

FRESNO TEST OF COMPETENCY AS A FORMATIVE ASSESSMENT TOOL AS AN AID TO LEARNING PROCESS

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ABSTRACT

AIM: Various assessment instruments have been developed to assess knowledge and skills of students. Fresno test of competency is one such tool that is used in an evidence-based medicine programme.

BACKGROUND: To study the use of “Fresno Test of Competency” for assessing evidence based medicine (EBM) course as a formative assessment tool as an aid to learning process.

METHODS: Fifteen Postgraduate students attending EBM course spanning two semesters (6 months each) were recruited. To formatively assess students’ skills one month after the start and at the end of the course, Fresno test of competency was applied. Mean scores with standard deviations were compared between pre- and post-course results.

RESULTS: Response rate was 55%, only 8 out of 15 students completed both parts of the study. Evidence based medicine skills and knowledge improved in 7 out of 12 questions assessing different EBM skills (formulating focussed research question, sorting evidence, literature search using different tools, epidemiology, and understanding confidence intervals). The scores in assessing critical appraisal (relevance, validity and magnitude) were lower in post course test. Paired sample correlation of pre and post course tests shows a significantly higher positive correlation ($r=0.945$, $p < 0.0001$).

CONCLUSION: The improved scores of students in different skills show that this test can be applied, with modifications, to assess the students formatively in Evidence Based Medicine, in terms of their ability to develop research question, sort the evidence, and understand its epidemiological application to the general population.

KEYWORDS: Fresno test, competence model, formative assessment

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INTRODUCTION

Evidence based medicine (EBM) is the application of best available evidence gained from scientific methods in clinical decision making for the benefits of a patient.¹ It is generally explained in 5 steps as mentioned in Sicily model:² ask, acquire, appraise, apply, and assess. Since the inclusion of evidence based medicine into the training programs, various assessment tools have been devised to assess the level of knowledge and skills of the student. A tool

that assesses all the major intending learning outcomes of such a course is the best suitable tool. Fresno test of competency is one such tool for the assessment of evidence based medicine programme and has proved to be reliable and valid.³ Most of the previous assessment methods for EBM were based on self-reporting while this test is based on open ended questions with a standard grading rubric, which provides a good means for uniform assessment especially if they are analytic and improve learn-

ing.⁴ The test has been validated in several studies⁵⁻⁸ with good inter- and intra-rater reliability, internal consistency, high construct validity^{5, 6}, good responsiveness⁶, and as a good measure of EBM skills.^{7, 9}

Competency can go up from conscious competence to unconscious competence and become part of the behavior.¹⁰ Although evidence based medicine courses improves knowledge and skills of the participants, student’s behavior is changed little.¹¹ This could be because EBM course is assessed with this test in the form of a summative assessment tool¹² which may cause the deep learners to become superficial learners in an attempt to pass the exams. This may lead to a reduced responsiveness and acceptability in the long term¹³ and hence lesser chances of adaptability.

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It is therefore logical to think of an assessment tool like this to be used for formative assessment without fear of pass or fail. This will allow the students to know about their weaknesses when they first take the test, think independently, work on it during the whole period of course and fill the gaps in their knowledge and skills when it comes to the post course test. Therefore advocating formative assessment with concurrent institutional way of examination purely to let the students know what they don't know and change their behavior, might be useful.

Therefore, the aim of this study was to assess whether "Fresno Test of Competency" can be used as a formative assessment tool for assessing evidence based medicine (EBM) course as an aid to learning process.

METHODS

Study design; This was a longitudinal intervention study with a descriptive element, involving 15 students enrolled in Evidence Based Medicine course and Master of Clinical Science, University of Glasgow at Royal hospital for Sick Children Yorkhill, Glasgow. The study period was from September 2010 till March 2011. All students were invited to participate in the study and were introduced to the study design and its purpose through a verbal presentation and the details of the study. Informed consent was taken from each participant and they were allowed to withdraw from the study at any point.

EBM course-the educational intervention: Participants included students enrolled in the Evidence Based Medicine course. This course was composed of the following core components to achieve deep understanding of evidence based medicine.

1. Journal clubs for critical appraisal of literature.
2. Reflective portfolio.
3. Study learning methods.
4. Case presentations.
5. Scientific techniques learning.

6. Telemedicine.
7. Statistics, basic and advanced medical statistics.
8. Medical ethics.
9. Clinical audit.
10. Data handling.

The entire course was divided in two semesters based on 5 days per week classes. The duration of each class was 2 hours.

Assessment Tool- the Fresno Test of Competency: The assessment tool selected for the study was Fresno test of competency, which is a validated tool for assessing EBM course. This test included two clinical scenarios with unanswered questions, statistics, and diagnostic and prognostic study design questions. The test scenarios and statistical analysis questions were modified to the designed EBM course contents. The questions based on clinical scenarios test the ability of the student to formulate a research question out of a real problem, form appropriate key words for search, do literature search using web resources, assess the magnitude of evidence, validity, relevance, reliability of evidence, and types of study designs suitable for the research question.

The standard grading rubric can be referred to on the following web address; <http://www.uthscsa.edu/gme/documents/PD%20Handbook/EBM%20Fresno%20Test%20grading%20rubric.pdf>

The test was modified according to the contents of the EBM course, maintaining the same structure and principles (Table 1). The scores assigned to each question are given in Table 2.

Statistical analysis

Scores were expressed as mean and standard deviation. Statistical tests applied were paired sample t-test to compare the means and standard deviation of pre and post course test and two sample correlation coefficient to calculate correlation between pre and post course test scores. P-value of <0.05 was considered significant. The results were analyzed using SPSS version 18.0.

RESULTS

Out of 15 students, 8 students completed both parts of the study (response rate of 55%). No significant difference in percentage score was found between the two tests taken before and after the course; 6 out

TABLE 1: THE MODIFIED FRESNO TEST OF COMPETENCY USED IN THIS STUDY

FRESNO TEST OF COMPETENCY

(Case study for Medical Education Course)

This is a test to assess the level of utilization of EBM skills. Please complete the entire test in one sitting. There are 7 short answer questions, 2 questions that require a series of mathematical calculations, and three fill-in-the-blank questions. Allow yourself at least 30 minutes to complete the test.

Answer question 1-4 based on the following scenarios

SCENARIO 1: Antihypertensive drug group angiotensin receptor blockers (ARBs) are widely used for the treatment of hypertension and congestive cardiac failure. You prefer to prescribe this drug for your diabetic hypertensive patient but concerns have been raised in the literature about the relationship of ARBs with risk of different types of cancers.

SCENARIO 2: you are intending to use accelerometer (which is a device measuring person's physical activity while it is in the pocket of that person) for your PhD project to measure physical activity. Your colleague is arguing with you that it is not helpful to use because it doesn't measure the activity while a person is cycling. Although he is sitting on a seat, he is actually doing a physical activity and burning his calories. So your colleague suggests you to measure it using treadmill in the hospital.

Q.1 Write a focused clinical question for each of these encounters that will help you organize a search of the clinical literature for an answer and choose the best article from among those you find. (answer should include population, intervention, comparison and outcome).

Q.2; Where might clinicians go to find an answer to questions like these? Name as many possible types or categories of information sources as you can. You may feel that some are better than others, but discuss as many as you can to demonstrate your awareness of the strengths and weaknesses of common information sources in clinical practice. Describe the most important advantages and disadvantages for each type of information source you list.

Q.3; Choose to focus on one of the clinical scenarios (ARBs or accelerometer). What type of study (study design) would best be able to address this question? Why?

Q.4; If you were to search Medline (PubMed) for original research on one of these questions, describe what your search strategy would be. Be as specific as you can about which topics and search categories (fields) you would search. Explain your rationale for taking this approach. Describe how you might limit your search if necessary and explain your reasoning.

Q.5; when you find a report of original research on these questions, what characteristics of the study will you consider to determine if it is relevant? Include examples. (Questions 6 and 7 will ask how to determine if the study is valid and how important the findings are....for this question, focus on how to determine if it is really relevant to your practice.)

Q.6; When you find a report of original research on these questions, what characteristics of the study will you consider to determine if its findings are valid? Include examples (You've already addressed relevance, and question 7 will ask how to determine the importance of the findings...for this question, focus on the validity of the study.)

Q.7; When you find a report of original research on these questions, what characteristics of the findings will you consider to determine their magnitude and significance? Include examples. (You've already addressed relevance and validity...for this question; focus on how to determine the size and meaning of an effect reported in the study)

Q.8; the following numbers refer to the length of time spent in hospital (days) for 7 patients after a particular operation ...

2 2 3 2 15 1 3

- Are these data categorical or numerical? calculate the mean, median and mode of this data compute the range, inter-quartile range and standard deviation of this data

- Are any of the data values unusual?

- Is it reasonable to assume that these data are normally distributed?

Q.9; In a population based study, a sample of 600 subjects was equally divided into two groups (300 each). One who smoked 30 cigarettes daily for the past 10 years and second group was control group (not smoking). 60% of the cigarette smokers and 10% of the control group developed lung cancer after 15 years.

- Calculate the relative risk for cigarette smoking.

- Calculate the odds ratio for cigarette smoking.

- Calculate relative risk reduction for cigarette smoking.

Q.10; studies have suggested an increase in risk of colorectal cancer with obesity. What statistical test would you apply to see if it really is associated with an increase in risk of cancer? What confidence interval would you think be appropriate for a relative risk of 2.8?

Q.11; Which study design is best for a study about diagnosis?

Q. 12; which study design is best for a study about prognosis?

of 8 students in the pre-course test and 5 out of 8 students in the post-course test achieved more than 50% score. Mean score of participants was slightly higher in pre-course test as compared to post-course test. However, paired sample correlation of pre and post course tests showed a significantly higher positive correlation ($r=0.945$, $p < 0.0001$). One-sample T-test revealed a mean difference of 10.69 ($p=0.004$ and 95%

confidence interval; 4.24-17.13) in pre-course test and 10.56 ($p= 0.001$, 95% confidence interval: 5.66-15.46) in post-course test in relation to the assigned scores. Standard deviation (SD) scores for the questions on critical appraisal (question 6 and 7) were wide, 12.04 and 5.32 respectively, showing the lack of uniform judgment among the students regarding these qualities. SD scores of questions on understanding taught sta-

tistics were relatively uniform (and within 2 SD), before and after the course.

Scores of the participants for question regarding formulation of research question, finding the sources of evidence, search techniques and sorting out study designs for a research question improved with the course of Evidence Based medicine. A statistically significant change was found in questions regarding epidemiology. However there was a fall in the total scores in questions regarding the critical appraisal of literature, which includes; judging the relevance of study, validity and magnitude and significance of a study. There was no change in score of the statistics part of the Fresno test. The standard deviation scores of questions in the post-course test remained relatively closer to 2 standard deviations as compared to the pre course test (Table 2).

All students had a perception of beneficence of this test in testing their level of competence in competencies tested by this test, but all of them were of the opinion that the test was too lengthy and slightly difficult to understand.

DISCUSSION

This study shows that an extensive and well-structured focused EBM course helps postgraduate students and researchers develop skills to find out the best available evidence. Overall, there was an improvement in the ability to find out a focused research question which enables them to find the best source of literature search. These results are in accordance with another study which showed an improvement in scores in first 7 questions of the test modified for senior undergraduate medical students.⁷ Through training in the bibliographic databases during the course, the students showed an increased capability to use web sources to sort out the appropriate evidence. This shows that the core concept of EBM based on evidence, was inculcated in students which

TABLE 2: MEAN SCORES AND STANDARD DEVIATION OF THE STUDENTS AT ONE MONTH AFTER THE START (PRE-COURSE) AND AT THE END (POST COURSE) OF EBM COURSE

Question No.	Area of Knowledge Tested	Score assigned	Pre course mean score (SD)	Post course mean score (SD)
1	Formulation of clinical questions (open-ended)	12	7.5 (3.66)	8.5 (2.33)
2	Sources of evidence (open-ended)	12	4.5 (2.56)	6.25 (2.49)
3	Study design to answer clinical question in No.1 (open-ended)	30	13.5 (7.69)	17.25 (6.76)
4	Search techniques (open-ended)	17	9.75 (3.28)	11.25 (2.12)
5	Critical appraisal: Relevance (open-ended)	26	14.25 (6.71)	10 (0.00)
6	Critical appraisal: validity; (open-ended)	57	37.5 (3.24)	29.5 (12.04)
7	Critical appraisal; Magnitude and clinical significance (open ended)	26	13.75 (6.63)	10.5 (5.32)
8	Basic Statistics	20	18 (1.85)	16 (3.02)
9	Understanding Epidemiology	12	3.5 (4.50)	10 (2.14)
10	Understanding of 95% confidence interval	4	1.5 (1.41)	2.5 (1.41)
11	Study design: study on diagnosis (short-answer)	4	1.5 (2.07)	1.5 (2.07)
12	Study design: study on prognosis (short-answer)	4	3 (1.84)	3.5(1.41)

was reflected in their answers.

Improvement in mean scores was observed in 7 out of 12 questions. This correlates well with our hypothesis that, this test can be applied to students undergoing the course of EBM as a formative assessment tool. The students were able to improve their understanding after knowing their weaknesses in the pre-course test. However the statistical significance was not evident in some of them. Part of the EBM course where the students have shown a lower score at the end of the course is a concern. The unexpected inconsistent application of principles in EBM course may point towards heterogeneity of the teaching methods, teachers, course contents and the professional background of the students.

There was no difference in mean score of the students in pre-course and post-course tests; in fact, the mean score of students in post-

course test was non-significantly lower than the pre-course test (125 vs. 128). This was particularly clear in questions regarding critical appraisal of evidence measuring the validity, relevance and magnitude and significance. Fresno test has a reduced internal consistency, as shown in the study by Argimon-Pallàs and colleagues.⁶ Also, the students in the group were from different specialties although they were all medical professionals. This might have affected their ability to appraise the evidence from questions that were not from their area of specialty. In the opinions of the students, the test was difficult to understand which could have affected their score. Item difficulty of Fresno test is generally high but varies among studies widely.⁵ Therefore the test can be used when the students have been instructed about evidence based medicine beforehand or the test is applied to dissect the weak-

nesses of the ongoing course. We therefore considered pre course test after one month from the start of the EBM course.

Most of the students did not elaborate their answers where required, contributing to their lower scores. This shows that although the element of “must” exam in summative assessment may contribute to a deficiency in developing deep learning, the students develop a tendency to lose interest and concentration while attempting the questions in formative assessment. This becomes one of the limitations of the study.

Students showed a statistically significant improvement in understanding epidemiological principles, particularly understanding the odds ratio, relative risk and relative risk reduction. Epidemiology is one of the core contents of evidence based medicine and vital to understand the applicability of research findings to general population for determining valid diagnosis, prognosis and treatment.

The perceived benefit from the test was one common agreement between the students. This is a helpful finding, because the students realized their weakness in the first test and improved in the next test showing better score, although the overall mean score was lower in the post course test as compared to the pre course test.

This study had limitations which might have affected the results. The sample size and hence the power of the study was low. However we recruited all the students in the course and attempted to retain them for both sessions. Moreover, the modified test was not judged for its validity, construct validity, and inter-rater reliability before being applied. There is a concern about the generalizability of EBM principles among different disciplines of medicine and research. Our participants were from different specialties and different academic setups. A general lack of interest on behalf of the participants in completing the test was observed

(short answers and unsolved questions). Test difficulty level was high for the study subjects. Furthermore, half of the participating students were enrolled in two courses at the same time (EBM course and health professional education course) each with its own unique requirements, which might have affected their dedication to EBM course. Fresno test has got its own limitations. The test has been designed primarily for medical students and medical graduates. Therefore it may not be fit for purpose in allied health sciences without modifications.¹⁴ Additionally, it cannot measure the effectiveness of EBM process.¹⁵ Finally, studies have shown reduced internal consistency of the test. The reason being, the test questions need to be balanced for the group under study. They cannot be made too easy or too difficult.

CONCLUSIONS

Notwithstanding these limitations, the authors believe that Fresno test of competency is a useful tool to formatively assess the progress of students in Evidence Based Medicine particularly their ability to develop research question, sort the evidence, and understand its epidemiological application to the general population. The weak areas in students understanding and application of principles of EBM can be picked

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NOTES ON CONTRIBUTORS

Both authors were involved in every part of the analysis, idea's development, write-up, and editing the final draft

CONFLICT OF INTEREST

Authors declare no conflict of interest.

ETHICS APPROVAL

The approval/permission was obtained from University of Glasgow Ethics Committee.

up and worked through by the tutors using Fresno test. However, the test needs to be modified for the learning environment and the EBM course content. The generalizability and the universal applicability of the contents of the test require further extensive studies.

REFERENCES

1. Timmermans S, Mauck A. The promises and pitfalls of evidence-based medicine. *Health Affairs*. 2005;24(1):18-28.
2. Dawes M, Summerskill W, Glasziou P, Cartabellotta A, Martin J, Hopayian K, et al. Sicily statement on evidence-based practice. *BMC Med Edu*. 2005;5(1):1.
3. Straus SE, Richardson WS, Glasziou P, Haynes RB. Evidence-based medicine: how to practice and teach EBM. 2005.
4. Jonsson A, Svingby G. The use of scoring rubrics: Reliability, validity and educational consequences. *Edu Res Rev*. 2007;2(2):130-44.
5. Ramos KD, Schafer S, Tracz SM. Validation of the Fresno test of competence in evidence based medicine. *Bmj*. 2003;326(7384):319-21.
6. Argimon-Pallàs JM, Flores-Mateo G, Jiménez-Villa J, Pujol-Ribera E. Psychometric properties of a test in evidence based practice: the Spanish version of the Fresno test. *BMC Med Edu*. 2010;10(1):45.
7. Lai NM TC. Competence in evidence-based medicine of senior medical students following a clinically integrated training programme. *Hong Kong Med J*. 2009;15(5):332-8.
8. Tilson JK. Validation of the modified Fresno test: assessing physical therapists' evidence based practice knowledge and skills. *BMC Med Edu*. 2010;10(1):38.
9. Morris J, Maynard V. The feasibility of introducing an evidence based practice cycle into a clinical area: An evaluation of process and outcome. *Nurs Edu Prac*. 2009;9(3):190-8.
10. Holmboe ES, Hawkins RE. Methods for evaluating the clinical competence of residents in internal medicine: a review. *Ann Int Med*. 1998;129(1):42-8.
11. McCluskey A, Lovarini M. Providing education on evidence-based practice improved knowledge but did not change behaviour: a before and after study. *BMC Med Edu*. 2005;5(1):40.
12. Aronoff SC, Evans B, Fleece D, Lyons P, Kaplan L, Rojas R. Integrating evidence based medicine into undergraduate medical education: combining online instruction with clinical clerkships. *Teach Lear Med*. 2010;22(3):219-23.
13. Dory V, Gagnon R, De Foy T, Duyver C, Leconte S. A novel assessment of an evidence-based practice course using an authentic assignment. *Medical teacher*. 2010;32(2):e65-e70.
14. McCluskey A, Bishop B. The Adapted Fresno Test of competence in evidence-based practice. *Con Edu Heal Prof*. 2009;29(2):119-26.
15. Ilic D. Assessing competency in Evidence Based Practice: strengths and limitations of current tools in practice. *BMC Med Edu*. 2009;9(1):53.