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# Cost analysis of enhanced recovery after surgery in microvascular breast reconstruction

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## KEYWORDS

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**Summary Background:** Enhanced recovery after surgery (ERAS) pathways have been shown in multiple surgical specialties to decrease hospital length of stay (LOS) after surgery. ERAS in breast reconstruction has been found to decrease hospital LOS and inpatient opioid use. ERAS protocols can facilitate a patient's recovery and can potentially increase the quality of care while decreasing costs.

**Methods:** A standardized ERAS pathway was developed through multidisciplinary collaboration. It addressed all phases of surgical care for patients undergoing free-flap breast reconstruction utilizing an abdominal donor site. In this retrospective cohort study, clinical variables associated with hospitalization costs for patients who underwent free-flap breast reconstruction with the ERAS pathway were compared with those of historical controls, termed traditional recovery after surgery (TRAS). All patients included in the study underwent surgery between September 2010 and September 2014. Predicted costs of the study groups were compared using generalized linear modeling.

**Results:** A total of 200 patients were analyzed: 82 in the ERAS cohort and 118 in the TRAS cohort. Clinical variables that were identified to potentially affect costs were found to have a statistically significant difference between groups and included unilateral versus bilateral procedures ( $p=0.04$ ) and the need for postoperative blood transfusion ( $p=0.03$ ). The cost

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regression analysis on the two cohorts was adjusted for these significant variables. Adjusted mean costs of patients with ERAS were found to be \$4,576 lesser than those of the TRAS control group (\$38,688 versus \$43,264).

**Conclusions:** Implementation of the ERAS pathway was associated with significantly decreased costs when compared to historical controls. There has been a healthcare focus toward prudent resource allocation, which dictates the need for plastic surgeons to recognize economic evaluation of clinical practice. The ERAS pathway can increase healthcare accountability by improving quality of care while simultaneously decreasing the costs associated with autologous breast reconstruction.

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## Introduction

The implementation of enhanced recovery after surgery (ERAS) protocols aims to reduce postoperative morbidity to allow for shorter recovery times and decreased length of hospital stay (LOS).<sup>1-3</sup> Multimodal pain management can also expedite recovery and discharge.<sup>4</sup> All these factors have an economic advantage in terms of resource allocation and cost-benefit ratio.

Results from a cohort of free flap patients comparing the ERAS and traditional recovery after surgery (TRAS) pathways at the Mayo Clinic, Rochester, MN, concluded a shorter mean hospital LOS and decreased postoperative opioid usage.<sup>5</sup> This study used the same cohort to perform a cost comparison analysis of the ERAS versus TRAS pathways.

## Methods

### Development of the ERAS pathway

A multidisciplinary team developed the ERAS pathway. ERAS diverges from TRAS beginning in the preoperative holding area where patients are administered acetaminophen, celecoxib, and gabapentin for pre-emptive pain management. The anesthesia team administers antiemetics upon induction and maintains euvoemia. Intraoperative local anesthesia for the ERAS pathway is administered in the form of liposomal bupivacaine (Exparel; Pacira Pharmaceuticals, Inc.) diluted with normal saline as a subfascial transversus abdominis block, as well as in the rectus sheath and lower abdominal subcutaneous tissues. Patients recover in the postanesthesia care unit and are transferred to the general postsurgical floor under the care of a plastic surgery floor nurse familiar with flap monitoring. Patients are administered scheduled acetaminophen and celecoxib and are given oral opioids as needed and also parenteral agents for breakthrough pain. Patients are immediately started on a general diet and encouraged to ambulate as tolerated. Intravenous fluids are discontinued as soon as the patient has 600 ml of oral intake. Urinary catheters are removed on postoperative day 1. Discharge planning begins the day after surgery, with a goal for discharge on postoperative day 3 or 4. The ERAS pathway was implemented in November 2012, including incorporation into the electronic medical record as a standardized order set.

In the TRAS cohort, the perioperative course was not standardized except for postoperative intensive care unit

(ICU) admission and use of patient-controlled analgesia (PCA). Postoperative pain control and fluid balance were managed by the intensivist on-call.

### Study design

A database was developed using REDCap (Vanderbilt University, Nashville, TN). Consecutive patients underwent immediate or delayed abdominally based microsurgical breast reconstruction between September 2010 and September 2014. The patient cohort was expanded from Batdorf et al.'s study by two additional years.<sup>5</sup> In this retrospective cohort study, women in the ERAS cohort were compared with consecutive historical controls in the TRAS cohort. Specific operative technique was not standardized among the surgeons. The Mayo Clinic Institutional Review Board approved this study. All patients declining research authorization were excluded from analysis.

### Data sources

Direct medical costs of all services and procedures billed were estimated using a standardized costing approach. These billed services were obtained from the Mayo Clinic Cost Data Warehouse (MCCDW).<sup>6</sup> This database provides estimated facility (hospital) costs from line item billed charges using department-level cost-to-charge ratios from the Medicare cost reports. Medical professional costs are estimated using the appropriate Medicare physician fee schedule for each Current Procedural Terminology (CPT) fourth edition code or Healthcare Common Procedure Coding System (HCPCS) tag. To account for potential differences over time in cost-to-charge ratios and Medicare reimbursement rates, services were valued using 2014 dollars.<sup>7</sup> Services that could not be mapped to identical services in 2014 were adjusted to 2014 US dollars using the Gross Domestic Product implicit price deflator.<sup>8</sup> Costs were categorized into the Berenson-Eggers Type of Service categories (BETOS).<sup>9,10</sup> The BETOS coding system analyzes growth in Medicare expenditures and allows for clinical categorization that is relatively immune to minor changes in technology or practice patterns, providing objective cost categories.

### Statistical analysis

Descriptive statistics were reported as mean (SD) or median (IQR) for continuous variables and as the number of patients

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