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THE PRACTICE OF CARDIAC MONITORING AMONG NURSES WORKING AT CASE HOSPITAL - AN INTERVENTION STUDY

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ABSTRACT

Background
Cardiac monitoring provides important diagnostic information for timely clinical decision making in hospitalized patients. It is within the scope of practice of nurses to place electrodes on patients and to select appropriate leads with which to monitor patients for any dysrhythmias and ST-segment ischemia. Several studies, however, have shown that nurses' practices regarding ST segment monitoring, proper placement of electrodes, lead selection and rhythm interpretation were lacking.

Objectives
The purpose of this study was to assess the practice of cardiac monitoring among ICU and EU nurses working at Case Hospital. It had two specific objectives namely; to assess baseline practice on use of cardiac monitors, and to evaluate whether there was change in practice on use of cardiac monitors after the training (Intervention).

Methods
The study employed a one group pre- and post-intervention quasi experimental design. It was carried out at Case Hospital among 23 nurses working in ICU and EU. The study utilized a skills checklist developed out of the protocol on cardiac monitoring as recommended by the American Association of Critical Care Nurses (AACN) and the American Heart Association.

Results
Before the intervention, the majority of respondents identified a normal sinus rhythm (n = 17, 73.9%). Three participants (13.0%) correctly identified the five anatomical locations of electrodes in a 5-lead system, the conditions that required QTc monitoring, and effective treatment for Torsades de points. Appropriate lead selection and ST segment monitoring were never observed. After the intervention, a McNemar test of correlated proportions revealed a statistically significant improvement in electrode placement (p < .001), and rhythm identification on the cardiac monitor (p < .001).

Conclusions
The study showed an improvement in cardiac monitoring practices and rhythm interpretation. However, it did not improve monitoring behavior related to ST segment monitoring and lead selection on the units.

INTRODUCTION

Cardiac monitoring refers to recording the heart's electrical activity using electrodes placed on the patient's chest. These electrodes detect electrical changes arising from the heart's muscle activity which are reflected on the cardiac monitor. Electrodes can be likened to cameras looking at the heart's electrical activity. Depending on the location of the camera observing the heart, electrical fields as a result of depolarization of the myocardial cells will look different on the ECG. The signal reflected on the cardiac monitor depends on the location of the electrode and its contact with the skin (Alinier *et al.* 2006).

The ECG contains important diagnostic information used to inform clinical decision making for hospitalized patients (Drew *et al.* 2004). Cardiac monitoring of the critically ill provides basic pieces of information including heart rate and any abnormalities, cardiac rhythm and any disturbances and any patterns of ischemia (Fox, Kirkendall & Craney 2010). Several lead systems for ECG monitoring the 3-, 5- and 12- lead systems, all of which are simple, inexpensive and noninvasive, yet provide valuable diagnostic information.

About 90% of all episodes of myocardial ischemia are not realized because they are clinically silent (Drew *et al.* 2004). Using the conventional single 12-lead ECGs which only provide a snapshot of cardiac muscle activity would miss out on most of the ischemic events, hence the need for continuous cardiac monitoring. Critically ill patients require continuous monitoring of dysrhythmia and ST-segment for detection of ischemia because there is more demand for oxygen compared to supply from the stress of the critical illness and hemodynamic instability (Fox, Kirkendall & Craney 2010; Sandau & Smith 2009b; Sandau & Smith 2009a; Sangkachand, Sarosario & Funk 2011).

Globally, cardiac monitoring which started in the 1960's had the initial aim of tracking the heart rate and simple dysrhythmias but more recently has looked

at the complex dysrhythmias (Drew *et al.* 2004). The American Heart Association (AHA) issued practice standards about ECG monitoring based on the following rating system; "**Class I,** patients in whom cardiac monitoring is indicated in most if not all, **Class II,** patients in whom cardiac monitoring may be of benefit but is not considered essential for all and **Class III,** patients in whom cardiac monitoring is not indicated because there is no therapeutic benefit"(Drew *et al.* 2004). In reference to the above standards, the American Association of Critical-Care Nurses (AACN) identified practice alerts with recommendations for preparing the skin, placing electrodes, selecting the appropriate lead, and measuring the QTc interval (Evenson & Farnsworth 2010). In Africa, the use of cardiac monitors has been introduced more recently with reference to the above monitoring standards. Several studies have examined the use of cardiac monitors for example in drug induced prolonged QTc syndromes (Harausz *et al.* 2015), with heart failure (Karaye & Sani 2008), and with cardiac arrest studies (Bonny *et al.* 2014). Among heart failure patients ECG tracings were always abnormal with evidence of abnormalities like ventricular hypertrophy (Karaye & Sani 2008). Harausz *et al.* (2015) highlighted that cardiac monitoring among patients suffering from Tuberculosis (TB) and on TB medication minimizes the potential for cardiotoxicity. Cardiac monitoring companies have to date provided many improvements in the cardiac monitors such as assisting with the diagnosis of dysrhythmias and ischemia. However, nurses, especially those working in critical care settings, play a major role in identifying dysrhythmia among hospitalized patients (Drew & Funk 2006). Attaching a patient to an ECG monitor automatically activates, the computer to detect dysrhythmias; however, the computer is so sensitive that it will trigger an alarm even when it is unnecessary. Nurses therefore have a responsibility to

distinguish the different alarms as either true or false (Drew & Funk 2006). Nurses should also document the beginning and end of the dysrhythmia because it provides diagnostic clues. Treatment decisions are then made together with the physician based on the rhythm interpretation of the nurse (Keller & Raines 2005).

Cardiac monitoring practice improves practice and increases the nurse-physician interaction which results in better patient outcomes like shortening length of stay in ICU and preventing patient complications (Cadden 2007; Sumner *et al.* 2012).

Several protocols on cardiac monitoring have been designed in the developed countries. In the 2008 recommendations of the American Association of Critical-Care Nurses (AACN), the standard protocol for ICU cardiac monitoring must include ST-segment and dysrhythmia monitoring. It recommended that patients with a history of acute coronary syndrome should be monitored for ST-segment abnormalities using cardiac leads V_3 and III while V_5 and III for non-cardiac patients (Evenson & Farnsworth 2010; Fox, Kirkendall & Craney 2010).

Surveys among nurses in hospital intensive care and emergency units revealed that even in hospitals well equipped with cardiac monitors for ST-segment and dysrhythmia monitoring, ischemia and dysrhythmia monitoring were frequently not done (Evenson & Farnsworth 2010; Fox, Kirkendall & Craney 2010; Sangkachand, Sarosario & Funk 2011).

Reasons for inappropriate use of cardiac monitors have included lack of ST-segment and dysrhythmia monitoring protocols and confusion about the appropriate lead selection (Sangkachand, Sarosario & Funk 2011).

However, nurses working in critical and emergency care units should possess the necessary skills to appropriately monitor critically ill patients on cardiac monitors. Theses skills have been shown to be life saving in early detection of cardiac injury

and dysrhythmias among ICU and EU patients (Blakeman, Sarsfield & Booker 2015).

Purpose of the study

The purpose of the study was to assess the practice of cardiac monitoring among ICU and EU nurses working at Case Hospital. It was guided by two Specific objectives;

1. To assess baseline practice on use of cardiac monitors among ICU and EU nurses working at Case Hospital.
2. To evaluate whether there was change in the practice on use of cardiac monitors after the training (Intervention) among ICU and EU nurses working at Case Hospital.

Conceptual Framework.

King's Conceptual System and Theory of Goal Attainment and Transactional Process was modified and used to guide this study (King 1981). King stresses the relationship between the patient and the nurse. In this study the relationship was between the researcher and each individual respondent. King also makes use of the nursing process parameters: assessment, diagnosis, planning, intervention, and evaluation. In this study assessing baseline practice on use of cardiac monitors was the initial assessment. It was upon this initial assessment that possible deficiencies in practice were identified. Mutually attainable goals were set to achieve the intended outcomes. In the process of goal attainment, however, many factors such as individual nurse factors and hospital factors come into play. During the intervention phase, respondents had face to face sessions, guided hands on practice and self- study packages. Finally, evaluation of post education intervention change in practice on use of cardiac monitors was done.

METHODS

Study area

The study was carried out at Case Hospital. Case Hospital is a private for profit hospital located in the heart of Kampala-Uganda with a total bed capacity

of 180. It also has a well equipped 9 bed ICU with cardiac monitors. In total, Case Hospital ICU has a staff of 18 nurses. In addition, Case Hospital has got an EU also equipped with cardiac monitors. On average Case Hospital receives 20 cases per month requiring emergency care. In total, the EU has a staff of 14 nurses.

Research design

The study employed a quasi experimental one group pre -and- post test intervention to assess the practice of cardiac monitoring among ICU and EU nurses.

Sample size

Case Hospital has a total of 18 nurses working in ICU and 14 nurses working at the EU. For the planned dependent sample *t*-test analysis, a priori power analysis indicated a total sample size of 19 to detect a large effect (*Cohen's d = .5*) with α=.05 and 1-β=.95 (Buchner, Erdfelder, Faul, & Lang 2009). To allow for anticipated attrition of ten percent, the researcher aimed at having all 32 nurses participate in the study.

Data collection method and tools

Each instance of a nurse working with a patient who required cardiac monitoring was considered an opportunity for observation for electrode placement (especially the position for the V1 electrode (4^{th} intercostal space on the right sterna boarder- 4ICS RSB) in a 5-lead system), appropriate lead selection, asking the participant to identify the rhythm on the patients' monitor, and ST segment monitoring.

A total of 90 pre-intervention observations were collected on the two units, ICU (80 observations) and EU (10 observations) over a week so as to assess baseline practice in the use of cardiac monitors. Study participants were then taken through practical sessions over a period of eight weeks on: Rhythm strip analysis and Basic dysrhythmias, Cardiac monitors (electrode placement and choosing the best lead for particular conditions), and ST segment monitoring

After the intervention (practical sessions), each instance of a nurse working with a patient who required cardiac monitoring was again considered an opportunity for observation. A total of 90 post-intervention observations were collected on the two units, ICU (80 observations) and EU (10 observations) over a week so as to evaluate post- intervention change in practice of use of cardiac monitors.

Validity:

The patient observation checklist and teaching materials were given to research and critical care experts for validity and corrections were made as per their advice.

Data Analysis

Data was entered in spreadsheets (Excel) and later exported to SPSS version 20 for statistical analysis. For descriptive statistics, data was analyzed and presented in frequencies and percentages. To test whether an educational intervention improved practice, the McNemar test and P-values were used.

Ethical considerations

Approval was obtained from the Institutional Review Board (IRB) of the Faculty of Medicine, Mbarara University of Science and Technology and Case hospital. There was collaboration with the hospital head nurse and administration on how best to implement the project without any disruption of the nursing service.

RESULTS

Sample Characteristics

A total of 30 nurses were initially recruited for the study during the data collection period from February to May, 2017. A total of 23 nurses completed all three phases of the study.

As shown in Table 1, the majority of respondents were female (n = 15, 65.2%). More than half were aged between 24 and 28 years (Mdn = 28.0, IQR = 15.0).

Respondents' nursing qualifications were mostly certificate (n = 12, 52.2%) and diploma (n = 10, 43.5%). The majority of the respondents had spent less than a year on their respective units (n = 13, 56.5%) and had no prior training on cardiac monitoring and rhythm interpretation (n = 15, 65.2%).

Each instance of a nurse working with a patient who required cardiac monitoring was considered an opportunity for observation. A total of 90 pre-intervention observations were collected on the two units, ICU (80 observations) and EU (10 observations) to assess baseline practice in the use of cardiac monitors.

As shown in Table 2, appropriate lead selection and ST segment monitoring were never observed.

Each instance of a nurse working with a patient who required cardiac monitoring was again considered an opportunity for observation. A total of 90 post-intervention observations were collected on the two units, ICU (80 observations) and EU (10 observations) to evaluate post-intervention change in practice of use of cardiac monitors.

To assess whether there was a statistically significant improvement in practice, two by two contingency tables with a McNemar test of correlated proportions were used for the above categorical data. A p value of less than .05 was considered significant for all analyses. Results show a statistically significant improvement in electrode placement ($p < .001$), and rhythm identification of the monitor ($p < .001$) as shown in Table 3. Statistical significance could not be determined with lead selection and ST segment monitoring because initially (Pre) there was nothing with which to compare the final result (Post-).

Table 1: Demographic characteristics of respondents. (*N* = 23)

Variable	Frequency/Percentage (%)
Gender	
Male	8(34.8)
Female	15(65.2)
Age(Years) (*Mdn* = 28.0, *IQR* = 15.0)	
24-28	13(56.5)
29-33	8(34.8)
34-38	1(4.3)
>38	1(4.3)
Level of education	
Enrolled nurse(Certificate)	12(52.2)
Registered nurse(Diploma)	10(43.5)
Graduate nurse(Bachelors)	1(4.30)
Unit of work	
Intensive care Unit	12(52.2)
Emergency Unit	11(47.8)
Length of time on the Unit(Months) (*Mdn* = 7.0, *IQR* = 45.0)	
1-10	13(56.5)
11-20	6(26.1)
21-30	3(13.0)
>30	1(4.30)
Length of time in service as a nurse(Years) (*Mdn* = 5.0, *IQR* = 12.0)	
1-5	12(52.2)
6-10	10(43.5)
>10	1(4.30)

Table 2: Respondents' baseline (Pre-intervention) practice on use of Cardiac monitors.

Variable	YES	NO
1. Correct placement of electrodes on a patient, especially V1 in the 4ICS RSB	25	65
2. Selected lead on monitor meets patient criteria for identifying any dysrhythmia	0	90
3. Correctly identifies rhythm on the patient's cardiac monitor at that particular moment of observation and documents it.	10	80
4. Demonstrates proper ST segment monitoring (Only in ICU)	0	80

Table 3: Respondents' practice on use of Cardiac monitors before and after intervention

	BEFORE		AFTER		
Variable	YES	NO	YES	NO	McNemar test *p value*

1. Correct placement of electrodes on a patient, especially V1 in the 4ICS RSB	25	65	89	01	< .001
2. Selected lead on monitor meets patient criteria for identifying any dysrhythmia.	0	90	73	17	----*
3. Correctly identifies rhythm on the patient's cardiac monitor at that particular moment of observation and documents it.	10	80	76	14	< .001
4. Demonstrates proper ST segment monitoring (Only in ICU)	*0*	*80*	3	77	----*

(----**No measures of association are computed for the respective cross tabulation. Values in each **2× 2** table must be greater than 1*)

DISCUSSION

Each nurse caring for a patient who required cardiac monitoring was considered an opportunity for observation. A total of 90 observations were therefore made on both ICU and EU regarding the use of cardiac monitors. Results generally showed poor performance among nurses in all four areas observed; incorrect electrode placement (72.2%), incorrect lead selection on monitor (100%), incorrect rhythm identification on the monitor (88.9%), and no ST segment monitoring (100%). All patients before the intervention were being monitored in lead II and there was no ST segment monitoring. One possible explanation for this deficit is because lead selection and ST segment monitoring are advanced practices which require mastery of basic knowledge prior to implementation. Second, there was no cardiac monitoring protocol or lead selection algorithm on either of the two units. Cadden (2007) stated that if there is need to change practice, a unit standard or policy that guides the nurse to a level of monitoring expertise should be availed.

In agreement, Funk *et al.* (2010), revealed that nurses did not monitor for ST-segment changes because of lack of physician support for it, lack of knowledge about how to use the technology and perception of difficulty in use. Indeed more studies have shown that nurses' use of continuous ST monitoring is still low (Chronister 2014; Drew & Funk 2006; Funk *et al.* 2010).

Zaremba *et al.* (2014) in a descriptive study among nurses from 100 Veterans Health Administrative facilities across the United States reported that 77 percent of the participants used lead II was as the primary default lead on their units for the reason it gave a better view of the ECG.

Change in practice on use of cardiac monitors after the training (Intervention)

A McNemar test of correlated proportions for categorical data showed statistical improvement in electrode placement ($p<.0001$) and rhythm identification of the cardiac monitor ($p<.0001$). After the intervention, the investigator noted that respondents remembered some things very well, such as V1 placement as demonstrated during the teaching sessions and rhythm identification of the monitor. The possible explanation for this was the method of teaching used.

Statistical significance however, could not be determined with lead Selection and ST segment monitoring because these two were never done initially. Despite the nurse participants receiving intense training and demonstration about ST segment monitoring and lead selection they did not demonstrate statistically significant change in practice of these parameters. This implies that training alone may not necessarily mean change in practice. Perhaps support from interdisciplinary team members such as physicians could be an additional catalyst for improving practice.

Funk *et al.* (2010), revealed that nurses did not monitor for ST-segment changes because they lacked physician support for it and perceived it to be difficult to use. Zaremba *et al.* (2014) also reported that nurses mostly used lead II as the primary default lead on their units because it gave a better view of the ECG on the monitor. It should also be noted that after the session on lead selection, the investigator put a poster on every monitor about the lead selection criteria as defined by Evenson & Farnsworth 2010. This could explain why lead selection after the intervention greatly improved.

CONCLUSION

The study showed an improvement in cardiac monitoring practices and rhythm interpretation. However, it did not improve monitoring behavior related to ST segment monitoring and lead selection on the units.

LIMITATIONS OF THE STUDY

This study had the following limitations: First, it was conducted with a small sample size of nurses and therefore results cannot be generalized. Secondly, nurses were the only staff members included in the study and received the education; however patient outcomes are impacted not only by nurses but also other staff, such as general doctors, resident anesthesiologists and intensivists who are also responsible cardiac monitoring. Thirdly, the study did not look at patient outcomes given its short duration, contrary to Funk et al. (2009) who looked at patient outcomes such as mortality, length of stay, and cost of medical care.

WEAKNESSES OF THIS STUDY DESIGN

Since study participants were few and not randomly assigned, this could limit the generalizability of the results to a larger population. With lack of randomization, the conclusion that cardiac monitoring practices improved following the training (Intervention) is less definitive. Other factors and influences that could have contributed towards the outcome on cardiac monitoring practices following the training (Intervention) were not taken into account because of less control. For this reason therefore, the researchers cannot be assured that the training was the sole factor causing improvement in cardiac monitoring practices and rhythm interpretation.

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