
Why Do Long-Distance Travelers Have Improved Pancreatectomy Outcomes?



Manila Jindal, BS, Chaoyi Zheng, MS, Humair S Quadri, MD, Chukwuemeka U Ihemelandu, MD, Young K Hong, MD, Andrew K Smith, BS, Vikas Dudeja, MD, Nawar M Shara, PhD, Lynt B Johnson, MD, FACS, Waddah B Al-Refaie, MD, FACS

- BACKGROUND:** Centralization of complex surgical care has led patients to travel longer distances. Emerging evidence suggested a negative association between increased travel distance and mortality after pancreatectomy. However, the reason for this association remains largely unknown. We sought to unravel the relationships among travel distance, receiving pancreatectomy at high-volume hospitals, delayed surgery, and operative outcomes.
- STUDY DESIGN:** We identified 44,476 patients who underwent pancreatectomy for neoplasms between 2004 and 2013 at the reporting facility from the National Cancer Database. Multivariable analyses were performed to examine the independent relationships between increments in travel distance mortality (30-day and long-term survival) after adjusting for patient demographics, comorbidity, cancer stage, and time trend. We then examined how additional adjustment of procedure volume affected this relationship overall and among rural patients.
- RESULTS:** Median travel distance to undergo pancreatectomy increased from 16.5 to 18.7 miles (p for trend < 0.001). Although longer travel distance was associated with delayed pancreatectomy, it was also related to higher odds of receiving pancreatectomy at a high-volume hospital and lower postoperative mortality. In multivariable analysis, difference in mortality among patients with varying travel distance was attenuated by adjustment for procedure volume. However, longest travel distance was still associated with a 77% lower 30-day mortality rate than shortest travel among rural patients, even when accounting for procedure volume.
- CONCLUSIONS:** Our large national study found that the beneficial effect of longer travel distance on mortality after pancreatectomy is mainly attributable to increase in procedure volume. However, it can have additional benefits on rural patients that are not explained by volume. Distance can represent a surrogate for rural populations. (*J Am Coll Surg* 2017;225:216–225. © 2017 by the American College of Surgeons. Published by Elsevier Inc. All rights reserved.)
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Disclosure Information: Nothing to disclose.

Support: This study was supported by a grant from the Georgetown-Howard Universities Center for Clinical and Translational Science.

Received January 25, 2017; Revised March 28, 2017; Accepted April 4, 2017.

From the MedStar-Georgetown Surgical Outcomes Research Center (Jindal, Zheng, Quadri, Ihemelandu, Smith, Al-Refaie), Department of Biostatistics, Bioinformatics and Biomathematics, Georgetown University (Zheng, Quadri), Department of Surgery, MedStar-Georgetown University Hospital (Hong, Johnson, Al-Refaie), Georgetown University Medical Center (Smith), MedStar Health Research Institute (Shara, Al-Refaie), Georgetown-Howard Universities Center for Clinical and Translational Science (Shara), Washington, DC, and Department of Surgery, University of Miami, Miami, FL (Dudeja).

Correspondence address: Waddah B Al-Refaie, MD, FACS, Department of Surgery, MedStar Georgetown University Hospital, MedStar-Georgetown Surgical Outcomes Research Center, Georgetown Lombardi Comprehensive Cancer Center, 3800 Reservoir Rd NW, PHC Building, 4th Floor, Washington, DC 20007. email: wba6@georgetown.edu

The documented volume to outcomes relationship in complex surgery, including pancreatectomy, has prompted increasing referrals to surgical centers with large case volumes. As a result, the percentage of pancreatic resections performed at hospitals with 20 or more cases/year has increased.¹ This quest for quality might compromise patient-centeredness of care—evidence has shown that regionalization has led to an overall 40% increase in travel distance to receive pancreatic cancer surgery, and can substantially lengthen their travel time.^{2,3} In addition, travel requirement is typically more onerous for patients who are socially disadvantaged and those who live in rural areas.⁴ For instance, our group reported recently that younger and white patients tend to travel longer distances.⁵ Therefore, regionalization and travel burden

also caused concern about equity of healthcare delivery, among other unintended consequences.⁶⁻¹¹

To date, the literature remains inconclusive about the effect of travel distance on surgical outcomes. Emerging evidence links greater travel distance with improved pancreatectomy outcomes^{12,13} and speculates that high-volume hospitals are the reason patients travel. In contrast to that, other investigations revealed worse short- and long-term operative outcomes.^{14,15} However, little research has focused on uncovering factors leading to increased travel, and it has not been elucidated why outcomes improve (or not) as travel distance increases. In particular, it remains unclear why this association is solely attributable to the role of hospital volume, or if travel distance also has an independent effect. In this current era of an expanding trend of regionalization nationwide and contradicting emphasis on patient-centered care, these questions necessitate careful evaluation.

With these gaps in the literature, we intend to provide an in-depth analysis of the intertwined relationships among travel distance, case volume, and post-pancreatectomy operative outcomes. We used a decade of data from the National Cancer Database to explore 3 related hypotheses. First, travel distance varies widely by patient demographic and geographical characteristics. Second, increase in travel distance has both positive and negative effects on outcomes of pancreatectomy. Third, receiving pancreatic cancer surgery at high-volume centers is the main reason travel distance is correlated with lower mortality of pancreatectomy.

METHODS

Data source and study population

The National Cancer Database (NCDB) is a clinical oncology database composed of registry information on patients treated in more than 1,500 Commission on Cancer-accredited facilities nationwide for malignant neoplastic diseases. It is estimated that the NCDB includes around 70% of all newly diagnosed cancer cases in the US.¹⁶ Using the NCDB, we identified adult patients diagnosed with pancreatic neoplasms between 2004 and 2013 who had partial pancreatectomy, total pancreatectomy, or Whipple procedure as the first course of treatment at the reporting facility for benign or malignant tumors. Patients whose travel distance was missing from the database ($n = 935$ [2.0%]) were removed from the analysis. The analytic sample consisted of 44,476 patients.

Variable of primary interest

The variable of primary interest in this study is the travel distance, which is defined as the great circle distance

between the centroid of the patient's ZIP code area and the facility's address. We categorized travel distance into quartiles, resulting in 4 equally sized groups—patients whose great circle distances were 6.9 miles or shorter, 7.0 to 17.7 miles, 17.8 to 49.2 miles, and 49.3 miles or longer.

Outcomes (dependent) variables

Our 3 outcomes (dependent) variables were delayed surgery (more than 30 days after diagnosis); 30-day mortality; and survival time, defined as time from pancreatectomy to death or end of follow-up. To minimize the confounding effect of operative mortality as a result of operative complication on long-term survival, we excluded those who survived after 30 days from the surgery.

Covariates

Covariates included demographics (age, sex, race/ethnicity, insurance status, median household income and percentage of adults without high school degree for the patient's ZIP code area, and rurality of patient's residence), clinical factors (level of comorbidity, extent of pancreatic resection [distal pancreatectomy vs Whipple/total pancreatectomy], and stage of cancer), and hospital characteristics where appropriate (hospital's Commission on Cancer category, area of the US, and case volume). The categories used for median income and education level came from corresponding variables in the NCDB data set, where they were categorized based on national quartiles.¹⁷

Case volume was calculated based on the entire study period; it was categorized into low, medium, and high, so that each category had roughly one-third of all pancreatectomy cases.

Location of diagnosis was recoded into a binomial indicator from the NCDB class of case variable; it distinguished patients who were diagnosed at the reporting and operating facility or offices of its affiliated physicians from those who were diagnosed elsewhere.

Statistical methods

We first cross-tabulated and compared the distribution of covariates and patient outcomes by travel distance using chi-square tests. To evaluate each patient factor's independent association with travel distance, we used them as predictors in a multivariable linear model where log-converted travel distance was the end point. The regression coefficients can be interpreted as approximate percentage changes in travel distance associated with level change in the predicting factor independent of covariates. Next, we developed a logistic model for each patient end

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