Critical Post-Surgical Challenges: An Evidence-Based Review of Complications in Gastrointestinal Procedures

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Background

Despite countless surgical advances, **postoperative complications continue to be a reality** within the world of gastrointestinal surgery.

- Gastrointestinal (anastomotic leak, postoperative ileus)
- Sepsis
- Wound complications (surgical site infection)
- Renal & Urinary (acute kidney injury, urinary tract infection)
- Respiratory (pneumonia, pulmonary edema)
- Thrombic (deep vein thrombosis (DVT), pulmonary embolism)
- Bleeding
- Cardiac (myocardial infarction)
- Neurological (delirium)
- Other complications (postoperative fever, reoperation, 30-day unplanned readmission)

Application of Artificial Intelligence (AI) and Machine Learning (ML) in the surgical space has opened new doors for **predicting postoperative complications earlier, more precisely, and less invasively**, with great potential for improving patient outcomes. However, it is critical that the landscape of postoperative complications be fully understood to develop accurate ML models.

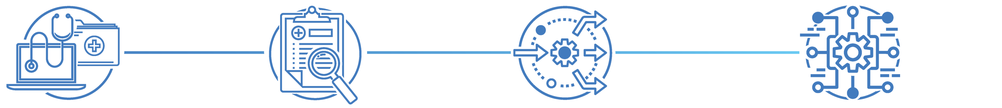
This study fills a gap in this space, undertaking a **comprehensive literature review** aimed at describing **the most pressing postoperative complications** impacting colorectal and hepatobiliary (HPB) procedures.

Methods

A **systematic review** of over 200 peer-reviewed papers on postoperative complications in colorectal and hepato-pancreato-biliary (HPB) surgeries was conducted. This review also **incorporated an analysis of current Standard of Care (SOC) practices and interventions**, referencing several gold-standard medical texts to evaluate the impact of early prediction of postoperative complications by assessing the potential for early intervention.

Meta-analysis techniques were applied **to compare complication patterns between colorectal and HPB procedures.**

A decision matrix was created to rank complications based on key factors: **cost, incidence, morbidity/mortality rate, actionality (potential for early intervention), and technical feasibility (the availability and performance of existing AI/ML models for predicting complications).**



RESULTS

For colorectal surgeries, the most significant complications identified included **surgical site infections, anastomotic leaks, bleeding, and sepsis, which have average incidence rates of 18.4%, 7.6%, 13.3%, and 10.7%, respectively.**

These complications significantly contribute to postoperative mortality and result in excess costs ranging from **$14,643 to $32,546** per incidence. These complications are also associated with **increased resource utilization, prolonged hospital stays, and delayed discharge times.**

These outcomes contribute to **prolonged hospital stays and economic burdens reaching greater than $100,000 in severe cases.**

Mortality rates in HPB surgeries were also noticeably high, with some complications (e.g. POPF) reaching **23.33%, on average.**

While various AI/ML models exist, their performance in predicting the full range of complications remains inconsistent, with **AUC/ROC scores ranging from 0.31 to 0.98.**

Consequence	Incidence (Average)	Mortality (Average)	Excess Cost (Average, USD)	Current ML Model AUC/ROC core range (Min-Max)
Surgical Site Infection	18.38%	9.63%	$14,643.56	0.65-0.93
Anastomotic Leak	7.5%	20.51%	$32,546.64	0.724-0.952
Bleeding	13.28%	11.13%	$23,967.86	0.773-0.85
Sepsis	10.70%	26.28%	$19,168.20	0.82-0.94

Table 1 - Highest Significance Postoperative Complications following Colorectal Surgery - Metrics

Consequence	Incidence (Average)	Mortality (Average)	Excess Cost (Average, USD)	Current ML Model AUC/ROC core range (Min-Max)
Fistula Formation	13.9%	23.33%	$41,699.50	0.68-0.85
Bleeding	8.5%	4.13%	$32,834.33	0.77-0.85
Sepsis	4.62%	7.81%	$34,565.00	0.83-0.84

Table 2 - Highest Significance Postoperative Complications following HPB - Metrics

Conclusion

This review highlights the most significant postoperative complications in colorectal and HPB surgeries, emphasizing their impact on **cost, incidence, and mortality.**

Its outcomes can be used to guide further research and the development of ML models to predict such complications in advance.

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