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Effectiveness of Smart Two-Dimensional Barcodes in Designing Cardiopulmonary Resuscitation Posters

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ABSTRACT

Introduction: Today, the use of new technologies has expanded in various fields. One of these cases is the use of smartphones and barcode reader software and two-dimensional barcodes. In this study, we tried to evaluate the influence of barcode utilization in the training of residents.

Method: This descriptive cross-sectional study was conducted in the Emergency Department of Ghaem Hospital, Mashhad, Iran in which the effect of using educational barcodes versus conventional posters on 30 medical residents of the Emergency, Internal Medicine, and Neurology Departments was investigated. A questionnaire was used to record the performance of residents in terms of medical emergency procedures. Moreover, demographic variables of residents were recorded. Data analysis was performed using descriptive and inferential statistics in SPSS software.

Result: In total, 30 residents completed the study questionnaire before installing the poster, and 29 of them completed the questionnaire post-test. It should be mentioned that 10 (33.3%), 13 (43.3%), and 7 (23.3%) subjects were Emergency Medicine, Internal Medicine, and Neurology residents, respectively. All of them (100%) found the use of QR codes practical and easy. Analysis of data related to pre-test and post-test scores of residents showed that their mean scores in the pre-test and post-test stages were 7±2.39 and 10.86 ±2.431, respectively, which indicated a significant increase after using the QR code poster (p-value=0.000).

Conclusion: The use of QR codes has been practical, easy, and user-friendly. In addition, comparing the mean scores of participants before and after the installation of these codes showed that it had a significant effect on training residents.

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Introduction

Today, the use of new technologies in clinical education has grown and developed a lot. The widespread use of smartphones allows the use and implementation of many of these technologies in the context of clinical education (4). Learning content delivered to students is further enriched with multimedia elements, such as interactive presentations, movies, sound recording, animation, and computer games (5). One of the most useful software that can be used to transfer information and data in various fields is barcode reader software and the use of two-dimensional barcodes to transfer educational content (1).

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Quick Response (QR) code is a matrix or two-dimensional barcode. It can be read by imaging devices, such as smartphones with QR scanner apps. After scanning, the code becomes a uniform source finder (URL), allowing quick access to a web page for relevant information; hence, there is no need to type the URL in a browser (8). Usage of QR codes in education can be considered a kind of learning through mobile phones. Research on mobile learning has been conducted worldwide, but only a few studies have investigated the use of QR codes in education (10). The use of the QR code in medicine has been considered as well. While the use of QR codes in medical educational settings is still in its infancy, it is evolving to its full potential. Recent research, however, on the implementation of QR codes in education has focused on the ability of codes to "access information when needed" (11).

Despite studies on the impact of virtual education and e-learning, studies that use QR codes in medical practice are rare both globally and nationally. Besides, some of these studies have examined the impact of these codes on medical education in patients. Particularly, in Emergency Medicine education where residents are trained in usually crowded emergency departments while facing unstable patients with life-threatening conditions, there is a need for rapid transfer of necessary information to the residents. However, conventional training methods in emergency medicine do not allow such proper training.

Materials and Method

This descriptive cross-sectional study was performed from July 6, 2020, to September 22, 2020, on 30 residents in the first year of Emergency Medicine, Internal Medicine, and Neurology in the Emergency Department. Initially, due to the situation caused by the COVID-19 pandemic, residents were taught through messenger apps how to use two-dimensional (2D) training barcodes and barcode reader (QR code scanner) software installed on their smartphones. The protocol of cardiopulmonary resuscitation (CPR) was chosen as the training topic of this study.

The CPR training protocols were commonly available as a poster in the CPR emergency room, while we installed it on the phones of participants as two-dimensional barcodes in the Emergency Room of Ghaem Hospital, Mashhad, Iran. In the initial evaluation before installing the barcode poster, the information of residents was evaluated with a questionnaire about the content of the educational posters that were conventionally installed in the CPR room. Afterward, the educational posters were turned into barcodes and installed in the CPR room. The residents were re-evaluated a month and a half after the exposure. To evaluate the role of educational barcodes at the end of this period, the study questionnaire included demographic information of residents, technical characteristics of their mobile phones, their use of educational barcode posters, user-friendliness of the software, and the frequency of using the barcode posters. In addition to the above, the effectiveness of barcode educational posters was examined by evaluating the scientific content of the posters in the questionnaire. For this purpose, the effectiveness of the posters was assessed with a questionnaire including questions about their scientific content.

Moreover, the scores of residents were compared after exposure to the two types of posters. These contents included algorithms and educational videos related to the basic and advanced resuscitation and management of tachycardia and bradycardia in adults. Moreover, the use of posters by barcode or conventional method was evaluated using a score between 0 and 20. Inclusion criteria were willingness to participate in the study and agreement to use the barcode posters. On the other hand, the exclusion criteria were non-usage of barcode posters during the study time, non-usage of a smartphone, and unwillingness to continue the study. Data analysis was performed using descriptive and inferential statistics in SPSS software (version 20). The characteristics of the subjects were presented by descriptive statistical methods, including central indicators, dispersion, and frequency distribution in the form of appropriate tables and graphs. For data analysis, paired t-test was used if the data distribution was normal and otherwise its parametric equivalent, the Wilcoxon test, was used. The significance level in all tests was considered less than 0.05.

Results

In total, 30 residents completed the relevant questionnaires before installing the poster, and 29 (96.66%) of them completed the post-test questionnaire. It should be mentioned that 10 (33.3%), 13 (43.3%), and 7 (23.3%) of them were residents of Emergency Medicine, Internal Medicine, and Neurology, respectively. Furthermore, 14 patients (46.7%) were male and 16 patients (53.33%) were female. Besides, The participants were within the age range of 27-50 years old. and their mean and median ages were 34.2 and 31.5, respectively, while their standard deviation was 6.890. All participants believed that using QR barcode educational posters was practical and easy.

Moreover, 26 subjects (89.65%) used these posters as educational resources, while 3 subjects (10.35%) did not use them as educational resources. In addition, 14 subjects (48.27%) had previously read the content of the posters in other

sources, 11 subjects (37.93%) had used some other sources before using the posters, and 4 subjects (13.8%) had not previously read the poster content. The results of the paired t-test related to the pre-test and post-test scores of residents showed that the mean scores of their pre-test and post-test were 7 ± 2.39 and 10.86 ± 2.431, respectively. Comparison of these two categories showed that the correlation coefficient of the blade and test post scores was -0.148, which indicated an inverse and statistically insignificant relationship between these two categories of data (p-value=0.445) (Table 1).

Table 1: Difference between Pre-test and Post-test scores

	MEAN	STANDARD DEVIATION	P-VALUE
Pre-test	7	2.39	<0.001
Post-test	10.86	2.431	

The mean scores of residents after using the QR code poster increased significantly (p-value=0.000). The difference between the mean scores of each question is shown in Figure 1.

This difference was statistically significant in questions 3, 4, 8, 11, 12, 14, and 15, which has increased in all of them. In other questions, the mean scores of the post-test questionnaire increased as well, while in comparison with the pre-test, there was no statistically significant difference.Moreover, the mean scores of each question in the pre-test and post-test stages were compared between male and female residents (figures 2 and 3). The results showed an increase in the mean value of post-test scores of the participants compared to that of their pre-test scores with a statistically significant difference between females (p-value=0.003) and males (p-value=0.001).

Figure 1: Comparison of the average scores of each question in the pre-test and test post

Moreover, the mean scores of each question in the pre-test and post-test stages were compared between male and female residents (figures 2 and 3). The results showed an increase in the mean value of post-test scores of the participants compared to that of their pre-test scores with a statistically significant difference between females (p-value=0.003) and males (p-value=0.001).

Figure 2: Comparison of the mean scores of each question in the pre-test and post-test in female assistants

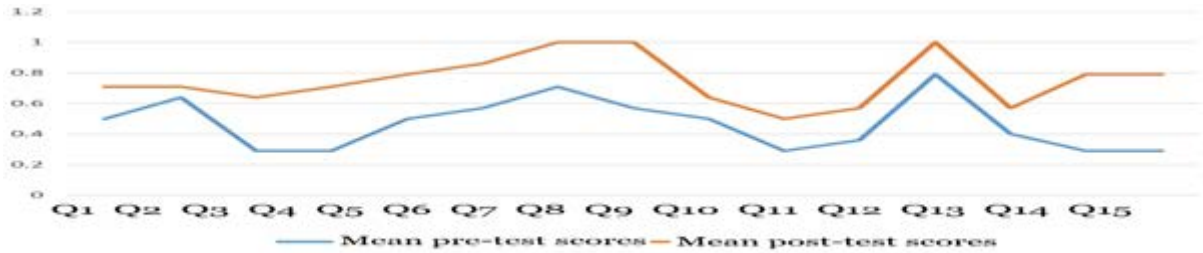

Figure 3: Comparison of the mean scores of each question in the pre-test and post-test in male assistants

Discussion

In the current study, all the residents considered the use of educational posters containing QR codes easy and practical. In total, 26 of them used, while 3 of them did not use these posters as educational resources. In a similar study, Traser et al. (12) examined the effect of QR codes on students attending the 2013 Medical Anatomy Course. The results of their study showed that 56% of the users said that the QR code was more useful than traditional educational methods, and the majority (89%) of users felt that the QR code would help them improve their anatomy learning.

In the aforementioned study, there was a small positive, yet significant linear relationship between the number of times students used QR codes and their sense of increased anatomy learning. However, in the present study, the clinical performance of students before and after the intervention was evaluated, but the mean scores were not statistically significant. The better educational outcomes of the study performed by Traser et al., compared to those of our study could be attributed to the higher number of subjects and the longer duration of the intervention period in the above-mentioned study. Smith et al. (13) examined the effect of QR codes on the education and enjoyment of 100 non-senior biology students in their learning environment.

Similar to the findings of the present study, they stated that most students believed that using these codes would both make learning more enjoyable and effective. Smith et al. also conducted an objective study in three areas of knowledge, comprehension, and application to compare the training outcomes in students using QR codes versus training through lectures. They did not find any significant relationship between the QR code group and the lecture group. Moreover, 69% of those who were trained through QR codes and answered the questions correctly had a statistically significant difference with those in the group trained through lectures.

Toyohiro et al. (14) in their study examined the effect of using QR codes on medical education in the field of maxillofacial and sinus lesions in fourth-year students and found the increased tendency of students towards the course, while no training outcome management was performed. Lin and Teng (15) used QR codes for the pharmacology teaching to nursing students in the third year and evaluated the efficiency and ease of using QR codes in these students. They found that in terms of efficiency, approximately 77% of the participants showed positive outcomes and that participants with average scores expressed higher satisfaction. Results of their study showed that participants with different scores had different opinions about the use of QR codes in these training courses. The difference between the aforementioned study and our study is that the objective study of the impact of QR codes was through the level of participation of subjects in class discussions, which was not assessed in the present study. The common denominator of all these studies and our study is that most users found the use of QR codes practical and easy.

Finally, the results of this study showed that the use of QR codes in medical education in the field of Emergency Medicine is easy and user-friendly and also affects their training in special emergencies, which indicates the need to review previous methods of medical education. In addition, studies on the impact of QR codes have been limited, and this study has taken steps to increase the existing knowledge of this tool in medical education.

Limitations

One of the limitations and weaknesses of this study was the location of the study which was limited to Mashhad and the small number of subjects participating in the project. This affects the results of the research in such a way that not all the impact on the information of the residents during the project can be attributed to the educational posters. However, as mentioned before, research on the impact of QR codes on medical education is limited, and no research has been conducted to specifically examine its impact on Emergency Medicine education.

In addition, another limitation of this research has been its duration. Since the use of QR codes depends on having smartphones and access to the Internet at a reasonable speed, it may sometimes limit users. Another point is that future research should also address the impact of using this new training method on the skill level of medical staff. In other words, it should be studied whether the use of this method, compared to previous methods, is able to increase the skills and speed of subjects in performing medical interventions or not.

Conclusion

The results of the present study showed that all students used QR codes as an educational resource and all studied residents found the use of QR codes practical and easy. This result showed that they are easy to use and can be used as a new educational tool that is user-friendly. Moreover, a comparison of the mean scores of the participants before and after the installation of these codes showed that it had a significant effect on the training of residents and was useful to users

from a subjective point of view. Moreover, the analysis of statistical data related to user scores also indicated their usefulness from an objective point of view as well.

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Conflict of interest

There is no any kind of conflict of interest in this article.

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