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CLINICAL TRIAL STUDY

The Impact of Brief Text Messages on Critical Care Nurses' Ability to Interpret Arrhythmia: A Randomized Controlled Trial

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Abstract:

Background:

A lack of electrocardiogram (ECG) interpretation competency could threaten patient safety, and there is an urgent need to improve nurses' abilities to identify life-threatening arrhythmias.

Aim:

To check the hypothesis that Coronary Care Units (CCUs) nurses who received Short Message Service (SMS) data concerning irregular cardiac rhythms can better interpret cardiac arrhythmias than the control group.

Methods:

WhatsApp messages were sent to the intervention group two times a week for 10 weeks. At the baseline line, the test was given to both groups, while reassessment was done on the same day as the last WhatsApp SMS.

Results:

The intervention score increased after receiving SMS messages compared to the control group (M[SD]; 16.60 ± 2.23 *vs.* 11.40 ± 3.10, t=10.40, p <0.001).

Implications for Nursing:

Text messaging is a cost-effective, time-saving, and practical tool of mobile learning and enhance nurses' ECG interpretation skills.

Conclusion:

The study demonstrated that sending SMS messages using WhatsApp is practical and useful for improving nurses' cardiac arrhythmia interpretation skills.

Clinical Trial Study Registration Number:

NCT 05419554

Keywords: Arrhythmias, Cardiac rhythm interpretation, Critical care units, Nurses, Brief text messages, ECG.

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1. INTRODUCTION

All patients admitted to Critical Care Units (CCUs) due to cardiovascular conditions require early detection, close monitoring, and rapid electrocardiogram (ECG) interpretation, which facilitates earlier treatment planning and improved patient health outcomes, including an increased survival rate [1, 2]. Therefore, it is important to discover cardiac arrhythmias as early as possible to prevent the occurrence of complications and the exacerbation of symptoms. Faster evaluation of cardiac arrhythmias is the responsibility of CCU nurses, who are the front-line healthcare providers dealing with

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the patients in the CCU [3 - 5]. Consequently, they should be at the highest level of competency to detect any abnormal cardiac rhythm, especially life-threatening ones. However, despite the eponymously critical nature of CCU nurses' role, numerous studies have demonstrated that ECG interpretation may be challenging for many nursing professionals [6 - 9].

For instance, a study conducted in Hong Kong found that the majority of emergency nurses were unable to recognize second- or third-degree heart blocks with any degree of accuracy [9]. Similar investigations were conducted in Tanzania and Turkey, where it was discovered that only a tiny percentage of nurses could identify third-degree heart blocks, ventricular fibrillation, and ventricular tachycardia [6, 8]. Approximately half of the nurses employed in critical care settings in Turkey, according to another observational study, was unable to interpret atrial fibrillation [5]. Therefore, there is an urgent need to improve nurses' ECG interpretation abilities since their lack of ECG identification competency could increase patient morbidity and death [10].

CCU nurses are usually busy providing direct care for their patients in under-resourced and under-staffed wards, performing highly demanding tasks of routine care. Consequently, they have limited time available for conducting specialized courses and prolonged in-service education. For this reason, methods of enhancing CCU nurses' competencies and abilities should be feasible, convenient, and inexpensive, thus this study explores the use of SMS *via* applications such as WhatsApp (*i.e*., mobile texting *via* the internet) to improve nursing care effectiveness [11 - 14].

SMS texting is one of the most common communication methods used worldwide by the general population, as well as in healthcare and medical education [5, 11]. A literature search of key healthcare databases undertaken by the researchers identified only one study that was specifically designed to investigate the effect of an SMS intervention on nurses' abilities to interpret cardiac arrhythmias [5]. However, no studies were conducted in the Middle East and North Africa (MENA) region. Consequently, this study investigates whether CCU nurses who receive SMS messages can exhibit improved abilities to interpret cardiac arrhythmias (than the control group who do not receive such notifications) in the context of four major tertiary hospitals in Jordan.

2. MATERIALS AND METHODS

2.1. Study Design, Setting, and Sample

This was a randomized controlled trial (RCT) with a pre-test and post-test design, conducted at four major hospitals in Amman, Jordan, including one teaching, one governmental, and two private tertiary hospitals. These hospitals were chosen because they are considered the largest hospitals in Amman, and they receive patients from all over the country, as well as from neighboring countries. Each hospital has at least one large CCU, and the occupancy rate is nearly 95% all the time. The nurse-patient ratio is 1:1.5 during the morning shifts and 1:2 during the night shift.

Nurses working in these units should hold at least BSc in nursing, pass the licensure examination by the Jordanian Nurses' Council, and they should have a basic life support certificate. Nurses were included in the study if they met these criteria and had been working in CCU for more than three months. Nurse managers were excluded from the study because they are not usually involved in direct patient care. Nurses who did not already use the WhatsApp application were also excluded.

The sample size was calculated using G*Power software, and paired and independent t-tests, with power of 0.8 and α of 0.05. Based on these assumptions, the needed sample size was 35 per group. The study population comprised the whole nursing workforce of the study settings. Of 80 nurses who were contacted, 6 refused to participate, 2 were nurse managers, and 2 were lost during the study period (*i.e*., they did not complete the post-test); thus 70 CCU nurses ultimately participated, and were randomly allocated into the intervention and control groups, with 35 members each.

2.2. Randomization and Blinding

The study's goal and its substance were explained to the nurses, who also agreed by participating in it not to share the instructional SMSs that would be sent to them with anyone else. A list of participants was obtained from each unit manager. All eligible participants were approached by the principal investigator *via* email. After receiving their written agreement, they were asked to share some socio-demographic information with the principal investigator, including age, gender, level of education, WhatsApp phone number, and years of experience.

The intervention and control groups were chosen using a random number generator by a statistician not involved in the study. Nurses were informed about their allocation and were informed not to inform anyone about that. Due to the nature of the intervention, the participants could not be blinded to their allocation, but they were unaware of the outcome evaluation. Data were analyzed by an independent statistician blinded to the groups of the study.

2.3. Intervention

The intervention consisted of WhatsApp SMS messages explaining rhythms that nurses found difficult to interpret; the message content was based on previous literature [5, 6, 8, 9, 15] and pertained to atrial fibrillation, atrial flutter, ventricular tachycardia, torsades de pointes rhythm, ventricular fibrillation, asystole, heart block, and normal sinus rhythm. The WhatsApp message included the details of each arrhythmia and the rhythm strip illustrative of pictures of cardiac irregularities, an example of which is shown in Fig. (**1**).

These were initially sent to 10 field experts who worked as nurses and doctors in the emergency and CCU departments to verify the content validity. The expert opinions were evaluated using the content validity index (CVI). The item CVI was computed by dividing the number of experts who gave each text message a rating of 3 for "somewhat relevant" or 4 for "extremely relevant" by the total number of experts; a value of more than 0.80 was deemed satisfactory [16]. With the exception of two WhatsApp messages, the CVIs ranged between .85-.95. For these two items, revisions were done

based on the experts' opinions, and CVIs were recalculated and found to be 0.85 and 0.9. Finally, the revised WhatsApp message was piloted on 10 nurses, which reflects that understanding was not a problem for the nurses, as indicated by the percent agreement (90%). Based on these results, adequate content validity was assured for the intervention items [5, 16].

Fig. (1). WhatsApp SMS: Normal sinus rhythm. The general characteristics of a normal sinus rhythm are as follows:
• Rhythm: Regular for atria and ventricular rhythm
• Rate: 60-100 bpm
• P Wave: All P waves are rounded similar in size and shape, and upright in lead II; P: QRS complex ratio is 1:1.
• PR Interval: 0.12-0.20 second
• QRS Complex: 0.06-0.10 s seconds; all QRS complexes similar in size and shape
• T Wave: The T waves are rounded, and upright in lead II
• QT Interval: 0.36-0.44 second

The developed WhatsApp messages were sent to the intervention group two times a week (on Monday and Thursday) for 10 weeks by the principal investigator. Nurses were instructed to look carefully for the rhythm, and to read the rhythm explanation sent along with the figures.

2.4. Outcome

To evaluate CCU nurses' competency in interpreting cardiac arrhythmias, a specific test was developed by specialized professors in critical care and was validated by seven CVI experts. Then, the test along with the WhatsApp message was piloted on 10 CCU nurses, which reflected the SMS messages' comprehensibility, and that the nurses experienced no difficulties in comprehending the questions and the possible answers.

The test contained 20 multiple-choice questions related to the SMS rhythms, and the overall score varied from 0 to 20, with higher scores indicating stronger ECG interpretation competency. Each question had only one correct response out of five potential ones, and each answer was worth one point. At the baseline, the test was given to both groups before the intervention (*i.e.*, before any WhatsApp messages were sent). The reassessment was conducted on the same day as the last WhatsApp message.

2.5. Data Analysis

Data were analyzed using SPSS version 25. Descriptive statistics, including mean and standard deviation (SD) values, was used to describe the sample characteristics. These characteristics were compared between the intervention and control groups using t-test and chi-square test. Since there were no statistically significant differences between the intervention and control groups regarding the sample characteristics, an independent t-test was used to compare the level of competency at baseline and follow-up between the two groups. In addition, a paired t-test was done to compare the baseline and reassessment results for both the intervention and the control groups. Any p-value less than 0.05 was considered to be statistically significant.

2.6. Ethical Considerations

The principles of the Declaration of Helsinki were followed for research involving human subjects in this study. The Applied Science Private University (Amman, Jordan) IRB committee approved the study [IRB No.: Faculty 2022-2023-2-3], as well as all of the hospitals included in the study. Participants were informed that their phone numbers would be used only by the principal investigator and not be shared with anyone else, and that they would be deleted after study completion. The voluntary nature of participation and the right to withdraw at any time without giving a reason was explained, and that participation would not affect their professional development or statutory rights. All participants signed an informed consent form.

3. RESULTS

A total of 70 CCU nurses participated in this RCT, comprising 46 females, and 24 males, with a mean age of 26.3 ± 2.6 years. The majority of the sample (N = 63, 90%) held a bachelor's degree. The results of the independent t-test showed that at baseline, there was no statistically significant difference between the intervention and the control groups (M[SD]; 12.28 ± 2.64 *vs.* 11.72 ± 2.8, t=0.99, p=0.46) (Table **1**), but following the intervention, the intervention group had a higher mean score (M[SD]; 16.60 ± 2.23 *vs.* 11.40 ± 3.10, t=10.40, p <0.001). Paired t-test showed that the intervention group had higher mean levels at the reassessment compared to the baseline. However, there were no differences regarding the control group; (M[SD]; 16.60 ± 2.23 *vs.* 12.28 ± 2.64, t=8.64, p <0.001), (M[SD]; 11.72 ± 2.8 *vs.* 11.40 ± 3.10, t=0.30, p=0.21) respectively.

Table 1. Sociodemographic characteristics of the sample (N=70)

Variable	Intervention (n=35)	Control (n=35)	T or chi-square, p-value
Age	25.4 ± 2.4	26.9 ± 2.1	0.36, NS
Gender Male Female	 11 (31.4) 24 (68.6)	 13 (37.1) 22 (62.9)	0.92, NS
Level of education BSc Master	 32 (91.4) 3 (8.6)	 31(88.6) 4 (11.4)	1.1, NS
Years of experience	5.3 ± 2.3	5.1 ± 2.3	0.1, NS

Note: BSc: Bachelor's degree; NS: Not significant. Values are n (%) or M ± SD.

4. DISCUSSION

Mobile learning finds wide acceptance among most of the Jordanian population [17, 18]. Text messaging is a cost-effective, time-saving tool of mobile learning that could support learners by sending messages than voice communication and print-based interventions [19]. Apart from learning, text messaging could also encourage reflective practice, emotional support, and teaching in unpredictable situations, in addition to motivating participants to engage in SMS-related dialogues [20]. Hence, the present study was implemented to check the effect of SMS messages on CCU nurses' ECG interpretation skills.

The findings of the present study supported the study hypothesis geared towards investigating the effectiveness of SMS messages in enhancing the nurses' cardiac arrhythmias interpretation than the control group in 10 weeks of intervention. Given the homogeneity between the two groups of nurses, statistically significant improvements in the intervention group can be attributed to the effect of SMS messaging learning. The finding supports the information processing theory concept that "organization" and "repeating" of acquiring information *via* SMS can assist learners to transfer important information into short-term or even long-term memory [21]. Thus, in this intervention, learners (*i.e.*, CCU nurses) could retrieve the relevant ECG interpretation-related information from memory during their daily practice to minimize patient's life-threatening conditions.

To our knowledge, no similar interventions focusing on ECG interpretation learning have been reported in the literature. Recently, only one study has assessed the impact of SMS messages on the ability to interpret cardiac arrhythmias [5]. Previous studies have reported the positive effects of using text messaging as a training tool in the fields of medicine, nursing, and midwifery. For instance, sending education-focused SMS messages to ICU nurses has been found to increase their understanding of, attitudes toward, and practices surrounding nosocomial infection prevention [19]. Similarly, sending SMS texts was a successful strategy to increase breast cancer awareness among gynecology residents [22], improve midwives' prenatal education [23], and improve anesthesia nurses' knowledge levels [20].

The outcomes of this RCT showed that after 10 weeks of intervention, nurses in the intervention group had considerably higher scores than those in the control group. Based on that, it is practical, feasible, effective, and useful to incorporate sending SMS messages using WhatsApp into CCU nurses' clinical education in CCUs [24]. To our knowledge, no RCTs have been conducted to test the effectiveness of SMS messages in improving CCU nurses' ECG interpretation skills in Jordan or MENA in general, and this study addressed this identified research gap. Future studies are needed to affirm the effectiveness of SMS messaging in different healthcare systems with various socio-economic and educational parameters of various healthcare professionals, as well as in different care contexts and ward types.

5. LIMITATIONS

Some limitations merit mention in the present study. First, the study was conducted in four hospitals in Amman, so the findings' generalizability is limited beyond this metropolitan context. Second, one of the inclusion criteria for this study was having a BSc in nursing, which may reduce the implications of the intervention's effect for nurses with diploma degrees; this is important as such nursing professionals are highly instrumental in direct bedside patient care in many contexts.

6. IMPLICATIONS FOR NURSING

The utilization of the brief and simple SMS intervention applied in this study has emerged as a highly effective strategy to enhance CCU nursing knowledge and subsequently impact the quality of nursing care provided to patients. Implementing such interventions is significant in modern and multifaceted approaches to holistic care, offering a user-friendly, cheap, and immediately applicable technological solution to improve care delivery worldwide greatly. The intervention improved patients' outcomes and is conducive to an advanced professional practice environment, amplifying professional service quality *via* technology utilization without the need for expensive training. The use of SMS interventions facilitates ongoing professional development for CCU nurses. Regular SMS containing educational resources, research findings, and clinical updates can promote lifelong learning and enable nurses to enhance their knowledge-base. By keeping well-informed of emerging trends and advancements, nurses can refine their skills and competencies, improving patient care and positive health outcomes.

CONCLUSION

The results indicated that nurses in the intervention group had higher mean scores than those in the control group at 10 weeks of intervention. This study demonstrates that sending SMS messages using WhatsApp is a practical, feasible, effective, and useful method to improve nurses' cardiac arrhythmia interpretation skills, thereby improving the quality of care, patient health outcomes, and health system efficiency.

LIST OF ABBREVIATIONS

CCUs	=	Coronary Care Units
SMS	=	Short Message Service
CCUs	=	Critical Care Units
ECG	=	Electrocardiogram

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study was approved by the IRB committee (IRB No.: Faculty 2022-2023-2-3) at Applied Science Private University, Amman, Jordan.

HUMAN AND ANIMAL RIGHTS

No animals were used in this research. All procedures performed in studies involving human participants were in accordance with the ethical standards of institutional and/or research committee and with the 1975 Declaration of Helsinki, as revised in 2013.

CONSENT FOR PUBLICATION

Informed consent was obtained from all participants.

STANDARDS OF REPORTING

CONSORT guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

All data are available with the corresponding author on request.

FUNDING

None.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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