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# Multimorbidity and access to major cancer surgery at high-volume hospitals in a regionalized era



Chukwuemeka Ihemelandu, M.D., F.A.C.S.<sup>a,\*</sup>, Chaoyi Zheng, B.S.<sup>b</sup>,  
Erin Hall, M.D.<sup>c</sup>, Russell C. Langan, M.D.<sup>b</sup>, Nawar Shara, Ph.D.<sup>b,d</sup>,  
Lynt Johnson, M.D., F.A.C.S.<sup>b,c,e</sup>, Waddah Al-Refaie, M.D., F.A.C.S.<sup>b,d,e</sup>

<sup>a</sup>Department of General Surgery, MedStar Washington Hospital Center, 106 Irving St, NW, POB Suite 3900, Washington, DC, 20010, USA; <sup>b</sup>MedStar-Georgetown Surgical Outcomes Research Center, Washington, DC, USA; <sup>c</sup>Department of Surgery, MedStar-Georgetown University Hospital, Washington, DC, USA; <sup>d</sup>MedStar Health Research Institute, Hyattsville, Maryland, USA; <sup>e</sup>Lombardi Comprehensive Cancer Center, Washington, DC, USA

## KEYWORDS:

Multimorbidity;  
High-volume hospitals;  
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## Abstract

**BACKGROUND:** The Institute of Medicine has recently prioritized access of quality cancer care to vulnerable persons including multimorbid patients. Despite promotional efforts to regionalize major surgical procedures to high-volume hospitals (HVHs), little is known about change in access to HVH over time among multimorbid patients in need of major cancer surgery. We performed a time-trend appraisal of access of multimorbid persons to HVH for major cancer surgery within a large nationally representative cohort.

**METHODS:** We identified 168,934 patients who underwent 6 major cancer surgeries from the Nationwide Inpatient Sample (1998 to 2010). Comorbidities were identified using Elixhauser's method. HVHs were defined as hospitals of highest procedure volumes that treated 1/3 of all the patients. Logistic regression models and predictive margins were used to assess the adjusted effects of comorbidity on receiving major cancer surgeries at HVH.

**RESULTS:** Of all, 45.7% of the patients had 2 comorbidities or more. Multimorbidity predicted decreased access to HVH for esophagectomy, total gastrectomy, pancreatectomy, hepatectomy, and proctectomy, but not for distal gastrectomy, after controlling for covariates. A comorbidity level by year interaction analysis also showed that little disparity existed for receiving distal gastrectomy at an HVH, whereas the predicted difference in probability of receiving any of the other 5 major cancer procedures remained prominent between the years 1998 and 2010.

**CONCLUSIONS:** In this large 12-year time-trend study, multimorbid cancer patients have sustained low access to HVH for major cancer surgery across many oncologic resections. These results continue to reinforce and highlight the need for policy targeted research and intervention aimed at improving these access gaps.

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\* Corresponding author. Tel.: +1-202-877-4599; fax: +1-202-877-0448.

E-mail address: [Chukwuemeka.u.Ihemelandu@medstar.net](mailto:Chukwuemeka.u.Ihemelandu@medstar.net)

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Multiple studies have documented the positive association between high-volume centers and improved surgical outcome. Consequently, hospital volume as a surrogate metric for quality has fostered regionalization of major cancer surgery to high-volume hospitals (HVHs) specializing in specific complex surgical procedures.<sup>1-4</sup> However, with regionalization has come the concerns of access to care at these HVH.<sup>5,6</sup> It has been reported that substantial disparities exist with regards to access to HVH.<sup>7</sup> Although multiple studies have shown that access to HVH and hospital outcomes may be affected by socioeconomic status and race,<sup>7,8</sup> a paucity of studies have analyzed the role of multimorbidities in access to HVH for major cancer surgery. To what extent, and how this drive for regionalization has affected access to high-quality cancer care at HVH for multimorbid patients, has not been well documented.

The prevalence of multimorbidity and cancer has been shown to increase with age, with over 60 % of patients diagnosed with cancer aged 65 or older and many having associated multimorbidity.<sup>9-11</sup>

As the average life expectancy in the United States increases, the proportion of adults older than 65 diagnosed with cancer is expected to increase.<sup>12</sup> An analysis of Medicare beneficiaries showed that 64% of the participants had 2 or more conditions, and 24% had 4 or more conditions.<sup>13</sup> It has been projected that between 2000 and 2020, the number of Americans with multimorbidity is expected to rise from 60 million to 81 million, this changing demographics in the United States is expected to place new demands on the cancer care delivery system.<sup>14-16</sup>

Unfortunately, increasing multimorbidity has been linked to the increased risk of complications<sup>17-19</sup> and steadily declining surgical management regardless of cancer site and disease stage.<sup>20-23</sup> Probably, negatively impacting referral of this cohort of patients to HVHs for complex cancer surgery and subsequent acceptance of this cohort of patient for treatment at HVHs. Other factors such as low socioeconomic status, advanced age, and ethnic minority, which have been shown to detrimentally impact access to HVH, have also been intricately linked with multimorbidity.<sup>24,25</sup>

Intuitively, if the prevalence of multimorbidity is higher in the vulnerable and underserved populations; racial and ethnic minorities, older adults, individuals living in rural and urban underserved areas and populations of lower socioeconomic status, then access of multimorbid patients to HVH for complex cancer would probably also be detrimentally impacted as a result of this association.

Our objectives in this study were twofold: (1.) To assess the relationship between multimorbidity and access to major cancer surgery at HVH, (2.) Perform a time-trend appraisal of the association between multimorbidity and access to HVH for major cancer surgery. With the aim of defining gaps in accessing HVH for major cancer surgery and identifying potential public policy targets that may improve access for this cohort of patients. We hypothesize that multimorbid patients are less likely to receive major cancer surgery at HVH over time.

## Methods

### Data source and study population

We obtained discharge data from the Nationwide Inpatient Sample (NIS) from 1998 to 2010. The NIS database is a part of Healthcare Cost and Utilization Project, Agency for Healthcare Research and Quality. NIS contains all the discharges from a stratified 20% sample of all nonfederal community hospitals in the United States, regardless of type or status of insurance. We identified 8,655 esophagectomies, 27,018 distal gastrectomies, 13,855 total gastrectomies, 7,851 hepatectomies, 27,422 pancreatetectomies, and 84,133 proctectomies on patients 18 years or older, using primary procedure code on the discharge record via *International Classification of Diseases, 9th Revision, Clinical Modification* procedure codes (Volume 326).<sup>26</sup>

### Variables of interest

Our outcome variable was the volume status of the hospital that performed the surgery. The procedure volume of a hospital was dichotomized into high and low so that HVHs performed one-third of all the procedures of a specific type (Stitzenberg), that is, the overall probability of receiving operation at HVH was 33.3%. Hospital volume status and categorization cut-off values were assigned for each procedure each year.

Our primary explanatory variable was the level of comorbidity. Comorbidity is defined as “any additional clinical entity that has existed or that may occur during the clinical course of a patient with an index disease under study”.<sup>27,28</sup> In this study, it is measured by number of comorbidities included in Elixhauser’s algorithm present on the discharge record (Elixhauser, others). The comorbidities were identified using the Healthcare Cost and Utilization Project Comorbidity Software based on *International Classification of Diseases, 9th Revision* diagnosis codes (ref). Year of admission was used as a continuous variable in time-trend analysis.

### Covariates

Information on patients’ sex, age, race, and primary insurance was extracted from the discharge records. Type and region of the admission was also obtained from NIS. Missing information on a covariate was coded as a separate category in that variable.

### Statistical analyses

Distributions of all covariates were calculated by volume status of the operative hospital and by comorbidity status, respectively. Chi-square tests were used to test homogeneity of the distributions. Multivariable logistic

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