Team-Based Learning versus Small Group Discussions for delivering an Evidence-Based Medicine course to undergraduate medical students: An Educational Quality Improvement Project

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ABSTRACT

Teaching of Evidence-Based Medicine (EBM) in the new undergraduate medical curriculum at the Faculty of Medicine of the American University of Beirut (AUB) is designed to start in first year and continue vertically till graduation from medical school. Current methods of EBM instruction at AUB include Team-Based Learning (TBL), lecturing and medium-sized group discussions, whereas the classical format of teaching EBM is small group discussions. We do not know however whether TBL is more, less or as effective as small group discussions in increasing students' EBM knowledge and skills since there has been no head-to-head comparison of the two instructional methods.

In this project, we aim to conduct a randomized controlled trial to investigate which of the two methods is more effective in improving student's EBM knowledge and skills. Medical students of the 2021 class will be randomly allocated to receive EBM instruction during second year either in TBL or in small group discussion format. EBM knowledge of the two groups will be compared using a validated EBM questionnaire at the end of second year. EBM skills will be compared at the end of the final clinical year. The findings from this project will provide much needed evidence about the effectiveness of TBL in teaching EBM to large classes. This project is approved by the curriculum committee of the Faculty of Medicine and the Institutional Review Board as a quality improvement project.

BUDGET

One research assistant (RA) is needed for 1year on part-time basis.

RA salary: $500 per month x 12 months= $6000.

Supplies (printing and photocopying of reading material for 120 students, several modules, over 1 year)= $1000.

Total= $7000.

RATIONALE

The Faculty of Medicine at the American University of Beirut (AUB) implemented recently a new curriculum, the Impact curriculum, which includes Evidence-Based Medicine (EBM) as one of its competencies. In this curriculum, the teaching of EBM principles starts in first year medical school and continues vertically till graduation at the end of the fourth year. In year 1, students are taught how to formulate a clinical question and how to search medical databases using different teaching formats such as didactic lectures for large classes and medium-sized groups (15-20 students), supplemented with group exercises. In year 2, they are taught critical appraisal skills in large classes using team-based learning (TBL) due to the unavailability of sufficient facilitators that can lead small group discussions, the method often used to teach EBM. We do not know however whether TBL is more, less or as effective as small group discussions in increasing students' EBM knowledge and skills.

In this educational quality improvement project (QI), we plan to compare the effectiveness of two EBM teaching methods in second year of medical school: TBL versus small group discussions, taking advantage of the currently ongoing training of eight faculty members of different clinical specialties in EBM. This project is expected to guide us in choosing between

TBL and small group discussions as the most effective method to teach EBM in large classes of preclinical medical students at AUB. Dissemination of the results of this project through publication in peer-reviewed medical education journals will fill a knowledge gap in this field and guide international evidence-based medicine teachers.

SPECIFIC AIMS

To investigate which of the two instructional methods (TBL versus small group discussions) is more effective in:

1. Improving students' knowledge and skills of EBM at the end of second year medical school.
2. Improving students Evidence-Based Practice during the clinical years, as assessed at end of fourth year.

LITERATURE REVIEW

EBM is "the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients".[1] Evidence-based practice (EBP) is associated with reduction in medical errors, promotion of individualized care and increased application of best practices.[2,3] Moreover, EBP improves physicians' performance and patients' outcomes.[4-5] EBP requires physicians to be trained in the skills of EBM. Early introduction of EBM in the undergraduate medical curricula facilitates the development of necessary professional competencies such as self-directed learning.[6-7] Different educational strategies for teaching EBM in the undergraduate medical curriculum have been reported in the literature. These include didactic lectures, workshops, online courses and blended techniques.[7] However, in a systematic review that compared different instructional methods, no single method stood out as superior to other methods in teaching EBM.[6] Two other systematic reviews reported that well-conducted

studies comparing the effectiveness of EBM teaching methods were lacking, and that there is a need for more rigorous trials to assess the effectiveness of the different teaching methods.[2,6] TBL is an active instructional method developed to help students achieve course objectives while learning how to function in teams.[8] It has recently gained popularity in medical education, and can be applied to large groups of up to 100 students.[8,9] However, TBL as an EBM teaching method was described in few studies[10,11,12] that reported high level of students' engagement and interaction in class,[10] as well as fostering individual accountability and promoting teamwork behaviors consistent with effective EBM practice.[10] To our knowledge, there have been no robust designs such as randomized controlled trials that compared the effectiveness of TBL versus small group discussions as EBM instructional methods.

METHODS

Context

This QI is designed in accordance with the Revised Standards for Quality Improvement Reporting Excellence (SQUIRE 2.0).[13]It will be conducted at the Faculty of Medicine of the American University of Beirut in Lebanon beginning of academic year 2018-2019. Participants will be all medical students of class 2021 during their second year. Medical students belonging to other classes will be excluded. The team of instructors will be faculty members who are currently undergoing training in EBM, and who will constitute the EBM team at AUB.

Interventions

At the beginning of their second year, the students will be divided randomly into two groups during their EBM sessions: *TBL* group and *small group discussions* group. In each module, the same EBM exercise will be delivered using TBL format in the first group (half the class),

whereas the second group will be further divided into 7 smaller subgroups of 8 students each, and will do the same EBM exercise as the TBL group using small group discussions format. All group/subgroup sessions will be conducted at the same time with one EBM facilitator assigned to each group. The EBM facilitators will rotate over all groups/subgroups during the academic year in order to assure similar exposure of students to the different facilitators. The facilitator-group assignment will be done randomly using the computer to avoid selection bias. **(Appendix 1: EBM topics and Description of interventions)**

Participants

Given that this is a quality improvement project, and that this course is a curricular requirement from all students during medical school, participants will include all students of 2021 class during their second year of medical school. This number is estimated to range between 100 and 120 students at the American University of Beirut's Faculty of Medicine.

Students will be allocated on a 1:1 ratio into either a TBL group or a standard method group (small group discussions). The random allocation of the students into groups will be done by an independent statistician with codes replacing student names. The allocation list will be kept with the statistician till the first day of the EBM course in second year when students will be told of their allocation by the course coordinator. A computer generated stratified randomization will be done using permuted blocks of variable sizes. The stratification will be according to the student's self-reported preferred teaching method so as to have equal distribution of students who prefer TBL versus other methods in both groups. Students' preferred teaching method will be assessed at the end of the first year by asking students to choose from among 3 different teaching methods **(Appendix 2: Survey of the students' preferred teaching method).** By the end of the first

year, students would have had enough exposures to all three teaching methods and hence would be able to choose their preferred teaching method.

EVALUATION

The effectiveness of the two instructional methods will be measured as follows:

1. The validated Berlin questionnaire [14] will be used to measure the students' knowledge in EBM at the end of second year.
2. Students' EBP (behavior) will be assessed by using the EBM checklist, which is a 6-item tool that we developed and that will be tested during the academic year 2017-2018. **(Appendix 3: EBM checklist)**. The students' competency in EBM will be assessed by the trained EBM faculty during EBM rounds that will be conducted in Internal Medicine, Family Medicine and Pediatrics clerkships during fourth year.
3. Students' self-efficacy in EBM will be measured by the validated EBM Self-efficacy scale[15] at the end of the fourth year. **(Appendix 4A: Self-efficacy in EBM scale)**.
4. Students' self-assessed EBP implementation will be measured with the validated EBP implementation instrument at the end of fourth year.[15] **(Appendix 4B: EBP implementation scale)**.
5. Agreement between teachers' assessment of students' competency in EBM and students' assessment of EBM self-efficacy and implementation at the end of fourth year. (EBM checklist Versus Students' self-efficacy and implementation respectively)

Analysis

Data Collection

At the end of second year, we will test students on their knowledge and skills in EBM using the Berlin questionnaire. During fourth year, EBM instructors in Internal Medicine, Pediatrics and Family Medicine will evaluate students EBP (behavior) during clinical rounds using the EBM checklist. At the end of fourth year, students' EBM checklist's scores will be averaged into a single score for each student. In addition, students will self-evaluate their efficacy in EBM and EBM implementation at the end of fourth year during the Capstone course.

Statistical methods

The class size will assure at least 80% power to detect a difference of 0.55 standard deviations in the mean scores of both groups on the Berlin questionnaire, with 5% alpha level.

We will describe distributions using mean and standard deviation for continuous data and numbers and percentages for categorical data. We will compare the mean scores of the 2 groups on the Berlin questionnaire using Student's independent t test. Similarly, we will compare their mean EBM checklist's scores, mean EBM self-efficacy scores and mean EBM implementation scores. We will investigate the correlation between the mean checklist's scores and the self-report on efficacy and implementation of EBM using the Pearson correlation coefficient test.

We will build a multivariate regression model to investigate the relationship between the teaching methods (TBL vs. small group discussions) as predictors, and Berlin score as the outcome while adjusting for the following covariates: gender, MCAT score, rank upon admission to medical school, and grade on Fundamentals of Medical Research course. Similar models will be built for each of EBM checklist's score, EBM self-efficacy score, and EBM implementation score as outcomes, with the same previous predictors. We will also do repeated measures

analysis of the student scores on the EBM checklist at different time points (in the different clerkships). This will help show the change in scores over time.

Data analysis will be conducted using the intention to treat analysis. A *p* value of 5% will be considered significant and 95% confidence intervals will be calculated for all analysis when possible. We will use IBM SPSS version 24 (Chicago, IL) for data entry, management and analysis.

KNOWLEDGE DISSEMINATION

The final report of this project will be presented in national and international medical education conferences. It will also be submitted for publication in peer-reviewed medical journals.

HUMAN SUBJECTS

This quality improvement project is approved by the Curriculum Committee and the Associate Dean for Medical Education, Faculty of Medicine, American University of Beirut. It was also submitted to the Institutional Review Board of the American University of Beirut for review and was considered exempt because it is a quality improvement project. Written informed consent will be sought from students for permission to use their course grades in aggregate form for later publication **(Appendix 5: Consent form)**.

TIMELINE

	May 2018	AUG. 2018-May 2019	June 2019-May 2021	June-Oct. 2021
Med 1: Randomization, consenting, and division into groups	**X**			
Med. 2: EBM instruction (TBL vs. small groups)		**X**		
Med 2: Berlin Questionnaire administration		**X**		
Med 3 & 4: EBM clinical rounds			**X**	
Med 4: EBM self-efficacy & implementation questionnaire administration			**X**	
Analysis & write up				**X**

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APPENDIX 1-A

List of EBM topics taught during the four years of medical school at the Faculty of Medicine, American University of Beirut.

1- First year:

- How to phrase a focused clinical question using the PICO strategy
- How to search medical databases: Medline, PubMed, Cochrane

2- Second year:

- How to appraise a Randomized Controlled Clinical Trial
- How to appraise a Diagnostic Accuracy Study
- How to appraise a Systematic Review
- How to appraise a Cohort Study
- How to appraise a Case-Control Study
- An introduction to the GRADE method of assessing the quality of evidence

3- Third year:

- Application of the 5 elements of EBM on a real patient.
- A PowerPoint presentation that summarizes the application of the 5 EBM steps on the patient during EBM rounds.

4- Fourth year:

- Incorporation of EBP into clinical care of patients: case presentations during EBM rounds, with emphasis on the balance between evidence for benefits, harms, cost and patient preferences and values.

APPENDIX 1-B

Description of the interventions

A- Team Based Learning group

Each session will be organized as follows:

-Learning Objectives will be posted on Moodle one week prior to the session

- Required readings prior to the session will be uploaded one week before the session. Readings include one chapter about critical appraisal of a particular study design and a paper that has the same study design.

-Individual readiness assurance test (iRAT) will be administered at the beginning of the session. Students are expected to individually answer the multiple choice questions (MCQs) of the iRAT that relate to the topic of the session.

-Afterwards, the iRAT answers will be collected and students will answer the group readiness assurance test (gRAT) which is composed of the same questions as the iRAT in groups of 5 to 6 students.

-The gRAT answers will then be collected and teams will discuss with the instructor questions that need further clarification or explanation.

-Application activity: Students will work in groups on an application exercise.

-Discussion of the application activity with the facilitator, wrap-up and conclusions.

Instructor's responsibilities during TBL:

1) Prepare reading materials before each session, as well as the individual and the group Readiness Assurance Tests (iRAT and gRAT)

2) Respond to appeals posed by students with regards to the iRAT/gRAT questions

3) Prepare the application exercise

4) Guide class discussions and provide feedback

5) Prepare and grade all course assessments (iRATs, gRATs and application exercise)

B- Small group discussions

Students will be divided into subgroups of 8-10 individuals. Each group is assigned one EBM facilitator (instructor). They will be provided with the same learning objectives and required readings prior to the session as the TBL group. During the session, the students will discuss the provided paper amongst themselves with the guidance of the facilitator. After the session, the students will be provided with an application paper that they submit as homework in groups. They will be graded on their appraisal skills and participation in discussions during class, as well as their group homework exercise.

Instructors' duties during small group discussions:

1) Prepare the material given to students
2) Assess and reply to all students' questions and clarifications
3) Guide group discussion and provide feedback
4) Evaluate students' appraisal skills during class and in homework application exercise.

APPENDIX 2

Survey of Students' Preferred Teaching Method

Student name: _____

Student ID number: _____

Please indicate your most preferred teaching method by encircling ONE of the below choices:

- o Didactic lectures
- o Team Based Learning
- o Small group discussions

Appendix 3: EBM checklist

Instructor's EBP Implementation Scale

DIRECTIONS: During this round, please indicate how much you agree or disagree with the below statements that assess the student's competence of each skill by selecting the response that most closely corresponds to your opinion.

Strongly Disagree **Disagree** **Neutral** **Agree** **Strongly Agree**

SD **D** **N** **A** **SA**

ITEM	SD	D	N	A	SA
1. Generated a PICO question about a real patient					
2. Accessed the Cochrane database of systematic reviews. Or Searched for an EBP guideline or a systematic review.					
3. Critically appraised evidence from a research study.					
4. Shared evidence from a study/ies in the form of a report or presentation to >2 colleagues.					
5. Assessed application to patient in terms of benefit/harm/cost balance					
6. Critically compared current practice with evidence findings					

Appendix 4: EBM self-efficacy and implementation questionnaires

A- Assessment of EBM Skills in Medicine IV

Academic year: 2020-20-21

Time (End of Med4)

Student's name:_____

Evidence-Based Practice (EBP) Self-Efficacy Scale

DIRECTIONS: For each of the following statements, please indicate how much you agree or disagree by selecting the response that most closely corresponds to your opinion.

Strongly Disagree Disagree Neutral Agree Strongly Agree

SD D N A SA

STATEMENT	SD	D	N	A	SA
1. I believe that EBP results in the best clinical care for patients.					
2. I am clear about the steps of EBP.					
3. I am sure that I can implement EBP.					
4. I believe that critically appraising evidence is an important step in the EBP process.					
5. I am sure that evidence-based guidelines can improve clinical care.					
6. I believe that I can search for the best evidence to answer clinical questions in a time efficient way.					
7. I believe that I can overcome barriers in implementing EBP.					
8. I am sure that I can implement EBP in a time efficient way.					
9. I am sure that implementing EBP will improve the care that I deliver to my patients.					
10. I am sure about how to measure the outcomes of clinical care.					
11. I believe that EBP takes too much time.					
12. I am sure that I can access the best resources in order to implement EBP.					
13. I believe EBP is difficult.					
14. I know how to implement EBP sufficiently enough to make practice changes.					
15. I am confident about my ability to implement EBP where I work.					
16. I believe the care that I deliver is evidence-based.					

B- Evidence-Based Practice (EBP) Implementation Scale

DIRECTIONS: During the past 8 weeks, please indicate how often you performed each of the following items:

ITEM	0 Times	1-4 Times	5-6 Times	7-8 Times	>8 Times
1. Used evidence to change my clinical practice.					
2. Critically appraised evidence from a research study.					
3. Generated a PICO question about my clinical practice.					
4. Informally discussed evidence from a research study with a colleague.					
5. Collected data on a patient problem.					
6. Shared evidence from a study/ies in the form of a report or presentation to >2 colleagues.					
7. Evaluated the outcomes of a practice change.					
8. Shared an EBP guideline with a colleague.					
9. Shared evidence from a research study with a patient/family member.					
10. Shared evidence form a research study with a multidisciplinary team member.					
11. Read and critically appraised a clinical research study.					
12. Accessed the Cochrane database of systematic reviews.					
13. Accessed the National Guidelines Clearinghouse.					
14. Used an EBP guideline or systematic review to change clinical practice where I work.					
15. Evaluated a care initiative by collecting patient outcome data.					
16. Shared the outcome data collected with colleagues.					
17. Changed practice based on patient outcome data.					
18. Promoted the use of EBP to my colleagues.					

Appendix 5 : The consent form

Consent for Permission to Use Course Grades in Publication

Project title: Team-Based Learning versus Small Group Discussions for Delivering an Evidence-Based Medicine Course to Undergraduate Medical Students: An Educational Quality Improvement Project.

Investigators: Dr. Mona Nabulsi, MD, MS

Dr. Dayane Daou, MD

Address: Medical Education Unit

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Phone: 01-350 000 Ext 5523

You are asked to consent to the use of your EBM course grades for a quality improvement project conducted at the American University of Beirut. Please take time to read the following information carefully before deciding whether you want to consent to the use of your course grades. Feel free to ask the instructors if you need more information or clarification about what is stated in this form and the project as a whole.

We are instructors teaching the undergraduate EBM course at AUBMC and are currently conducting an educational quality improvement project (QI) that aims at comparing the effectiveness of two EBM teaching methods in second year of medical school: TBL versus small group discussions. This project is expected to guide us in choosing between TBL and small group discussions as the most effective method to teach EBM in large classes of preclinical medical students at AUB.

During this course, all students will be tested for their knowledge and skills in EBM in each module during second year. Later in clinical years, students will be evaluated on their application of their EBM skills.

We plan to publish our findings in a Medical Education journal when the QI project is over so other medical educators teaching EBM to large classes can benefit from our experience. We therefore ask for your permission to use your course grades and evaluations for the quality improvement project purposes.

Confidentiality

Course grades will be reported in aggregate form only, in one or more publications. Your name and other identifying information will never be attached to your grades, or reported when data is published. All data will be kept secure in a password-protected computer in the private office of Dr. Mona Nabulsi at the Faculty of Medicine. Data access will be limited to the instructors working directly on the project as listed at the top of this document. All data will be destroyed responsibly after a maximum of five years from publication.

Your participation is voluntary. You have the right to decline this invitation for any reason. Your decision to withhold your consent will in no way affect your relationship with your instructors or with AUB- Faculty of Medicine.

Instructor's Statement:

I have reviewed, in detail, the informed consent document for this quality improvement project with _____ (name of student), the purpose of the project and its benefits. I have answered to all the student's questions clearly.

_____ _____

Name of Instructor or designee **Signature**

_____

Date & Time

Student's Participation:

I have read and understood all aspects of the quality improvement project and all my questions have been answered. I voluntarily consent for my EBM course grades to be used for the QI project, and I know that I can contact Dr. Mona Nabulsi on **01-350000 Ext 5445/ mn04@aub.edu.lb**, or her designees at **76 75 46 35.** I understand that I am free to withdraw this consent at any time, even after signing this form, and it will not affect any benefits to which I am otherwise entitled, or my relationship with AUB or AUBMC. I know that I will receive a copy of this signed informed consent document.

Name of Student _____ **Signature** _____

Date & Time _____