

ORIGINAL ARTICLE

The economics of recovery after pancreatic surgery: detailed cost minimization analysis of an enhanced recovery program

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Abstract

Background: Clinical pathways (CPW) are considered safe and effective at decreasing postoperative length of stay (LoS), but the effect on economic costs is uncertain. This study sought to elucidate the effect of a CPW on direct hospitalization costs for patients undergoing pancreaticoduodenectomy (PD).

Methods: A CPW for PD patients at a single Canadian institution was implemented. Outcomes included LoS, 30-day readmissions, and direct costs of hospital care. A retrospective cost minimization analysis compared patients undergoing PD prior to and following CPW implementation, using a bootstrapped *t* test and deviation-based cost modeling.

Results: 121 patients undergoing PD after CPW implementation were compared to 74 controls. Index LoS was decreased following CPW implementation (9 vs. 11 days, $p = 0.005$), as was total LoS (10 vs. 11 days, $p = 0.003$). The mean total cost of postoperative hospitalization per patient decreased in the CPW group (\$15,678.45 CAD vs. \$25,732.85 CAD, $p = 0.024$), as was the mean 30-day cost including readmissions (\$16,627.15 CAD vs. \$29,872.72 CAD, $p = 0.016$). Areas of significant cost savings included laboratory tests and imaging investigations.

Conclusions: CPWs may generate cost savings by reducing unnecessary investigations, and improve quality of care through process standardization and decreasing practice variation.

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Introduction

Postoperative clinical pathways (CPWs), also known as critical pathways, fast-track protocols, or enhanced recovery after surgery (ERaS) programs, are structured multidisciplinary clinical management instruments for patients following surgery. These tools standardize postoperative care and stipulate the timing and sequence of specific processes of care (e.g. catheter removal, dietary advancement). Variability in care delivery between patients and institutions leads to disparities in the quality of care.¹

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Thus the goal of postoperative CPWs is to enhance the quality of care by decreasing variations in the processes of care, and facilitate uptake of best practices to reduce morbidity and support functional recovery for patients. Introduced in the 1990s, postoperative CPWs have been demonstrated to be safe and effective in decreasing the duration of hospitalization.^{2,3} Reports of their effectiveness have prompted the use of CPWs following myriad surgical procedures, from cardiovascular to bariatric, including complex oncologic operations such as pancreaticoduodenectomy (PD).^{4–6} The results of a recent meta-analysis of CPWs following pancreatic surgery found that CPWs decreased postoperative length of stay (index LoS) without increasing complication rates, readmissions, or mortality.⁷ These results suggest that CPWs for

PD may be effective at improving the quality of care, leading to decreased costs of hospitalization.

A modest number of studies have reported the economic impact of CPWs on hospitalization costs, but few have evaluated patients undergoing PD.⁸ A recent systematic review identified 4 publications describing cost savings associated with implementation of a CPW for pancreatectomy patients⁹; three evaluated PD patients,^{10–12} and one evaluated patients undergoing distal pancreatectomy.¹³ Only one study has reported the influence of a CPW on component costs of the postoperative PD hospitalization, and this study did not observe decreased costs associated with CPW implementation.¹⁴ Therefore, the ability of a CPW to decrease hospital costs in the modern era of postoperative recovery, and the mechanism by which it affects these savings, remains in question. We sought to answer the question, what is the effect of implementing a CPW for patients undergoing PD at a high-volume hepato-pancreato-biliary (HPB) center on the overall and component economic costs of the postoperative hospitalization?

Methods

A retrospective cohort study was conducted at the Toronto General, University Health Network (UHN). Institutional Research Ethics Board approval was obtained (UHN-11-0273). The study was conducted at a high-volume HPB center of excellence which performs >100 pancreatectomies annually, in the province of Ontario, Canada which has a population of 13 million with a single payer government administered healthcare system.

The clinical pathway

An evidence-based CPW for the postoperative management of patients undergoing open PD procedures was developed. The CPW encompasses the episode of care from the date of surgery to discharge. Preoperative care elements (e.g. carbohydrate loading) were not included in the CPW. A literature review was completed to evaluate best evidence for recommendations on key elements of the CPW. Utilizing the input of 78 end user participants from 7 high-volume designated HPB centers, the design and content of the CPW was finalized. CPW materials developed included: a multidisciplinary CPW tool, preprinted orders, and evidentiary support for the best practice recommendations. The individual care elements composing the CPW are presented in Fig. 1. No routine postoperative imaging studies were included in the CPW. Following a 3 month pilot phase (Oct. 1, 2012–Dec. 31, 2012), the CPW was uniformly implemented at the Toronto General Hospital on January 1, 2013 for eligible patients undergoing open PD.

Clinical pathway adherence and outcomes

Performance of CPW elements of care were documented by the medical and allied health team. Patients were designated as

having achieved key CPW goals if they fulfilled all of the following 4 criteria: tolerated sips of clear fluids by postoperative day (POD) 1; discharged from the monitored care setting (Step Down Unit) by POD2; ambulated in room by POD1; solid diet started by POD4. Patients who were not able to meet the predefined goals of the CPW were discontinued from the CPW, whereupon they reverted to physician-directed care. Therefore, failure to adhere to the CPW was driven by patient status, but the decision to remove a patient from the CPW was at the discretion of their healthcare providers. While the CPW order sets could be overridden at the discretion of the treating physician when in the patient's best interests, there was prospective agreement among all participating surgeons to abide by the CPW. Demographic and clinical characteristics (age, gender, indication for surgery, multivisceral resection, comorbidity) were obtained by chart review, including postoperative complications which were categorized according to the Clavien–Dindo classification.¹⁵ Final pathologic diagnosis was used to define indication for surgery, and American Society of Anesthesiologists level was used to define comorbidity. Postoperative length of stay was defined as beginning on the first postoperative day (i.e. the day after surgery) and including the day of discharge, as has been previously described in analyses of outcomes at this institution.¹⁶

Patient selection and surgical procedure

To compare the postoperative hospitalization costs of patients managed according to the CPW to patients managed according to the previous standard of care, a historical cohort of all patients undergoing open PD at UHN between January 1, 2010–December 31, 2010 were identified as the control cohort (N = 74). This methodology has previously been employed for the economic analysis of postoperative CPWs.^{11,17} These control patients were then compared to all patients undergoing PD at UHN in the first 18 months following implementation of the CPW (N = 122) for whom relevant cost and outcomes data was available (one patient excluded due to missing cost data, N = 121). All patients underwent open PD performed by one of 7 fellowship-trained HPB surgeons, each with over 5 years of subspecialty practice experience. Postoperatively, all patients were managed initially in a monitored step-down unit, and then transferred to a high-volume inpatient ward. Patients requiring immediate postoperative intensive care unit (ICU) admission were not initiated on the CPW.

To assess for the influence of secular trends on postoperative length of stay, the postoperative PD lengths of stay for the fiscal years 2009–2015 were recorded using the UHN institutional database.

Cost analysis

Cost analysis was conducted from the institutional perspective. The UHN Case Costing Department (CCD) collects data on the in-hospital costs of each patient. Costs are subdivided by departmental budgetary category (post-anesthesia care unit,

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