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Efficacy of Mobile Learning to Train Cardiac Arrhythmia Interpretation in Critical Care Nurses

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ABSTRACT

Aim: Interpretation of cardiac arrhythmias in detecting cardiac disorders and diseases is crucial. The immediate interpretation of cardiac arrhythmias is one of the most important clinical skills of medical and nursing staff. With the increasing use of training based on modern techniques in medical education, this study was performed to design and evaluate the efficacy of cardiac arrhythmias simulator application on critical care nurses' learning and satisfaction in comparison with the booklet.

Design: This quasi-experimental study with a control group was carried out in 2018 on 80 critical care nurses that were allocated in two groups.

Methods: The interventions involved mobile learning via a researchers-designed application and learning via a booklet on the interpretation of cardiac arrhythmias. Four weeks following the interventions, both groups were evaluated and the results from both groups were compared and analyzed by descriptive and inferential statistics (independent sample t-test, paired sample t-test, and ANCOVA).

Results: The research results revealed that the mean knowledge and skill scores of the participants by are searcher made questioner in the mobile learning and booklet groups, before intervention were 17.6 ± 4.565 and 19.00 ± 4.630 (P-value=0.201), and after intervention were 21.33 ± 2.693 and 19.27 ± 4.596 (P-value=0.018), respectively. The statistical analyses also revealed that the mean post-intervention learning scores of the mobile learning group were significantly higher than the mean pre-intervention learning scores of this group (P-value<0.001). However, no significant difference was observed between the pre and post-intervention scores of the booklet group (P-value=0.249). Besides, the mean satisfaction of the critical care nurses participating in this research with the arrhythmia simulator mobile application was approximately 85.72% and their satisfaction with the booklet was 78.05%, reflecting the acceptable level of satisfaction.

Conclusions: in this study researchers designed and developed an arrhythmia simulator mobile application and a booklet on the interpretation of cardiac arrhythmias according to the predetermined principles, instructional design, and learning goals. The research results revealed that mobile learning in this field leads to more efficiency, positive impact, and more satisfaction rather than learning via booklet. Hence, Mobile learning can be considered as an appropriate educational strategy to train cardiac arrhythmia interpretation skills in health care providers and learners.

KEYWORDS: cardiac arrhythmia interpretation, mobile learning, critical care nurses, cardiac arrhythmia simulator, mobile application

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INTRODUCTION

Education has a direct relationship between health care providers' professional competencies and the organizational training that they have received(1-3). In addition, the main goal of education in medical sciences is setting the scene to grow and reinforce professional competencies, clinical reasoning, and problem-solving skills (2, 4, 5). The importance of interpretation of cardiac arrhythmias and electrocardiogram in the diagnosis of heart diseases is evident(6-14), For this reason, the immediate interpretation and awareness of cardiac arrhythmias interpretation principles are important clinical requirements for health care providers(10, 14-17). Nurses, especially critical care nurses, have a key role in the diagnosis of cardiac arrhythmias(17-20). Hence, the accurate interpretation of cardiac arrhythmias is considered an important clinical skill and also essential competency(10, 16, 17, 20, 21).

This essential skill is taught through different methods, therefore applying an appropriate training strategy is substantially important(20, 22). In general, nowadays, with the advances in information and communication technology, distance learning and e-learning are effective methods in health care education(23-25). e-learning has evolved into a useful and authentic alternative strategy due to its advantages such as availability at anytime and anywhere(23, 25, 26). In this regard, e-learning can help learners to improve critical thinking, team collaboration, self-directed learning, lifelong learning, and transition to student-centered learning(27-30). Mobile learning is one of the newest and the most interesting forms of distance education and e-learning strategies that allow learners to use educational technology on their mobile devices(20).

Using new learning methods such as mobile learning can improve the quality of cardiac arrhythmias interpretation and management(20, 31). In addition, cardiac arrhythmia simulators increase the health care providers' knowledge and performance since simulation-based training has strong educational effects and lead to active learning(12, 17, 20, 32). therefore, according to the growth of e-learning in medical sciences, the high popularity of mobile learning and mobile applications, researchers' experiences in critical care and e-learning in medical sciences, the researchers decided to design and develop an application including all items and notions related to the interpretation of cardiac arrhythmias based on the instructional design. This study aimed to design and develop a mobile application of cardiac arrhythmia interpretation and to evaluate the impact of mobile learning on the learning and satisfaction of critical care nurses.

MATERIALS AND METHODS

The study was designed and developed by the researchers for the intervention included applying and evaluating a mobile application and an educational booklet about cardiac arrhythmias interpretation. A systematic approach based on the instructional design was applied to develop the mobile application and booklet (14). Also, Mobile Application Development Cycle Model (MADLC), which is a model to design the mobile application, was applied for this purpose(33, 34).

The arrhythmia simulator mobile application design and development process consisted of the following phases:

Identification (need assessment) phase: all information required to design the mobile application was collected in this phase. Identification of important requirements and priorities in the interpretation of arrhythmias were collected with an e-survey of critical care nurses' and physicians' opinions and combined with the expert opinions and then analyzed.

Design phase: After collection and analysis of information based on the results from the need assessment, the decision on the content of the mobile application was made by experts' approval in medical sciences e-learning, medical education, heart electrophysiology, and information technology. The prototype of the mobile application was also prepared.

Development phase: in this phase, the final output was formulated as an original application that provides training in the most prevalent items of cardiac arrhythmias and contains important therapeutic and caring requirements. some of the application specifications mentioned as user-friendly, the ease of content availability, the repeatability of educational content to improve accelerated learning, multimedia environment, curiosity and persuasion of learners to practice self-directed learning, and the possibility of quick search.

Prototyping phase: the scientific content was revised, and nursing and medical specialists identified the possible errors. The final version of the mobile application was prepared for installation.

Testing phase: In this phase, the application was tested several times and was prepared to deliver as the final version after finalizing icons, interface, etc.

Maintenance phase: The application was modified frequently and its scientific validity was approved by different scientific societies and cardiac nursing, heart electrophysiology, and medical sciences e-learning experts. The effectiveness of this mobile application is also demonstrated through our findings in this study.

This mobile application is simulation-based and has been designed based on instructional design. Furthermore, clinical and practical points were considered and all educational content was designed by the research team, especially its rhythms, images, etc. To conclude, the interpretation of cardiac arrhythmias booklet was developed as a PDF file containing all information presented in the mobile application and was approved by experts and faculty members. Ethical issues were considered and this study was registered with Research Project No: 9601176 – 34601 and IRCT Code No: IRCT2017053034231N1.

In this quasi-experimental comparative study, critical care nurses from Lavasani heart center (LHC) and Panzdah-e Khordade Varamin hospital (PKVH) participated with a convenience sampling technique. randomly, 45 participants

of LHC were recruited for mobile learning and also 45 participants of PKVH were selected for learning via the booklet as two study groups. The participants were recruited from different hospitals to minimize the contamination of research progress.

In two groups, after getting permission and informed consent of participants, they were made clear about the objectives of the study, then the baseline characteristics form and the knowledge and skill levels questionnaire on cardiac arrhythmias interpretation were completed by them. The questionnaire consisted of 25 multiple choice questions that covered the principles of cardiac arrhythmias interpretation and related nursing care and medical interventions were researcher-made and was designed based on the latest references and clinical guidelines. To ensure validity, the instrument was reviewed by 10 faculty members who were experts in research, emergency care and intensive care gave their comments on the validity of the questionnaire and their comments were considered in the revised version of the questionnaire. To ensure the reliability of the knowledge questionnaire, a test-retest was conducted, based on which a correlation coefficient of 0.95 was calculated indicating acceptable consistency of the instrument over time.

Then the mobile application was installed on the participants' cell phones in the mobile application group and explanations as to how to use the mobile application were provided to the participants. In the booklet group, the educational content of interpretation of cardiac arrhythmias was provided as a PDF file to the participants.

The knowledge and skill levels of the participants were evaluated in both groups after four weeks of the intervention. As well as participants completed a questionnaire regarding satisfaction with learning via mobile application and booklet. A 10-points scale questionnaire was used to measure respondents' satisfaction based on the Likert scale. To conclude, data were analyzed by SPSS software version 20 using descriptive and inferential statistics (independent sample t-test, paired sample t-test, and ANCOVA). After the study, the accessibility of application and booklet was provided for both groups.

RESULT

80 critical care nurses participated in this research (response rate =88%). Table 1 shows some of the participants' demographic and baseline characteristics data. As shown in table 2, the critical care nurses' knowledge and skill in the interpretation of cardiac dysrhythmias improved significantly after the intervention in the mobile learning group (P–value<0.001), however; no significant difference was observed in the booklet group (P-value = 0.249). The comparison of participants learning scores in mobile learning and booklet groups after the intervention has been shown in table 3 (Assuming their pre-intervention scores as covariant variables). The participants' satisfaction in mobile learning and booklet groups respectively were 85.72% and 78.05% that shown in Table 4.

DISCUSSION

The result of the present study revealed that critical care nurses' knowledge and skill level in the field of cardiac arrhythmias interpretation increased significantly via mobile learning (about 15%). Based on our literature review, the results of other studies have shown the effect of simulators on the improvement and enhancement of nurses' knowledge and skills of cardiac arrhythmias interpretation, which are consistent with the present study result. Despite the previous researches on this subject, few studies have been performed on mobile learning and were mostly based on Windows(13, 31, 35, 36), compact discs(20), or web-based(14, 17, 37).

One of the strengths of this study is that the instructional design was applied in the design and development of the mobile application, even in images, rhythms, and content, whereas in many other studies, available applications in the market and the commercial versions were applied. However, one of the most important requirements to design mobile applications and mobile learning is instructional design because it is essential to attain educational goals and effective learning outcomes(38).

The study results also revealed that critical care nurses' satisfaction in both groups was acceptable. The highest rate of satisfaction is related to the mobile application availability as it can be used anytime and anywhere with no special requirements and ease of operation and availability, whereas the other cardiac arrhythmia simulators require specific instruments and devices, which make them difficult to use(39, 40).

In addition, the educational content not only relied on the knowledge but also based on clinical and practical aspects such as therapeutic interventions and nursing care priorities while in the previous studies, medical interventions and caring issues have been considered rarely. Moreover, in this study, simulation of rhythms that applied to rhythm design (In the form of animation) was another aspect of this mobile learning method because simulation-based training has strong educational effects, particularly with high impact on the psychomotor domain that can lead to effective learning outcomes (25-27). Moreover, simulation-based training increases efficacy, motivation, critical thinking, and improved performance in critical situations. furthermore, it has a positive impact on the development of reflective learning styles, and deep learning approaches(20, 37).

CONCLUSION

we designed and developed a mobile application and a booklet on the interpretation of cardiac arrhythmias according to the predetermined principles, instructional design, and learning goals. Our findings revealed that mobile learning in this field leads to more efficiency, positive impact, and more satisfaction rather than learning via booklet. Hence, Mobile learning can be considered as an appropriate educational

strategy to train cardiac arrhythmia interpretation skills in health care providers and learners. However, achieving this goal requires prerequisite infrastructures and accurate development, design, Implementation, and Delivery of mobile learning.

Table (1): The frequency of some demographic variables of the critical care nurses included in the mobile application and cardiac arrhythmias interpretation booklet groups

Intervention group / Variable		Booklet		Mobile learning		P-value
		Frequency	Percentage	Frequency	Percentage	
Gender	Male Female	12 28	30 70	9 31	22.5 77.5	P–value<0.001 t = 35.099
Age	25 to 39 years old	35	87.5	36	90	P–value<0.001 t = 63.473
Shift	Fixed Temporary	12 28	30 70	7 33	17.5 82.5	P–value<0.001 t = 36.812
Academic degree	Bachelor's degree	37	92.5	35	87.5	P–value<0.001 t = 53.141
Marital status	Married Single	33 7	82.5 17.5	30 10	75 25	P–value<0.001 t = 26.345
Working experience (year)	10-19 years	26	65	34	85	P–value<0.001 t = 20.361
Employment status	Official	34	85	31	77.5	P–value<0.001 t = 18.432
Critical care experience (year)	1 to 9 years	31	77.5	35	87.5	P–value <0.001 t = 10.431

Table (2): The comparison of the learning scores of critical care nurses before and after the intervention (cardiac arrhythmias interpretation training) in mobile learning and booklet groups

Intervention / Phase	Mobile learning				Booklet				P-value
	Quantity	Mean	Standard deviation	SD Mean	Quantity	Mean	Standard deviation	SD Mean	
Pre-intervention	40	17.68	4.565	0.722	40	19.00	4.630	0.732	P–value = 0.201 t = -1.289
Post-intervention	40	21.33	2.693	0.426	40	19.27	4.693	0.727	P–value = 0.017 t = 2.434
P-value	P–value < 0.001 t = -7.009				P–value = 0.249 t = -1.171				

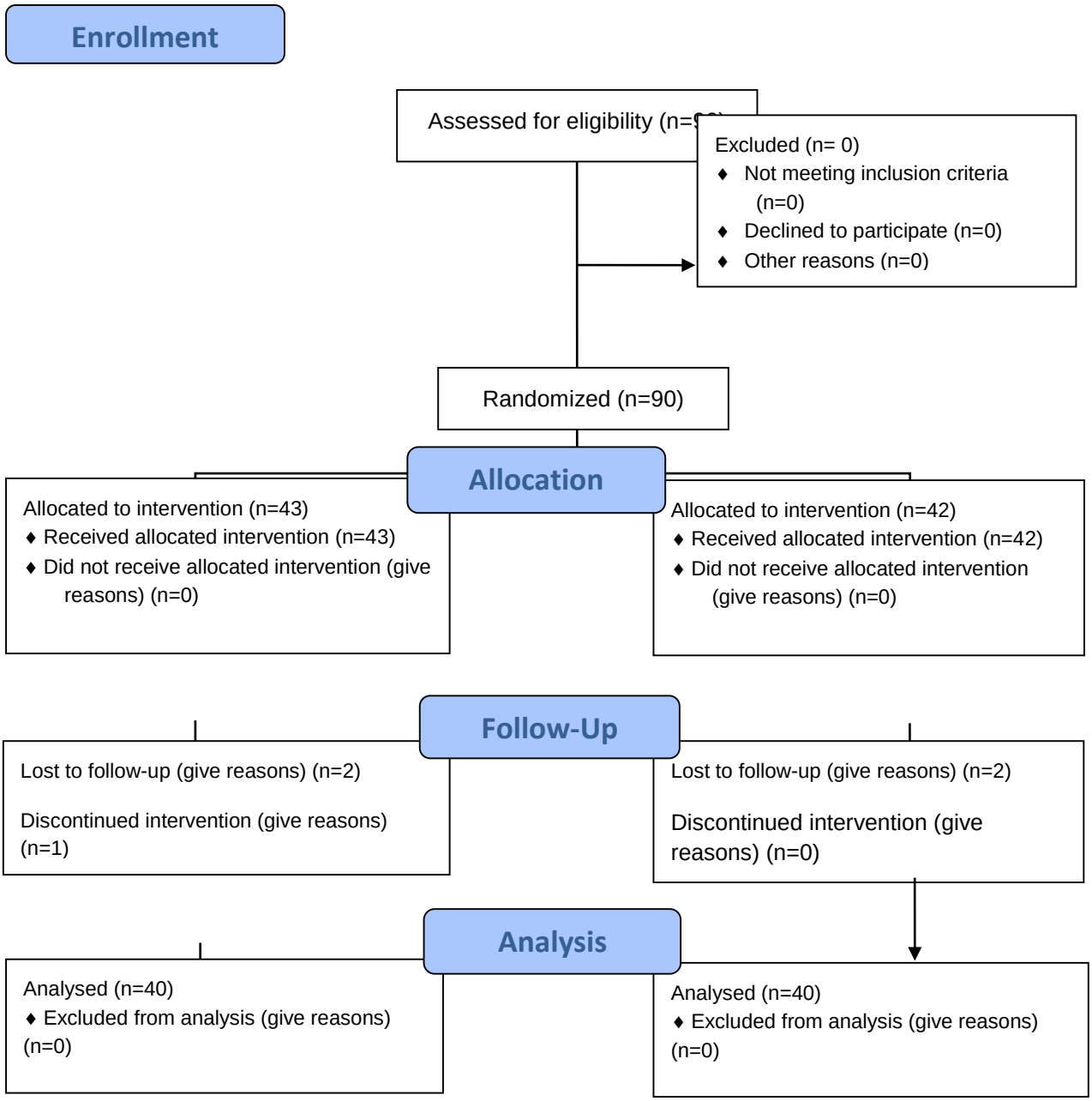
Table (3): Comparison of the learning scores of critical care nurses in the Mobile learning and booklet groups after the intervention (Assuming their pre-intervention scores as covariant variables)

Learning score Stage	Quantity	Mean	Standard deviation
Mobile learning	40	21.33	2.693
Booklet	40	19.27	4.596
Total	80	20.30	3.882
Group	Type III sum of squares = 170.727	Df=1 Mean Square= 170.727	P–value < 0.001 F = 489.38

Table (4): Critical care nurses' satisfaction with the mobile application and booklet on cardiac arrhythmias interpretation concerning the satisfaction items (on the 10-point scale)

Intervention / Satisfaction items	Mobile application		Booklet	
	Mean	Standard deviation	Mean	Standard deviation
Easy access to educational content	8.77	0.926	7.75	1.581
Transparency and unambiguity of educational content	8.29	1.296	7.28	1.109
User friendly educational method	8.42	1.006	7.68	0.917
The enrichment of educational content	8.57	1.206	8.63	1.005
Motivating due to the use of the educational method	8.77	1.000	6.32	1.071
Quality of acquired information and lessons learned	8.55	1.022	8.30	0.758
The effect of cardiac arrhythmias simulation on the better understanding	8.26	1.066	7.85	0.770
Satisfaction of your learning expectations	8.91	0.981	7.85	0.770
Spending energy and time of educational method	8.49	1.052	7.78	1.000
Time saving in this method	9.10	0.825	8.77	0.733
Total	85.72	7.366	78.05	4.878
Paired sample t-test results	P–value < 0.001 t = -1.171			

Diagram of data collection procedures and phases:



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