PRÁTICAS EDUCATIVAS, MEMÓRIAS E ORALIDADES

Rev.Pemo – Revista do PEMO

Evidence-based practice improves clinical learning of medicine students: a study before and after training

ARTICLE

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Abstract
This study aimed to compare medical students' performance in solving clinical cases before and after training in Evidence-Based Practice (EBP). A longitudinal study with medical students evaluated the impact of EBP training. Twenty-nine students (15 male, 14 female) participated in the study. The average age was 22.8 years, with the majority (51.7%) in the eighth semester. The Wilcoxon test showed an improvement in student performance after the training, with statistically significant differences in scores of -4.52, -3.92, -3.46, -4.62, and -4.70 ($p<0.01$) in clinical cases 1, 2, 3, and 4, and in the Fresno test, respectively. Furthermore, there was a significant difference between clinical cases.
Keywords: High Education. Clinical Learning. Evidence-based Medicine. Evidence-based Practice. Medical Learning.

A prática baseada em evidências melhora o aprendizado clínico de estudantes de medicina: um estudo antes e após capacitação

Resumo
O presente estudo teve por objetivo comparar o desempenho dos alunos de medicina na resolução de casos clínicos antes e após a capacitação em Prática baseada em evidências (PBE). O estudo longitudinal com estudantes de Medicina avaliou o impacto da capacitação em PBE. Participaram da pesquisa 29 alunos (15 masculino, 14 feminino) com idade média de 22,8 anos, sendo a maioria do 8º semestre (51,7%). Nas notas que os participantes do estudo obtiveram, analisadas pelo teste de Wilcoxon, podemos ver uma melhora no desempenho dos alunos após a capacitação com diferença nas notas estatisticamente significante, de -4,52, -3,92, -3,46, -4,62 e -4,70 ($p<0,01$) nos casos clínicos 1, 2, 3 e 4 e no teste de Fresno, respectivamente. Assim como houve diferença significativa entre os casos clínicos. Desta forma, a prática baseada em evidências melhora o aprendizado clínico de estudantes de Medicina.
Palavras-chave: Educação Superior. Aprendizagem Clínica. Medicina Baseada em Evidências. Prática Baseada em Evidências. Ensino em Medicina.

DOI: https://doi.org/10.47149/pemo.v8.e15775
https://revistas.uece.br/index.php/revpemo
ISSN: 2675-519X

1 Introduction

Evidence-Based Practice (EBP) consists of the triad: the best and most recent available scientific evidence, the clinician's prior clinical experience, and patient preferences (Albarqouni *et al.*, 2018). The term emerged from concerns and needs experienced in the personal practice of health professionals, as well as from political movements aimed at organizing health systems with universal coverage, largely driven by the widespread demand for changes in professional education (Faria, De Oliveira-Lima; Almeida-Filho, 2021).

In Brazil, according to Article 196 of the Federal Constitution, health is a right of all and a duty of the State. This right must be guaranteed through social and economic policies designed to reduce the risk of diseases and other health conditions (Brazil, 1988). In order to ensure this right, health professionals should have access to the best available evidence-based treatment, with the aim of promoting the best prognosis for patients without imposing unnecessary costs on the public health system (Walewska-Zielecka *et al.*, 2021).

Furthermore, the inability to address the main health needs at the primary and secondary levels of care overloads tertiary care, increases treatment costs through the ordering of unnecessary tests, and, most importantly, harms patients by delaying the resolution of their health conditions (Saldiva; Veras, 2018). In response to these needs, EBP emerged to improve the efficiency and quality of health services provided to the population and to reduce operational costs in prevention, treatment, and rehabilitation processes (Faria, De Oliveira-Lima; Almeida-Filho, 2021).

Currently, EBP has been increasingly incorporated as a central component of undergraduate and graduate curricula, as well as continuing health education programs worldwide (Albarqouni *et al.*, 2018). A systematic review by Kyriakoulis *et al.* (2016) suggests that, although multiple interventions may support undergraduate students in learning about EBP, the evidence is insufficient to determine the most effective teaching–learning method.

Rev. Pemo, Fortaleza, v. 8, e15775, 2026
DOI: https://doi.org/10.47149/pemo.v8.e15775
https://revistas.uece.br/index.php/revpemo
ISSN: 2675-519X

In this context, the current National Curricular Guidelines (DCNs) for undergraduate medical education indicate decision-making as a required competency for newly graduated physicians, aiming at the appropriate use, effectiveness, and cost-effectiveness of workforce, medications, equipment, procedures, and practices. In addition, the DCNs recommend that the course structure should employ methodologies that prioritize active student participation in knowledge construction and the integration of content (Brasil, 2014).

On the other hand, EBP is expected to be beneficial for future physicians by fostering active engagement in the learning process and ensuring their preparedness for clinical practice. In other words, students will remain supported by scientific evidence even after completing their academic training.

Considering the *Sistema Único de Saúde* (SUS), EBP enables patients to receive care supported by the best and most recent available scientific evidence. Consequently, more effective treatments lead to fewer medical consultations, shorter waiting lines, fewer follow-up visits, fewer diagnostic test requests, and, therefore, lower costs.

In light of the above, the general objective of the present study was to compare the performance of medical students in solving clinical cases before and after training in EBP.

2 Methodology

This is a longitudinal study involving the application of clinical case scenarios and the Fresno Test in Evidence-Based Medicine, conducted before and after training medical students in Evidence-Based Practice (EBP). The study was approved by the Research Ethics Committee of the Universidade Municipal de São Caetano do Sul (USCS) under opinion number 4.812.927, in accordance with Resolution No. 466/12 of the National Health Council, which regulates research involving human subjects. Participants were duly informed about the objectives and procedures of the study and, after clarification, signed the Informed Consent Form (ICF).

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ISSN: 2675-519X

This study was conducted both in person and online. The ICF and the clinical cases administered before the training were delivered at the first meeting and completed in person. The study population consisted of second- to fourth-year medical students who are members of the Academic League of Trauma and Emergency (LATEM) at Centro Universitário Integrado, in the city of Campo Mourão, Paraná, Brazil.

The sample size was 29 students. A non-probabilistic convenience sampling method was used. No sample size calculation was performed, as the proposal was to offer the training to all eligible students. Students participating in LATEM are selected through an annual examination, in which 30 positions are offered to interested candidates. All members of LATEM were given the opportunity to participate in the present study.

Regarding sociodemographic data, the following information was collected: full name, e-mail address, age, gender, and the current semester of the undergraduate medical program. Initially, clinical case scenarios were applied before the training, referring to the four topics that would be addressed, along with the Fresno Test of Evidence-Based Medicine (Ramos; Schafer; Tracz, 2003).

Training in EBP was conducted during the first week and lasted two hours. Subsequently, four in-person biweekly meetings were held, during which new clinical case scenarios were delivered. These cases were identical to those previously answered, with one clinical case being applied at each meeting, after prior study and topic-specific research by the participants, in accordance with EBP principles.

The total duration of the study was six months, with two months dedicated to the clinical case activities and four months dedicated to completion of the Fresno Test form.

This project followed the following stages:

a) LATEM students were invited to participate in the study during the first in-person meeting, after approval by the Research Ethics Committee. Those who agreed to participate signed the Informed Consent Form (ICF) and completed the clinical case scenarios (pre-training) and the Fresno Test of

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ISSN: 2675-519X

Evidence-Based Medicine. No time limit was established for completing the clinical cases or the Fresno Test;

b) In the first week, students received in-person training in EBP, which was also made available in video format (for later review in case of questions), with a duration of two hours, delivered by the authors of the study;

c) After the training, a cycle of four in-person meetings was conducted at fifteen-day intervals for students who agreed to participate in the project and signed the documents listed above. The topics addressed in the clinical cases were: airway trauma, pneumothorax, shock in polytraumatized patients, and burns. These topics were selected because they involve frequent decision-making in clinical practice;

d) At each meeting, students brought an individually completed clinical case and submitted it before the discussions began. After submission of the clinical cases, a participant-led discussion was initiated regarding the questions answered in each case. During this discussion, students justified their responses and presented the sources on which their answers were based;

e) After the discussion period of each clinical case, a high-fidelity manikin-based simulation was carried out on the topic addressed, in which participants were able to apply the knowledge acquired during prior study and discussion. In total, the meetings lasted approximately two hours and thirty minutes;

f) At the end of each meeting, the next clinical case was provided, with a new topic, for students to complete by following the guidance given during the EBP training on health science databases and to bring to the next meeting in order to assess the knowledge acquired by the students. At the end of the cycles, the Fresno Test of Evidence-Based Medicine was also reapplied.

One student who was unable to participate in the training was excluded from the study.

Rev. Pemo, Fortaleza, v. 8, e15775, 2026
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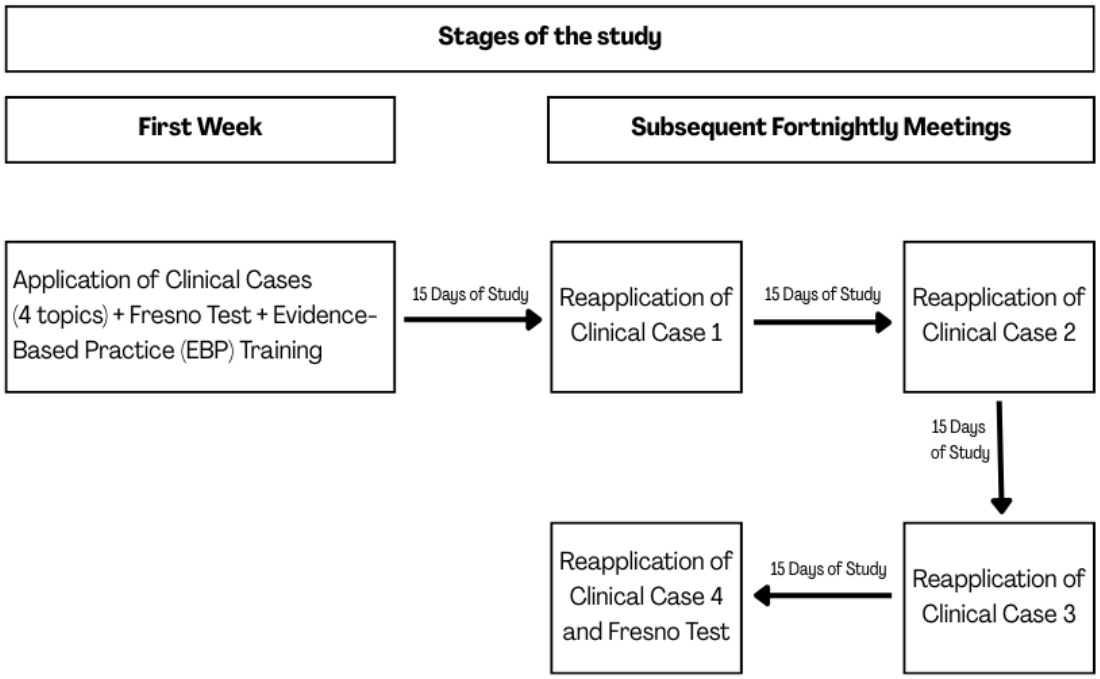
ISSN: 2675-519X

Figure 1 illustrates the study design proposed in this research:

Figure 1 – Stages of the study



Source: Elaborated by the authors, 2022.

Data were collected using the following instruments: an initial form containing sociodemographic data, clinical case scenarios, and the Fresno Test of Evidence-Based Medicine.

The clinical cases were developed by the authors of the study due to the lack of similar instruments in the literature. To prepare the cases, an extensive literature review was conducted, and an answer key was developed with up-to-date references in accordance with EBP principles. After the development of the cases, they were reviewed by two specialist physicians recognized as references in the field of traumatology. The reviewers suggested changes to the presentation of the clinical scenarios to improve clarity, which were implemented before the application of this instrument, and this version was considered the pilot version.

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Clinical case scenarios were provided on airway trauma, pneumothorax, hypovolemic shock in polytraumatized patients, and burns. After presentation of the initial clinical scenario, all cases contained open-ended questions regarding diagnostic hypotheses, complementary examinations required for the condition, treatment, and the references used to support the previous answers.

For case resolution, students were required to conduct an extensive search in health databases and critically reflect on the data obtained, taking into account the scientific evidence presented as well as the risks and benefits involved. After the analysis, students were expected to request only the examinations proven to be necessary for each case, that is, without excessive testing, and to indicate treatment according to EBP principles.

The scoring of the clinical cases ranged from 0 to 10 points. To calculate the final score for each clinical case, the mean of the scores assigned to each of the four questions was calculated. In responses composed of multiple items, such as several complementary examinations, the score was divided among the items considered correct.

The Fresno Test is among the few available and validated instruments to assess competence in Evidence-Based Medicine in the Portuguese language (Salerno *et al.*, 2019). The test consists of 12 open-ended questions, each scored from 0 to 24 points. Thus, the questionnaire total score ranges from a minimum of 0 to a maximum of 288 points.

Data were collected from the answer sheets of each instrument and subsequently tabulated using Microsoft Excel, version 2018. Sociodemographic data were analyzed using descriptive analysis. Data normality was assessed using SPSS software. The data were considered non-parametric due to p-values < 0.05. Therefore, the Wilcoxon test was performed. All analyses were conducted using SPSS software, version 26.

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3 Results

The sample consisted of 29 students, of whom 15 (51.7%) were male and 14 (48.3%) were female. The mean age was 22.8 years (± 2.9). Most students were in the eighth semester (51.7%), followed by students in the sixth semester (31.0%), as shown in Table 1. Categorical variables were expressed as number and percentage (%) (Table 1).

Table 1 – Sample characteristics according to sex, age, and semester of the course

Sample (n=29)	Frequency	Percentage
Sex		
Male	15	(51,7%)
Female	14	(48,3%)
Semester		
4th	2	(6,9%)
5th	3	(10,3%)
6th	9	(31,0%)
8th	15	(51,7%)

Source: Elaborated by the authors, 2022.

Table 2 presents the median and interquartile range of students' scores on the clinical cases and the Fresno Test before and after the training. Data from the clinical cases were separated by diagnosis, complementary examinations, treatment, and references used in each clinical case. The total medians of clinical cases 1, 2, 3, and 4 before the training were, respectively, 0.00 (±2.50), 4.12 (±4.63), 4.37 (±2.75), and 2.12 (±1.44). After training in EBP, the total medians for clinical cases 1, 2, 3, and 4 were, respectively, 5.87 (±4.19), 8.37 (±2.50), 6.18 (±1.47), and 5.12 (±1.38).

For the Fresno Test, the students' median scores were 0.00 (±14.40) before training and 195.98 (±50.19) after training. Continuous data were expressed as median and interquartile range (±) (Table 2).

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ISSN: 2675-519X

Table 2 – Median scores in clinical cases and Fresno Test before and after EBP training

	Score before training	Interquartile range	Score after training	Interquartile range
Case 1				
Diagnosis	0,00	0,00	10,00	0,00
Examinations	0,00	0,00	0,00	10,00
Treatment	0,00	0,00	10,00	8,00
References	0,00	3,50	3,50	0,00
Total median	0,00	2,50	5,87	4,19
Case 2				
Diagnosis	10,00	10,00	10,00	0,00
Examinations	5,00	10,00	10,00	0,00
Treatment	0,00	10,00	10,00	5,00
References	0,00	1,80	3,50	1,80
Total median	4,12	4,63	8,37	2,50
Case 3				
Diagnosis	7,50	2,50	7,50	2,50
Examinations	3,75	5,00	5,00	2,75
Treatment	10,00	7,00	10,00	5,00
References	0,00	3,50	3,50	2,75
Total median	4,37	2,75	6,18	1,47
Case 4				
Diagnosis	5,00	0,00	10,00	0,00
Examinations	0,00	3,00	2,00	6,00
Treatment	3,00	2,00	5,00	2,00
References	0,00	0,00	3,50	0,00
Total median	2,12	1,44	5,12	1,38
Fresno Test	0,00	14,40	195,98	50,19

Source: Elaborated by the authors, 2022.

Table 3 presents the differences in the median scores of the clinical cases and the Fresno Test before and after training in Evidence-Based Practice (EBP), analyzed using the Wilcoxon test. In clinical case 1, a statistically significant difference was

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ISSN: 2675-519X

observed between the pre- and post-training periods (Z = −4.52; p < 0.01). The same was observed in clinical case 2 (Z = −3.94; p < 0.01), clinical case 3 (Z = −3.46; p < 0.01), and clinical case 4 (Z = −4.62; p < 0.01). Similarly, the Fresno Test showed a statistically significant difference between the pre- and post-training periods (Z = −4.70; p < 0.01).

Table 3 – Difference in scores before and after EBP training

	Z value	P value
Case 1: before vs. after training	-4,52	0,00
Case 2: before vs. after training	-3,94	0,00
Case 3: before vs. after training	-3,46	0,00
Case 4: before vs. after training	-4,62	0,00
Fresno Test: before vs. after training	-4,70	0,00

Source: Elaborated by the authors, 2022.

Table 4 presents the differences in the median scores obtained by students, comparing each clinical case with the subsequent one after training in Evidence-Based Practice (EBP). This analysis was performed to verify whether students continued to demonstrate learning progression in the weeks following the training. When comparing the median of clinical case 1 with that of clinical case 2, both in the post-EBP training period, a statistically significant difference was observed (Z = −2.33; p = 0.02). Likewise, a statistically significant difference was found between the medians of clinical case 2 and clinical case 3 (Z = −2.47; p = 0.01), and between the medians of clinical case 3 and clinical case 4 (Z = −2.45; p = 0.01), as shown in Table 4.

Table 4 – Differences in scores between clinical cases after EBP training

	Z value	P value
Case 1 – Case 2	-2,33	0,02
Case 2 – Case 3	-2,47	0,01
Case 3 – Case 4	-2,45	0,01

Source: Elaborated by the authors, 2022.

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ISSN: 2675-519X

4 Discussion

When comparing the participants' median scores using the Wilcoxon test, an improvement in students' performance was observed after the training, with statistically significant differences in scores of −4.52, −3.92, −3.46, −4.62, and −4.70 ($p < 0.01$) in clinical cases 1, 2, 3, and 4 and in the Fresno Test, respectively.

Corroborating the present study, Dinkevich *et al.* (2006) conducted an investigation with pediatric residents (n = 60), assessing students' learning through the Fresno Test and clinical cases, and observed an improvement in participants' mean scores from 17% to 63% (Dinkevich *et al.*, 2006).

An Iranian study conducted with medical residents evaluated participants in two groups: one received active interventions (12 hours of EBP training) and the other received passive EBP interventions (guidance during daily rounds, medical journals, or morning reports) over a one-year period (Goodarzi *et al.*, 2021). The results showed that both interventions were effective; however, the active intervention proved to be superior to the passive intervention. Participants in the active intervention group showed significantly higher scores in knowledge, attitude, decision-making, outcomes, and behavior compared with the passive group (Goodarzi *et al.*, 2021).

A study conducted by Bastaninejad *et al.* (2019), which evaluated otorhinolaryngology residents (n = 41) using the Fresno Test before and after training in Evidence-Based Medicine (EBM), also observed improvements in scores (57.43 to 79.26). The study was conducted longitudinally over six months, with weekly discussions and readings of scientific journals. However, Bastaninejad *et al.* (2019) assessed participants at only two time points, at the beginning and at the end of the six months, unlike the present study, which conducted assessments at baseline and at four subsequent time points.

Given that the differences in mean scores were statistically significant at all assessment time points, it can be assumed that students' learning in the items evaluated

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ISSN: 2675-519X

in the clinical cases — diagnosis, ordering of complementary examinations, treatment, and bibliographic references — was indirectly achieved.

Regarding the limitations of the present study, it is important to highlight the sample size (n = 29) as a factor that may be considered limiting. As the academic league consists of only 30 students, due to internal regulations of the medical school, it was not possible to form a comparative group in which the intervention was not performed.

Another factor is that the sample was composed of students from a single medical school who participate in the Academic League of Trauma and Emergency, which makes the sample highly specific and limits the generalizability of the data. However, the present study was conducted longitudinally and assessed students across a sequence of meetings, providing more consistent data that reflect a longer time interval than other studies found in the literature. Another important aspect was the use of an assessment questionnaire that had already been validated, including for the Portuguese language, and which achieved statistical significance across all collected data.

Future studies are recommended to be conducted with larger samples in order to expand the possibility of generalizing the results and to achieve greater statistical power, including sub-analyses according to academic period and the participation of students from different educational institutions. It is also suggested that data collection be carried out over longer time intervals, in order to evaluate students' progression at multiple time points and to identify the time required for learning to stabilize after the initial improvement.

5 Final considerations

Evidence-Based Practice (EBP) improves the clinical learning of medical students. Through EBP, students improved their performance in managing clinical cases and were therefore able to provide better patient care through evidence-based treatment. In addition, students became capable of conducting searches in health science databases and critically appraising scientific articles.

DOI: https://doi.org/10.47149/pemo.v8.e15775
https://revistas.uece.br/index.php/revpemo
ISSN: 2675-519X

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Rev. Pemo, Fortaleza, v. 8, e15775, 2026
DOI: https://doi.org/10.47149/pemo.v8.e15775
https://revistas.uece.br/index.php/revpemo
ISSN: 2675-519X

Author contribution: elaborou a pesquisa, analisou os dados e escreveu o artigo.
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Responsible publisher: Genifer Andrade.

***Ad hoc* specialist:** Tássia Fernandes Ferreira and Eli Conceição Vasconcelos Tapajós.

How to cite this article (ABNT):
NASCIMENTO, Sarah Beatriz Obadovski Alves; LAZARI, Alan Henrique de; ARAUJO, Amanda Costa. A prática baseada em evidências melhora o aprendizado clínico de estudantes de medicina: Um estudo antes e após capacitação. **Rev. Pemo**, Fortaleza, v. 8, e15775, 2026. Available in: https://revistas.uece.br/index.php/revpemo/article/view/15775

Received on June 27, 2025
Accepted on October 9, 2025
Published on January 1, 2026