



Evaluation of Evidence Based Medicine Knowledge and Skills among a Sample of Medical Students in King Abdul Aziz University: A Follow up Study

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Authors' contributions

This work was carried out in collaboration between all authors. Author MAH designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors HA and QM managed the analyses of the study. Author AZE managed the literature searches, edited the final manuscript and supervised the work. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/BJMMR/2017/30248

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- Complete Peer review History: <http://www.sciencedomain.org/review-history/17492>

Original Research Article

Received 28th October 2016
Accepted 4th January 2017
Published 11th January 2017

ABSTRACT

Background: Evidence-based medicine (EBM) is an essential method of teaching that represents the integration of clinical expertise, patient values, and high-quality evidence in the process of decision making concerning healthcare. The current study aims to evaluate the EBM skills of

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medical students four years after having taken this course. In order to evaluate the effectiveness of this course, students who took the course are compared with students who did not take the course.

Materials and Methods: The current study was conducted at the Faculty of Medicine of King Abdulaziz University in Saudi Arabia between 2009 and 2013. Fifteen students out of 165 in the fourth year selected this course as one of their student-selected components (SSC), and this was their first experience in learning about EBM. Immediately after the end of the course, faculty members asked the first student cohort to evaluate the effectiveness of the course and rate the EBM project, the material taught, and the instructional handouts using a five-point Likert scale questionnaire. Out of the 15 who enrolled in the course, 14 were surveyed four years after taking the EBM course, in addition to another 14 medical students who did not take the EBM course. The students self-assessed their confidence with EBM skills in the following areas: formulation of clinical questions in the "PICO" format (patient population, intervention [or exposure], comparison, outcomes), literature searches, evaluation of articles, and ability to apply this process to other clinical situations. In addition, student performance was evaluated with regard to the five steps applied in their learning experiences during the course. A five-point Likert-type scale was used in the questionnaires, with "strongly disagree" coded as 1 and "strongly agree" coded as 5. The collected data were analyzed in terms of descriptive statistics using SPSS.

Results: The results indicate that the overall scores from the four-year prospective study were lower than those collected immediately after the EBM course. Students who took the course (EBM group) has better skills in critiquing articles and linking EBM with clinical skills than those who did not (non-EBM group). Moreover, subjects from the EBM group had more interest in medical updates and research and were more familiar with the medical database library.

Conclusion: EBM teaching should be integrated as an initial course and applied early, followed by continuous EBM-based practice with clinical activities throughout the clinical years. Moreover, smartphone based E-learning has become an efficient way to handle medical knowledge and deliberation among medical students and healthcare providers.

Keywords: Evidence-based medicine; learning; smartphone.

1. INTRODUCTION

Evidence-based medicine (EBM) is an essential method of teaching that is applied in clinical decision making [1,2]. EBM represents the integration of clinical expertise, patient values, and high-quality evidence in the process of decision making concerning patient healthcare. EBM merges individual clinical data and individual clinical experience with the scientific evidence obtained by clinical research [3,4].

EBM was invented to reduce the time between detection and application of proper medical treatments, to carry out high-quality practice among physicians, and to reduce the time needed for a physician to stay informed about recent advances in medicine. Moreover, EBM is of importance to provide an easy, accurate link between research and practice and save time for busy physicians [3,5].

EBM involves dealing with clinical problems using a five-step method based on the Evidence Based Medicine Resource from McMaster University: (1) the patient's problem is defined, (2) a search for sources of relevant information from clinical articles is conducted, (3) clinical evaluation and critical appraisal of the evidence

for the validity and usefulness of the information is conducted, (4) the information is implemented into clinical practice, and (5) an efficient evaluation of the results of said application on the patient is conducted [3,6,7].

In the past few years, EBM has been integrated into medical school curricula as a core requirement across the world [8] in both undergraduate and postgraduate study, as well as during pre-clinical and clinical years [9]. Teaching EBM principles and practices improves the skills and attitudes of critical appraisal of both undergraduate medical students and postgraduate physicians [4].

Because there is an abundance of medical knowledge obtainable every day through the media and online, it is mandatory for physicians to have skills in searching for, evaluating, and apply up-to-date information to deal with clinical problems [1,7]. The School of Medicine at King Abdulaziz University started the process of introducing a new curriculum four years ago. One of the features of the updated curriculum is the introduction of a special study module and electives as student-selected components (SSCs) in the fourth year. SSCs are presented

as two credit hour courses over two weeks in both the fourth and fifth years. Students are asked to select one of 20 SSCs in both basic and clinical science. Student assessments in SSCs at King Abdulaziz University are performed through standardized forms of assessment invented by the module committee members.

A course called "Introduction to Evidence-Based Medicine" was one of the SSCs in the new special study module. Throughout this course, students are asked to attend lectures and tutorials on introductory topics in EBM, complete an EBM workbook, work with their tutor on focused clinical questions, and participate in feedback sessions. In addition, they review articles for their projects using the User's Guide worksheet, and finally, they present and hand in their projects on the last day of the course.

The aim of the current study is to evaluate the EBM knowledge and skills of medical students four years after having taken this course. In order to evaluate the effectiveness of this course, students who took the course are compared with students who did not take the course.

2. MATERIALS AND METHODS

The current study was conducted at the Faculty of Medicine at King Abdulaziz University in Saudi Arabia between 2009 and 2013. The study methods followed ethical guidelines of the Faculty of Medicine of King Abdulaziz University, at the time of writing its proposal and conducting it in the year (2009).

2.1 Course Description and Evaluation

The study protocol was previously tested and described by Hassanien [7]. The course was based on an online tutorial called "Introduction to Evidence-Based Medicine," developed by Connie Schardt at the Duke University Medical Center Library in Durham, NC and by Jill Mayer at the University of North Carolina Chapel Hill Health Science Library in Chapel Hill, NC. Students used the workbook developed by Lyndee Knox at the University of Southern California in Los Angeles, CA. Permission was obtained from the authors of the online tutorial and the student workbook before the start of the study.

The research methodology took the form of a focus group: 15 students out of 165 in their fourth year selected the EBM course as an SSC. It was their first time learning about EBM. The course was given over two weeks in five theory-based lectures. The course content involved the basic

principles of EBM, database manipulation (introduced in five workshop-style discourses in a computer laboratory), the basic five steps of EBM, and 15 hours of self-directed learning, during which students completed their workbooks.

Immediately at the end of the course, faculty members asked the first student cohort to evaluate the course and rate the effectiveness of the EBM project, the material taught, and the instructive materials using a five-point Likert scale, as an extension of the study of Hassanien [7]. Overall, 14 medical students, of the total of 15 enrolled in the course, were surveyed four years after taking the EBM course in addition to another 14 medical students who did not take the EBM course. Both cohorts had the same grade point average and were surveyed with questions that measure EBM skills in clinical practice.

The students performed self-assessments of their confidence with EBM knowledge and skills in the following areas: formulation of clinical questions in the "PICO" format (patient population, intervention [or exposure], comparison, outcomes), literature searches, evaluation of articles, and ability to apply this process to other clinical problems. In addition, student performance was evaluated according to the five steps applied throughout the course in their learning experiences. A five-point Likert-type scale was the method used in the questionnaires, with "strongly disagree" coded as 1 and "strongly agree" coded as 5. The resulting data were analyzed in terms of descriptive statistics using SPSS (v 10.0; IBM Corporation, Armonk, NY).

PICO is a method that has been proposed to improve physician ability to search the clinical literature. The physician is guided to define the clinical question in terms of PICO. Then, the clinical question is matched to the relevant scientific literature [10,11].

During the surveying sessions, the use of the PICO questionnaire was explained by the research team. The participant students were then presented with the questions. The components of the PICO questionnaire are presented in Table 1.

Another questionnaire was developed by the authors to compare EBM skills among students who took the EBM course and among those who did not. This questionnaire was validated through an expert in medical education followed by a pilot to a group of medical students (Table 2).

Table 1. Components of the pico questionnaire

Questions	
1.	After this course, I searched for and used research literature in addressing patient issues
2.	I still understand the concept of evidence-based medicine.
3.	I feel capable of critically appraising articles dealing with issues of therapy and prevention
4.	I feel comfortable using Evidence-Based Medicine skills in day-to-day patient care responsibilities
5.	I believe critical appraisal skills have value to me as a house officer.
6.	I am more likely to use the literature to support my clinical decision-making.
7.	I am more likely to critically appraise the articles I read.
8.	I am more likely to search the primary literature available on my patients' problems.
9.	The medical clerkship is an appropriate time to learn the concepts of evidence-based medicine
10.	I felt that my clinical question was resolved through identification and appraisal of the literature.
11.	My appraisal of the literature benefited my patient in some way.
12.	My EBM project increased my sense of involvement in the clinical decision made on my patient.
13.	I am likely to use the EBM process again during my medical training.

Table 2. EBM skills questionnaire

1-	If there is a debate in any medical information, what will you do to know the answer?
A.	Using books.
B.	Find out from any website like Wikipedia.
C.	Asking your consultant.
D.	Seeing the latest article.
E.	Using PICO method.
2-	Do you criticize the article which you read, or the information you got?
A	Yes
B	No
3-	What kind of information do you prefer?
A.	Theoretical information.
B.	Evidence based information.
4-	Do you believe that EBM could help your clinical practice?
A.	Yes
B.	No
5-	Are you interested to know the sensitivity and specificity of any signs, symptoms or lab result?
A.	Yes
B.	No
6-	Are you interested in searching for medical updates?
A.	Yes
B.	No
7-	Do you have an account in any medical database library?
A.	Yes
B.	No
8-	Have you ever done a research or being a part of it?
A.	Yes
B.	No
9-	Are you familiar with interpreting P-value?
A.	Yes
B.	No
10-	How many hours/week did you use the Internet for reading about medical subjects?
A.	Less than 2 hours
B.	2–4 hours
C.	4–6 hours
D.	More than 6 hours
11-	Do you use any medically related applications on your smart phone in your daily practices?
A.	Yes
B.	No

2.2 Statistical Analysis

The collected data were entered and analyzed using IBM SPSS statistical software (version 20). The results are presented as means (\pm SD) or as frequencies according to variable types.

3. RESULTS

The results of the current study are illustrated in Tables 3 and 4. The results indicate that the overall scores from the four-year prospective study (the same sample) were lower than those collected immediately after the EBM course.

A comparison of the students who took the course (EBM group) and those who did not (non-EBM group) shows that the EBM group had better skills in critiquing articles, linking EBM with clinical skills, and interpreting sensitivities and specificities. Moreover, subjects from the EBM group had more interest in medical updates and research and were more familiar with the medical database library. However, the groups reported equal use of medical applications on smartphones.

The EBM group reported that they reviewed the latest articles if they encountered any debates about medical information, whereas the non-EBM group reported that they read medical notes or asked a consultant.

4. DISCUSSION

The results of the current study revealed lower test scores four years later than at the end date of the EBM course. A very similar finding was reported by Riegelman et al. [12] who reported higher test scores and EBM knowledge immediately after the course than three years later among the same student group.

Medical students, clinical researchers, and physicians must implement EBM to provide quality healthcare and improve their skills in diagnosis and therapy [2,13]. The School of Medicine at King Abdulaziz University is one of the most recent pioneers in teaching EBM to medical students. The EBM curriculum was recently introduced as one of the special study modules and presented as an elective course for medical students in their fourth year as an SCC. Students may select EBM as one course out of 20 SSC courses in basic and clinical science. This could explain the low number of students enrolled in the current study (15 out of 165

students in the first part of the study and 14 out of 15 students in the second part).

Another finding in the present study is that the students who took the course had better skills in critical appraisal of scientific articles, applying EBM in clinical practice, and interpreting sensitivities and specificities than those who did not take the course. This result is in agreement with the results of Liabsuetrakul et al. [14] who evaluated skills and aptitudes of students before and after they took an EBM course. They found significant improvement after integrating the course into the curricula of their medical school. They concluded, based on their study and previous studies, that integration of EBM courses into the curricula of medical schools should be mandatory and could result in improvement of student skills in using EBM knowledge [14–16]. Liabsuetrakul et al. [14] also reported a limitation of their study: There is no data about the sustainability of EBM skills over time. This point is tested in our study; we discovered a decline in the skills and aptitude scores four years after the course. Therefore, we suggest that it is better to apply short EBM courses through the years of medical school.

This study confirms a hypothesis that was previously reported and studied by West et al. [17]. They concluded that the EBM curriculum in medical schools should be implemented as an initial course, followed by subsequent integration of continuous EBM-based practice with clinical activities. This could result in sustained improvement in EBM-knowledge and aptitude [13,17,18].

One of the most important findings of the current study is the use of smartphones among physicians in acquiring knowledge, whether they took the EBM course or not. This finding proves the importance of e-learning and smartphone-based learning as new tools in medical education; 100% of surveyed students in the preclinical basic science and clinical phases had smartphones.

E-learning and smartphone-based learning have become popular methods to facilitate teaching and learning in medical education. These methods also allow flexibility and enable clinicians to fit learning into their heavy clinical duties [16,19]. The use of mobile internet devices (MIDs) and software applications (known as "apps") can also facilitate communication among healthcare providers and save time [20,21].

Table 3. The comparison between 2009 and 2012

Questions	Mean ± SD	Mean ± SD	P value (two- Tailed)
	2009–2010 (Just after taking the course)	2012–2013 (4 years after the course)	
1. Before this course, I searched for and used research literature in addressing patient issues	3.1± 1.3	2.8±1.19	0.52
2. I still understand the concept of evidence-based medicine.	4.0±0.45	2.6±1.4	0.001*
3. I feel capable of critically appraising articles dealing with issues of therapy and prevention	3.6±0.8	2.6±1.6	0.04*
4. I feel comfortable using Evidence-Based Medicine skills in day-to-day patient care responsibilities	3.8±1.0	2.4±1.2	0.02*
5. I believe critical appraisal skills have value to me as a house officer.	3.5±0.82	2.6±1.0	0.013*
6. I am more likely to use the literature to support my clinical decision-making.	3.6±0.8	2.7±1.2	0.025*
7. I am more likely to critically appraise the articles I read.	3.7±0.77	2.6±1.0	0.025*
8. I am more likely to search the primary literature available on my patients' problems.	3.8±0.6	2.8±1.0	0.002*
9. The medical clerkship is an appropriate time to learn the concepts of evidence-based medicine	3.9±0.7	2.7±1.3	0.004*
10. I felt that my clinical question was resolved through identification and appraisal of the literature.	2.4±0.4	2.6±1.2	0.54
11. My appraisal of the literature benefited my patient in some way.	3.6±0.93	2.9±1.2	0.089
12. My EBM project increased my sense of involvement in the clinical decision made on my patient.	3.9±0.57	2.4±1.0	00003*
13. I am likely to use the EBM process again during my medical training.	4.0±0.67	2.9±1.3	0.007*

*Significant $P \leq 0.05$

Table 4. The comparison between the EBM and non-EBM groups

No.	Questions	Yes		No	
		EBM	Non-EBM	EBM	Non-EBM
1	If there is a debate about medical information, what will you do to find the answer?				
a.	Read medical notes	7.1%	35.7%	92.9%	64.3%
b.	Refer to a website such as Wikipedia	0%	28.6%	100%	71.4%
c.	Ask your consultant	42%	35.7%	58%	64.3%
d.	See the latest article	50%	0%	50%	100%
e.	Use the PICO method	0%	0%	100%	100%
2	Do you criticize the article that you read or the information you received?	57.1 %	14.3%	42.9%	85.7%
3	What kind of information do you prefer?				
a.	Theoretical information	28.6%	57.1%	71.4%	42.9%
b.	Evidence-based information	71.4%	42.9%	28.6%	57.1%
4	Do you believe that EBM could help you in clinical practice?	78.6%	50%	21.4%	50%
5	Are you interested to know the sensitivity and specificity of any Diagnostic test you might use?	78.6%	28.6%	21.4%	71.4%
6	Are you interested in searching for medical updates?	92.9%	42.9%	7.1%	57.1%
7	Do you have an account in any medical database library?	57.1%	42.9%	42.9%	57.1%
8	Have you ever done research or participated in research?	78.6%	7.1%	21.4%	92.9%
9	Are you familiar with interpreting <i>P</i> -value?	71.4%	0%	28.6%	100%
10	Do you use any medically related application on your smart phone in your daily practice?	85.7%	85.7%	14.3%	14.3%

In recent years, the use of smartphones has become common among the general public and among healthcare workers because they offer easy access to information. The use of smartphone devices—such as personal digital assistants (PDAs) and handheld tablets—could have a positive effect on patient care [22,23]. The usefulness of smartphones has attracted the interest of medical researchers and healthcare providers [24,25].

5. CONCLUSION

It can be concluded from the current study that EBM should be integrated as an initial course early on, followed by continuous EBM-based practice with clinical activities throughout the clinical years. Moreover, smartphone-based e-learning has become an efficient means to facilitate medical knowledge handling and deliberation among medical students and healthcare providers; therefore, this method should be further investigated, and more applications for smartphones should be identified.

6. LIMITATION OF THE STUDY

The small participant sample enrolled in the current study. This limitation is justified as this study is a follow up study based on a previous study done by one of the authors [7]. Almost all participants in the previous study participated in the current one, the number of participants in first study was 15 students who are the total number of students participated in the EBM course (100% participation of students enrolled in this elective course), in the follow up study no of participants was 14 students (93.3% participation of students enrolled in the elective course. The missed participant applied for his internship outside KAU). For The comparison between the EBM and non-EBM groups, we decided to take the same sample number (14) participants to be comparable with the studied group.

CONSENT

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
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