Health Policy Analysis

Physician Social Networks and Variation in Rates of Complications After Radical Prostatectomy

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A B S T R A C T

Objectives: Variation in care within and across geographic areas remains poorly understood. The goal of this article was to examine whether physician social networks—as defined by shared patients—are associated with rates of complications after radical prostatectomy. **Methods:** In five cities, we constructed networks of physicians on the basis of their shared patients in 2004-2005 Surveillance, Epidemiology and End Results-Medicare data. From these networks, we identified subgroups of urologists who most frequently shared patients with one another. Among men with localized prostate cancer who underwent radical prostatectomy, we used multilevel analysis with generalized linear mixed-effect models to examine whether physician network structure—along with specific characteristics of the network subgroups—was associated with rates of 30-day and late urinary complications, and long-term incontinence after accounting for patient-level sociodemographic, clinical factors, and urologist patient volume. **Results:** Networks included 2677 men in five cities who underwent radical prostatectomy. The unadjusted

rate of 30-day surgical complications varied across network subgroups from an 18.8 percentage-point difference in the rate of complications across network subgroups in city 1 to a 26.9 percentage-point difference in city 5. Large differences in unadjusted rates of late urinary complications and long-term incontinence across subgroups were similarly found. Network subgroup characteristics—average urologist centrality and patient racial composition—were significantly associated with rates of surgical complications. **Conclusions:** Analysis of physician networks using Surveillance, Epidemiology and End Results-Medicare data provides insight into observed variation in rates of complications for localized prostate cancer. If validated, such approaches may be used to target future quality improvement interventions.

Keywords: cancer, claims data, health services, outcomes research.

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Introduction

Although variation in care across different geographic areas has been widely described since the 1970s [1], there has been increased recognition of variation within particular locales [2]. The potential mechanisms underlying this variation between and across areas remain poorly understood. Physician networks based on shared patients may be one tool to help better delineate variation in care. In patient-sharing networks, physicians are considered connected to one another if they provide care to the same patient [3]. Patient-sharing networks signal connections between physicians such as those based on practice structure and hospital affiliation [4–6]. Importantly, they also represent informal connections between physicians including referral patterns and advice seeking [3]. By reflecting both formal and

informal connections that may shape clinical practice, physician patient-sharing networks may provide insight into variation in care.

Physician patient-sharing networks have been associated with the costs and intensity of medical care within geographic areas [7]. In the setting of prostate cancer, physician patient-sharing networks have been associated with the likelihood of receiving a radical prostatectomy for localized disease within three cities [6]. We seek to extend previous work by exploring whether physician patient-sharing networks are associated with variation in complications after radical prostatectomy for prostate cancer.

Complications after radical prostatectomy are an important case study. In the United States, an estimated 238,590 men received a diagnosis of prostate cancer in 2013 [8]. The decision to undergo radical prostatectomy—a common treatment modality for men with localized disease [9]—is preference-sensitive.

The surgery is associated with surgical complications in the month after surgery as well as longer term urinary incontinence and erectile dysfunction [10–12]. Although research has demonstrated that men who undergo radical prostatectomy by high-volume surgeons and at high-volume institutions are less likely to have complications [13–15], relatively little is known about the reasons underlying variations in the rates of complications [16,17].

Within five cities, we constructed patient-sharing networks composed of urologists, primary care providers (PCPs), and radiation oncologists who care for patients with prostate cancer. We then examined whether the network structure was associated with different rates of complications after radical prostatectomy. Our underlying hypothesis was that patients seen by providers who more frequently share patients with one another may have similar rates of complications, after adjusting for patients' clinical and sociodemographic characteristics.

We further explored whether particular characteristics of these network subgroups were associated with differences in rates of complications. We focused on two network characteristics—the average importance (centrality) of the doctors and the proportion of minority patients in the network subgroups. Doctors who are important in the network structure may have achieved their prestige by providing higher quality of care and may play an important role in shaping local norms and behaviors [18]. We hypothesized that patients treated by network subgroups with higher levels of importance would have lower likelihood of complications. The disparities literature has shown that health care providers [19] and institutions [20,21] who treat a disproportionate share of minority patients may have greater difficulty providing high-quality care. Thus, patients treated by network subgroups with a high proportion of minority patients were hypothesized to have lower quality of care.

Methods

Study Design

The study was a retrospective, observational cohort study using registry and administrative claims data from the Surveillance, Epidemiology and End Results (SEER)-Medicare database. The study was approved by the institutional review boards at the University of Pennsylvania and Johns Hopkins University School of Medicine.

Data Sources

The SEER-Medicare database links patients' demographic and tumor-specific data collected by SEER cancer registries to longitudinal health care claims for Medicare enrollees [22]. Data on physicians' specialties were available from the Medicare Physician Identification and Eligibility Registry file linked through Unique Provider Identification Numbers.

Study Population

We identified men aged 65 years or older living in five cities with prostate cancer diagnosed between January 1, 2004, and December 31, 2005, in SEER, with follow-up through December 31, 2006, in Medicare. Two years of data were analyzed to allow for adequate connectivity of the networks based on our preliminary analyses. Cities were defined on the basis of US Census definitions of Combined Statistical Areas, which refer to cities and the surrounding areas that are linked by economic and social activity (http://www.census.gov/population/www/metroareas/metrodef. html). Combined Statistical Areas represent a larger geographic region than do health referral regions, as preliminary analyses

revealed that urologists cared for high numbers of patients from multiple, adjacent health referral regions. Cities were included if they had at least 200 patients who underwent prostatectomy across the 2 years and SEER-Medicare included the great majority of the geographic area. We do not present city names to ensure patient and doctor confidentiality.

Data on patients with incomplete Medicare records (i.e., those enrolled in health maintenance organizations or not enrolled in fee-for-service Medicare program) were excluded. For the construction of the patient-sharing networks and definition of network subgroups (see below), we included all men without metastatic disease (N = 13,465). We then used these network subgroups in analyses that examined prostatectomy complications for a more homogeneous patient cohort. Specifically, we limited the sample to men with American Joint Committee on Cancer 6th edition stage 2 and 3 disease who underwent radical prostatectomy (N = 2974). Prostatectomy was identified from Medicare inpatient, outpatient, and physician/supplier component files as described previously [23]. We excluded those with node-positive disease (N = 59), unknown Gleason grade (N = 13), men who could not be matched to their surgical urologist (N = 225), and, because of their small sample size, men with stage 1 disease (N = 107). The final analytic sample size was 2677.

Definition of Variables

Complications

Complications were defined according to the work of Begg et al. [13] using *International Classification of Diseases, Ninth Revision* diagnosis and procedural codes. Thirty-day surgical complications included cardiac, respiratory, vascular, wound, genitourinary, miscellaneous medical, miscellaneous surgical, and blood transfusion complications. Late urinary complications were defined as occurring from 31 to 365 days after surgery and included bladder neck obstruction, uretheral stricture, intestinal fistula, lymphocele, cystitis/bleeding, and definitive incontinence repair. Long-term incontinence was defined as occurring 18 months or more after the surgery [24].

Explanatory variables

Gleason grade was categorized as less than 7, 7, and 8 to 10. Prostate-specific antigen level at the time of diagnosis was classified as 4 ng/mL or less, more than 4 ng/mL to less than 10 ng/mL, 10 ng/mL or greater, or unknown. Patient comorbidities were identified by classifying all available inpatient and outpatient Medicare claims for the 90-day interval preceding prostate cancer diagnosis into 46 categories [25], and, for clarity, reported as 0, 1, or 2 or more. Race was classified from both SEER and Medicare sources, and individuals were classified as white if they did not have a classification of black, Hispanic, or Asian in either data file or as nonwhite. Area-level U.S. Census information was used as a proxy for individual measures of socioeconomic status. Men were linked to their census tract and, when not available, ZIP code to determine median income, which was categorized into quartiles on the basis of sample distribution in each city. Urologist surgical volume was defined as the number of radical prostatectomies performed over the 2-year period, with high volume defined as the top quartile in a given city (cutoff point for high volume ranged from 16 to 41) [13].

Network creation

We created networks for each city in which doctors were connected to one another via shared patients. From each network, we then sought to identify subgroups of doctors who frequently share patients with one another (as defined below).