Rapid Communication

Beneficial Intelligence in Laboratory Medicine: Aligning Human and Artificial Intelligence for Value-Based Outcomes

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Keywords

Abstract

The integration of artificial intelligence (AI) into healthcare and laboratory medicine is reshaping diagnostics, workflows, and patient management. Yet, technological progress alone cannot ensure meaningful outcomes. The concept of Beneficial Intelligence (BI), defined as the synergy of human and artificial intelligence (H + A = B), emphasizes that technology must be guided by human purpose, ethics, and empathy. BI reframes AI not as a replacement for human expertise but as an augmentation that enables laboratory professionals to deliver care that is accurate, sustainable, and patient-centered. In alignment with value-based healthcare, BI prioritizes outcomes that matter most-clinical, operational, economic, and societal. Laboratory medicine provides a fertile ground for this framework, where digitalization, automation, and machine learning models already enhance diagnostics, risk stratification, and decision support. However, responsible adoption requires validation against patient outcomes, adherence to structured evaluation frameworks and continuous human oversight. Ultimately, Beneficial Intelligence is not only a technical model but a mindset: a commitment to ensure that the alliance of human wisdom and AI fosters equitable, efficient, and sustainable healthcare for the future.

Introduction

The rapid integration of artificial intelligence (AI) into healthcare and laboratory medicine offers unprecedented opportunities to transform patient care, streamline workflows, and optimize outcomes [1,2]. Yet, there is a growing awareness that AI alone cannot guarantee meaningful progress. Human judgment, empathy, and ethical responsibility remain indispensable. The concept of Beneficial Intelligence (BI) embodies the synergy of human intelligence (H) and artificial intelligence (A), expressed as H + A = B. BI should not be understood merely as a technical framework, but as a way of thinking. It is a concept that redefines how human and artificial intelligence are integrated, emphasizing that technology must be guided by human purpose, ethics, and empathy. BI emphasizes that optimal healthcare outcomes are achieved when human and artificial intelligence work together to serve the well-being of patients and society. In laboratory medicine, BI aligns closely with the principles of value-based healthcare, prioritizing outcomes that matter to patients while ensuring sustainability and efficiency.

The Case for Beneficial Intelligence

Laboratory medicine is experiencing a paradigm shift shaped by digitalization, automation, and AI. Machine learning models, particularly in diagnostics, have demonstrated improved accuracy in areas such as the detection of myocardial infarction through algorithms like CoDE-ACS [2]. These tools enhance risk stratification, accelerate decision-making, and reduce unnecessary admissions. Yet, their full potential is realized only when combined with human oversight and contextual judgment. As highlighted in the European AI Act, human oversight is a prerequisite for high-risk AI deployment in healthcare [2]. BI thus reframes the discussion: rather than replacing human expertise, AI should augment it, enabling clinicians and laboratory specialists to deliver care that is both technologically advanced and ethically grounded.

Value-Based Laboratory Medicine as the North Star

The goal of laboratory medicine is not the performance of individual tests, but their impact on patient outcomes [3]. Outcome-based studies demonstrate how laboratory information supports effective management, improves treatment pathways, and reduces adverse events. However, important gaps remain in linking test results directly to clinical outcomes, underscoring the need for multidisciplinary approaches and robust study designs [3]. Value-based laboratory medicine seeks to optimize the clinical utility of tests while ensuring sustainability and patient-centeredness [4].

In this context, BI provides a framework to integrate AI-driven analytics with human expertise in order to define, measure, and achieve outcomes that truly matter-clinical, operational, and societal. Yet, for AI to be trusted and deployed responsibly, its performance must be validated against outcomes and assessed with existing frameworks such as the EFLM checklist [1].

This checklist emphasizes laboratory-specific challenges, including analytical variability, harmonization, metadata, and reproducibility. BI aligns with this structured approach, embedding ethical, technical, and methodological rigor into AI adoption. Crucially, the human role remains central: only professionals can set meaningful outcome measures, interpret results within context, and ensure that technology ultimately serves patients. This partnership between human judgment and artificial intelligence is essential to foster trust, ensure compliance, and advance equitable implementation

Trends Shaping Beneficial Intelligence

Emerging technologies such as hyperautomation, point-of-care testing, and wearable devices are expanding access to diagnostics and prevention [5]. Coupled with exposome research and omics integration, laboratory medicine is moving toward personalized and proactive healthcare. AI facilitates the identification of patterns and predictive biomarkers, while human expertise ensures that interventions are patient-centered and ethically sound. This duality exemplifies the promise of BI: technology with a human purpose, addressing both efficiency and equity.

Principles of Beneficial Intelligence

BI is rooted in a few core principles:

- **Technology with Purpose**: AI informs, but conscience decides.
- **Humans augmented, not replaced**: machines provide the map, humans choose the destination.
- **Well-being as the true metric**: success is measured in human benefit, not just technical performance.
- **Continuous co-learning**: each interaction between human and artificial intelligence strengthens the other.

The integration of BI must be evaluated through the lens of value-based outcomes.

These include:

- **Clinical outcomes**: improved diagnosis, timely interventions, reduced morbidity and mortality.
- **Operational outcomes**: streamlined workflows, optimized test utilization, and reduced errors.
- **Economic outcomes**: cost-effectiveness, reduced hospital admissions, and better allocation of resources.
- **Societal outcomes**: equitable access, patient empowerment, and sustainable healthcare systems. By prioritizing these outcomes, Beneficial Intelligence ensures that technology serves the common good.

Conclusion

Beyond algorithms and workflows, Beneficial Intelligence is first and foremost a mindset. It is a concept that reminds us that technology alone cannot deliver value; it is the alliance of human judgment and artificial intelligence that generates outcomes aligned with the well-being of patients and society. Beneficial Intelligence reframes the role of AI in healthcare and laboratory medicine. The equation H + A = B illustrates

the alliance between human wisdom and artificial intelligence, a partnership that fosters outcomes aligned with value-based healthcare. Laboratory professionals are uniquely positioned to lead this transformation, ensuring that technological advances are harnessed responsibly, ethically, and sustainably. By embracing Beneficial Intelligence, laboratory medicine can become a cornerstone of patient-centered, efficient, and equitable healthcare in the decades to come. Its success, however, will depend on continuous evaluation & audit, transparent governance & collaborative governance, innovation & ethical compliance, finally the commitment of professionals to balance progress with accountability and patient trust.

Declaration of Conflict of Interest

The authors declare that they have no conflicts of interest related to the content of this manuscript.

Ethical Approval and Compliance with Ethical Standards

This article does not involve any new studies with human participants or animals performed by any of the authors.

All considerations discussed are based on previously published literature and conceptual analysis.

Therefore, ethical approval and informed consent were not required.

The manuscript is fully compliant with the ethical principles of the Declaration of Helsinki.

Authors' Disclosures

The authors declare that they have no financial or personal relationships that could inappropriately influence or bias the content of this work.

CRediT Author Contribution Statement

Damien Gruson: Conceptualization; Writing – original draft; Writing – review & editing; Visualization; Supervision.
Pradeep Dabla: Writing – review & editing; Critical revision of the manuscript for important intellectual content.
All authors have read and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

Data Availability Statement

No new data were generated or analyzed in this study. Therefore, data sharing is not applicable to this article.

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