VIEW POINT

Should Artificial Intelligence Become a Standard Component of Perioperative Risk Stratification and Surgical Planning?

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ABSTRACT

The field of perioperative medicine has the potential for transformative uses of artificial intelligence (AI), notably in risk stratification and in surgical planning. AI models can now combine high-dimensional datasets such as electronic health records, images, genomics and real-time vital signs to generate predictions for complications, mortality, and resource utilization after surgery. Proponents claim that AI minimizes cognitive bias, detects hidden patterns of risk, and allows for personalized surgical strategies, which could have a positive impact on patient outcomes and efficiency. However, significant limitations persist: some models have no external validation, limited generalizability for a variety of populations, and operate as "black boxes" with unclear clinical reasoning. Ethical challenges involve algorithmic bias amplifying disparities, informed consent for AI recommendations, and liability uncertainty when predictions fail. Implementation hurdles include interoperability of data, regulatory approval, clinician training, and integration with workflow. Currently, AI should be used as a decision support tool rather than a replacement for clinical standards. Explainable architectures, a clear medicolegal framework, prospective validation, and fairness audits are required to achieve widespread adoption. AI is not a universal standard yet, but targeted use in high-risk or high-volume areas can be justified. A responsible path forward is phased and evidence-based, initiating with low-risk advisory applications before broader expansion.

Keywords: Artificial Intelligence; Decision Making; Machine Learning; Perioperative Care; Postoperative Complications; Risk Assessment; Surgical Procedures.

VIEW POINT

Artificial intelligence (AI) is becoming a practical reality rather than a futuristic theory when it comes to perioperative risk assessment and surgery planning [1,2]. Machine learning algorithms have shown potential for predicting postoperative complications, including acute kidney injury, sepsis, delirium, and mortality. However, their performance must be evaluated against established clinical risk scores using external validation and prospective clinical studies [3]. With this possibility, the question arises: Should AI be considered a standard aspect of surgical care? A balanced perspective recognizes the considerable potential of AI while acknowledging that current evidence does not justify its universal adoption as a standard component of perioperative care. There are some limitations for the use of AI including ethical issues and implementation that mean it is not warranted to be universal at present, though certain and limited activities might be considered appropriate in well controlled environments.

Precision Beyond Human Cognition: AI identifies interactions between hundreds of factors in the patient, many of which clinicians may not notice, such as the interaction between a so-called frailty indicator from gait analysis and subtle abnormalities in the electrocardiogram (ECG) [4]. Deep learning and automated analysis of preoperative CT images can quantify skeletal muscle and adipose tissue characteristics, providing additional information about frailty and postoperative risk [5]. Furthermore, AI can adapt to risk assessments continuously during surgery as new intraoperative data (such as blood pressure fluctuations, blood loss, etc.) become available, allowing for real-time surgical planning [6]. This might help minimize unplanned admissions to the intensive care unit (ICU), optimize blood product allocation, and inform better about patient-specific risk probabilities. AI-driven risk scores could help in determining the best surgical approach (such as open or minimally invasive surgery, or even hospice referral) in high-stakes surgery cases, such as pancreaticoduodenectomy or aortic aneurysm repair.

The Generalizability Gap (Limitations): Although these results are promising in retrospective, the majority of AI models do not perform well on different population, hospital system, or surgical subspecialty [7]. Most perioperative machine-learning models have relied on single-center datasets, with limited external validation, raising concerns about their generalizability across different hospitals and patient populations [8]. The integration of clinical biomarkers, advanced imaging, and predictive analytics may further strengthen evidence-based surgical decision-making by providing complementary information for patient assessment, risk estimation, and individualized perioperative planning [9]. Continued use of historical patterns also reinforces the treatment algorithm. This transition from association to utility into clinical areas is not proven, if deployment trials are not conducted.

Ethical Concerns: Bias, Autonomy, and Transparency: These AI models, which are often designed predominantly white, male, or privately insured populations, may miss the mark for other groups and result in systemic biases that further exacerbate inequities [10]. Using past healthcare utilization as a proxy for frailty could penalize socioeconomically disadvantaged patients. Because these patients historically have less access to preventive care, they appear healthier in utilization data than they actually are [11]. An algorithm relying on that data may then underestimate their risk and divert resources away from those who need them most [12]. From an ethical perspective, how should surgeons reveal that a "black box" neural network with unintelligible decision boundaries was used in part of the patient's risk assessment? AI ignores the norm of intelligible reasoning required by traditional informed consent. Furthermore, liability is uncertain if a patient is incorrectly labeled as high-risk and surgery is postponed, leading to the progression of the condition. It is unclear under current malpractice law who is responsible, the algorithm creator, the hospital, or the surgeon.

Implementation Challenges (From Code to Clinic): Even the best AI model faces formidable real-world challenges. Hospitals do not have standardized data pipelines: missing data is still common, and electronic health records from several vendors (Epic, Cerner, Meditech) employ non-interoperable ontologies [13]. Workflow integration is critical for AI adoption. Alerts that interrupt documentation workflows are dismissed, and passive, non-contextual reports have low clinician engagement and are rarely accessed [14]. Technical training alone is insufficient; clinicians also need to understand probabilistic predictions, confidence intervals, model limitations, and the appropriate interpretation of algorithmic outputs [15]. Few perioperative AI tools have been approved by regulatory agencies, such as the U.S. Food and Drug Administration (FDA), and these are primarily for image interpretation rather than for forecasting changes in risk [16]. Without defined reimbursement pathways, the investment in hospitals to support the use of AI for surgical planning will be hindered.

FUTURE PERSPECTIVES

It is not feasible today to have AI be the universal standard, but there can be a roadmap of an adoption path. First, the professional societies should lay down benchmark requirements: prospective validation across ≥3 different health systems, demonstration of non-inferiority or superiority compared with the current risk tools through randomized control trials, and mandatory fairness audits for protected attributes. Second, the validity of explainable AI techniques (such as attention maps) should be tested in clinical context to offer clear explanations. Third, regulatory and/or legal policies should be clearer that while AI can provide a probabilistic guidance, it cannot replace prescriptions. Fourth, high-risk specialties (e.g., hepatobiliary surgery, cardiac, transplant, oncologic surgery) may serve as a high-risk standard, pending real-time monitoring for adverse predictions. Achieving a future of pervasive AI in healthcare will require approaches that enable model training across institutions without sharing raw patient data, thereby improving generalizability while addressing privacy and data-governance concerns.

CONCLUSION

AI has the real potential to improve perioperative risk stratification and surgical planning with its promise of identifying patterns that are not discernible to humans. There are challenges with the external validity of current studies, questions of ethical issues involving the potential for bias and transparency, as well as significant implementation issues, which should not warrant AI as required standard of care at this time. Rather, a balanced approach positions AI as an adjunct, an intelligent but not infallible assistant whose outputs clinicians consider during decision-making. AI could be an integral part of succession in the next decade, with robust prospective validation, fairness protection, explainable designs and clear medicolegal rules. At present, AI is not justified as a universal standard of perioperative care, although its targeted use may be appropriate in selected clinical settings where adequate validation, clinical oversight, and implementation safeguards are established.

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