

SMART SURGERY

THE ROLE OF MACHINE LEARNING IN PREDICTING POSTOPERATIVE COMPLICATIONS IN GASTROINTESTINAL SURGERY, AND HOW FLUIDAI'S LATEST INNOVATION, STREAM™ CARE, IS REVOLUTIONIZING THE FIELD

What is Artificial Intelligence and Machine Learning?

Artificial Intelligence (AI) is a broad field of computer science focused on creating systems capable of performing tasks that typically require human intelligence. These tasks include problem-solving, learning, reasoning, perception, and language understanding. Machine Learning (ML) is a subset of artificial intelligence that involves the development of algorithms that enable computers to learn from and make decisions based on data. In the context of medicine, ML algorithms can be used to glean insights from large datasets, including medical records, imaging, genetic information, and more to identify patterns, make predictions, and provide recommendations.

What Role does AI and ML Play in the Surgical Context?

AI and ML have shown significant promise in gastrointestinal (GI) surgery, offering innovative solutions to complex problems. These technologies are employed to enhance preoperative planning, intraoperative guidance, and postoperative care, contributing to improved surgical outcomes and patient safety (Stam et al., 2022; Sakamoto et al., 2022). For example, AI algorithms can analyze patient data to assist surgeons in identifying optimal surgical approaches, while ML models can predict potential complications, enabling proactive measures to mitigate risks (Nudel et al., 2021).

One of the most game-changing impacts AI can have within the realm of GI surgery is enabling early prediction of postoperative complications. Researchers have developed various models that leverage patient data to forecast complications such as infections, leaks, and other adverse events (Solanki et al., 2021). These predictive models utilize a range of data inputs, including preoperative health status, intraoperative variables, and postoperative recovery metrics, to generate accurate risk assessments.

What Are the Benefits of Using AI/ML in GI Surgery?

Patient Outcomes

The integration of AI and ML in GI surgery has led to notable improvements in patient outcomes. These technologies have been instrumental in enhancing the accuracy of surgical procedures, reducing complication rates, and improving overall patient health. For instance, the use of AI in surgery can significantly reduce the incidence of postoperative complications, and in the postoperative phase, predict complications that do arise earlier. As just one example, artificial intelligence has been used to predict postoperative sepsis in the context of liver transplantation, with one study finding sensitivity, specificity, and AUC values of 0.94, 0.90, and 0.97, respectively.

Length of Hospital Stay

AI and ML technologies have also been shown to impact the length of hospital stay (LOS) for patients undergoing GI surgery. By accurately predicting postoperative complications and optimizing perioperative care, these technologies can help in reducing the overall LOS. AI and ML can enhance ERAS protocols by predicting patient outcomes, personalizing recovery plans, and optimizing postoperative care, thereby reducing complications and shortening hospital length-of-stay.

A systematic review and meta-analysis by Wang et al. (2024) found that ML models could predict LOS with improved accuracy compared to traditional methods, reducing the average LOS for patients undergoing major GI surgeries. This reduction in LOS not only benefits patients by facilitating quicker recoveries but also helps healthcare facilities optimize their resources and manage patient flow more effectively. AI and ML can increase patient throughput in hospitals by optimizing resource allocation, streamlining patient flow, and predicting discharge times, enabling faster transitions and more efficient use of hospital capacity.

Economic Impact

The economic implications of AI and ML applications in GI surgery are profound. By improving surgical outcomes and reducing complication rates, these technologies can lead to significant cost savings for healthcare systems. AI-driven predictive models can help optimize resource allocation and reduce healthcare costs associated with prolonged hospital stays and readmissions.

For patients, this means improved health outcomes, quicker recovery, and fewer medical expenses. For care providers, it enhances decision-making efficiency, leading to better resource management and lower workload related to complications. Hospital systems benefit from reduced operational costs, as shorter stays and fewer readmissions free up beds, improve patient throughput, and enhance overall capacity, resulting in lower costs and optimized use of hospital resources. This cost-saving approach creates a more sustainable healthcare model with improved patient satisfaction and economic efficiency.

Innovating Postoperative Patient Care: Stream™ Care

While AI and ML have remarkable potential for changing the face of medical care globally, no technologies exist in clinical practice that monitor patients for numerous high-impact complications in real-time. Models tend either to be tailored to single complications, and often are based on features (i.e. variables) that may or may not align with well-established clinical guidelines. FluidAI's Stream™ Care fills this gap, combining powerful insights from EHRs with real-time physiological monitoring through technology such as Origin™ (which monitors peritoneal drainage fluid following gastrointestinal surgery).

About Stream™ Care

Development of Stream™ Care is based on rigorous research and examination of clinical guidelines and medical texts, with in-depth analyses conducted for high-yield postoperative complications, ranging from anastomotic leak, to sepsis, to bleeding, to deep vein thrombosis, to surgical site infections (and more). One branch of Stream™ Care utilizes both rule-based models and ML based models to predict the risk of postoperative complications in real-time, built off established medical guidelines for each respective complication.

Stream™ Care brings in the power of ML algorithms to predict - using carefully tested models - the presence of each of the many complications Stream™ Care has been developed to monitor for.

Through Stream™ Care, clinicians, medical teams, patients, and healthcare systems as a whole can have greater peace of mind - knowing constant monitoring for postoperative complications is occurring, enabling earlier prediction, treatment (if required), and reduction in the deadly and costly outcomes associated with complications following gastrointestinal surgery.



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