

Cost Analysis of Enhanced Recovery After Surgery (ERAS) in Elective Colorectal Surgery in a Philippine Government Hospital

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ABSTRACT

Background. The Division of Colorectal Surgery at the Philippine General Hospital (PGH) conducts hundreds of surgeries annually for benign and malignant colorectal conditions. Since 2019, the Division has implemented an Enhanced Recovery After Surgery (ERAS) program to improve patient outcomes. However, its impact on hospital costs—critical for a government hospital—has not yet been studied.

Objective. This study aimed to evaluate the effect of ERAS on healthcare costs for elective colorectal surgeries performed at PGH in 2021.

Methods. A retrospective observational study was conducted on adult patients who underwent elective colorectal surgeries under the ERAS protocol in 2021. Medical and billing records were retrieved using the hospital's electronic medical records (EMR) system, excluding cases with incomplete data. Procedures were categorized by type [stoma closure, colonic or rectal resection, reversal of Hartmann's, or cytoreductive surgery with hyperthermic intraperitoneal chemotherapy (CRS-HIPEC)] and surgical approach (open, laparoscopic, or robotic). Costs were classified into diagnostics, facility fees, medications, surgery, and hospital supplies. ERAS compliance rates were extracted from the online ERAS Interactive Audit System (EIAS), and linear regression analysis was performed.

Results. Among 114 elective colorectal surgeries, records for 90 cases were analyzed. Surgery-related expenses accounted for the highest mean hospital costs across all procedure types. An inverse correlation between ERAS compliance and total cost was observed for open surgeries, with statistically significant reductions in stoma closures and open colon resections (p -value: 0.0213 and 0.0134, respectively). However, minimally invasive surgeries (MIS) did not demonstrate cost reductions with increasing ERAS compliance, likely due to additional expenses associated with advanced equipment. Linear regression indicated that higher compliance rates generally led to decreased hospital costs.

Conclusion. Standardized care through ERAS has been associated with cost savings compared to traditional perioperative management. This study supports the conclusion that higher ERAS compliance can reduce hospital costs in open colorectal surgeries. However, the higher costs of MIS procedures, driven by equipment-related expenses, may offset potential savings from ERAS adherence. Further research is warranted to explore the cost implications of ERAS in MIS cases.

Keywords: cost analysis, cost minimization, colorectal surgery



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INTRODUCTION

Being one of the largest hospitals in the country that provides government-subsidized healthcare, the Philippine General Hospital (PGH) caters to thousands of Filipinos. In 2021 alone, the Department of Surgery of PGH catered to more than 14,000 patients in both in- and out-patient settings, and another 18,000 consults via telemedicine. In the same year, 821 colorectal surgeries, both elective and emergency, were performed at the PGH. Patients admitted under the charity service of PGH have no financial obligations to the hospital and all healthcare costs incurred are shouldered by the hospital. It, therefore, is important that the hospital is able to properly allocate its resources while serving the most optimal number of patients possible. Despite restrictions brought about by the pandemic, we were still able to perform 150 major colorectal surgeries in the charity service.

Enhanced Recovery After Surgery (ERAS) is a multi-modal management protocol developed using evidence-based practices that aims to improve patient outcomes, decrease complications, and reduce hospital stay.¹⁻³ Majority of compliance studies using ERAS advocate for a 70% compliance rate. Studies have shown improved outcomes with increasing adherence to the many components of ERAS.⁴ A study from Canada showed that every \$1 invested in ERAS would bring \$3.80 in return.⁵ This reflects the cost-saving potential of the program.⁵ ERAS has been implemented by the Division of Colorectal Surgery at the PGH in 2019. While we have completed and published studies on our experience, none were on the impact on hospital cost.³

General Objective

This study aimed to conduct a comprehensive hospital cost analysis of elective colorectal surgeries and evaluate the impact of ERAS implementation and compliance on total healthcare costs.

Specific Objectives

1. To assess the effect of ERAS compliance on the length of hospital stay.
2. To analyze actual hospital expenditures based on the type of surgery and surgical approach.
3. To determine the potential cost reductions associated with increasing compliance rates to ERAS protocols.

The findings of this study are intended to guide PGH and other government healthcare institutions in optimizing the use of limited hospital resources. Additionally, this research aims to encourage other departments within PGH and similar institutions to adopt and implement ERAS programs to improve cost-efficiency and patient care outcomes.

MATERIALS AND METHODS

A retrospective observational study was conducted on all adult cases who underwent elective colorectal surgery and were enrolled to ERAS at the PGH from January 1 to December 31, 2021. A review of the medical records and itemized billing charges were done using the Integrated Surgical Information System of the Department of Surgery and OpenERP system of the billing department of PGH. Cases were classified based on the type of surgery (stoma closure, colonic or rectal resection, reversal of Hartmann's, or CRS-HIPEC) and type of approach (open, laparoscopic, or robotic). Emergent and urgent cases, cases not enrolled to ERAS, and cases wherein records were unavailable for review were excluded from the study.

All resources utilized during the hospital stay of the eligible cases in the study were retrieved from OpenERP of the hospital. All expenses incurred during the hospital stay were categorized into the following cost components:

1. Diagnostics – this included all perioperative laboratory tests – blood tests, urinalysis, radiologic examinations, electrocardiography, and other diagnostics tests.
2. Facility – this covered the cost of a hospital bed per day, as well as the daily food ration provided by the hospital.
3. Medications – this included all intravenous and oral medications (e.g., antibiotics, proton pump inhibitors, analgesics, maintenance medications for chronic conditions) given to patients for the duration of the hospital admission. Blood products given at any time during the admission were included. Medications related to the actual surgery and anesthesia were not included in this category. The actual prices of these medicines were obtained from the hospital pharmacy.
4. Surgery – this covered all the items used in each surgery of the patient – use of anesthesia machine, anesthetic medicines, operating gowns and drapes, gloves, surgical supplies (e.g., sutures, operating sponges, drains), charges for the use of surgical equipment, and operating room and recovery room charges. The cost and fees for all items and equipment used during surgery were obtained from the operating room pharmacy.
5. Hospital Supplies – this included all hospital and ward supplies, machine and equipment rental, and wound care items. The prices of these items were obtained from the cashier and hospital pharmacy.

After obtaining the resource utilization data of each case, the total cost per category as well as the total cost per case were computed. The cost per category were analyzed and compared based on type of surgery and approach. The ERAS compliance rate of each case was retrieved from EIAS. The compliance rate (0 to 100%) retrieved per case was based on the combined number of ERAS parameters during the preoperative, intraoperative, and postoperative phases

that each case adhered to. A linear regression analysis was then performed.

The relationship between total hospital cost and ERAS compliance rate of each case was then determined for each type of surgery and approach also using a linear regression analysis.

RESULTS

A total of 114 elective colorectal surgeries were performed in 2021 under ERAS, and complete records were retrieved for 90 cases. The mean age of the patients included in the study was 50.92 years (range, 22 to 75 years). The types of surgery and surgical approach are shown in Table 1.

The mean total length of hospital stay (LOS) for all cases was 7.56 days (range: 3 – 20 days). The average postoperative LOS for all cases was 5.3 days, and was almost similar across all types of surgery. Cases of stoma closures and laparoscopic colon resections had the shortest post-operative LOS and total LOS with a mean of 4.25 and 4 days for postoperative LOS while 6 and 6.4 days for total LOS, respectively. Those who underwent CRS + HIPEC had the longest LOS (Table 2).

Major complications requiring surgical or endoscopic intervention (Clavien-Dindo grade III) were also recorded as they would significantly impact on total cost (Table 3).

On review of the medical and billing records, robotic rectal surgeries were noted to have the highest average total hospital cost at PhP 235,894.30, followed by CRS-HIPEC with an average total hospital cost of PhP 152,299.10. Stoma closures, on the other hand, had the lowest average total hospital cost at PhP 45,726.52. Surgery cost was noted to have the highest mean cost among hospital expenses across all types of surgery, and comprised almost half of the total cost (Table 4).

The average ERAS compliance rate among all cases was 68.21%, with the highest compliance rate observed in laparoscopic colon resections (77.63%), and stoma closures (72.62%) (Table 5). An inverse correlation was noted between ERAS compliance rates and total cost for all open surgeries, reaching statistical significance for colon resections (p=0.0134) and stoma closures (p=0.0213). Minimally-invasive surgery failed to show a cost reduction despite increasing compliance rates. Linear regression analysis between compliance rates and mean total hospital cost showed that an increase in compliance rate resulted in decreased cost for most cases (Figure 1).

DISCUSSION

Enhanced Recovery After Surgery (ERAS) is an evidence-based, multimodal perioperative care pathway designed to optimize patient outcomes, reduce complications, and enhance recovery. Studies have consistently shown that ERAS leads to shorter hospital stays and reduced healthcare expenses.^{3,6,7} Systematic reviews have highlighted that the standardization of care through ERAS is associated

Table 1. Demographics of Adult Cases Undergoing Elective Colorectal Surgery under ERAS

Characteristics	Number (n=90)
Age (years)	
Mean	50.92
Median	53
Range	22 - 75
Gender	
Female	48 (53.33%)
Male	42 (46.66%)
Type of surgery	
Stoma Closure	28 (31.11%)
Colonic Resection	28 (31.11%)
Rectal Resection	23 (25.55%)
Reversal of Hartmann's	6 (6.66%)
CRS + HIPEC	5 (5.55%)
Surgical approach	
Open	73 (81.11%)
Laparoscopic	13 (14.44%)
Robotic	4 (4.44%)

Table 2. Average Hospital Length of Stay of Adult Cases Undergoing Elective Colorectal Surgery under ERAS

	Pre-operative (days)	Post-operative (days)	Total (days)
Stoma Closure	1.75	4.25	6.00
Colonic Resection			
Open	2.48	5.61	8.09
Laparoscopic	2.40	4.00	6.40
Rectal Resection			
Open	2.82	5.27	8.09
Laparoscopic	2.63	7.25	9.88
Robotic	1.75	6.25	8.00
Reversal of Hartmann's	1.83	5.17	7.00
Cytoreductive surgery ± HIPEC	2.80	7.60	10.40

Table 3. Summary of Major Complications Encountered in Adult Colorectal Surgery Cases under ERAS

	Major Complication	Percentage
Open		
Stoma closure	1 (hemoperitoneum)	3.57% (1/28)
Colonic Resection	1 (small bowel perforation)	4.34% (1/23)
Rectal Resection	-	-
Reversal of Hartmann's	-	-
CRS + HIPEC	-	-
Laparoscopic		
Colonic Resection	-	-
Rectal Resection	-	-
Robotic		
Rectal Resection	1 (stoma complication)	25% (1/4)

Table 4. Summary of Categorized and Total Healthcare Cost of Elective Colorectal Surgeries under the ERAS

	n	Mean Diagnostic Cost (PhP)	Mean Facility Cost (PhP)	Mean Medication Cost (PhP)	Mean Surgery Cost (USD)	Mean Hospital Supplies Cost (PhP)	Mean Total Hospital Cost (PhP)
Open							
Stoma Closure	28	5662.07	3000.00	12722.05	19798.58	4543.80	45726.52
Colon Resection	23	16511.47	4043.47	19703.64	46847.76	6922.65	94029.02
Rectal Resection	11	10748.43	4045.45	17547.74	48275.39	8163.25	88780.27
Reversal of Hartmann's Procedure	6	5795.37	3500.00	14985.58	31766.75	7494.37	63542.08
CRS-HIPEC	5	20059.95	5200.00	38190.26	72846.55	16002.35	152299.10
Laparoscopic							
Colon Resection	5	12492.45	3200.00	19211.13	65088.25	7640.38	107632.20
Rectal Resection	8	9241.09	4937.50	22374.38	92213.00	6261.90	135027.90
Robotic							
Rectal Resection	4	15159.25	4000.00	35164.10	172901.00	8669.91	235894.30

Table 5. Summary of Total Healthcare Cost and ERAS Compliance Rates of Elective Colorectal Surgeries

	n	Mean Total Hospital Cost (PhP)	Mean ERAS Compliance Rate (%)	Cost Reduction per 1% Increase in ERAS Compliance Rate (PhP)	p-value (CI:95%)	R ² -value
Open						
Stoma Closure	28	45726.52	72.62	1185.51	0.0213	0.1876
Colon Resection	23	94029.02	67.30	1810.10	0.0134	0.2577
Rectal Resection	11	88780.27	63.81	1340.95	0.1215	0.2451
Reversal of Hartmann's Procedure	6	63542.08	67.18	536.46	0.2194	0.3460
CRS-HIPEC	5	152299.10	53.33	1110.36	0.6482	0.0783
Laparoscopic						
Colon Resection	5	107632.20	77.63	-723.91 (<i>Cost increase</i>)	0.5522	0.1293
Rectal Resection	8	135027.90	67.59	2460.38	0.4406	0.1020
Robotic						
Rectal Resection	4	235894.30	64.40	-6834.1 (<i>Cost increase</i>)	0.2876	0.5076

with significant cost savings compared to conventional perioperative management.^{1,8} This approach has transformed healthcare delivery in developed countries, where reduced total healthcare costs have been widely reported.⁹

Our study revealed that surgical procedure-related expenses constituted the largest proportion of total hospital costs. Other hospital costs, such as diagnostics and medications, showed no significant differences across different types of surgery or surgical approaches. Notably, the resource utilization for minimally invasive surgeries (MIS), including laparoscopic and robotic procedures, was significantly higher than that for open surgeries. This disparity was particularly pronounced in the limited number of robotic surgery cases analyzed.

The implementation of ERAS in laparoscopic colorectal procedures has been associated with cost reduction, thereby increasing cost-effectiveness.¹⁰ The employment of MIS alone is an independent factor that significantly reduces length of hospital stay (LOS), complication rates, and overall costs. Furthermore, the combined use of ERAS and MIS has been shown to have a synergistic effect.¹¹ In a randomized trial comparing outcomes of laparoscopy and fast-track multimodal management, no significant differences in total hospital costs were observed. However, a statistically

significant reduction in median LOS was noted for patients who underwent laparoscopic surgery within the fast-track program.¹²

In contrast, our data did not reflect similar cost reductions for robotic cases. Currently, we are conducting a separate cost analysis study focusing on robotic colorectal procedures and their nuances, which may provide insights relevant to our setting.

In a government hospital like PGH, all healthcare expenses for patients in the charity service are funded by the state. However, fund allocation becomes increasingly challenging given the scarcity of resources. PGH serves an estimated 600,000 patients annually on a limited budget, which is allocated not directly by the Department of Health but through the national budget for the University of the Philippines (UP).¹³ In this context, the high expenses associated with operating a robotic platform necessitate careful review.

The financial implications become even more complex for private patients, where out-of-pocket payments remain the norm. According to the Philippine Statistics Authority (PSA), household out-of-pocket spending constituted 44.7% of total healthcare expenditures in the Philippines in 2022. Unsurprisingly, this high reliance on personal funds



Figure 1. Linear regression plot of ERAS compliance rates and total hospital cost of cases undergoing elective colorectal surgery under ERAS.

for healthcare places many individuals at a considerable financial disadvantage.

Our study showed, on linear regression analysis, an inverse relationship between ERAS compliance rates and total hospital cost for all types of surgery, except for robotic surgery. The computed cost reduction expected for every 1% increase in ERAS compliance ranged from PhP 536.46 to as much as PhP 2,460.38 per case. According to a study by Gustafsson et al., in 2011, when adherence to ERAS protocol was increased from a baseline of 43% to 70%, they noted a 27% reduction in relative risk for any 30-day postoperative complication after colorectal cancer surgery.¹⁴ In this study, the average ERAS compliance rate observed was 68.21% and the program still has the potential to improve adherence to several ERAS components. With this comes the prospect of additional cost savings. Reviewing the aspects where compliance was low, and focusing on interventions to increase compliance, may be looked into.

Public health systems of lower middle-income countries, however, face a multitude of challenges in health service delivery. Understanding hospital cost is critical to value-based care, however, existing literature reviews on the economic impact of implementing ERAS involve high-income countries. At the height of the COVID-19 pandemic, the need for efficient utilization of resources became more apparent. The centralization of cases towards ERAS experience centers has shown that despite the limitations imposed by the pandemic, ERAS may help optimize perioperative outcomes¹⁴, minimize healthcare cost, and allow for judicious allocation of resources. Our study covered a period where surgical cases were just on the upswing after months of closure and limited operations. There are plenty of realizations and experience from this period that may be applied to today's practice, such as, the wider implementation of ERAS.

Several limitations of this study, however, need to be addressed. This retrospective observational study included only patients on whom ERAS was implemented on. A comparison to a pre-implementation group would be more informative. The nature of the disease was also not considered in the study. Both benign and malignant conditions—wherein the magnitude of the intervention was often not comparable—were included and may have influenced the outcomes observed in the study. This needs to be considered especially when reporting outcomes and a subgroup analysis might improve the quality of data from the study. Manpower costs were also not included in the computation of total hospital resource utilization, and this was a significant area of costing and future studies should involve this aspect.

Studies on the economics of ERAS are mainly focused on in-patient expenses and reporting of data on out-of-hospital costs is lacking.¹⁵ Effecting measures to decrease the cost of care is imperative especially in a resource-limited environment. It is timely to consider the implementation of ERAS in lower middle-income countries and to standardize surgical practices that ultimately prevent complications,

improve outcomes, and save on healthcare cost.^{7,8,9,16} Furthermore, a more relevant version of ERAS may be looked into that may find wider acceptance and applicability in developing countries.

CONCLUSION

This study demonstrated that the implementation and adherence to the Enhanced Recovery After Surgery (ERAS) protocol in elective colorectal surgeries can reduce total healthcare costs, particularly for open surgical procedures. Higher ERAS compliance was associated with a decrease in hospital expenditures and length of stay, highlighting the program's potential for improving cost-efficiency in resource-limited settings.

Our findings also provided a detailed analysis of hospital expenditures based on surgical type and approach, showing that minimally invasive surgeries incurred higher costs, which may offset the cost-saving potential of ERAS due to the expenses associated with advanced equipment and instruments.

These preliminary data suggest that ERAS has significant cost-reduction potential, particularly when compliance is optimized. However, further studies are needed to explore its impact on specific subsets of patients, such as those undergoing robotic surgeries or private cases, and to evaluate the cost-effectiveness of establishing and sustaining an ERAS program. This study may serve as a guide for PGH and other government institutions in improving resource utilization and may encourage broader adoption of ERAS protocols across departments and healthcare facilities.

Statement of Authorship

All authors certified fulfillment of ICMJE authorship criteria.

Author Disclosure

All authors declared no conflicts of interest.

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