Revista Española
de Educación Médica

The Role of Bayesian Approaches in Medical Education for Enhancing Evidence-Based Medicine.

El Rol de los Enfoques Bayesianos en la Educación Médica para el Fortalecimiento de la Medicina Basada en la Evidencia.

Andy Hermógenes Luque Loor[1], Paola Ceciliana Añazco Moreira[2], Ariel Melis Sosa[3], José André Cedeño Orejuela[4-5]*.

Docentes de la Carrera de Medicina, Universidad San Gregorio de Portoviejo, Ecuador
[1] ahluque@sangregorio.edu.ec, https://orcid.org/0000-0002-0381-3838; [2] pcanazco@sangregorio.edu.ec, https://orcid.org/0009-0001-7499-6141; [3] amelis@sangregorio.edu.ec, https://orcid.org/0009-0009-0671-2723; [4] jacedeno2@sangregorio.edu.ec, https://orcid.org/0009-0000-4754-0643; [5] Docente de Posgrado en Maestría en Docencia en Ciencias de la Salud, Universidad Iberoamericana del Ecuador

* Correspondencia: jacedeno2@sangregorio.edu.ec

Recibido: 4/13/26; Aceptado: 4/17/26; Publicado: 4/20/26

Abstract.

The increasing complexity of clinical decision-making in evidence-based medicine (EBM) highlights the need for probabilistic reasoning. Bayesian theory provides a structured framework to integrate prior knowledge with new evidence, yet its use in medical education remains limited. This paper argues that incorporating Bayesian approaches improves diagnostic accuracy and reduces reliance on heuristic judgments. Educational strategies such as case-based learning help bridge theory and practice, while Bayesian methods strengthen the link between research and clinical decision-making. Despite challenges such as perceived complexity and variability in estimating pre-test probabilities, these barriers reflect gaps in pedagogy. We conclude that Bayesian reasoning should be integrated as a core component of medical training to better address clinical uncertainty.

Keywords: Bayesian Approach, Decision Making, Evidence-Based Medicine, Medical Education

The increasing complexity of clinical decision-making within evidence-based medicine (EBM) has highlighted the need for educational approaches that move beyond deterministic reasoning toward probabilistic thinking. In this context, Bayesian theory has gained renewed relevance in medical education, as it provides a structured framework for integrating prior knowledge with new clinical evidence (1-2). Nevertheless, we contend that its incorporation into medical training remains insufficient and fragmented, limiting its potential to strengthen diagnostic accuracy and decision-making in real-world clinical settings.

From a methodological perspective, Bayes' theorem offers a coherent model for updating probabilities in light of new data, emphasizing the relationship between pre-test probability, test characteristics, and post-test probability. This approach aligns closely with the epistemological foundations of EBM, which prioritize the integration of best available evidence with clinical expertise (1-2). We argue that fostering probabilistic reasoning through Bayesian frameworks is essential, as it enables learners to reinterpret diagnostic information dynamically and reduces reliance on intuitive or heuristic-based judgments that may lead to diagnostic errors.

In medical education, the application of Bayesian principles demonstrates clear value in bridging the gap between theoretical knowledge and clinical practice. Educational strategies such as

case-based learning, interactive workshops, and problem-based approaches have proven effective in helping students and residents apply concepts such as sensitivity, specificity, and predictive values within authentic clinical scenarios. Beyond improving conceptual understanding, these approaches cultivate clinical reasoning grounded in evidence (3-5). In our view, this transition from deterministic to probabilistic thinking is foundational for managing the uncertainty inherent in clinical practice.

Moreover, Bayesian reasoning contributes to the integration of EBM in both clinical practice and research. Its application in clinical trials and evidence synthesis allows for the incorporation of prior knowledge into current analyses, generating more robust conclusions (6-7). We emphasize that this capacity strengthens the connection between research and bedside decision-making, reinforcing the principles of EBM and enhancing the relevance of evidence in clinical contexts.

Importantly, Bayesian approaches also address persistent misconceptions in medical education related to probability estimation and statistical reasoning. Evidence suggests that both students and clinicians struggle with interpreting diagnostic probabilities, often leading to inconsistent judgments (8-9). We assert that Bayesian training frameworks provide a necessary mechanism to mitigate these errors, improving diagnostic reasoning.

However, several challenges limit the adoption of Bayesian methods. Variability in estimating pre-test probabilities remains a critical issue, as inaccurate assumptions can compromise clinical reasoning. Additionally, the perception of Bayesian approaches as complex persists among learners and educators (8-9). In our opinion, these barriers reflect gaps in pedagogical design that must be addressed through accessible and context-driven strategies.

We argue that Bayesian theory should be systematically integrated into medical education as a core component of EBM training. Its structured and practice-oriented nature makes it a fundamental tool for addressing clinical uncertainty. Rather than being viewed as a supplementary statistical approach, Bayesian reasoning should be recognized as a central cognitive framework that strengthens the alignment between scientific evidence, clinical reasoning, and patient-centered care.

Conclusions

- Bayesian theory represents a valuable and underutilized framework within medical education and evidence-based medicine. Its capacity to integrate prior knowledge with new evidence enhances diagnostic reasoning and supports more accurate clinical decision-making under uncertainty. Despite its demonstrated benefits, its adoption remains limited due to pedagogical gaps and perceived complexity.
- We conclude that a systematic and practice-oriented integration of Bayesian reasoning into medical curricula is necessary. Educational strategies that emphasize contextual application can facilitate its understanding and use among learners. Ultimately, positioning Bayesian thinking as a core component of clinical reasoning will strengthen the alignment between research evidence, clinical expertise, and patient-centered care.

Funding: There was no funding.

Declaration of conflict of interest: The authors declare that they have no conflict of interest

Author contributions: Conceptualization: A.H.L.L.; Data curation: P.C.A.M.; Formal analysis: A.H.L.L., J.A.C.O.; Investigation: A.H.L.L.; Methodology: A.H.L.L.; Project administration: P.C.A.M.; Software: A.H.L.L.; Supervision: A.H.L.L., J.A.C.O.; Validation: J.A.C.O., A.M.S., P.C.A.M.; Visualization: J.A.C.O., A.M.S., P.C.A.M.; Writing – original draft: A.H.L.L.; Writing – review & editing: A.H.L.L., J.A.C.O.

6. References.

1. Kass R, & Raftery A. Bayes Factors. *J Am Stat Assoc*. **1995**, 90(430), 773-795. https://doi.org/10.1080/01621459.1995.10476572
2. Schoot R, Depaoli S, Gelman A, King R, Kramer B, Märtens K, et al. Bayesian statistics and modelling. *Nat Rev Methods Primers*. **2021**, 1(1). https://doi.org/10.1038/s43586-020-00003-0
3. Benbassat J. Teaching Clinical Reasoning to Undergraduate Medical Students. *Thinking Like a Policy Analyst*. **2005**, 53-71. https://doi.org/10.1057/9781403980939_3
4. Brush J, Lee M, Sherbino J, Taylor-Fishwick J, & Norman G. Effect of Teaching Bayesian Methods Using Learning by Concept vs Learning by Example on Medical Students' Ability to Estimate Probability of a Diagnosis. *JAMA Netw Open*. **2019**, 2(12), e1918023. https://doi.org/10.1001/jamanetworkopen.2019.18023
5. Nelson A. An Interactive Workshop Reviewing Basic Biostatistics and Applying Bayes' Theorem to Diagnostic Testing and Clinical Decision-Making. *MedEdPORTAL*. **2018**, 14, 10771 https://doi.org/10.15766/mep_2374-8265.10771
6. Elstein A. On the origins and development of evidence-based medicine and medical decision making. *Inflamm Res*. **2004**, 53(S2), S184–S189. https://doi.org/10.1007/s00011-004-0357-2
7. Helgason C, & Jobe T. Causality and clinical medicine: Using fuzzy measures for patient prediction and experimental design. *NAFIPS Annu Meet*. **2008,** 1-5. https://doi.org/10.1109/nafips.2008.4531320
8. Cahan A, Gilon D, Manor O, & Paltiel O. Probabilistic reasoning and clinical decision-making: do doctors overestimate diagnostic probabilities?. *QJM*. **2003**, 96(10), 763-769. https://doi.org/10.1093/qjmed/hcg122
9. Phelps M, & Levitt M. Pretest Probability Estimates: A Pitfall to the Clinical Utility of Evidence-based Medicine?. *Acad Emerg Med*. **2004**, 11(6), 692-694. https://doi.org/10.1197/j.aem.2003.08.022