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## Role of Post–Acute Care on Hospital Readmission After High-Risk Surgery



Austin J. Lee, BA,<sup>a,\*</sup> Xiang Liu, MS,<sup>b</sup> Tudor Borza, MD,<sup>c,d</sup>  
 Yongmei Qin, MD, MS,<sup>c</sup> Benjamin Y. Li, BS,<sup>c</sup> Kenneth L. Urish, MD, PhD,<sup>e</sup>  
 Peter S. Kirk, MS,<sup>c</sup> Scott Gilbert, MD,<sup>f</sup> Brent K. Hollenbeck, MD, MS,<sup>c,d</sup>  
 Jonathan E. Helm, PhD,<sup>g</sup> Mariel S. Lavieri, PhD,<sup>b</sup>  
 Ted A. Skolarus, MD, MPH,<sup>c,d,h</sup> and Bruce L. Jacobs, MD, MPH<sup>i</sup>

<sup>a</sup>School of Medicine, University of Pittsburgh, Pittsburgh, Pennsylvania

<sup>b</sup>Department of Industrial and Operations Engineering, University of Michigan, Ann Arbor, Michigan

<sup>c</sup>Divisions of Health Services Research, Department of Urology, University of Michigan, Ann Arbor, Michigan

<sup>d</sup>Divisions of Health Services Research and Oncology, Department of Urology, University of Michigan, Ann Arbor, Michigan

<sup>e</sup>Department of Orthopaedic Surgery, University of Pittsburgh, Pittsburgh, Pennsylvania

<sup>f</sup>Department of Urology, H. Lee Moffitt Cancer Center, Tampa, Florida

<sup>g</sup>W.P. Carey School of Business, Arizona State University, Tempe, Arizona

<sup>h</sup>Center for Clinical Management Research, VA Ann Arbor Healthcare System, Tempe, Arizona

<sup>i</sup>Department of Urology, University of Pittsburgh, Pittsburgh, Pennsylvania

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### ABSTRACT

**Background:** Payment models, including the Hospital Readmissions Reduction Program and bundled payments, place pressures on hospitals to limit readmissions. Against this backdrop, we sought to investigate the association of post–acute care after major surgery and readmission rates.

**Methods:** We identified patients undergoing high-risk surgery (abdominal aortic aneurysm repair, coronary bypass grafting, aortic valve replacement, carotid endarterectomy, esophagectomy, pancreatectomy, lung resection, and cystectomy) from 2005 to 2010 using the Healthcare Cost and Utilization Project's State Inpatient Database. The primary outcome was readmission rates after major surgery. Secondary outcome was readmission length of stay. **Results:** We identified 135,523 patients of whom 56,720 (42%) received post–acute care. Patients receiving post–acute care had higher readmission rates than those who were discharged home (16% versus 10%, respectively;  $P < 0.001$ ). The risk-adjusted readmission length of stay was greatest for patients who received care from a skilled nursing facility, followed by those who received home care, and lowest for those who did not receive post–acute care (7.1 versus 5.4 versus 4.8 d, respectively;  $P < 0.001$ ).

**Conclusions:** The use of post–acute care was associated with higher readmission rates and higher readmission lengths of stay. Improving the support of patients in post–acute care settings may help reduce readmissions and readmission intensity.

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\* Corresponding author. University of Pittsburgh, 5200 Centre Avenue, Suite 209, Pittsburgh, PA 15232. Tel.: +412 692-4100; fax: +412 605-3030.

E-mail address: [ajl97@pitt.edu](mailto:ajl97@pitt.edu) (A.J. Lee).

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## Introduction

Hospital readmissions and post-acute care are two components of the United States' health care system that lead to substantial costs. In 2011, hospital costs related to readmissions exceeded \$41 billion.<sup>1</sup> The following year, Medicare spending on post-acute care services reached \$62 billion, which represented 11% of Medicare's total yearly expenditures.<sup>2</sup> Patients hospitalized for major surgery represented a large component of these costs, with over 40% of surgical patients utilizing post-acute care services and 13% being readmitted.<sup>3,4</sup>

The relationship between hospital readmissions and the use of post-acute care remains unclear for surgical patients. On one hand, post-acute care may reduce readmissions due to care coordination among specialty support services (e.g., pharmacists, suppliers of medical equipment, health care providers, and therapists). A skilled nursing facility may provide more frequent, higher-intensity rehabilitation, which can lead to improved functioning in mobility and activities of daily living.<sup>5</sup> Alternatively, they may increase readmissions as the transition of care to other health care settings may lead to negative health outcomes, such as delirium and functional decline.<sup>6,7</sup> Poor transitions to these post-acute care settings may lead to medical errors, such as administering incorrect medications.<sup>8</sup>

For these reasons, we performed a study to examine the association of post-acute care after major surgery and readmission rates. Specifically, we examined patients undergoing major abdominal and chest surgeries. A better understanding of how post-acute care influences surgical readmissions will help providers make more informed decisions regarding post-acute care, thereby improving quality and reducing costs.

## Methods

### Data source and study population

We utilized the Healthcare Cost and Utilization Project's State Inpatient Database for New York, Iowa, North Carolina, and Washington to identify adult men and women (18 y or older) who underwent one of eight high-risk surgeries from 2005 to 2010. The State Inpatient Database provides information about hospital inpatient stays and patient-level discharge data for 97% of all United States' community hospital discharges.<sup>9</sup> We chose these four states because they comprise diverse patient and geographic populations and because they have data available to characterize readmissions. The included procedures were open abdominal aortic aneurysm repair, coronary artery bypass grafting (CABG), aortic valve replacement (AVR), carotid endarterectomy, esophagectomy, pancreatectomy, lung resection, and cystectomy. We chose these surgeries because they represent complex operations with high readmission rates (all >10%).<sup>3,10,11</sup>

We identified surgery types using their respective *International Classification of Diseases, Ninth Revision, Clinical*

*Modification* (ICD-9-CM) codes. Patients who underwent two or more of the designated surgeries were excluded unless they received both a CABG and an AVR, in which case they were identified as having an AVR; 46% of patients undergoing an AVR had a concomitant CABG. Using these criteria, our study consisted of 135,523 patients. We further identified 56,720 patients who received post-acute care after hospital discharge. Among the patients who received post-acute care, we identified 44,774 who received home care and 11,946 who went to a skilled nursing facility. Skilled nursing facility patients also included patients who were sent to intermediate care facilities, other facility, or short-term hospital.

### Outcomes

The objective of this study was to assess readmission rates among patients undergoing high-risk surgery, according to use of post-acute care. We defined a readmission as a hospital admission within 30 d of discharge after the index surgery admission. We used a 30-d time period to be consistent with the readmission definition used by the Hospital Readmissions Reduction Program.<sup>12</sup> Secondary outcomes included index admission length of stay and readmission length of stay, stratified by type of post-acute care (i.e., home, home care, skilled nursing facility).

### Statistical analysis

We first compared patient demographics and index admission characteristics among patients undergoing one of the eight major surgery types, according to whether or not they were discharged home or received post-acute care (i.e., home care, skilled nursing facility). Next, we examined the subset of patients who received post-acute care. For these patients, we compared hospital and patient characteristics. We measured comorbidity using an adaptation of the Charlson index.<sup>13-15</sup> Nominal and ordinal categorical variables were compared using general chi-square and Mantel-Haenszel chi-square tests, respectively.

Next, we used generalized estimating equations (GEE) modeling with PROC GENMOD with the "log link" function to examine factors associated with readmission. We utilized GEE modeling to account for the clustered nature of the data (patient within hospital). Covariates in our model included age, sex, comorbidity, socioeconomic status, primary payer, year, surgery type, hospital owning skilled nursing facility, number of hospital beds, number of full-time equivalent registered nurses in the hospital, presence of hospital case management team, and presence of hospital social work service. Finally, we focused on the relationship between type of post-acute care and length of stay at readmission. We hypothesized that more intense post-acute care (i.e., skilled nursing *versus* home care) would be associated with longer lengths of stay at readmission. We used GEE modeling with gamma distribution and "log link" to calculate the risk-adjusted readmission length of stay of each type of post-acute care. The means were then converted from the log scale to length of stay via an inverse log

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