Journal of INDEPENDENT MEDICINE

Evidence-Based Medicine vs Physiology-Based Medicine: A False Dichotomy?

Santiago M. Herrero[1]

Abstract

Evidence-based medicine (EBM) has profoundly influenced modern clinical practice by promoting standardized, data-driven decision-making derived from randomized trials and systematic reviews. In critical care, however, the increasing reliance on protocols and numerical targets has exposed important limitations related to patient heterogeneity, dynamic pathophysiology, and restricted external validity of population-based evidence. Physiology-based medicine (PBM), grounded in mechanistic understanding and continuous bedside interpretation of biological responses, has often been portrayed as subjective or insufficiently rigorous, fostering an artificial opposition between the two approaches. This viewpoint argues that the perceived conflict between EBM and PBM represents a false dichotomy. Rather than competing paradigms, they constitute complementary components of sound clinical reasoning. Using examples from hemodynamic resuscitation, mechanical ventilation, oxygen therapy, and metabolic support, we illustrate how rigid application of evidence without physiological contextualization may obscure clinically relevant signals, while physiology detached from evidence risks inconsistency. We propose an integrative framework in which evidence defines boundaries of safety and probability, while physiology guides individualized application at the bedside. Reaffirming physiology as the interpretive bridge for evidence is essential to restore clinical judgment, ethical accountability, and patient-centered care in complex clinical environments.

Keywords: Evidence-based medicine, physiology-based medicine, critical care, individualized patient care, clinical decision-making

Introduction

Over the last three decades, evidence-based medicine (EBM) has established itself as the prevailing framework guiding clinical practice across medical specialties. Its impact has been particularly marked in critical care, where clinical guidelines, care bundles, and standardized protocols increasingly shape everyday decision-making in the intensive care unit (ICU), with the promise of improving consistency, safety, and outcomes. Alongside these advances, however, growing concern has emerged among clinicians who perceive a persistent gap between protocol-driven recommendations and the complex physiological realities encountered in critically ill patients.

Patients in the ICU are not static or uniform. They are biologically diverse, physiologically unstable, and continuously evolving, and they are frequently excluded from—or only marginally represented in—the clinical trials upon which guidelines are based. In this setting, uncritical reliance on population-derived evidence risks shifting EBM from a tool that supports clinical reasoning to one that replaces it. Concurrently, physiology-based medicine (PBM), grounded in mechanistic understanding and

Intensive and Critical Care Unit, Policlinico San Donato S.P.A., Iraq Branch, based in Najaf, and Al-Najaf Al-Ashraf Teaching Hospital, Iraq

Corresponding author:
Dr. Santiago M. Herrero, MD, FCCP
Chief of Intensive and Critical Care Unit
Policlinico San Donato S.P.A., Iraq Branch, based in Najaf, Iraq
Al-Najaf Al-Ashraf Teaching Hospital, Iraq
Email: santiago.herrero@grupposandonato.it

real-time bedside interpretation, is often characterized as subjective, experience-based, or insufficiently rigorous. This narrative has fostered an artificial polarity between EBM and PBM, as if clinicians were compelled to choose between data and physiology, statistics and judgment. Increasingly, however, this perceived opposition has been challenged within both methodological and clinical discourse. (1–3)

The Evolution and Misapplication of Evidence-Based Medicine

The original formulation of EBM, as described by Sackett and colleagues, emphasized the integration of the best available evidence with clinical expertise and patient values. (1) Evidence was never intended to operate as an independent authority divorced from clinical context or judgment. Over time, however—particularly within healthcare systems shaped by performance indicators, audit processes, and medico-legal pressures—EBM has progressively shifted toward protocol-driven implementation.

In the ICU, this shift has been amplified by environmental complexity. High illness severity, time pressure, and multidisciplinary care models have made protocols appealing instruments for standardization. They enhance clarity, streamline communication, and facilitate training. Yet these same attributes also render protocols potentially hazardous when applied without careful physiological interpretation.

Randomized controlled trials (RCTs), the methodological foundation of EBM, are intrinsically reductionist. To preserve internal validity, they impose strict inclusion and exclusion criteria, isolate variables, and control confounding factors. While scientifically robust, this methodology yields evidence that reflects average effects within selected populations. By contrast, critically ill patients frequently exhibit overlapping syndromes, profound physiological disturbances, and non-linear responses to intervention. Consequently, the external applicability of many ICU trials remains constrained, even when their statistical validity is unquestioned. (2,3)

When recommendations derived from such trials are translated into rigid protocols, evidence risks being treated as directive rather than informative. Numerical targets—such as mean arterial pressure thresholds, hemoglobin levels, or oxygen saturation ranges—may become substitutes for clinical reasoning. Adherence to guidelines is equated with quality, whereas deviation, even when physiologically justified, may be viewed as error. This shift represents not the fulfillment of EBM, but a departure from its original intent.

Defining Physiology-Based Medicine

Physiology-based medicine neither rejects evidence nor represents a regression to anecdote or intuition. Rather, it is a clinical approach in which diagnostic and therapeutic decisions are guided by an understanding of human pathophysiology, biological mechanisms, and dynamic patient responses. PBM emphasizes causal relationships over associations, biological coherence over rigid conformity, and adaptive reasoning over procedural execution.

Within this framework, the patient is regarded not as a passive recipient of protocolized interventions, but as a dynamic biological system. Hemodynamics, gas exchange, metabolism, neuroendocrine activity, and inter-organ interactions are continually assessed and re-evaluated. Clinical interventions function as testable hypotheses, with physiological response providing immediate feedback. In this sense, PBM is inherently scientific: it is mechanism-based, hypothesis-driven, and continuously subject to bedside verification. (4)

Importantly, PBM acknowledges that identical numerical values may correspond to markedly different physiological states. A mean arterial pressure of 65 mmHg may be adequate for one patient yet insufficient for another. A “normal” oxygen saturation may coexist with impaired oxygen delivery or utilization. Similarly, normalization of laboratory parameters may obscure ongoing tissue hypoxia or cellular dysfunction. PBM therefore prompts clinicians to ask not whether predefined targets have been met, but whether meaningful physiological restoration has occurred.

Why the Dichotomy Is False

The apparent conflict between EBM and PBM does not stem from their foundational principles, but from how they are interpreted and applied. Evidence is often portrayed as objective and scientific, while physiology is framed as subjective or experiential. This oversimplification is misleading. Both approaches require interpretation, judgment, and engagement with uncertainty. Statistical significance does not eliminate the need for clinical reasoning, just as physiological plausibility does not

guarantee clinical benefit. (2,3)

Evidence delineates probabilities, safety margins, and average effects across populations. Physiology determines relevance, timing, and applicability at the individual level. Evidence applied without physiological context risks protocol-driven harm, whereas physiology practiced in isolation from evidence risks inconsistency and bias. When integrated, however, the two form a coherent and rational framework for individualized care.

In critical care, this integration is indispensable. The ICU is defined by non-linear physiological dynamics, rapid shifts in clinical status, and frequent trade-offs between competing therapeutic goals. No guideline can anticipate the full spectrum of shock phenotypes, ventilatory mechanics, or metabolic responses encountered at the bedside. Physiology serves as the interpretive lens through which evidence becomes clinically actionable rather than dogmatic. (4)

Clinical Domains Illustrating the Conflict

Hemodynamic Management

Hemodynamic resuscitation illustrates the limitations of protocol-driven EBM. Fixed targets for arterial pressure or central venous pressure, once widely advocated, have repeatedly failed to ensure adequate tissue perfusion. Physiological approaches prioritize flow, oxygen delivery, and microcirculatory function rather than isolated pressure values. Dynamic indices, lactate trajectories, and markers of organ perfusion provide contextual information that static thresholds cannot capture. (5)

Mechanical Ventilation

Population-based ventilation strategies have unquestionably improved outcomes, particularly in acute respiratory distress syndrome. Nonetheless, ventilator settings that are protective at the population level may become harmful when applied without regard to individual lung mechanics, chest wall compliance, or patient–ventilator interaction. PBM emphasizes interpretation of driving pressure, compliance, and mechanical heterogeneity, allowing evidence-based principles to be tailored rather than indiscriminately applied. (6) The COVID-19 pandemic further highlighted this tension, as rigid adherence to ARDS protocols was rapidly challenged by direct physiological observation at the bedside. (7)

Oxygen Therapy and Metabolism

Oxygen therapy and metabolic support further illustrate the need for integration between evidence and physiology. Although clinical guidelines define acceptable ranges for oxygen saturation or nutritional intake, physiological reasoning highlights that hyperoxia, excessive caloric delivery, or mechanical normalization of laboratory values may adversely affect recovery. Understanding mitochondrial function, substrate utilization, and cellular responses to stress is essential to interpreting such data in a clinically meaningful way. Without this physiological context, numerical targets may provide false reassurance while underlying metabolic or microcirculatory dysfunction persists. (4,8)

Ethical and Professional Implications

The predominance of protocol-driven EBM also carries important ethical and professional implications. When guidelines supplant clinical judgment, physicians risk becoming executors of algorithms rather than autonomous decision-makers. In such circumstances, moral responsibility may shift away from the bedside toward written standards, eroding professional accountability and weakening patient-centered care. These concerns are particularly relevant in resource-limited settings, where the uncritical application of protocols developed in different healthcare environments may inadvertently increase inequities rather than reduce them. (9)

Physiology-based reasoning, in contrast, reinforces the clinician's role as an interpreter of evidence and an advocate for the individual patient. It demands active engagement, responsibility, and transparency in decision-making. Importantly, PBM aligns closely with the principles of independent medicine by resisting excessive reliance on institutional or commercial influences that may shape guidelines more than biological reality itself. (2)

Education as a Pathway to Integration

Medical education represents a crucial avenue for reconciling evidence-based and physiology-based approaches. Training programs that integrate physiological reasoning with critical appraisal of evidence equip intensivists to adapt guidelines thoughtfully rather than apply them mechanically. Educational strategies based on simulation and realistic clinical scenarios enhance comprehension of complex physiological responses and foster flexi-

ble, reflective practice. (4) Such approaches help clinicians navigate uncertainty, encouraging adaptive reasoning grounded in both empirical knowledge and biological understanding.

Conclusion

The debate between evidence-based medicine and physiology-based medicine reflects a false dichotomy that obscures the central challenge of contemporary critical care. Evidence without physiology risks rigidity; physiology without evidence risks arbitrariness. In the ICU—where complexity, uncertainty, and rapid change are inherent—neither paradigm is sufficient in isolation.

Reintegrating physiology as the interpretive bridge between evidence and the individual patient restores clinical judgment, ethical accountability, and biological coherence. In doing so, evidence is allowed to fulfill its intended role—not as a substitute for thinking, but as a foundation upon which thoughtful, individualized care can be constructed.

Funding

No external funding was received for this work.

Conflicts of Interest

The author declares no conflicts of interest related to this manuscript.

Ethical Approval

Not applicable.

References

1. Sackett DL, Rosenberg WM, Gray JA, Haynes RB, Richardson WS. Evidence based medicine: what it is and what it isn't. *BMJ.* 1996;312(7023):71–72. doi:10.1136/bmj.312.7023.71
2. Ioannidis JPA. Evidence-based medicine has been hijacked: a report to David Sackett. *J Clin Epidemiol.* 2016;73:82–86. doi:10.1016/j.jclinepi.2016.02.012
3. Tonelli MR. The limits of evidence-based medicine. Respir Care. 2001 Dec;46(12):1435–40; discussion 1440-1. PMID: 11728302.
4. Vincent JL, Singer M. Critical care: advances and future perspectives. Lancet. 2010 Oct 16;376(9749):1354–61. doi: 10.1016/S0140-6736(10)60575-2. Epub 2010 Oct 11. PMID: 20934211
5. Cecconi M, De Backer D, Antonelli M, Beale, R., Bakker, J., Hofer, C, et al. Consensus on circulatory shock and hemodynamic monitoring. *Intensive Care Med.* 2014;40(12):1795–1815. doi:10.1007/s00134-014-3525-z
6. Gattinoni L, Pesenti A. The concept of "baby lung." *Intensive Care Med.* 2005;31(6):776–784. doi:10.1007/s00134-005-2627-z
7. Marini JJ, Gattinoni L. Management of COVID-19 respiratory distress. *JAMA.* 2020;323(22):2329–2330. doi:10.1001/jama.2020.6825
8. Myles, P.S., Bellomo, R., Corcoran, T., Forbes, A., Peyton, P., Story, D., Christophi, C. et al Restrictive or liberal fluid therapy for major abdominal surgery. *N Engl J Med.* 2018;378(24):2263–2274. doi:10.1056/NEJMoa1801601
9. Herrero S. The ethical crossroads of ICU care: ageism, resource scarcity, and the treatment of elderly patients during COVID-19. *J Indep Med.* 2025;1(2):301–305. Available: https://journalofindependentmedicine.org/articles/v01n02a02/ doi:10.71189/JIM/2025/V01N02A02