



## Evidence-based medicine in pre-clinical years: a study of early introduction and usefulness

YOGESH ACHARYA<sup>1\*</sup>, M.V. RAGHAVENDRA RAO<sup>2</sup>, SATEESH ARJA<sup>3</sup>

<sup>1</sup>Department of Epidemiology and Preventive Medicine, Avalon University School of Medicine, Curacao, Netherlands; <sup>2</sup>Department of Students' Affairs, Avalon University School of Medicine, Curacao, Netherlands; <sup>3</sup>Department of Administration, Avalon University School of Medicine, Curacao, Netherlands

### Abstract

**Introduction:** Evidence Based Medicine (EBM) has established itself as a strong predictor of future medical practice by medical students. The purpose of this study was to determine the effectiveness of EBM in pre-clinical years and reflect on self-assessment skill of 4<sup>th</sup> semester medical students regarding the understanding of EBM and its various determinants.

**Methods:** All of the 4<sup>th</sup> semester (MD4) medical students at the Avalon University of Medical School, Curacao who had completed their EBM curriculum were asked to voluntarily participate in a cross sectional student survey containing qualitative and quantitative questionnaires in a 10-point scale. The students' responses were analyzed statistically and the results reported.

**Results:** Twenty-three students participated in the survey. 91% of them reported that EBM had helped them to better understand research process and 95% believed that EBM was necessary to develop clinical skills in the future. 78% of the students agreed that they were provided with enough resources for effective implementation of EBM in the university. All participants (100%) self reported that they could appraise the research articles effectively (mean score 8.26, S.D-1.45).

**Conclusions:** EBM is an integrative and comprehensive way to successfully adopt concepts of acquired medical knowledge for effective medical practice. Early introduction of EBM in preclinical years proved favorable in students and better equipped them with the ability to critically apprehend and appraise new research and innovations in medicine for optimal learning experience. There is a definitive need for scientific and systematic design of the curriculum for early introduction of EBM in pre-clinical years, best suited for the students. The principles should be directed towards further research for the effective implementation of EBM to enhance clinical skills.

**Keywords:** Evidence-based medicine; Medical education; Medical students; Curriculum; Evaluation

### \*Corresponding author:

Yogesh Acharya, MD  
Department of Epidemiology  
and Preventive Medicine,  
Avalon University School of  
Medicine, Sta. Rosaweg 122-  
124, Willemstad, Curacao,  
Netherland Antilles  
**Tel:** +5999-788-8008  
**Fax:** +5999-788-8102

### Email:

yogesh.acharya@avalonu.org,  
dryogeshach@gmail.com

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### Introduction

Evidence-Based Medicine (EBM) is a dynamic process that forms the basis of modern medicine. EBM is defined as the holistic approach of combining current research and innovation

in modern medicine, and can be reflected in the patient care with optimal output. It incorporates basic fundamental medicinal tools, using real time evidence to benefit patients. EBM has increasingly been taken as a standard of medical

care in the modern times. EBM combines clinical competency with best available evidences. It provides a framework for clinical decisions and guides the action of the practitioner. One of the principles of EBM is to make the student competent enough to go through different available resources and enable them to interpret these resources and decide which one is best suited. In this regard, EBM definitely helps to make a suitable decision.

EBM supports the principles of integration and reflective model of learning and forms a solid foundation for incorporating these in medical curriculum. Integration, as such, is the basic principles in medicine for getting into the roots of disease causation, and thereby formulating the plan of care. Integration of fundamental biomedical knowledge, which is one of the core competencies of ACGME, is essential for understanding of patho-physiology of disease process and making right decisions for the management of the patient. Integration helps to retain the knowledge and establishes interest in medical students (1). Integration should reflect the learning aptitude. There is subsequent lack of interest in basic medical sciences as patient care is not directly reflected in learning techniques. Reflective practice, a model approach for EBM, reflects one's awareness of their own capability of visualizing the learning perception, directing the actions. Learning should be reflected in the students' behavior and subsequent practices (2). We can inculcate interest in the students by implementing vertical integration in the curriculum especially in the first two years by reflecting clinical principles throughout basic sciences, whereby EBM becomes a convenient tool. One of the objectives is to blend all these medical subjects, study their usefulness and create enthusiasm in students.

Most of the research articles interpret the finding in terms of statistics and whether the findings are statistically significant or not. Statistical knowledge and being literate in research methodology and interpretation are equally important in EBM (3). Statistical significance does establish the basis of selection of one group over the other, but there can be possible conflicts in future between statistical and clinical significance. This limitation of EBM can be overcome by group discussion and expert opinion to choose what is best for the patient. To enhance interest and promote student participation, focus should be on explaining application of knowledge and its significance for patient care with best available resources. This can be achieved by demonstrating proper integration of basic science

knowledge into clinical application, introduction of problem-based learning, EBM, journal club and short-term clinical observation and exposure.

Effective teaching techniques represent the first goal of successful EBM delivery and incorporation into the medical curriculum. Even though EBM increases skills in pre-clinical students, there is still a clear void in terms of superior method of EBM delivery; and the best suitable policy can be made based on specific objectives and available resources (4). It is pertinent to address the specific interest to make EBM learning a more suitable experience for the target audience (5). Blended methods have been proved to be superior in comparison with face to face teaching model for EBM delivery in terms of cost effectiveness, within a framework of teaching objectives. Blended techniques are also helpful in changing the positive attitude of medical students towards EBM techniques, clearly reflected in their practice (6, 7). Group discussions, learning through case methods; and single, brief training sessions are some of the alternative approaches that enhance understanding of EBM in medical students and can be applied as effective EBM teaching tools (8-10).

EBM does have limitations for successful implementation in preclinical years. This can be broadly divided into institutional limitations and student factor. It has always been a challenge to introduce EBM in the basic science program. Basic science is a foundation of clinical medicine and integrates comprehensive study of different systems and processes necessary for normal health as well as deviation, potentially resulting in disease. Basic science has limited exposure to clinical setting and real time simulations experience. Basic science is limited within the boundary of acquiring concepts and knowledge to step up in clinical rotations. As such practical approach, patient interaction and clinical decision within standard quality of care are traditionally part of the clinical medicine, clinically oriented curriculum should be the main focus in basic science. Therefore, curriculum should incorporate comprehensive integrated teaching methods in accordance with best evidence. Staff shortage and lack of confidence in tutors is another limitation to successful implementation of EBM in medical schools. Capable and trained faculty members with conceived knowledge of basic science medicine and clinical experience are necessary to establish a casual interaction and generate motivation in the classroom.

The early introduction of EBM in medical schools has been effective in changing the thought process of the medical graduates. It also increases

the ability for logical and critical appraisal, better suited for the understanding of the disease process and subsequent management (11). Students are better equipped with critical appraisal skills and decision-making capacity after the introduction of EBM. In this scenario, EBM definitely has a positive impact in building competency.

The purpose of this study was to investigate the efficacy and usefulness of early introduction of EBM in medical school curriculum. This study focuses primarily on the curriculum design of EBM at Avalon University School of Medicine, paired with cross-sectional student survey study to evaluate different determinants of successful implementation of EBM with the help of standard questionnaires.

Pre-clinical years are divided into 5 semesters (MD1-MD5) in Avalon University School of Medicine. MD1-MD4 consist of the foundation of basic sciences curriculum, and MD5 is structured and designed to prepare the students for competitive board exams and equip them with brief clinical exposure before starting the clinical rotations in different clinical settings. Although EBM is introduced systematically in the 4<sup>th</sup> semester (MD4), research methodology is introduced early into the syllabus in the pre-clinical years through journal clubs. Students are encouraged to participate in journal clubs and problem based learning from the very first semester. The class is divided into multiple small groups of maximum two members, and these groups are followed by a particular set of assignments. One of the assignments is a class presentation on a current medical topic that directly correlates to their teaching syllabus. These topics focus on current evidence in medicine. Students are required to play an active role in the class and reflect the learning in solving the problem.

University provides the students with different offline and online medical journals, and free access to research database, like EBSCO. These students are also trained to use online medical databases and portal, and encouraged to actively go through the university provided materials. They are taught and trained to follow patient, intervention, comparison, and outcome (PICO) model for EBM, which provides a systemic framework for practicing EBM. Students have to design a question based on PICO format and search for the answer using common available research tools. These tools can be PUBMED, EBSCO or journal in the library. The assessments of the tools will reflect the learning skills, provide answer to the structured questions, and guide intervention.

Students were encouraged to participate

actively in e-learning to effectively and efficiently implement EBM at the personal and practice level. Teaching materials included combination of different resources (readings journals, online tutorials and videos, free-shared software for calculating epidemiological measures) to solve the problems of each session; problems and exercises in which students apply concepts and acquire the skills necessary for searching and appraising the medical literature efficiently. These problems were delivered by the instructors during the sessions. They are motivated towards reading greater number of journal articles, understand research process and appraise the results. They are also equipped with ability to understand the problems behind carrying out a search of the literature from databases such as PUBMED and EBSCO, having an understanding of the different types of literature reviews. The most important thing is to be able to ask a focused research question, carry out a literature search, write a literature review and reference a document appropriately.

At the end of this semester, the students are expected to understand the scope and aim of EBM, and execute steps necessary to provide basic physical therapy services with best available current evidence. This would include common clinical guidelines, making the students capable of forming the questions, searching for evidence, conducting meta-analysis for systematic reviews, evaluate the evidence, etc.

The final course evaluation and scoring is based on the active participation in the class, class presentation on the aspects of evidence for various common clinical conditions, the understanding of the students to appraise the research article, and ability to apprehend it in their practice, which is reflected through their response to various questionnaires based on real life situations.

## Methods

A cross-sectional student survey was performed anonymously at the end of the 4<sup>th</sup> semester (MD4). All students currently in the 4<sup>th</sup> semester of Avalon University School of Medicine and attending EBM mandatory course as a part of their curriculum were voluntarily enrolled in the study to self assess their understanding of EBM in different aspects and satisfaction towards the course technique. The students who were not willing to participate in the studies and those with less than 80% of attendance at EBM classes were excluded from the study.

The students were briefed about the study and were ensured of anonymity. A set of questionnaires were prepared to address the objectives of the

study. All the participating students were provided with this set of questionnaires. These questions were divided into qualitative and quantitative questions. The quantitative questionnaires were graded on a 10-point scale. The questionnaires were collected after the response, recorded and the data were analyzed with SPSS.

As a part of the survey, the students were asked to evaluate the faculty members assigned for delivery of EBM and suggest different recommendations for successful implementation of EBM in pre-clinical years to enhance their skills. Finally, the students' performance at the end of the semester was evaluated. This final evaluation was performed, using an online test containing multiple choice questions structured to evaluate the students' understanding of EBM. Their responses were graded and documented.

#### Ethical considerations

A proposal of the study was presented and passed through the ethical review board. The objectives and aim of the study was thoroughly explained to all the voluntary participants and consent was obtained. Priority was given to maintain the anonymity of the respondents.

#### Results

Of 27 students, 23 (85%) participated in the survey. The students showed an encouraging response to the introduction of EBM in the curriculum, although most of the students did not seem to participate directly in research process during their pre-clinical years (Table 1).

#### Self-evaluation of the EBM skills

Students were asked to self evaluate their

understanding of EBM and its determinants. Most of the students reported they understood and appraised research articles and could effectively use Pubmed and EBSCO to search for the useful medical information (Table 2).

#### Students' evaluation of faculty members

The students were obliged to participate in class presentation, discussion and online assignments. The faculty members were evaluated by the students for their role in effectively organizing EBM curriculum. The mean score for faculty satisfaction and performance was 9.04 (10-point scale) and 95% of the students responded that they enjoyed the course.

#### Students' responses for successful implementation of EBM

The students recommended that early introduction of EBM would be a useful way to teach and train EBM with integration of statistics and active participation in research.

#### Faculty members' evaluation of medical students

The final evaluation of the class after the EBM course through online multiple choice questions to evaluate the students' knowledge and understanding of EBM yielded an average of 64.44% with scores ranging from 50% to 80%.

#### Discussion

There should be an effective way to educate students about the importance of EBM and its usefulness in future clinical practice. Effective classroom teaching incorporated with hospital demonstration and real time simulation will help students to better understand EBM (12). Online

**Table 1:** Students' responses on research process and Evidence Based Medicine (EBM)

	Agree	Do not agree
Possess adequate knowledge about research process	21 (91.30%)	2 (8.7%)
Involved in research activities at university	5 (21.73%)	18 (78.27%)
Believe EBM is necessary for effective clinical practice	22 (95.65%)	1 (4.35%)
Believe adequate resources are available for EBM	18 (78.26%)	5 (21.74%)

**Table 2:** Self-evaluation score of medical students on their understanding of EBM and its related factors: Evidence Based Medicine (EBM), Patient, Intervention, Comparison, and Outcome (PICO)

	Mean±SD	Med	Mode	Min	Max
Understand EBM	8.26±1.45	8	8	6	10
Understand PICO	6.85±1.95	7	6	3	10
Effectively use Pubmed	8.2±1.32	8	8	6	10
Effectively use EBSCO	8.33±1.53	8	10	5	10
Can appraise research article with therapy	7.42±1.74	7	7	4	10
Can correlate findings with disease process	7.55±1.88	8	8	4	10
Understand statistics	7.66±1.82	8	8	4	10
Understand abstract	9.25±0.85	9.5	10	8	10

module in EBM is very effective and enhances overall skills in medical students. Incorporation of EBM increases the knowledge; attitude, logical reasoning and self reported skills in the medical students (13).

Medical students' sudden exposure to EBM in clinical years has minimal effect in critical appraisal ability. Therefore, EBM should be introduced early and systematically in medical schools and continued in preclinical and clinical years with maximal benefit (14). Multiple studies have proved that early introduction and exposure of EBM will enhance understanding and aid in clinical practice. The key to success is frequent early exposure combined with motivation. Students should be introduced to EBM quite early in medical schools. Pre-clinical training and the education of the ways of EBM practices will enrich students with basic principles and provide a niche for motivation. This pre-clinical training has to be continued to consolidate clinical practices. The curriculum has to be revised with active participation from students and teachers directly involved in teaching and learning EBM (15). Educational institutions are recommended to introduce and implement EBM curriculum in pre-clinical basic science education for optimal output of the program. Change in curriculum to make it EBM friendly has improved medical students' aptitude, attitude and future application of medical knowledge (16).

Early introduction of EBM combined with blended learning techniques like group discussion and direct participation, online resources and structured curriculum has strong outcome in learning EBM. Blended learning approach with online resources and group activities are very effective. Blended teaching is effective owing to its reflective learning methodology. Students find blended approach more engaging and motivating. Blended teaching methods could be introduced quite early in basic science with the help of journal club and student forum for practice based research discussion (17). Clinical practice is based on the foundation of basic medical knowledge and its incorporation to answer clinical questions. There have been different attempts to introduce EBM effectively and efficiently in medical school curriculum in pre-clinical and clinical years (18). Multiple guidelines have been developed to evaluate the most suitable methodology for practice. EBM is based on logical reasoning with the use of most research materials and evidence best suited to answer the question in the problem. Since the pre-clinical year student has limited knowledge and lacks proper integration and logical reasoning capacity due to inadequate

medical knowledge halfway during training years, the dilemma still remains as how and when to introduce EBM in pre-clinical years. Therefore, suitable strategies should be developed to introduce EBM in preclinical years so that the students can acquire the required skills.

Another very important aspect in EBM is the test of competency. Although competence in EBM can be tested and assessed using Berlin questionnaire and Fresno test, they weakly correlate and cannot be interchanged for assessment in pre-clinical students (19). It is necessary to organize the course, develop strategies for effective implementation, organize assessment plan, and facilitate teaching with continuous student feedback to incorporate EBM successfully in the medical school curriculum. Appropriate placement in the curriculum, course outline and content with appropriate teaching methods, right educational tools and resources, small group discussions, appropriate assessment methods for students, student feedback and effective course directors are the key factors in successful implementation of EBM curriculum (20). This will facilitate medical students to use their skill in the future while working as clinicians. The implication is broad but rewarding.

## Conclusion

Evidence based-medicine (EBM) is an important aspect in medical education because it provides the opportunity to research deeply in the medical literature about a particular area of interest. It also gives an opportunity to the student to integrate basic and clinical sciences for developing skills as a future health professional. In order to practice quality health care, clinical decisions should be based on clinically relevant scientific evidence. Introduction of EBM from early pre-clinical years enables students to appraise the current work in medicine and use it for skill enhancement. Future research is warranted to establish these findings and establish an integrative multidisciplinary approach to introduce EBM as an integral part of curriculum, best suited for the medical students.

**Conflict of Interest:** None declared.

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