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Gastrointestinal surgery beyond tertiary centres: Experience from North Bengal, India

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Abstract:
Contemporary data on the spectrum and outcomes of gastrointestinal surgery from non-metropolitan India are limited. This retrospective clinical audit characterised gastrointestinal surgery performed by a single specialist surgeon across public and private facilities in North Bengal, India, from January 2024 to December 2025. The source log contained 307 procedure components that were consolidated into 291 operative episodes; 255 (87.6%) were elective, 36 (12.4%) emergency and 221 (75.9%) were open procedures. Non-fatal Clavien-Dindo grade I-IV morbidity occurred after 56/291 episodes (19.2%; 95% CI 14.9%-24.3%), while 12 deaths occurred (4.1%; 95% CI 2.1%-7.1%); mortality was 2.0% after elective surgery and 19.4% after emergency surgery (crude risk ratio 9.9, 95% CI 3.3-29.6; Fisher exact p<0.001). The findings describe a heterogeneous non-metropolitan gastrointestinal surgical workload and show a marked unadjusted mortality difference by urgency, but they do not establish causal effects of facility type, resources, or service adaptations.

Keywords: Gastrointestinal surgery, surgical audit, post-operative complications, Clavien-Dindo classification, emergency surgery, rural surgical care

Background:
Contemporary, locally generated data on gastrointestinal surgical workload and outcomes from non-metropolitan India are sparse, limiting service planning and benchmarking. Recent Indian and rural-surgery literature continues to identify gaps in subnational surgical data, specialist workforce and perioperative capacity **[1-3].** Access to safe, timely and affordable surgical care remains uneven in rural India, where infrastructure, workforce and blood-supply limitations have been identified as important system constraints **[2].** Geographical access to surgical care is associated with outcomes from acute abdominal conditions in India, supporting the need for locally generated data from non-metropolitan settings **[3].** Global surgery frameworks also emphasise that surgical outcomes should be interpreted together with access, workforce, service capacity and financial protection rather than as isolated crude rates **[4].** Therefore, it is of interest to evaluate the gastrointestinal surgical workload of one specialist surgeon across public and private facilities in North Bengal and to report short-term morbidity and mortality, with particular attention to elective and emergency surgery.

Methodology:
Study design and setting:
This was a retrospective, multicentre clinical audit or case series of GI operations performed by one trained super specialist GI surgeon between 1 January 2024 and 31 December 2025 in North Bengal, India. Cases were performed at one public teaching hospital and multiple private hospitals or nursing homes. After standardizing obvious spelling variants in the database, 4 facility names were represented. Facility resources varied; availability of dedicated GI anaesthesia, intensive care unit (ICU) beds, advanced laparoscopy, interventional radiology, endoscopic retrograde cholangiopancreatography (ERCP), blood bank, cross-sectional imaging, pathology and specialist postoperative nursing was not uniform. Because formal facility level resource scoring had not been prospectively recorded, the term resource constrained was not used as a quantitative exposure variable in the analysis.

Study population and unit of analysis:
The source surgical log contained 307 procedure entries. Sixteen entries were paired same-patient, same day component procedures. These were consolidated into 291 operative episodes for episode-level outcome analysis. The 307 procedure components were retained only for describing the anatomical procedural workload. Separate operations performed on different dates were retained as separate operative episodes. The audit comprised all consecutive operative entries in the surgeon's database during the study period. Patients evaluated but not operated on, patients referred elsewhere before an operation and non-operative consultations were not included in the database.

Variables and data sources:
Data were abstracted from the surgeon's operative database and the available operation records, discharge summaries, investigation reports and postoperative documentation. Variables used in the revised analysis included age, sex, treating facility, urgency (elective or emergency), diagnosis, malignant or non-malignant disease, operation, operative organ, open or laparoscopic approach, postoperative stay, operative duration where recorded, complications, Clavien-Dindo grade, ICU or ventilatory support and mortality or cause of death. Free-text diagnoses and procedure labels were standardized into clinically coherent categories while preserving the original record. Obvious spelling variants in facility and approach names were harmonized.

Outcome definitions:
The primary outcomes were non-fatal postoperative morbidity (Clavien-Dindo grades I-IV) and mortality (grade V). When more than one complication grade was recorded for an operative episode, the highest grade was used for episode-level reporting, consistent with conventional Clavien-Dindo reporting **[5, 6].** Grade IV was interpreted as a life-threatening complication requiring critical-care management rather than ICU admission alone. The available database primarily captured in-hospital postoperative events; one death was explicitly documented as occurring within 30 days after discharge. Because systematic 90-

day surveillance was not available across all facilities, 90-day mortality was not estimated.

Statistical analysis:

Continuous variables are summarised as median and interquartile range (IQR) and categorical variables as n (%). Exact binomial 95% CIs were calculated for major morbidity and mortality proportions. Emergency and elective mortality were compared using a crude risk ratio and Fisher's exact test. No multivariable mortality model was fitted because only 12 deaths occurred and the database did not contain a sufficiently complete, consistently measured set of preoperative risk-adjustment variables. Public or private and open or laparoscopic comparisons were treated as descriptive because of strong confounding by case selection and procedure complexity. Reporting was structured in accordance with STROBE/PROCESS guidelines **[7, 8].**

Results:

The source database contained 307 procedure components. Consolidation of 16 same-patients, same-day paired components yielded 291 operative episodes. Of these, 255 (87.6%) were elective and 36 (12.4%) emergency (**Figure 1**). Ninety-one episodes (31.3%) were performed in the public teaching-hospital dataset and 200 (68.7%) in private hospitals or nursing homes. The median age was 45 years (IQR 31-56); 147 episodes involved male and 144 female patients. Malignant disease was present in 59 episodes (20.3%) **(Table 1).** The 291 operative episodes comprised 307 recorded procedure components. The most frequent anatomical categories were gallbladder (63), bile ducts (46), small bowel (35), miscellaneous or abdominal wall procedures (35), colorectal (30), pancreas (26), anal canal (19), stomach (17), appendix (14) and liver (10). The series included major operations such as esophageal replacement with gastric conduit (n=1), pancreatico-duodenectomy (n=2), hepatectomy or liver resection (n=5), splenorenal shunt (n=1), ileal pouch-anal anastomosis (IPAA)(n=1), Frey's procedure (n=20), radical or extended cholecystectomy (n=17), Roux-en-Y hepatico-jejunostomy for various indications (n=15), right hemicolectomy (n=16) and low anterior resection (n=6) **(Table 2).** Using the highest Clavien-Dindo grade per operative episode, 223/291 episodes (76.6%) had no recorded postoperative adverse event, 23 (7.9%) had grade I, 22 (7.6%) grade II, 8 (2.7%) grade III, 3 (1.0%) grade IV and 12 (4.1%) grade V. Thus, non-fatal grade I-IV morbidity occurred after 56/291 episodes (19.2%; 95% CI 14.9%-24.3%), while any grade I-V adverse outcome occurred after 68/291 episodes (23.4%; 95% CI 18.6%-28.7%) **(Table 3).** Common documented non-fatal events included surgical-site/wound complications (33 episodes), delayed gastric emptying or nasogastric-tube reinsertion (7), fluid or renal problems (4), intra-abdominal collection requiring drainage or aspiration (3), gastrointestinal leak or fistula (2), bleeding or transfusion-related events (2), liver-function derangement (2) and isolated respiratory, neurologic and urinary-retention events. These counts are descriptive and some episodes contained more than one complication type. Overall mortality was 12/291 (4.1%; 95% CI 2.1%-7.1%). Mortality was 5 or 255 (2.0%; 95% CI 0.6%-4.5%) after elective surgery and 7/36 (19.4%; 95% CI 8.2%-36.0%) after emergency surgery. The crude risk ratio for death after emergency versus elective surgery was 9.9 (95% CI 3.3-29.6; Fisher exact p<0.001). This estimate was not adjusted for age, diagnosis, physiological severity or procedure complexity and should not be interpreted causally. Recorded causes of death included peritonitis and sepsis or multi-organ dysfunction, acute liver failure, septic cardiomyopathy, pulmonary embolism, acute kidney injury, cholangitis and advanced malignancy. The case mix differed substantially by setting. Emergency operations represented 20 or 91 (22.0%) public-hospital episodes compared with 16 or 200 (8.0%) private-hospital episodes. Non-fatal morbidity was recorded after 22 or 91 (24.2%) public episodes and 34 or 200 (17.0%) private episodes; mortality was 8 or 91 (8.8%) and 4 or 200 (2.0%), respectively. These crude differences were not adjusted for referral patterns, urgency, disease severity or procedure complexity and are presented only to demonstrate heterogeneity between settings.

Table 1: Clinical characteristics by urgency

Characteristic	Overall (n=291)	Elective (n=255)	Emergency (n=36)
Age, years, median (IQR)	45 (31-56)	45 (31-56)	45 (31-54)
Male sex, n (%)	147 (50.5)	122 (47.8)	25 (69.4)
Female sex, n (%)	144 (49.5)	133 (52.2)	11 (30.6)
Public setting, n (%)	91 (31.3)	71 (27.8)	20 (55.6)
Private setting, n (%)	200 (68.7)	184 (72.2)	16 (44.4)
Malignant disease, n (%)	59 (20.3)	56 (22.0)	3 (8.3)
Open approach, n (%)	221 (75.9)	190 (74.5)	31 (86.1)
Laparoscopic approach, n (%)	69 (23.7)	64 (25.1)	5 (13.9)
Laparoscopic-assisted, n (%)	1 (0.3)	1 (0.4)	0
Postoperative stay, days, median (IQR)	5 (2-7)	5 (2-7)	7 (4.5-9.3)
Operative duration, min, median (IQR)	120 (60-180)	120 (60-180)	120 (75-135)

Table 2: Distribution of 307 procedure components by organ category and urgency

Organ/procedure category	Total procedures	Elective	Emergency
Gallbladder	63	63	0
Bile ducts	46	45	1
Small bowel	35	22	13
Miscellaneous/abdominal wall	35	32	3
Colorectal	30	23	7
Pancreas	26	25	1
Anal canal	19	19	0
Stomach	17	17	0
Appendix	14	8	6
Liver	10	10	0
Duodenum	5	0	5
Spleen	5	5	0
Oesophagus	2	2	0

Table 3: Post-operative morbidity and mortality by highest Clavien-Dindo grade and urgency

Highest Clavien-Dindo grade	Overall n (%)	Elective n (%)	Emergency n (%)
No recorded adverse event	223 (76.6)	203 (79.6)	20 (55.6)
Grade I	23 (7.9)	20 (7.8)	3 (8.3)
Grade II	22 (7.6)	18 (7.1)	4 (11.1)
Grade III	8 (2.7)	7 (2.7)	1 (2.8)
Grade IV	3 (1.0)	2 (0.8)	1 (2.8)
Grade V (death)	12 (4.1)	5 (2.0)	7 (19.4)

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Non-fatal morbidity (I-IV)	56 (19.2)	47 (18.4)	9 (25.0)
Any adverse outcome (I-V)	68 (23.4)	52 (20.4)	16 (44.4)

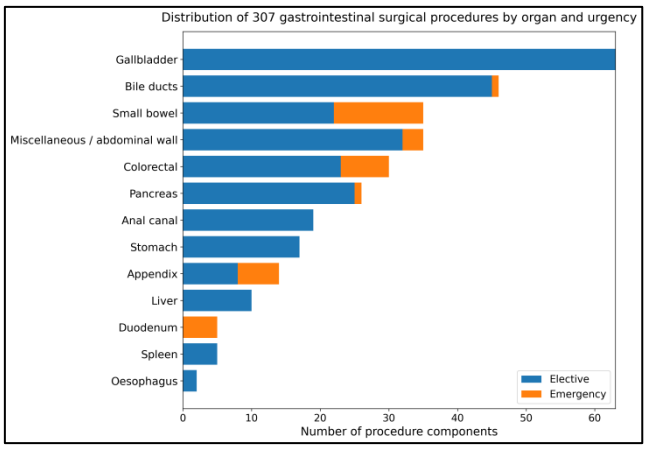


Figure 1: Distribution of 307 procedure components by organ category and urgency

Discussion:

The 307 database entries represented 307 procedure components but 291 operative episodes. The service-delivery challenges variable availability of advanced equipment, ICU support, specialist anaesthesia, diagnostic services, pathology and multidisciplinary input were not prospectively measured exposures and no intervention was evaluated. Recommendations such as context-appropriate equipment procurement, structured staff training, virtual specialist support and improved referral pathways should therefore be regarded as service-development priorities rather than demonstrated effects of this audit. Global surgery literature supports the importance of safe access to surgical and anaesthetic care, but local implementation requires facility-level assessment **[4].** Outcome reporting on the 291 episodes gives an overall non-fatal morbidity rate of 19.2% and mortality of 4.1%. The principal quantitative observation is the marked crude mortality difference between emergency and elective surgery. Similar directionality has been described in large general-surgery datasets, but those studies also show that urgency is intertwined with patient risk and procedure mix **[9, 10].** Accordingly, the present audit does not claim that the observed difference was caused by resource limitation itself. The procedural spectrum was unusually broad for a single-surgeon series, extending from common gallbladder and bile-duct operations to pancreatic, hepatic, colorectal and portal-hypertension procedures. To convey this heterogeneity, in addition to organ only grouping we report named major operations and distinguish the 307 procedure components from the 291 operative episodes. The wide range of procedures may limit the usefulness of a single aggregate complication rate as a quality benchmark but reflect the reality of under-served areas of our country. The public and private settings were not interchangeable. A larger proportion of public-hospital episodes were emergencies and crude mortality was higher in the public group. These differences almost certainly reflect differences in selection, referral, physiological severity, financial pathways and facility resources. The data are therefore unsuitable for a causal public-versus-private comparison. Likewise, the much lower adverse event frequency after laparoscopic procedures reflects strong procedural and patient selection and cannot be interpreted as an effect of laparoscopy. Experience with long-term clinical record systems also supports the value of structured data capture for service evaluation **[11, 12].** Regional evidence from North Bengal has described the presentation and management of cholangiocarcinoma in a rural tertiary setting **[13].** Perioperative nutrition and medication management in older patients have also been reviewed in gastrointestinal surgical literature, although these variables were not consistently available in the present audit **[14, 15].** Reviews of robotic surgery and machine-learning applications describe evolving approaches to gastrointestinal care, but these technologies were not evaluated in this series **[16-18].** Postoperative gastrointestinal motility disturbances, including iatrogenic constipation, have additionally been discussed in the literature but were not systematically assessed here **[19].**

Limitations:

This study has several limitations. It is a single-surgeon retrospective audit across multiple heterogeneous facilities and therefore has limited external validity. The operative database does not capture patients who were assessed but not operated on or those referred elsewhere before surgery, creating selection bias. Risk-adjustment variables such as ASA physical status, validated frailty/performance scores and consistently measured nutritional indices were not available across the full series; with only 12 deaths, reliable multivariable mortality modelling would in any case be unstable. The available outcome documentation primarily reflects the index admission and was not supported by uniform 90-day surveillance, so post-discharge events may have been under-ascertained. Minor complications are particularly susceptible to retrospective under-recording. Procedure complexity was heterogeneous, some patients underwent more than one operation on different dates and facility-level resource measures were not prospectively captured. Finally, because the reported service adaptations were not measured interventions, the audit cannot establish that protocols, training or resource adaptations caused the observed outcomes.

Conclusion:

Over two years, 307 gastrointestinal procedure components were recorded across 291 operative episodes in North Bengal. Non-fatal Clavien-Dindo grade I-IV morbidity occurred after 19.2% of episodes and mortality after 4.1%. Emergency surgery was associated with substantially higher crude mortality than elective surgery, but the comparison was unadjusted and confounded by case mix and severity. These findings should be viewed as a descriptive baseline for prospective, risk-adjusted service evaluation rather than evidence of equivalence between facilities or benefit from any specific resource adaptation.

Conflict of interest:

The authors declare no relevant financial or non-financial conflicts of interest. Funding: No funding was received for this study or manuscript.

Data availability:
Data relevant to the reported analyses are included in the article; access to source-level clinical records is subject to institutional and ethical requirements.

Ethics:
The study protocol has been submitted to the Institutional Ethics Committee of the public teaching institution for retrospective record review, waiver of individual informed consent and use of de-identified data.

Author contributions:
Barun Kumar Singh - conceptualisation and manuscript preparation; Parmanand Tiwari - preliminary drafting, data analysis, tables and graph preparation; Samiran Nundy - study design oversight and final editing.

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