
- **START DATE:** 04/15/2019

Figure 6. Project flyer.

Appendix I
Institutional Review Board Approval

NOTICE OF CLINICAL QUALITY IMPROVEMENT MEASUREMENT DESIGNATION

To: Joseph Urbanski, RN, BSN
    1341 Portland Ave NE
    Grand Rapids, MI 49505

Re: IRB# 19-0307-2
    Evidence-Based Practice Change: Cardiac Monitoring

Date: 03/11/2019

This is to inform you that the Regional Institutional Review Board (IRB) has reviewed your proposed research project entitled *"Evidence-Based Practice Change: Cardiac Monitoring".* The IRB has determined that your proposed project is not considered human subjects research. The purpose and objective of the proposed project meets the definition of a clinical quality improvement measurement. All publications referring to the proposed project should include the following statement:
"This project was undertaken as a Clinical Quality Improvement Initiative at and, as such, was not formally supervised by the Regional Institutional Review Board per their policies."

The IRB requests careful consideration of all future activities using the data that has been proposed to be collected and used "in order to implement an evidence-based change initiative to guide appropriate cardiac monitoring based on American Heart Association guidelines, which can eventually be implemented throughout the entire organization."

The IRB requests resubmission of the proposed project if there is a change in the current clinical quality improvement measurement design that includes testing hypothesis, asking a research question, following a research design or involves overriding standard clinical decision making and care.

Please feel free to contact me if you have any questions regarding this matter.

 Office of the IRB

 Copy: File

Figure 7. Organizational IRB approval letter.

CARDIAC MONITORING

Appendix J
Diagnostic Data Characteristics

Admitting Category	Pre-Implementation (number of patients with diagnosis n=20)	Post-Implementation (number of patients with diagnosis n=66)	Total (total number of patients with diagnosis n=86)
Cardiovascular	11	40	51
Electrolyte Abnormality	3	5	8
Gastrointestinal	1	0	1
Psychological	1	1	1
Pulmonary	2	6	8
Renal	2	7	9
Peripheral Vascular Disease	0	6	6
Infectious Disease	0	1	1
Total	20	66	86

Table 3. This chart displays the different categories the data was divided into based on the admitting diagnosis of each patient. Data was collected from 20 patient's pre-implementation and 66 patients post-implementation. Each patient was assigned to one admitting category based on the primary admitting diagnoses assigned to them. The diagnoses include cardiovascular (51), electrolyte abnormality (8), gastrointestinal (1), psychological (2), pulmonary (8), renal (9), peripheral vascular disease (6), and infectious disease (1).

CARDIAC MONITORING

Appendix K

American Heart Association Classifications
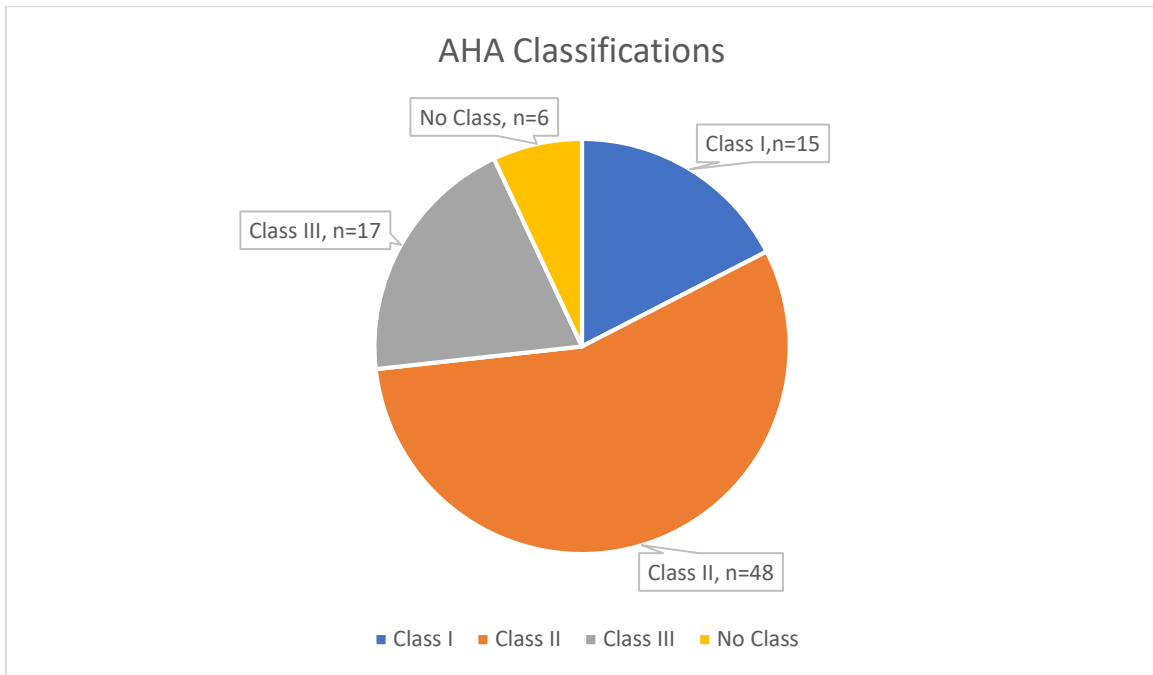
Figure 8. This figure displays the different AHA classifications each patient was assigned. The AHA classification range from I through III, I indicating the highest level of supporting evidence for CM and III indicating minimal to no supporting evidence for CM. If the patient did not meet criteria for any classes that patient was assigned to class 4 or no class. Class I (15), class II (45), class III (17), and no class (6).

CARDIAC MONITORING

Appendix L
Indications Used for Cardiac Monitoring
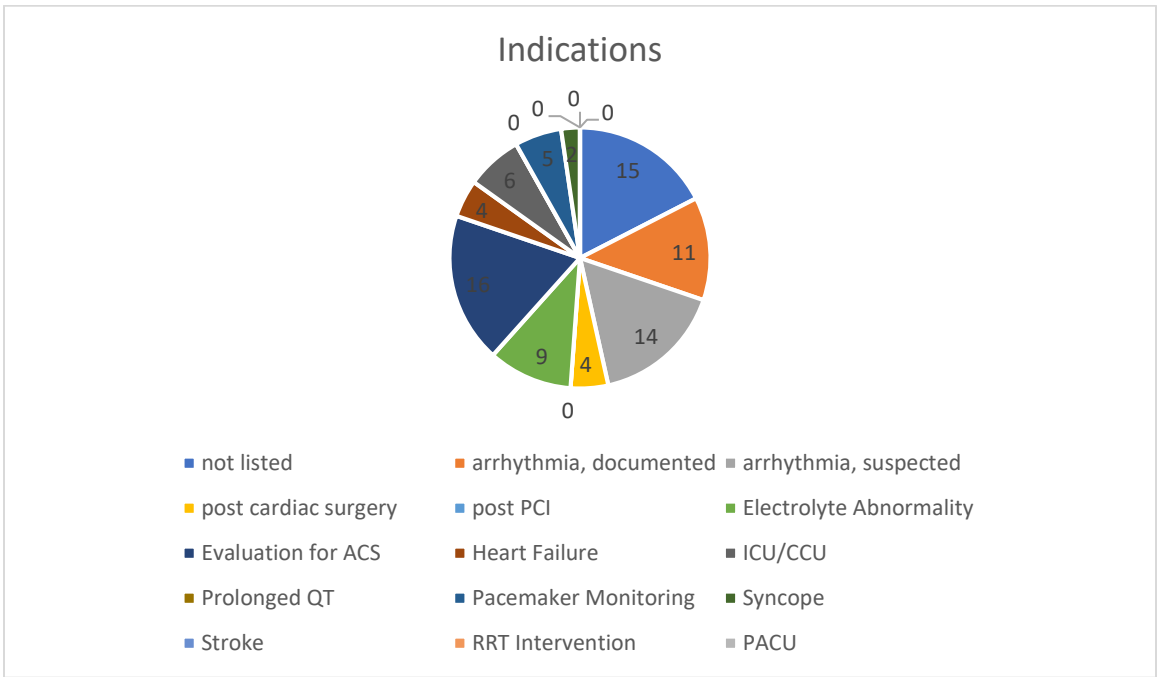
Figure 9. This chart displays the different possible indications an ordering provider could select when indicating why a patient requires cardiac monitoring. The indications are: not listed (15), arrhythmia, documented (11), arrhythmia, suspected (14), post cardiac surgery (4), electrolyte abnormality (9), evaluate for ACS (16), heart failure (4), ICU/CCU (6), pacemaker monitoring (5), and syncope (2). Post PCI, prolong QT, stroke, RRT intervention, and PACU were selected zero times.

Appendix M
Data Results Table

Data Results Table				
Outcomes	Pre-Implementation n=20	Post-Implementation n=66	Statistical Test	p-value
Inappropriate Cardiac Monitoring Orders (as a percentage)	35% (7 of 20)	12.1% (8 of 66)	Fisher's Exact	*0.019
Duration of Time Spent on Cardiac Monitoring (median hours: mins)	66:31	42:59	Wilcoxon Ranked Sum	0.2186
Patients Maintained on Cardiac Monitoring at Discharge (as a percentage)	95% (19 of 20)	66.7% (44 of 66)	Chi-Square	*0.0121 95% CI [0.1348 to 0.4319]

Table 4. Pre-implementation there were 13 appropriate orders (65.0%) and 7 inappropriate cardiac monitoring orders (35.0%). Post-implementation there were 58 appropriate orders (87.9%) and 15 inappropriate orders (12.1%). This statistical analysis was completed by using the Fisher's Exact test (p = 0.019). Duration of time patients spent on cardiac monitoring is represented by numerical values from the Wilcoxon Ranked Sum test. Wilcoxon test statistic = 947 (p = 0.2186). The median duration of time a patient spent on cardiac monitoring pre-implementation was 66 hours and 33 minutes. The median duration of time a patient spent on cardiac monitoring post-implementation was 42 hours and 59 minutes. Lastly, patients maintained on cardiac monitoring at discharges was interpreted using the Chi-Square Test. Pre-implementation 19 patients (95.0%) remained on cardiac monitoring at the time of discharge. Post-implementation 44 patients (66.7%) were found to be on cardiac monitoring at the time of discharge. Interpretation of the confidence interval: We are 95% confident that the difference between the population proportions of patients left on monitor when discharge of the pre- and post- groups is between 0.1348 and 0.4319 (p = 0.0121).

Appendix N
Return on Investment

Initial Cost: Evidence-based Practice Change for Cardiac Monitoring	
Potential Estimated Revenue	
Project Manager Time (in-kind donation) by DNP Student	$2,219.00
Potential RN savings with reduced cardiac monitoring hours (1-year period) (1.875 RN hours saved per day x RN wage x 365)	$20,805.00
Estimated cost savings for cardiac monitoring services (1-year period) (savings on service per day x 365)	$97,528.00
Statistician (in-kind donation)	5hrs x $37.65 ($188.25)
Total Revenue (potential savings and in-kind donations)	$120,740.25
Expenses (estimated costs)	
GVSU Project Manager Time (in-kind donation)	$49.00/hr x 10 hours ($490.00)
Organization Project Advisor	$49.00/hr x 10 hours ($490.00)
RN DNP Student (in-kind donation for education)	$34.00/hr x 10 hours ($340.00)
Registered Nurses (extra time spent at shift change huddle)	$30.40/hr x 10 hours ($304.00)
Education for Physicians (extra time spent reading e-mails and during meeting)	$104.00/hr x 10 hours ($1,040.00)
Miscellaneous Materials (educational materials)	$9.00
Clinical Nurse Specialists Consultation	$49.00/hr x 10 hours ($490.00)
Statistician (in-kind donation)	5hrs x $37.65 ($188.25)
Project Manager Time (in-kind donation) by DNP Student	$2,219.00
Total Expenses	$5,570.25
Final Return on Investment	$115,170.00

Table 5. Estimated costs and final return on investment for the DNP project.

Power Point Presentation Slides

CARDIAC MONITORING

Slide 1

Slide 2

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Slide 3

Slide 4

Slide 5

Organizational
Assessment

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Slide 6

Organizational Assessment

- 336-inpatient bed, Midwest hospital, with a 33-bed cardiac based inpatient unit
- Organization's Guiding Behaviors
- Baseline CM data:
  - Use of CM outside of evidence-based recommendations
  - Selecting of inappropriate CM indications or none at all (33%)
  - Patients were being maintained on CM for durations outside of the guidelines and up until the time of discharge
    - Average hours: 62
    - Number of patients being monitored at discharge: 134 of 157
  - Placed on CM without an active order (25%)

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Slide 7

Stakeholders

- Patients
- Healthcare Providers
  - Physicians, Nurse Practitioners, Physician Assistants, Clinical Nurse Specialist (CNS)
- Registered Nurses
- Supportive staff: Patient Care Assistants and Monitor Technicians
- Organizational Leadership
  - Unit manager, Clinical Nurse Leader (CNL), Chief Quality and Patient Safety Officer, and Director of Professional Practice and Development

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Slide 8

SWOT

Strengths	Weaknesses
• Cardiac monitor unit. Staff who primarily work on this unit receive specialty training. • Teaching based hospital. Adaptable to learning and accepting of change. • Clinical nurse specialist and leaders (CNS/CNL) on each unit. Graduate prepared nurses employed specifically to understand and implement change. • Motivated management and supportive staff with positive attitudes towards change.	• Open unit: frequent float staff from other units who may not knowledgeable to care for patients on cardiac monitoring. • Staff turnover and lack of experience. Many newly graduated nurses. • No current guidelines in place for monitoring appropriateness • No required annual educated for cardiac monitoring • Three different general medicine provider services.
Opportunities	**Threats**
• Implement a process that follows evidence-based guidelines. • Establish appropriate telemetry use education for staff. • Decrease staff workload regarding cardiac monitoring. • Enhance quality of patient care. • Utilize previously explored organizational information regarding cardiac monitoring. • Decrease costs of care.	• Staff and providers willingness and acceptance of change processes. • Ensuring appropriateness of care for all patient populations who may require cardiac monitoring.

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CARDIAC MONITORING

Slide 15

Project Purpose

- Implement pilot study as an evidence-based change initiative to guide appropriate CM
- Type of project:
  - Evidence-based practice change: a problem-solving approach to a clinical practice issue (Fineout-Overholt et al., 2005)
  - Change practice to:
    - Improve CM ordering and assessment practices
    - Be good stewards of healthcare resources

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Slide 16

Model to Examine Phenomenon

- PARIHS Framework
  - SI = f(E,C,F)
  - Successful implementation is a function of evidence, context, and facilitation

  (Kitson et al., 1998; Kitson et al., 2008)

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Implementation Model

Adapted from "Transforming Health Care from the Inside Out: Advancing Evidence-Based Practice in the 21st Century." by Fineout-Overholt, E., Melnyk, B. M., & Schultz, A. Copyright 2005 by Elsevier Inc.

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Participants

- All patients age 17 or older admitted to the pilot-study unit
- Unit Staff: (involved in direct patient care)
  - Ordering providers (Physicians, NPs, PAs,)
  - Nursing staff
  - Nursing specialties (CNL, CNS)

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Discussion

- Two significant outcomes were identified:
  – Statistically significant reduction in the overall occurrence of inappropriate CM orders
  – Statistically significant reduction in the number of patients maintained on CM until discharge.
- Interventions successfully used:
  – Use of AHA/ACC guidelines as a clinical tool
  – Education for RNs and ordering providers
  – RN and provider communication
  – Data dashboards and project flyers

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Discussion continued…

- ROI: $115,170.00 (1-year)
  – Total expenses included staff wages for education, educational material costs, and in-kind donations.
  – Potential RN savings: $20,805.00
    • Reduction in RN services needed by 1.25 assignments
  – Potential CM service savings: $97,528.00
    • Reduction in CM services for 5 patients each day

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Project Proposal

Evidence-Based Cardiac Monitoring: A Practice Change

Joseph Paul Urbanski

Kirkhof College of Nursing

Grand Valley State University

Advisor: Dianne Conrad DNP, RN

Project Team Members: Katherine Moran DNP, RN and Amy Kyes CNS

Abstract

Cardiac monitoring (CM) is a non-invasive treatment tool that is commonly over-used in

hospitalized patients (Benjamin et al., 2013). Overutilization of CM contributes to increased

healthcare costs, poor stewardship of resources, and a decrease in overall quality of care for

patients in a hospital setting (Benjamin et al., 2013). Findings from research demonstrate that

implementation of the American Heart Association's (AHA) evidence-based CM guidelines can

significantly improve appropriateness in use of CM (Sandau, Funk, Auerbain, Barsness, &

Wang, 2017). The purpose of this Doctor of Nursing Practice (DNP) project is to implement a

pilot study to answer the following clinical question: Does the implementation of a clinical

decision toolkit incorporating evidence-based American Heart Association guidelines, improve

appropriate use of cardiac monitoring in an acute care setting? The study will use pre- and post-

intervention data regarding appropriate use of CM to facilitate evidence-based practice change

throughout an acute care Midwest hospital.

Keywords: telemetry, utilization, cardiac monitoring

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In 2017, approximately 35 million Americans were admitted into hospitals around the country (AHA, 2017). Suspected cardiovascular disease is one of the most common reasons adults are admitted to hospitals (Benjamin, Klugman, Luckmann, Fairchild, & Abookire, 2013). Patients who are admitted to a hospital with cardiovascular problems often meet criteria for the use of cardiac monitoring (CM). Cardiac monitoring is used to identify deteriorating health conditions, life-threatening heart arrhythmias, sudden cardiac arrest, and other potential causes of cardiac related symptoms (Sandau, Funk, Auerbach, et al., 2017). Monitoring can be done by directly connecting a patient to a bedside monitor with wires or what are also known as "leads" or through a more portable system that is also known as telemetry. For this proposal, the two terms (cardiac monitoring and telemetry) will be used interchangeably. Cardiac monitoring is performed continuously through centralized data transfers, bedside equipment, and clinical observation (Piccini, 2012). The goal of CM is to provide healthcare providers with timely information regarding the health status of a patient in order to decrease adverse cardiovascular related events (Piccini, 2012).

Cardiac monitoring is a very practical and useful clinical tool when utilized appropriately within established guidelines. When overutilized CM can be burdensome to a healthcare organization. Over- and unnecessary utilization of CM contributes to increased healthcare costs for patients and healthcare organizations as well as wastefulness of healthcare resources (Rizvi, Munguti, Mehta, et al., 2017). Healthcare related costs in the United States account for approximately 18% of the nation's gross domestic product and per capita spending, about 3.6

trillion dollars. (Chong-Yik et al., 2018). It is estimated that as much as one third of healthcare

spending is considered waste (Chong-Yik et al., 2018). Previous research and appraisals of daily

telemetry costs range from a minimum of $53 to as much as $1400 per patient per day (Chong-

Yik et al., 2018). Due to the clinical significance of cardiac monitoring in a hospital setting there

has been an overall increase in monitor utilization. This increase in CM use eventually lead to

the first set of cardiac monitoring guidelines published in 1991 by the American College of

Cardiology (ACC). These practice standards were published as a response to rising concerns for

the costs associated with the spike in CM utilization (Chung-Yik et al.,2018). The ACC and

American Heart Association (AHA) continue to update cardiac monitoring guidelines to improve

patient safety and combat healthcare spending that is growing at an unsustainable rate (Chung-

Yik et al., 2018).

"Appropriate use", in an acute care setting, can be defined as obtaining an expected

health benefit from a procedure or service that exceeds the otherwise expected health risks

(Hopkins, 1993). Appropriate use of CM can and should be used in defined populations in which

CM is indicated to improve patient outcomes (Benjamin et al., 2013). Appropriate use can also

be defined from the prospective of a patient. A patient may and should entrust in healthcare

providers and healthcare systems to use appropriate care interventions as well as deliver care in a

competent manner (Hopkins, 1993). The American College of Cardiology (ACC) and American

Heart Association (AHA) are responsible for the expert recommendations that define the

populations in need of CM (Sandau et al., 2017). These expert recommendations are supported in

literature and distinctly defined throughout the presented guidelines by their varying levels of

evidence (Sandau et al., 2017).

      The setting in which the pilot-study will take place is a Midwest hospital with 336 inpatient beds. Included within the hospital is a 33-bed cardiac based inpatient unit where the pilot-study will be conducted. There are 144 total cardiac monitoring sectors within the hospital, 32 of which are utilized by the project unit. In total, the hospital can safely care for 144 patients who require CM at any given time. Monitoring services vary from unit to unit within the hospital. Each unit is capable of supporting some form of CM for patient care when deemed necessary. Each area within the hospital that uses CM requires staff, time, and money to successfully utilize this clinical tool. The more resources each unit require, the less there are available for others. There is a limit to the number of patients that can be monitored at any given period and a limit to the amount of staff that can physically care for individuals on CM. Additionally, there are designated units within the hospital whom primarily care for patients requiring CM. Overuse of CM contributes to delays in admitting capabilities and care when attempting to admit new patients into the hospital who require CM.

      A large, multicenter, study that was conducted to evaluate overutilization of CM concluded that approximately 35% of inpatient monitoring days did not meet clinical indications set forth by the AHA for CM (Benjamin et al., 2013). Additionally, the study outcomes found that eliminating CM on patients who did not meet evidence-based indications could save a minimum of $53 per patient per day (Benjamin, et al., 2013). The researchers then calculated what was deemed a "conservative estimate" on the projected savings for a 400-bed hospital in the United States. The conclusion was that by identifying inappropriate uses of CM and providing an appropriate intervention to correct practice concerning CM, an organization could save up to $250,000 per year (Benjamin, et al., 2013). The organization would also be able to

account for time saved regarding patient care surrounding CM for approximately 5,000 patients

who no longer required monitoring over that period of time (Benjamin, et al., 2013).

Hospital staff spend ample amounts of patient care time managing cardiac monitors,

maintaining equipment, answering monitor alarms, and communicating with staff regarding

actively monitored patients. A 2013 and 2015 study concluded that hospitals ranging from 300-

400 inpatient beds in size required staff to spend approximately 90 minutes per patient

assignment per day managing cardiac monitoring (Benjamin et al., 2013; Saley & Chatriwalla,

2015).

Additionally, overutilization of monitoring may also be contributed to improper ordering

practices by providers. Recent studies have shown that as many as 25% of providers were

unaware of at least one of the patients under their care who had active CM orders (Rizvi et al.,

2017; Sharma et al., 2017). Providers also failed to give an appropriate indication for use of

monitoring approximately 45% of the time (Rizvi et al., 2017; Sharma et al., 2017). In addition

to findings in the literature, previous data that was obtained by the project unit's clinical nurse

specialist (CNS) revealed that as many as 25% of patients had been placed on CM without

proper indication. This data was collected during a 24-hour snapshot of the units cardiac

monitoring practices as well as a 28-day chart audit to assess CM ordering practices.

Additionally, there is no formal process in place for reevaluating a patient's need for continued

CM on the pilot-study unit as well as the other units within the hospital. As a result, the

organization spends unnecessary resources managing patients on cardiac monitors.

There is clear evidence that gaps in care related to CM exist on this within this

organization. These gaps include but are not limited to a lack of use of evidence-based ordering

practices, inconsistent communication amongst healthcare staff to obtain monitor discontinuation

orders, and lack of continual assessment of the need for CM in patient populations admitted to this non-intensive care unit (ICU), acute care settings. The information that has been gathered supports the need for a pilot study to develop an evidence-based clinical decision tool to answer the following clinical question: Does the implementation of a clinical decision tool incorporating evidence-based American Heart Association guidelines, improve appropriate use of cardiac monitoring in acute care?

Assessment of Organization

Framework for Assessment

An organizational assessment of a 336-inpatient bed, Midwest hospital, with a 33-bed cardiac based inpatient unit was conducted using the Burke-Litwin Model of Organizational Performance and Change (1992), (Appendix A). The Burke-Litwin model is used to assess internal and external factors to develop a comprehensive understanding of the needs of an organization surrounding a specific topic. In this case the goal and therefore the outcome of the organizational assessment was to better understand the project organization and how it utilizes cardiac monitoring.

There are several system level factors regarding why the hospital and organization would want to address gaps in care concerning cardiac monitoring. The organization has both mission and vision statements along with a list of core values to describe the goals or purpose of the organization. The mission statement of the organization is to severe together in the spirit of the gospel, to heal the body, mind, and spirit, and to improve the health of the community in which the organization serves (XXXX, 2018).

The core values of the organization include; respect, social justice, compassion, care for the poor and underserved, and excellence (XXXX, 2018). The organization also defines guiding

behaviors that should remain constant while continuing its journey to serve the community.

These building behaviors are to support one another, communicate openly, honestly, and

respectfully, to be fully present, to be accountable, trust and assume goodness in intentions, and

always be continuous leaners (XXXX, 2018). Lastly, the organization has a nursing strategical

direction statement. This statement conveys the goal of developing a dynamic culture, through

shared leadership and evidence-based practice, that empowers nurses to deliver the best patient-

centered care possible (XXXX, 2018).

In order to better understand the organization from a unit perspective (micro), one month

of data, which was collected by the hospital statistician in 2018, was available for review

regarding CM and was analyzed to determine a current state of practice. This data was obtained

by a statistician within the organization who is assigned specifically to the project unit.

Additionally, a one-day snapshot chart audit was completed to help further analyze CM ordering

practices. The variables included for both data sets were age of the patient, admitting diagnosis,

date/time when CM order was placed, indication for CM, date/time of CM discontinuation order,

and duration time monitored. A Microsoft Excel report sheet was generated by extracting this

information from electronic health records (EHR) and charting system. All data was de-

identified by the hospital statistician.

The collected data was used to determine the following gaps in care: 1) Patients are being

placed on CM without appropriate orders from providers. 2) Providers are failing to select

appropriate indications for CM or select inappropriate indications for CM. 3) Patients placed on

CM are monitored for periods of time that exceed the evidence-based AHA guideline

recommendations. 4) Lastly, patients admitted through the emergency department (ED) are

placed on CM without orders to continue cardiac monitoring once admitted to the inpatient unit.

Further review of the CM data that was collected helped to identify several other issues. Over the duration of the data collection period there were 157 patients with CM orders, but only 23 of the 157 CM orders were discontinued prior to discharge. Therefore, cardiac monitoring orders are not being reassessed to determine if the intervention is appropriate. Rather, patients continue to be monitored until the time of discharge. On average, patients were placed on cardiac monitoring for 62 hours. According to AHA guidelines, many of the recommendations for cardiac monitor no longer apply once a patient has been hospitalized, monitored, and had no complications for 48 hours (Sandau et al., 2017).

Nursing documentation-identified that nurse-to-provider communication played a role in identifying patients who no longer required CM. According to the documentation nursing staff had communicated with a provider to obtain orders to discontinue CM on 16 of the 23 patients who had CM discontinued prior to discharge. It could be suggested that communication plays a large role in discontinue monitoring orders considering approximately 70% of the monitor discontinuation orders were a result of nurse-to-provider communication.

The organizational assessment confirmed that there are several concerning practice habits surrounding the use of cardiac monitoring. The information provides an understanding that much of the time, providers and healthcare staff utilize cardiac monitoring appropriately. However, it is ultimately clear that gaps in cardiac monitoring care do exist within the hospital, leading to the question of: Does the implementation of a clinical decision toolkit incorporating evidence-based American Heart Association guidelines, improve appropriate use of cardiac monitoring in this acute care setting?

Stakeholders

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A stakeholder is an individual or a group of individuals that are involved in or effected by a change process (AHRQ, 2014). Key stakeholders for appropriate use of CM include patients, healthcare providers (physicians, nurse practitioners, physician assistants), registered nurses (RNs), organizational leadership (managers, supervisors, directors), supporting staff (patient care assistants and technicians), and clinical nurse specialties (clinical nurse specialist and clinical nurse leaders).

Healthcare providers are responsible for ordering the use of CM. Providers rely on clinical expertise, practice guidelines, and previous education to determine the indication for use, duration of CM, and overall care for a patient. Registered nurses and supportive staff work on the unit and provide hands-on care for patients. Healthcare staff is responsible for cardiac rhythm review, assessment of the patient's condition, upkeep of CM related equipment, and continued communication with providers and other members of the hospital staff involved in patient care.

Organizational leadership and clinical nurse specialists assist in appropriateness of care delivery and identifying needs for change on the unit and throughout the entire hospital. Additionally, organizational leaders are responsible for ensuring best practice standards, improving patient outcomes, and appropriate utilization of organizational resources. Lastly, patients must be included as key stakeholders. Patients entrust the organization with their well-being and in return are responsible for fees regarding services rendered. Patients also play a large role in how healthcare organizations are perceived. Patients provider both positive and negative feedback surrounding care received during a hospitalization.

SWOT

Strengths, weaknesses, opportunities, and threats or SWOT analysis is a tool that is used to identify an organization's internal strengths and weaknesses as well as external opportunities

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and threats (Morrison, 2017). This type of analysis can be used to gain insight on current state

problems or potential problems within the organization. Information regarding identified

problems is then translated into conversation on how an organization can strategically plan for or

resolve these problems (Morrison, 2017). The SWOT analysis of the organization as it relates to

cardiac monitoring is available in Appendix B.

Strengths identified within the organization regarding CM involves the unit staff's

knowledge and expertise of the topic. Each RN, as well as supportive staff have been

appropriately trained to care for patients requiring CM. The project pilot study will take place on

one of the two non-ICUs that is specifically designated for patients requiring bedside CM. The

organization is also a teaching hospital, creating a welcoming environment for learning and

evidence-based practice change. Each unit within the hospital is equipped with a CNS and CNL.

These individuals are experts in quality and process change as well as implementation and

facilitation of evidence-based projects. The CNS and CNL for this cardiac based unit are

valuable resources and available daily to the DNP student. Lastly, staff is very accepting of

change. Unit staff members who were interviewed during the organizational assessment provided

a positive outlook on the willingness to engage in a DNP project. There is a unit-based council

(UBC) that meets monthly. This committee will be helpful for the development, implementation,

facilitation, and sustainability of best practice findings from the pilot study throughout the

organization.

Several weaknesses were identified during the assessment. This cardiac unit is an "open"

unit. Open units within the hospital share staff members amongst one another based on census

and need. Staff from other units may lack experience or education concerning CM. Additionally,

borrowed staff may lack awareness of unit specific projects such as decreasing inappropriate use

of CM. Weaknesses also exist within the organizational cardiac monitoring practice guidelines. Currently, there is no procedure in place for the continued evaluation of cardiac monitor appropriateness. Nursing staff has been asked to check that patients on cardiac monitors have active orders for monitoring. However, that does not address if monitoring is still appropriate for the patient. As a result, no group of staff members has taken the responsibility and/or accountability to strive for appropriateness of this service. Additionally, there are no continuing educational requirements for cardiac monitoring outside of continued basic life support certifications. Lastly, variability in the use of cardiac monitoring exists amongst the providers. Physicians, NPs, and physician assistants (PAs) designated to care for patients on this unit come from three different practices. These practices are the hospitalists group, internal medicine, and family medicine. Several physicians are required to mentor resident providers during their clinical rotations. Each mentoring physician provides varying educational opportunities. While these educational opportunities are necessary for the development of student residents, they do create a variance in what each resident is taught as well as how it is taught. Naturally, this can lead to a wide range of ordering practices concerning cardiac monitoring.

An opportunity to create an evidence-based practice change regarding appropriate use of CM exists within the organization. The organization had previously began developing a process for assessing appropriateness of cardiac monitoring for those admitted as observational or inpatient status that was not completed. The topic has already been discussed amongst leaders and perceived as an area where the organization could improve. As a result, the organization is very open to a pilot-study that would help identify interventions for improving appropriate use of CM, which could then be used throughout the entire organization.

Threats are anything within or outside of the project environment that can have or have the potential to disrupt change. For change to be successful it must be engaging to those involved. If staff is not receptive of change or an environment for change is not created effectively, the process may fail. Implementing a process change where staff can immediately see how that change is beneficial to the work they do on a daily basis will be a very important part of this project. Additionally, poor stewardship of resources threatens the organization. Wasted resources spent on inappropriately monitoring cardiac patients adds to staff workload and healthcare costs.

Clinical Practice Question

Accordingly, an evidence-based pilot study to answer the following clinical question is proposed: Does the implementation of a clinical decision toolkit incorporating evidence-based American Heart Association guidelines, improve appropriate use of cardiac monitoring in this acute care setting?

<div align="center">Summary of Pertinent Literature</div>

A comprehensive review of current literature regarding CM was conducted. The goal of this review was to report possible evidence-based interventions that could be utilized to improve CM appropriateness in a non-ICU, acute care setting. The American Heart Association (AHA) has developed evidence-based guidelines for cardiac monitoring that can be found in Appendix D (Sandau et al., 2017). For this literature review, it was beneficial to assess and determine which evidence-based practice complements the use of the guidelines. The following questions guided the literature review:

- What are the expected roles of providers and registered nurses regarding cardiac monitoring?

- Does collaborative nurse-physician communication improve appropriateness of cardiac monitoring?

- Does the discontinuation of cardiac monitoring using evidence-based guidelines lead to an increase in adverse events for patient populations?

- Does a procedure for reducing inappropriate cardiac monitoring effect the cost of care for patients and an organization?

- Does a procedure for reducing inappropriate cardiac monitoring affect the amount of time healthcare staff spend managing monitor related tasks?

Method

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline was used as the framework to help guide the literature review (Moher, Linerati, Tetzlaff, Altman, & PRISMA Group, 2009; Appendix C). The search yielded 43 studies; duplicate results were excluded. Each study was screened using inclusion and exclusion criteria per PRISMA criteria (Moher et al., 2009). The primary intervention included in the reviewed literature are the current practice standards for cardiac monitoring that were developed by the American College of Cardiology (ACC) foundation and American Heart Association (AHA) Task Force (Sandau et al., 2017). The updated 2017 guidelines were adapted from the pre-existing 2004 practice standards. These guidelines and be found and reviewed in Appendix D. The AHA and ACC note that some interventions have become firmly established just based on common practice, without significant amounts of evidence to support the interventions (Sandau et al., 2017). As a result, finding high-level studies (randomized control trials and meta-analyses) to support interventions aimed at reducing inappropriate CM was difficult.

In total, four studies met inclusion criteria for the literature review. These studies are included in Appendix E. Each study involved the use of the American Heart Association cardiac monitoring guidelines in non-intensive care unit settings. Additionally, each study used pre- and post-intervention data collection methods. The most common types of intervention for improving cardiac monitoring appropriateness were alteration in electronic ordering systems (EOS), improved communication amongst hospital staff, and education on current AHA practice guidelines. It is important to note that no study reported the occurrence of adverse events during research that related to changes in cardiac monitoring practices.

Several outcome measures were used throughout each study. Cardiac monitoring appropriateness was measured by the reduction of orders placed for inappropriate indications. AHA monitoring guidelines were used to determine appropriateness of monitoring orders. The AHA separates patient populations in to defined classes; I, IIa, IIb, and III. These classes are separated by expert recommendations as well as levels of evidence supporting each classification. Class of recommendation (COR), is defined by the benefit of an intervention versus the risk of no intervention (AHA, 2017).

Dressler (2014) reported a 70% reduction in telemetry utilization without adversely affecting patient safety by using a revised telemetry order set in an electronic ordering system (EOS) (Dressler et al., 2014). The number of inappropriate telemetry orders weekly was reduced from 1032.3 to 593.2 (p <0.001) (Dressler et al., 2014). The duration of time patients spent on telemetry was reduced from an average of 57.8 hours to 30.9 hours (p <0.001) (Dressler et al., 2014). The average number of patients requiring cardiac monitoring on a daily basis was reduced from 357 to 109.1 (Dressler et al., 2014). Nurse time spent attending to cardiac monitoring was approximately 19.5 minutes per day per nurse. Daily costs of cardiac monitoring were reduced

from $18,971 to $5,772 per day or approximately $4.8 million dollars annually. (Dressler et al., 2014).

Leighton (2013) reported that alterations of an electronic ordering system (EOS) can significantly improve adherence to AHA guidelines for cardiac monitoring. Alterations in the EOS were made to include appropriate indications for CM defined by the AHA. These alterations were then studied to determine their effect on CM appropriateness. Additionally, providers were asked to complete an online education session that reviewed current AHA guidelines and appropriate CM practices. Of the 156 patients studied, 65% of patients placed on telemetry met appropriate monitoring guidelines prior to the intervention (Leighton et al., 2013). Post-intervention, 81% of patients (p <0.001) met appropriate monitoring guidelines from the time monitoring was initiated up to 48 hours of use (Leighton et al., 2013).

That data provided suggests that patients often meet criteria and in fact are monitored appropriately up to the 48-hours after being placed on cardiac monitoring. However, when incorporating the AHA guidelines into practice it is important to note that many patient populations defined by these guidelines no longer require monitoring after 48-hours. It would be appropriate to conclude that an intervention to reassess the need for CM at 48-hours could improve appropriateness of cardiac monitoring (Leighton et al., 2013).

Ramkumar (2017) conducted a three-phase study at a metropolitan area hospital. Phase I and II assessed telemetry use over a six-month period. The first three months of the study was spent collecting baseline data based on patient demographics, cardiac risk factors, telemetry data (order data), and patient outcomes (Ramkumar et al., 2017). The researchers collected an additional three months of baseline data to ensure that the original data collected could be duplicated without any major outlying results (Ramkumar et al., 2017). Patients were then

categorized according to AHA guidelines (Classes I, IIa, IIb, and III) to determine if telemetry was appropriate for each patient.

Education on AHA guidelines for cardiac monitoring, appropriate indications for CM, and standardized CM rounding was provided to all admitting medical physicians. Post-intervention data was collected daily over a three-month period (Ramkumar et al., 2017). Cardiac monitoring for patients with AHA class III indications (telemetry not indicated) decreased from 38% to 11% (p < 0.01). There were minimal changes noted for patients with class I indications, 18% to 14% (p = 0.43). Additionally, the study yielded an increase in appropriate utilization of CM for class II patients, as well as determining the need for monitoring, 71% vs 49% (p = 0.008). Phase II (intervention phase) showed a reduction in median telemetry duration from 2.4 days to 1.8 days, (p = 0.047) when compared to phase I (Ramkumar et al., 2017). The study authors deemed that a greater than 12-hour reduction in median telemetry duration was a significant result (Ramkumar et al., 2017).

The last study implemented an educational module defining appropriate telemetry use using AHA guidelines. Baseline data was collected pre-intervention over three months. Post-intervention data was also collected over three months. An additional three-month extension period was added to the study to assess sustainability (Svec et al., 2015). The study was conducted at a 444-bed, academic medical center. Outcomes for length of stay (LOS), telemetry associated costs, and knowledge regarding daily telemetry utilization were assessed. Implementation of the interventions were successful at reducing average LOS for patients on telemetry from 2.75 days to 2.13 days (p = 0.005) (Svec et al., 2015). A post-intervention survey determined that hospitalist trainees gained significant improvements in knowledge regarding the most cost-saving actions and the least cost-saving actions regarding telemetry utilization (Svec et

al., 2015). The extension period of the study later determined that education, as an intervention, was sustainable revealing the average LOS had decreased to 1.93 days (Svec et al., 2015). These results support the sustainability of telemetry-based interventions. Due to adding an additional data collection period the authors were able to present sound evidence that an educational intervention incorporating AHA guidelines can be successful when attempting to sustain a practice change.

Limitations

Limited literature exists regarding appropriateness of cardiac monitoring within a non-ICU, acute care, hospital setting. Many of the articles were excluded due to inappropriate patient population or because the research took place outside of an acute care setting. Additionally, there were several studies that had to be excluded that took place in acute care setting but were conducted in an emergency department (ED) or ICU. Limited data was available regarding interventions that did not involve modifying electronic ordering systems. It is noted in an article by Najafi (2014) that little to no randomized trial studies have been conducted evaluating telemetry appropriateness. Most studies up to this point in time have been purely observational (Najafi, 2014).

Findings from this review suggest that three different interventions can be utilized to improve appropriate use of cardiac monitoring without negatively affecting adult patients ages 18 or older who are admitted to an inpatient, acute care hospital, which include: 1.) Implementation of AHA guidelines as an evidence-based intervention for improvement of CM appropriateness, 2) education regarding AHA guidelines and CM appropriateness for hospital staff, specifically ordering providers and nurses, and 3) improved communication between providers and nursing staff. All four studies concluded that the use of AHA CM

guidelines in practice and education regarding those guidelines for ordering providers and

nursing staff can significantly decreases patient time spent on cardiac monitors, the number of

class III patients that are placed on cardiac monitoring, and CM related costs. (Dressler et al.,

2014; Leighton et al., 2013; Ramkumar et al., 2017; Svec et al., 2013).

Model to Examine Phenomenon

The phenomenon for this DNP project is the appropriate use of CM in an acute care

setting. The phenomenon model used to help guide this project is Bernadette Melnyk's five

sequential steps to evidence-based practice (EBP) which can be found in Appendix F (Fineout-

Overholt, Melnyk, & Schultz, 2005). By using Melnyk's model the DNP student will conduct

five essential steps for introducing evidence into practice, improving the likelihood of success

outcomes concerning evidence-based practice change (Fineout-Overholt, Melnyk, & Schultz,

2005). These steps are; 1) asking a clinical question, 2) searching for best evidence, 3) review of

evidence, 4) strength of the evidence, and 5) evaluating outcomes. Steps one through four have

already been completed. The clinical question was based on an in-depth organizational

assessment, which guided the completion of a literature review concerning cardiac monitoring.

The organization and literature review information that was collected provides evidence to

support the need for a cardiac monitoring practice change. The final step will be fulfilled once

the practice change has been implemented, data has been collected and analyzed, and the

outcomes evaluated.

Melynk (2005) also offers insight on several additional strategies that can be used to

accelerate EBP in healthcare settings and in clinical practice (Melynk et al., 2005). Some of these

strategies that pertain specifically to this project include the following. The first strategy is to

have EBP mentors or champions in the healthcare setting (Fineout-Overholt et al., 2005). The

organization and unit where this evidence-based project takes places has two graduate-level

trained nurses, a CNS and CNL. These two individuals are involved in the implementation of

EBP changes throughout the entire organization as well as on the project unit. A second, and

very important, facilitator for EBP change is administrative support (Fineout-Overholt et al.,

2005). The project has full support from the organization's chief medical safety officer as well as

the organization's DNP prepared project head. Several meetings have been held that included the

involvement of these two individuals to help facilitate the project and to make sure the project

fits the needs of the organization. Melnyk's framework helps to guide the exploration of the

project phenomenon by further identifying best approaches for evidence-based practice change

while also offering insight on improving the likelihood of successful implementation of change.

Framework for Project Implementation: PARiHS

The phenomenon of inappropriate and overutilization of cardiac monitoring is best seen

through the promoting Action on Research Implementation in Health Services (PARIHS)

framework (Appendix G) which will be used to guide project implementation for cardiac

monitoring within this acute care setting. Over time and through research, there has been new

recognition that evidence-based change/implementation requires participation not only from

single individuals but from the entire organization (Kitson, et al., 1998; Kitson et al., 2008).

Evidence-based change is an extremely complex process that requires a detailed approach for

success. The use of the PARIHS framework helps to ensure that no important details become

overlooked when implementing change. As a result, there is greater chance for that change to

remain in effect throughout the future.

The PARIHS framework is comprised of three main parts: evidence (E), context (C), and

facilitation (F). These three components help predict successful implementation (SI) of new

ideas (Kitson et al., 1988; Kitson et al., 2008). The framework is described as SI = function (E, C, F). This algorithm describes the functionality of the framework as well as the interrelations between all three key elements of the framework (Kitson et al., 1988; Kitson et al., 2008).

Evidence. Evidence encompasses all sources of knowledge that can be used in a process change. Evidence includes research, clinical expertise, individual knowledge, and individual experience (Kitson et al., 1988; Kitson et al., 2008). It is important to note that patient experiences and preferences are also included as evidence. The primary source of evidence for this project comes from the literature review and organizational assessment. Evidence through research exists supporting evidence-based implementation of the AHA guidelines in practice to improve appropriate use of CM (Dressler et al., 2014; Leighton et al., 2013; Ramkumar et al., 2017; Svec et al., 2013). The literature review provided evidence that increased communication amongst providers and nursing staff has a positive correlation with improved CM appropriateness (Dressler et al., 2014; Leighton et al., 2013; Ramkumar et al., 2017; Svec et al., 2013). Unfortunately, much of the literature that is available concerning this topic is not considered to be high-level evidence, lacking RCT's and MA's which rank at the top of the evidence hierarchy (Burns, Rohrich, & Chung, 2012).

Evidence for a change in practice also exists within the organization, as evident by completion of an organizational assessment. Through the organizational assessment the need to implement CM guidelines for improving appropriate of CM was identified. The organization had previously identified several issues resulting from overutilization of CM. These issues include but are not limited to: increased healthcare costs, increased staffing needs, and poor stewardship of hospital resources. Lack of high-level evidence in literature can be seen as a barrier and an opportunity. The complex nature and increasing demands of healthcare requires innovation of

new and old problems. Lack of high-level evidence simply encourages research to build upon

previously obtained information and continue to ask how we can continue to improve. The lack

of high-level evidence also leads to the development of the clinical question which will be used

to identify interventions for appropriate use of cardiac monitoring.

Context. Context refers to the environment or setting as well as the culture in which a

proposed change will be implemented (Kitson et al., 1988; Kitson et al., 2008). This part of the

framework presents detail such as the structure, leadership, and cultural aspects within the

organization and that of the individuals who work for the organization (Kitson et al., 1988;

Kitson et al., 2008). Burke-Litwin's (1992) casual model of organizational performance and

change was used to assess the organization's culture and leadership. Patient-centered goals of

care is the greatest concern to the organization. The organization strives for excellence and is

guided by values aimed at meeting the needs of the patients under the care of the organization as

well as the needs of the community. The organization is committed to improving patient care

through evidence-based practice.

Leadership is an important aspect of change. The leadership hierarchy and individual

roles within the pilot project organization are well defined. Those included within the

organization are groomed to work effectively as a team through workplace training and exposure

to previous ideas of change. The unit where the pilot-study will take place is a well-developed

relationship amongst the healthcare employees whom trust one another to work hard and provide

the best patient care possible. This is described in the organizational values, which includes

assuming the best intentions of all employees (XXXX, 2018).

Leaders within the organization and on the unit also help with measurements; another

important factor described within the context of this framework. Measurement involves a system

of checks and balances regarding change. This includes the use of feedback tools, chart and peer audits, and continual conversations regarding evidence-based practice changes taking place within the organization (Kitson et al., 1988; Kitson et al., 2008). Each unit has a manager, CNL, CNS, charge nurse, and unit-based committee whom all play varying roles in practice changes.

Important measurements concerning CM are not currently a part of the everyday practices of the organization. Some of these measures include but are not limited to: reassessment of need for active CM orders, using appropriate indications for continued use of CM, and accountability for ensuring appropriate use. In order to successfully implement and sustain a practice change on the selected unit, these topics will need to be addressed. This pilot study unit will be used to help determine what CM measurements and clinical resources are important for success and sustainability of the practice change that will be implemented throughout the entire organization.

Facilitation. Facilitation or the way a process is facilitated is used to improve the likelihood of success of a process. Anything that can be utilized or applied to make change easier for all individuals involved can be considered under this framework feature (Kitson et al., 1988; Kitson et al., 2008). Facilitators are individuals or teams who work with individuals and other teams to enhance the process of implementation (Kiston et al., 1988; Kiston et al., 2008). In the case of this pilot study, the project facilitators are the CNL, CNS, unit nursing staff, the DNP student, and medical providers who provide care to patients, specifically on the project unit. Support for process changes is high amongst the staff on the project unit and within the organization. Staff working on the pilot project unit can visualize the practice changes direct effect on daily workflow almost immediately. If the practice change is viewed as beneficial to

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staff and yields beneficial outcomes, the more likely the project is to succeed (Kitson et al.,

1988; Kitson et al., 2008).

Ethical Considerations

The project organization and graduate school utilizes an Institutional Review Board (IRB) to

help ensure ethical and regulatory oversight of research that involves human subjects (NIH,

2018). An application for review and approval or exemption of this project will be submitted to

the XXXX Institutional Review Board. Beyond further planning, no project activities will

commence until the review is completed and Board approval or exemption is granted. The

purpose and scope of this project are limited to evidence-based practice improvement or quality

improvement. No patient identifiable inform will be collected. No physical, social,

psychological, legal, or economic threats to patients are associated with this project. As such, it

is anticipated that the impact of the project will pose minimal or no risk to participants. These

may include the inconvenience or impacts associated with the request of anonymous and

voluntary participants in the project. All members of the team have completed human subjects

protection training via the Collaborative Institute Training Initiative and their interactions with

patients will be guided accordingly.

All data collected during the completion of the DNP project will be de-identified to meet

healthcare privacy standards. The organization utilizes research electronic data capture or

REDCap as a secure, web-based application to store data for research. Data that is collected

during the project will be stored on REDCap. Students conducting projects at the organization

may use designated computers to access REDCap (XXXX, 2018). Access to REDCap will be

granted with a designated username and password. Additionally, the DNP student has completed

ethics training as a requirement by GVSU. The ethics training, known as Epigeum, is an online trainer that uses interactive activities and video to teach students the importance of responsible learning, professionalism, and proper research.

Project Plan

Purpose of Project

The purpose of this DNP project is to implement an evidence-based change initiative to guide appropriate cardiac monitoring, based on American Heart Association guidelines, which can eventually be implemented throughout the entire organization. The project will aim to answer the clinical question: Does the implementation of a clinical decision toolkit incorporating evidence-based American Heart Association guidelines, improve appropriate use of cardiac monitoring in this acute care setting?

Objectives and Implementation Strategies

Objectives for this DNP project will be focused on promoting appropriate use of CM and associated resources. The promoting Action on Research Implementation in Health Services (PARIHS) evidence-based implementation framework will guide implementation of the project with the following objectives:

1. Gain institutional review board (IRB) approval prior to implementing scholarly project after proposal defense.

   - Work with organization IRB representatives and project team to submit finalized IRB application.

2. Develop and obtain approval for cardiac monitoring clinical practice toolkit by February 2019.

- A toolkit based on evidence-based guidelines will be developed and include: AHA

  guidelines, diagnoses requiring CM, criteria for monitor continuance and discontinuation,

  rationale for monitor discontinuation, and any additional elements the organization feels

  necessary to incorporate into the toolkit. Additional elements will be discussed with

  project advisor Amy Kyes prior to the adoption of the toolkit on January 21st. Alterations

  to the toolkit will again be reviewed by the project team prior to finalization.

- Adapt existing toolkit found in literature to fit the needs of the organization. John

  Hopkins Hospital previously developed a cardiac monitoring discontinuation protocol

  that uses the recommended AHA guidelines to facilitate appropriate CM utilization. With

  the approval of John Hopkins as well as the organization, this toolkit will be adapted to

  fit the needs of the project organization.

- Toolkit approval by organizational mentor Amy Kyes.

3. Two-week chart audit to begin after completion of proposal defense and IRB determination

   for pre-intervention baseline data surrounding cardiac monitoring.

   - Pre-intervention data collection will be conducted on a pilot inpatient unit with maximum

     cardiac monitoring capacity of all 33 beds. Patients admitted to this specific hospital unit

     who had cardiac monitoring ordered at any time during the hospitalization will be

     included in the data collection.

   - Data collection will be completed by chart audit and an automated reporting system

     created by the unit assigned statistician employed through the organization. Data

     collection variables include: Admitting diagnoses, date and time of initial cardiac monitor

     order, indication for cardiac monitoring, duration of order, and discontinuation date and

     time. Additional data from the electronic health record will be gathered via chart audit if

necessary. This additional information will be used to determine a provider's rationale for continuing or discontinuing cardiac monitoring.

- The DNP student will review all collected data to determine appropriate and inappropriate CM practices based on AHA guidelines.

- Results of the baseline and ongoing data collection bi-weekly will be made available to staff for RN discussion at shift change huddle on the education board on a bi-weekly basis. This information will be displayed in graph form.

4. Education for providers and RNs on CM clinical practice changes will start upon completion of proposal defense and IRB determination. Educational sessions for RNs will be held regarding the implementation of an evidence-based CM toolkit will help to promote appropriate facilitation of the project and will therefore increase the likelihood of success of the project (Kiston et al., 1988; Kiston et al., 2008). Additionally, a Situation, Background, Assessment, Recommendation (SBAR) form will be made for nursing staff and ordering providers regarding the details of the DNP project.

    - A formal e-mail will be sent to ordering providers outlining the details of the pilot-study after IRB determination has been completed. This e-mail will include the SBAR form explaining the project in synthesized detail.

    - Nursing staff on the project unit will receive additional education regarding the DNP project at a monthly staff meeting via power-point.

    - Ongoing education for staff will occur at shift change huddle and on an individual basis during project hours spent at the organization. Printed handouts of the chosen cardiac monitoring clinical toolkit will be made available in the north-end workroom of the project unit as well as the SBAR form.

- Education will begin during the pre-intervention collection period and continue through the completion of the project as needed.

5. Identify unit-based coalition to aid in the successful implementation of project goals and objectives, February 2019.

- Build relationships with cardiac unit CNS, CNL, charge RNs, and unit-based RNs to identify project champions willing to participate and promote this project.

- Facilitation of project with unit RNs regarding understanding of AHA guidelines and the chosen clinical decision toolkit at: Shift change huddle, being present on the unit on a regular basis regarding the project, unit-based committee meetings, and staff meetings if possible.

- Meet with project site advisor Amy Kyes, CNS on a weekly basis during data collection periods to review data results and discuss continued facilitation of the project.

- Present previously gathered CM data to medical providers at monthly Hospitalists meeting. This is a multidisciplinary project that seeks support from all staff caring for patients on the cardiovascular unit. Continued partnership along with the support and ideas provided by medical providers will help influence change. It is also important that providers be aware a quality improvement project is taking place on the unit.

6.) Implement practice change for six weeks after completion of prior project plan steps. Data will be collected on a weekly basis over the six-week time period. The project unit has a maximum capacity of 33 patients as well as the ability to have all 33 of those patients on cardiac monitoring at any given time. This should allow the project team to collect a minimum of 10 patient data points per collection day, allowing for statistical significance when analyzing the data.

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- Data variables/collection methods can be found in Appendix I.

- Data will include admitting diagnosis, admission date/time, indication for cardiac monitoring, and duration of cardiac monitoring order. For patients who were previously on cardiac monitoring while admitted to the pilot study unit, discontinuation date/time of monitoring order will be obtained as well as the indication for discontinuation if available. Patients will be identified in numerical order. All patient identifiers include name and medical record number will be removed when generating the report sheet.

- Data analysis will be completed to determine appropriateness of monitoring, AHA classification, duration of monitoring order, and examination of indications for monitoring as outlined by the clinical toolkit. The AHA cardiac monitoring guidelines will be used to interpret the data.

- Run-chart analysis of the data points will be made available on a bi-weekly basis as well as at the end of the data collection periods to show the significance of change during the project implementation period. Run-chart data can also be used to identify sustainability of the project in the future.

- Continued communication with unit staff to promote evidence-based change and obtain feedback regarding the project. If a patient is found to be on CM inappropriately during an audit period, the facilitator will communicate with the RN caring for that patient to facilitate discontinuation of unneeded orders.

- Provide practice change results to staff to continue to help facilitate change. This allows staff to better understand how the additional work being done effects daily workflow and utilization of unit resources.

7.) Complete "next step" planning for the project organization with recommendations and plan

for other cardiac units to adopt the clinical practice toolkit at a systems level.

- Meet with clinical nurse specialists and clinical nurse leaders on other units to discuss

  building of nursing staff coalition to implement and guide the practice change on each

  non-intensive care unit that utilizes cardiac monitoring. This will be completed once the

  data from the pilot-study has all been collected, interpreted, and made presentable to

  other units within the hospital.

- Make changes to the clinical toolkit, if required, to fit the needs of each individual unit

  and the organization.

- Address any barriers/limitations that were noted during the pre- and post-intervention

  data collection periods.

8.) Complete final report on project including goals and objective outcomes related to answering

the posed clinical question, to be completed by April, 2019.

- Project results will be shared with the unit manager and then presented in April-May staff

  meeting. This meeting will allow RNs to see the results of their daily efforts to create

  change in the workplace (Kitson et al., 2008).

- Project presentation/defense at Kirkhof College of Nurse (KCON) as well as other

  potential professional organizations and/or publications will take place in April or May of

  2019.

Type of Project

This DNP project is an evidence-based practice change. Evidence based practice (EBP) is

problem solving approach, in this case, to a clinical practice issue (Melynk & Fineout-Overholt,

2014). Evidence-based practice allows for an individual(s) to formulate a clinical question as

well as use a systematic approach for answering that clinical question. Answering the clinical

question allows for high quality evidence to be applied to everyday practice to help support and

sustain high levels of quality in care.

Participants

The participants in this DNP project will include all adult patients (18 years or older) who

were placed on cardiac monitoring while admitted to the inpatient project unit. Registered nurses

and ordering providers will be encouraged to utilize the clinical decision toolkit to facilitate

appropriate use of cardiac monitoring. Any patient that was placed on cardiac monitoring once

admitted to the inpatient unit, even if the order has been discontinued prior to the data collection

day, will be included in the pilot-study.

Data Collection Management and Procedures

Data collected during this project will be de-identified to protect patient and organization

privacy rights. Data will not be stored, shared, or saved on a thumb drive, in personal storage

devices, or any publicly accessible database. Data collection will be done using an excel

spreadsheet. The collected data will then be stored on a password protected drive and folder that

will be provided by project site advisor Amy Kyes. REDCap data management system will be

used to store surveys and data entry forms.

The following data points to be collected throughout this project can also be found in the

data collection table in Appendix I. Data variables and data collection methods include: 1)

Patient diagnoses and monitoring reason or indication will be exported to an excel spreadsheet

by the statistician assigned to the project unit by the organization. These variables will be used to

classify patients into the three defined AHA classes I, IIa-IIb, and III. Once patients have been

placed in a specific class, the data will be used to determine whether cardiac monitoring is appropriate for the patient or if further information is needed to determine appropriateness. Appropriateness of CM is determined by the diagnosis, duration of monitoring, and indication for monitoring. If all three criteria meet within the set AHA guidelines than CM is appropriate for that patient and 2) in order to determine the duration of time patients are continuously monitored, ordering dates and times must also be collected. Collection of these variables for both initiation and discontinuation of CM orders determines the total duration of time a patient is monitored. Additionally, the duration of a CM order determines if a patient has exceeded the amount of time one would expect the patient to require monitoring as defined by the AHA guidelines. This information will be exported from the EHR to an excel spread sheet by the organization statistician.

The last two data variables to be collected are regarding communication and potential need of additional information from the electronic health record. The EHR in use by this organization is called Cerner. Within the charting system of Cerner, there is an area where RN staff can document communication with a provider. Using the date and time that a CM order has been discontinued it can be determined if the RN was in communication with the provider regarding CM to answer a yes or no question: Did communication between the RN and ordering provider lead to the discontinuation of the CM order? Lastly, it may be necessary, in some cases, to understand why a patient has CM continued outside of evidence-based recommendations. To obtain this information, it may be necessary to review patient progress notes. Reviewing provider written progress notes can assist with understanding why a provider has felt it necessary to leave a patient on CM. This information will be stored as "other reasons for cardiac monitoring" in the data collection table.

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Data collection will take place both pre- and post- intervention. Pre-intervention data will be used to establish a baseline to compare post-intervention data. Pre-intervention data collection will take place over two weeks. Post-intervention data collection will take place over six weeks. This period was determined to allow for a minimum number of at least 30 patients to be reviewed to ensure adequate statistical power for identifying significant change. Pre-intervention and post-intervention data will be compared to one another once the data collection period has ended. Throughout the six-week post-intervention data collection period the DNP student will post a biweekly dashboard as a progress report. The dashboard will display: 1) The number of cardiac monitoring orders during that time period and 2) the number of inappropriate/incorrect cardiac monitoring orders. 3) The average duration of time a patient is monitored. This information will be used to facilitate the implementation of the project by allowing unit staff to visualize improvements in cardiac monitoring practices throughout the duration of the project. An analysis of variance or ANOVA test will be used to determine the significance of the data with the independent variable as the intervention. Calculations for change of mean regarding the number of inappropriate cardiac monitoring orders and duration of cardiac monitoring orders will also be completed along with a run-chart analysis.

Budget

An outline of the budget for this DNP project can be found in the appendices (see Appendix H). Most of the expenses for this DNP project will be as a kind donation of time by the DNP student. The DNP student will donate time creating educational pieces for RN staff and providers as well as research and creating the clinical practice toolkit. These educational pieces include project introduction e-mails, educational fliers, SBAR form, and meetings RNs. Additionally, the DNP student will spend approximately 8-10 hours per week at the project site

during the pilot study (7 weeks total). The DNP student is an RN with 9 years' experience in emergency department, medical-surgical, intensive care, and progressive care Bachelor of Science in nursing (BSN) level work. Michigan, state funded organizations, determined that the estimated 2017-2018 nurse hourly wage is approximately $30.82 (salary.com, 2017a). The total donated cost by the DNP student is approximately $2,219.00. This does not include time spent on research and scholarly writing required for completion of the DNP project.

Additional resources that can be included in the project budget are time invested by other members of the project team as well as the staff on the project unit. A GVSU staff member who is a DNP prepared nurse will be consulted regularly to ensure the DNP project is compliant with both GVSU standards and organization standards. The average hourly wage of a DNP prepared RN in the state of Michigan is $49.00/hour (salary.com, 2017b). The organization's statistician will be asked to create data reports during the pre-intervention data collection and bi-weekly during the post-intervention data collection period. The average hourly wage of a statistician in the United States is $37.65 (salary.com, 2018f). With data collection taking place five times during the project it is estimated the statistician will spend approximately five hours retrieving data.

A CNS ($48.00/hour) has been kind enough to take on the role of the project advisor for the organization where the project is taking place (salary.com, 2017c). Her expertise in scholarly projects as well as her knowledge of organizational requirements and standards are and will be frequently used in the implementation of the DNP project. The organization also has a dedicated RN ($34.00/hr) to help review scholarly projects and prepare them for IRB approval (salary.com, 2017a). Continued communication with this individual will help assist a successful and timey IRB application and determination. She will also spend an undetermined amount of time

reviewing the projects IRB application for editing purposes. Education of providers (medical

doctors, NPs, and PAs) will take place via e-mail and through SBAR form communication.

Providers hourly salary ranges from $49.00/hr for the NPs and PAs to $104.00/hr for medical

doctors (salary.com, 2017d; salary.com 2017e).

Nursing staff will also be educated via e-mail, during shift change huddle, and during

times the DNP student is present on the unit. Most individuals will receive education during their

normal schedule shifts or meetings. Additional costs for the project may also include printed

education materials. One ream of 500 count printer paper has an estimated cost of $9.00. For an

appropriate approximation of the project budget, it will be assumed that RN and providers spend

approximately 10 hours total reviewing the educational material provided. The scheduled work

hours, estimated time spent, and miscellaneous project costs are all provided in appendix H.

Return on investment (ROI) will be calculated during the final analysis of the project and

provided in the final report. The ROI from the project outcomes will be used to assist adaptation

of the cardiac monitoring intervention throughout the hospital.

Implications for Practice

Individual hospital units as well as organizations strive to reduce costs/spending, be good

stewards of resources, and provide the highest quality of care to patients as possible. Cardiac

monitoring is a tool that is used daily by healthcare organizations all around the United States yet

very little research exists exploring how it is best utilized. For this reason, it is important to

conduct a pilot-study concerning cardiac monitoring to better understand best unit level practices

for implementation of a clinical toolkit as well as recommendation on how to adopt the toolkit

throughout other organizational units. Completing this DNP project will help contribute to

evidence-based research that can be used to define appropriate cardiac monitoring use and best

practice tailored to the organization. Completion of this DNP project will also provide evidence

for interventions that can be used to facilitate appropriate CM for the organization.

Sustainability

The practice change will remain in use on the unit after the completion of the project. The

outcomes of the project will be presented to the DNP project team as well as to the organization.

The identified unit-based coalition who aided in the successful implementation of the projects

goals and objectives will continue to uphold the practice change on the unit. Sustainability of this

DNP project will require the cooperation of the pilot-study unit staff as well as other units within

the organization wishing to adapt this practice change. Stakeholder support from the CNS and

CNL on the pilot-study unit already existed prior to the beginning of the DNP project.

Stakeholder support from other inpatient units within the organization will need to occur to

facilitate CM practice change throughout the organization. Sustainability of this DNP project can

be done by: 1) Presenting the final outcomes of the project to other units within the organization

so they may see the significance of the practice change. An ROI will assist in the determination

of the cost benefit for the practice change 2) Outlining the steps that are required by each unit to

build a practice change coalition team to help implement and facilitate change on each unit 3)

Working with the organizational stakeholders to adjust the CM toolkit and goals/outcomes of the

project to meet both the individual needs of each unit as well as the needs of the organization.

Plan for Dissemination

Completion and dissemination of the implementation of a cardiac monitoring clinical

practice toolkit will occur first within the organizational stakeholders and project team. The DNP

student will then create a presentation with the goal of sharing the results of the study. The DNP

student will defend the project to the project team members. Finally, the DNP student will

publish the findings of the study, with the help of the project team, to Scholar Works. The

organization where the study took place may continue to adapt the previously completed work to

fit the needs of the entire organization.

Conclusion

The research that is available and discussed in the literature review highlights the need

for continued research on this topic to better understand the needs of patient populations

requiring cardiac monitoring (Dressler et al., 2014; Leighton et al., 2013; Ramkumar et al., 2017;

Svec et al., 2013). Additionally, overuse of cardiac monitoring is costly to patients as well as

healthcare organizations and time consuming to healthcare staff. This project proposal aims to

answer the following clinical question: Does the implementation of a clinical decision toolkit

incorporating evidence-based American Heart Association guidelines, improve appropriate use

of cardiac monitoring in this acute care setting? Pre-intervention and post-intervention data will

collection will be utilize to answer the stated clinical question and be utilized to build support for

evidence-based cardiac monitoring practice.

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Appendix A

The Burke-Litwin Model of Organizational Performance and Change
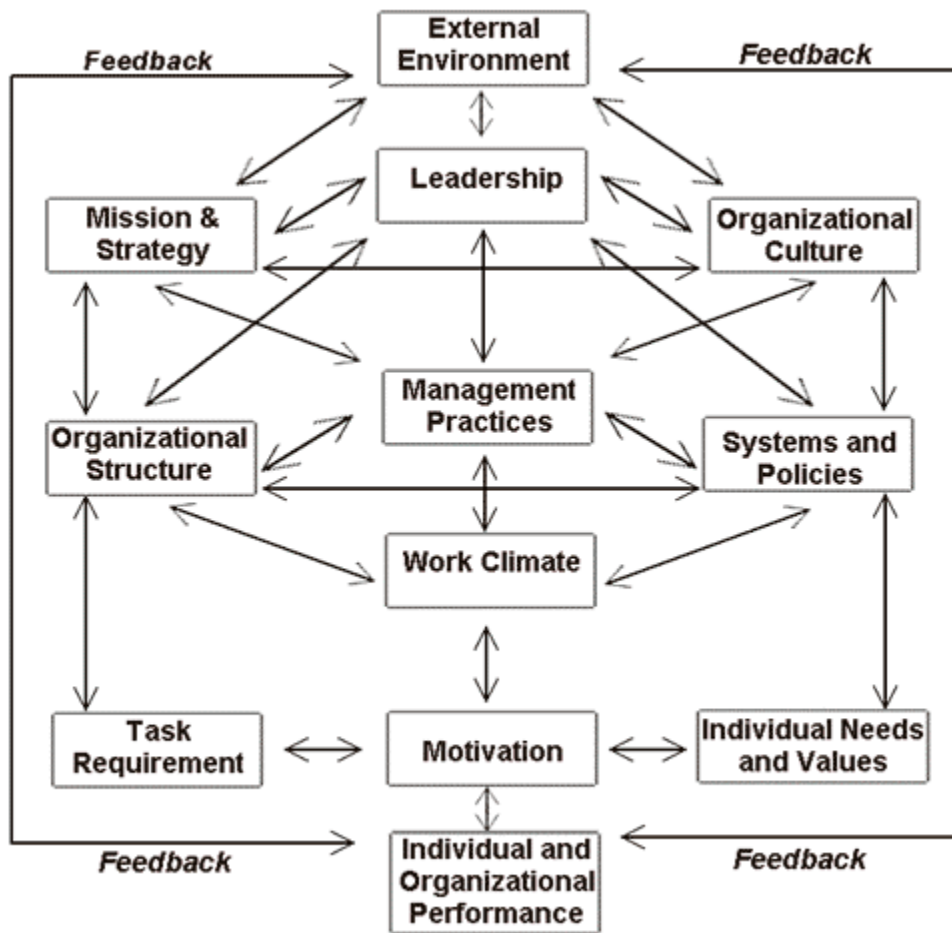
Figure 1. A model of organizational performance and change. Reprinted from "A Causal Model

of Organizational Performance and Change, "by W. W. Burke and G. H. Litwin, 1992, *Journal*

of Management, 18, 528. Copyright 1992 by Southern Management Association.

Appendix B

SWOT Analysis of Cardiac Unit

Strengths	Weaknesses
- Cardiac monitor unit. Staff who primarily work on this unit receive specialty training. - Teaching based hospital. Adaptable to learning and accepting of change. - Clinical nurse specialist and leaders (CNS/CNL) on each unit. Graduate prepared nurses employed specifically to understand and implement change. - Motivated management and supportive staff with positive attitudes towards change.	- Open unit: frequent float staff from other units who may not knowledgeable to care for patients on cardiac monitoring. - Staff turnover and lack of experience. Many newly graduated nurses. - No current guidelines in place for monitoring appropriateness - No required annual educated for cardiac monitoring - Three different general medicine provider services.
Opportunities	Threats
- Implement a process that follows evidence-based guidelines. - Establish appropriate telemetry use education for staff. - Decrease staff workload regarding cardiac monitoring. - Enhance quality of patient care. - Utilize previously explored organizational information regarding cardiac monitoring. - Decrease costs of care.	- Staff and providers willingness and acceptance of change processes. - Ensuring appropriateness of care for all patient populations who may require cardiac monitoring.

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Appendix C

PRISMA 2009 Flow Diagram

Identification

Records identified through
database searching
(n = 43)

Screening

Records after duplicates removed
(n = 38)

Full-Text Records
screened for eligibility
(n = 38)

Full-text articles assessed
for eligibility
(n = 8)

Records excluded
(n = 30)

Related to inappropriate:

Population (n = 20)

Intervention (n = 13)

Comparison (n = 7)

Eligibility

Included

Studies included in
qualitative synthesis
(n = 4)

Full-text articles excluded,
with reasons
(n = 4)

Population (n = 0)

Intervention (n = 2)

Comparison (n = 1)

Outcomes (n = 2)

Some articles were
excluded for multiple

Flow diagram of search selection process. Adapted from "Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement," by D. Moher, A. Liberati, J. Telzlaff, D. Altman, and PRISMA Group. Copyright 2009 by PLoS Medicine

Appendix D

Recommended Electrocardiographic Monitoring of Hospitalized Adult Patients by Population

CARDIAC MONITORING

Patient Population/Indication	Arrhythmia Monitoring Recommendations	Continuous ST-Segment Ischemia Monitoring Recommendations	QTc*
Major cardiac interventions Continued			
Transcatheter structural interventions		Not indicated unless ischemic origin is suspected; then follow indications and duration per ischemia criteria	
After TAVR, particularly with periprocedural conduction abnormalities	≥3 d after procedure (*Class I; Level of Evidence C*) and after day 3 (*Class IIa; Level of Evidence C*)		
Other transcatheter interventions (eg, VSD, ASD, valvuloplasty)	Duration of monitoring varies with procedure, device, and patient factors (*Class I; Level of Evidence C*)		
Arrhythmias			
VTs; postresuscitation from VT/VF cardiac arrest or hemodynamically unstable VT	Until ICD implanted or underlying problem resolved (*Class I; Level of Evidence C*)	For all arrhythmias, add ST-segment monitoring only if ischemic origin is suspected; then follow indications and duration per ischemia criteria	
Nonsustained VT	*Class IIb; Level of Evidence C*		
Atrial tachyarrhythmias			
New or recurrent AF: monitor until treatment strategy determined	*Class I; Level of Evidence C*		
Hemodynamically unstable or symptomatic AF	*Class I; Level of Evidence C*		
Ongoing rate control management	*Class I; Level of Evidence C*		
Initiation of new antiarrhythmic agent†	See text; QTc monitoring may be indicated for hospitalized patients		*
Chronic AF			
If admitted for reason other than arrhythmia or rate and patient are hemodynamically stable	*Class III: No Benefit; Level of Evidence C*		
If medical condition affects ventricular rate or patient is unstable	*Class IIa; Level of Evidence C*		
Sinus bradycardias			
Symptomatic	*Class I; Level of Evidence C*		
Asymptomatic, significant bradycardia with negative chronotropic medications initiated	*Class IIa; Level of Evidence C*		
Asymptomatic, hemodynamically stable, admitted for other indication	*Class III: No Benefit; Level of Evidence C*		
Atrioventricular block			
Symptomatic second- or third-degree atrioventricular block of any anatomic origin	*Class I; Level of Evidence C*		
Asymptomatic second- or third-degree block caused by distal conduction system disease	*Class I; Level of Evidence C*		
Third-degree atrioventricular block caused by intranodal disease	*Class I; Level of Evidence C*		
Asymptomatic Wenckebach or transient atrioventricular block of vagal origin	*Class III: No Benefit; Level of Evidence C*		
Congenital or genetic arrhythmic syndromes (eg, WPW, Brugada, LQTS)			
Hemodynamically unstable, recurrent syncope, increased arrhythmia susceptibility	Until appropriate therapy is delivered (*Class I; Level of Evidence C*)		
WPW with rapid conduction via accessory pathway during atrial arrhythmia	Until therapy such as antiarrhythmic medication or ablation is delivered (*Class I; Level of Evidence C*)		
Congenital long QT with unstable ventricular arrhythmias or further QT prolongation induced medically or metabolically	Until stable, exacerbating cause reversed, QTc returned to baseline (*Class I; Level of Evidence C*)		*

(*Continued*)

Table 7. Continued

Patient Population/Indication	Arrhythmia Monitoring Recommendations	Continuous ST-Segment Ischemia Monitoring Recommendations	QTc*
Syncope of suspected cardiac origin			
Meeting admission criteria for syncope, cause of syncope suspected to be cardiac	Monitor ≥24 h; until cause and treatment identified; then follow indications and durations per criteria in these practice standards (*Class I; Level of Evidence B*)	Not indicated unless ischemic cause is suspected; then follow indications and duration per ischemia criteria	
After electrophysiology procedures/ablations			
Uncomplicated SVT ablation	Can be discontinued after immediate postprocedure area (*Class IIb; Level of Evidence C*)	For signs and symptoms of ischemia, follow indications and duration per ischemia criteria	
Complex ablation (pulmonary vein isolation) or serious comorbidities (eg, heart failure)	Monitor for 12–24 h (duration of monitoring varies with procedure, vascular access, and patient factors) (*Class I; Level of Evidence C*)		
Atrioventricular nodal ablation after incessant tachycardia and after chronic AF with concomitant pacemaker implantation	Monitor for 12–24 h (*Class I; Level of Evidence C*)		
After pacemaker or ICD implantation procedures			
Transcutaneous pacing pads	Monitor until pacing is no longer necessary and the device is removed or replaced with a permanent device (*Class I; Level of Evidence C*)	*Class III: Harm; Level of Evidence C*	
Standard temporary transvenous pacing wires	Monitor until pacing is no longer necessary and the device is removed or replaced with a permanent device (*Class I; Level of Evidence C*)		
Semipermanent transvenous pacing			
Day 1	*Class IIa; Level of Evidence C*		
After day 1	*Class IIb; Level of Evidence C*		
Permanent pacemaker or ICD			
Pacemaker dependent	For 12–24 h (*Class I; Level of Evidence C*)		
Not pacemaker dependent	For 12–24 h (*Class IIb; Level of Evidence C*)		
Generator change	In immediate postprocedure period (*Class IIb; Level of Evidence C*)		
Preexisting rhythm devices			
ICD shocks, requiring hospital admission	For duration of related hospitalization until precipitating event treated (*Class I; Level of Evidence C*)	*Class III: No Benefit; Level of Evidence C*	
ICD or pacemaker, admission for unrelated indication	*Class III: No Benefit; Level of Evidence C*		
Stable with wearable defibrillator, admission for unrelated indication	*Class III: No Benefit; Level of Evidence C*		
Other cardiac conditions			
Acute decompensated heart failure	Until precipitating event (eg, volume overload; ischemia; anemia; progressive ventricular, respiratory, or renal failure; hypertension; exacerbation of comorbidities; new-onset AF; or infection) is successfully treated (*Class I; Level of Evidence B*)	Only if possible ischemic origin and in the setting of evaluable ST segments (*Class IIb; Level of Evidence C*)	
Infective endocarditis	Until clinically stable (*Class IIa; Level of Evidence C*)	*Class III: No Benefit; Level of Evidence C*	
Noncardiac conditions			
Postconscious sedation	May be of benefit until patients are breathing per baseline and hemodynamically stable; consider that monitoring other than ECG may be more appropriate (eg, oximetry, end-tidal CO_2) (*Class IIb; Level of Evidence C*)	Decision based on preoperative cardiac risk assessment	

(*Continued*)

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Patient Population/Indication	Arrhythmia Monitoring Recommendations	Continuous ST-Segment Ischemia Monitoring Recommendations	QTc*
Noncardiac conditions Continued			
Noncardiac surgery	Not indicated among asymptomatic postoperative patients; postoperative patients with angina equivalent symptoms or rhythm changes should be treated according to chest pain/coronary artery disease standards above (*Class III: No Benefit; Level of Evidence C*)	Only if specific practice standard met (*Class III: No Benefit; Level of Evidence C*)	
Noncardiac major thoracic surgery	After noncardiac major thoracic surgery such as pulmonary resection to identify AF through postoperative day 2–3 and may be helpful until discharge from acute care (*Class IIa; Level of Evidence B*)		
Medical conditions			
Stroke	Monitor 24–48 h (*Class I; Level of Evidence B*) Monitor longer if cryptogenic stroke (to assess for intermittent AF and asymptomatic rapid ventricular response) (*Class IIa; Level of Evidence B*)	ST-segment monitoring should be considered only in patients with acute stroke at increased risk for cardiac events with evaluable ST-segments (24–48 h) (*Class IIb; Level of Evidence C*)	
Moderate to severe imbalance of potassium or magnesium	Until normalization of electrolytes (*Class I; Level of Evidence B*) In less severe electrolyte abnormalities, if 12-lead ECG at time of abnormal laboratory result demonstrates electric abnormalities, consider continuous electrocardiographic monitoring	*Class III: No Benefit; Level of Evidence C*	*
Drug overdose	Monitor until free of the influence of the drug(s) and clinically stable (*Class I; Level of Evidence B*) (see specific recommendations for QTc monitoring in Table 6)	*Class III: No Benefit; Level of Evidence C*	*
Hemodialysis	Efficacy is not well established for most patients receiving chronic hemodialysis unless they have another indication (eg, hyperkalemia, arrhythmia) (*Class IIb; Level of Evidence B*) (see specific recommendations for QTc monitoring in Table 6)	*Class III: No Benefit; Level of Evidence C*	*
DNR/DNI			
When data gained from monitoring would trigger interventions consistent with patient wishes (eg, rate control if symptomatic)	Follow practice standards for related conditions	Follow practice standards for related conditions	
When data will not be acted on and comfort-focused care is the goal	*Class III: Harm; Level of Evidence C*	*Class III: Harm; Level of Evidence C*	

Need for continuous electrocardiographic monitoring should be reevaluated at least every 24 to 48 hours.

Patients in an intensive care unit and immediate postprocedure area (eg, catheterization laboratory) will have continuous electrocardiographic monitoring.

Patients with Class I indications for arrhythmia monitoring who need to be transported off the unit should have continuous electrocardiographic monitoring via a portable monitor–defibrillator/pacemaker with a healthcare provider skilled in use of the equipment and in electrocardiographic interpretation.

For chest pain/coronary artery disease, complications such as cardiogenic shock or recurrent angina or angina-equivalent syndromes require continued arrhythmia monitoring beyond 24 to 48 hours.

For chest pain/coronary artery disease, reapplication of ischemia monitoring should be considered in previously stable patients who experience recurrent signs/symptoms of ischemia.

For continuous ST-segment monitoring, monitor all 12 leads in the setting of a nursing unit with technology, education, and protocols that facilitate reduction of false and nonactionable alarm signals; not appropriate for patients with uninterpretable ECG (ST segments).

ACS indicates acute coronary syndrome; AF, atrial fibrillation; ASD, atrial septal defect; DNR/DNI, do not resuscitate/do not intubate; ICD, implantable cardioverter-defibrillator; LQTS, long-QT syndrome; MI, myocardial infarction; NSTE-ACS, non–ST-segment–elevation acute coronary syndrome; PCI, percutaneous coronary intervention; STEMI, ST-segment–elevation myocardial infarction; SVT, supraventricular tachycardia; TAVR, transcatheter aortic valve replacement; VF, ventricular fibrillation; VSD, ventricular septal defect; VT, ventricular tachycardia; and WPW, Wolff-Parkinson-White.

*QTc monitoring indicated; see comprehensive QTc monitoring recommendations in Table 6.

Sandau, K. E., Funk, M., Auerbach, A. Barsness, G. W. & Wang, P. J. (2017). Update to Practice Standards for Electrocardiographic Monitoring in Hospital Settings: A Scientific Statement from the American Heart Association. doi:https://doi.org/10.1161/CIR. 0000000000000527

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Appendix E

Literature Review

Author (Year) Purpose	Design (N)	Inclusion Criteria	Intervention vs Comparison	Results	Conclusion
Dressler (2014) Increase appropriate use of cardiac telemetry through the integration of AHA guidelines into our electronic ordering system.		Non-ICU patients 18 years or older.	Implementation of revised telemetry order sets to align with AHA guidelines for telemetry indications. Education	*Efficacy:* Number of weekly telemetry orders were reduced from n=1032.3 (SD 32.1) to n=593.2 (SD 21.2). Mean duration from 57.8hrs (SD 2.4 SD) to n=30.9 (0.9) hours. (43% and 47% P< 0.001 Mean daily number of patients monitored decreased 70%, from n=357.5 (SD 20.6) to n=109.1 (SD 4.3). Mean nursing time spent per day on telemetry: n=19.5 minutes (>115 hrs system wide). Daily costs decreased from $18,971 to $5,772	Sustained 70% reduction in telemetry utilization without adversely affecting patient safety using a revised telemetry order set.
Leighton (2013) Investigate the effect of the institution of an electronic ordering system (EOS) on adherence to	n=196	18 or older, non-ICU patients	Electronic ordering system prompt to reassess indication for monitoring. Initial	*Efficacy:* n=196, reduced to 156 after intervention.	Alterations in electronic ordering systems can be used to improve adherence to

guideline-based telemetry use.			telemetry order expires at 48 hours if not assessed. Education	Pre-intervention 65% of patients met guidelines. Post-intervention 81% (P<0.001) met guidelines. At 48 hours, compliance with EOS dropped from 31% to 13% (P<0.001). Adverse Events: None	guideline-based utilization of hospital resources
Ramkumar (2017). Evaluate the outcomes of guideline-based application of cardiac telemetry.	RCT n=200 double-blind 3 phases	18 or older age. Admitted under general medicine with initiation of telemetry within 24 hrs.	Daily telemetry ward rounding admission form based on AHA guidelines Education Improved communication	*Efficacy*: Pre-intervention, n=75 (38%) class III tele indication n = 116 (58%) class II indication n=9 (4%) class I indication Post-intervention Patients placed on telemetry with class III indications for cardiac monitoring reduced from 38% to 11% (P<0.001). *Adverse Events:* Unknown, follow-up data post-discharge not collected.	Dissemination and education of existing guidelines, a telemetry admission form, and daily telemetry ward rounding significantly reduces inappropriate telemetry use.
Svec (2015). Determine effective methods to guide appropriate use		Baseline data: January 2012 – December 2012).	Module on appropriate telemetry usage	*Efficacy:* Reduction in length of stay	Hospital-driven intervention to improve appropriate use of

| | | Intervention data: (Jan. 2013 – August 2013).

Extension data collection period: (Sept. 2014- March 2015).

>18-year-old, adult hospitalized patients admitted and placed on telemetry. | versus no intervention

Education | (LOS) (2.75 vs 2.13 days, P = 0.005).

22.5% total cost reduction for telemetry bed utilization during intervention period.

LOS sustained at 1.93 days during extension period.

Increased knowledge of most cost saving action (P = 002) and least cost-saving action (P= 0.003). | telemetry reduces LOS and cost, and increases knowledge of cost-saving actions. |

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Appendix F

The Evidence Based Practice Process

Evidence-Based Practice Process

1. Ask the burning clinical question.

2. Collect the most relevant and best evidence.

3. Critically appraise and synthesize the evidence.

4. Integrate all evidence with one's clinical expertise, patient preferences and values in making a practice decision or change.

5. Evaluate the practice decision or change.

The Merging of Science and Art: EBP within a Context of Caring Results in the Highest Quality of Patient Care

Context of Caring

Research Evidence & Evidence-based Theories

Clinical Expertise and Evidence from assessment of the patient's history and condition as well as healthcare resources

Clinical Decision-making

Patient Preferences and Values

Quality Patient Outcomes

© Melnyk & Fineout-Overholt, 2003

EBP Conceptual Framework

from http://nursingandhealth.asu.edu/evidence-based-practice/resources/process.htm

Adapted from "Transforming Health Care from the Inside Out: Advancing Evidence-Based Practice in the 21st Century." by Fineout-Overholt, E., Melnyk, B. M., & Schultz, A. Copyright 2005 by Elsevier Inc.

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Appendix G

The PARiHS Model

Adapted from "Enabling the implementation of evidence-based practice: a conceptual framework," by A. Kitson, G. Harvey, and B. McCormack. Copyright 2011 by University of Maryland School of Nursing.

Appendix H

Return on Investment

Initial Cost: Evidence-based Practice Change for Cardiac Monitoring	
Potential Estimated Revenue	
Project Manager Time (in-kind donation) by DNP Student	$2,219.00
Potential RN savings with reduced cardiac monitoring hours (1-year period) (1.875 RN hours saved per day x RN wage x 365)	$20,805.00
Estimated cost savings for cardiac monitoring services (1-year period) (savings on service per day x 365)	$97,528.00
Statistician (in-kind donation)	5hrs x $37.65 ($188.25)
Total Revenue (potential savings and in-kind donations)	**$120,740.25**
Expenses (estimated costs)	
GVSU Project Manager Time (in-kind donation)	$49.00/hr x 10 hours ($490.00)
Organization Project Advisor	$49.00/hr x 10 hours ($490.00)
RN DNP Student (in-kind donation for education)	$34.00/hr x 10 hours ($340.00)
Registered Nurses (extra time spent at shift change huddle)	$30.40/hr x 10 hours ($304.00)
Education for Physicians (extra time spent reading e-mails and during meeting)	$104.00/hr x 10 hours ($1,040.00)
Miscellaneous Materials (educational materials)	$9.00
Clinical Nurse Specialists Consultation	$49.00/hr x 10 hours ($490.00)
Statistician (in-kind donation)	5hrs x $37.65 ($188.25)
Project Manager Time (in-kind donation) by DNP Student	$2,219.00
Total Expenses	$5,570.25
Final Return on Investment	$115,170.00

Appendix I
Data Collection Table

Variable	Measurement	Data Location	Collection Method	Data Collector	Data Collection Time Intervals
Admitting Diagnosis(es)	ICD-10 Diagnosis	Pre/Post data collection excel spreadsheet	Retrieved from EHR, data report (de-identified)	Organization Statistician	Pre- and Post-Intervention (Weekly)
Indication(s) for Cardiac Monitoring	Provider selected indication for patient to be placed on cardiac monitoring. Drop down list or described in order comments	Pre/Post data collection excel spreadsheet	Retrieved from EHR, data report (de-identified)	Organization Statistician	Pre- and Post-Intervention (Weekly)
Cardiac Monitor Order Duration	Date/Time of Initial Cardiac Monitor order, Date/Time of Discontinued Order, Total Duration of Cardiac Monitor Order	Pre/Post data collection excel spreadsheet	Retrieved from EHR, data report (de-identified) Gathered through EHR audit if necessary (de-identified)	Organization Statistician and DNP Student	Pre- and Post-Intervention (Weekly)
EHR Documentation of RN/Provider Communication	Yes/No	Pre/Post data collection excel spreadsheet	EHR Audit (de-identified)	DNP Student	Pre- and Post-Intervention (Weekly)

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Was There Communication Between RN and Provider Prior to Discontinuation of Cardiac Monitor Orders				