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# Hospital safety-net burden does not predict differences in rectal cancer treatment and outcomes

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## ABSTRACT

**Background:** Safety-net hospitals have been shown to have inferior short-term surgical outcomes. The aim of this study was to compare rectal cancer management and survival across hospitals stratified by payer mix.

**Materials and methods:** Rectal cancer patients ( $n = 296,068$ ) were identified using the 1998-2010 National Cancer Data Base. Hospitals were grouped into safety-net burden categories, according to the proportion of patients with Medicaid or no health insurance, as follows: low-, medium-, and high-burden hospitals (HBHs). Patient and tumor characteristics, processes of care, and outcomes were evaluated, and regression analysis was used to investigate correlations between hospital safety-net burden on patient survival.

**Results:** HBH encountered patients with more advanced disease ( $P < 0.001$ ). Despite this, stage I-III patients at HBH had equal likelihood of receiving surgery and guideline-appropriate radiation and chemotherapy (all  $P > 0.05$ ). The 30-day readmissions and mortality were also similar across safety-net groups (all  $P > 0.05$ ). Multivariate analysis showed no difference in survival between HBH and low-burden hospital ( $P = 0.164$ ).

**Conclusions:** Hospital payer mix may not adversely influence management of rectal cancer. This study highlights potential areas to improve cancer care for vulnerable patient populations.

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## Introduction

Treatment of colorectal cancer has become more complex and specialized in recent years.<sup>1</sup> Recent evidence has highlighted the variability that exists among hospitals with regard to outcomes such as surgical margins and appropriate use of adjuvant therapies.<sup>1-3</sup> As evidence-based treatment guidelines continue to proliferate regarding cancer management, it

will be increasingly necessary for providers to adhere to them and provide current standard-of-care therapies. This requires appropriate screening, preoperative workup, surgical technique, and multidisciplinary decisions with regard to adjuvant and neoadjuvant chemotherapy and/or radiation.<sup>4</sup>

Safety-net hospitals are institutions that have an explicit mission to provide care to all patients, regardless of the ability to pay,<sup>5</sup> which includes a large number of patients with colon

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and rectal cancer. These centers have been identified as having inferior surgical outcomes<sup>6,7</sup> and being particularly at risk for financial penalties given recent changes in healthcare policy.<sup>8,9</sup> This puts their sustainability at risk, and subsequently threatens the vulnerable population that they serve. Patients treated at safety-net hospitals are often limited in their ability to travel and miss work<sup>10,11</sup> and thus are limited in their ability to travel to the “best” hospital in their region.<sup>12</sup>

In this study, we sought to understand how processes of rectal cancer care vary with hospital payer mix, and how this may affect overall survival. We hypothesized that hospitals with a higher safety-net burden would have worse overall survival as well as higher 30-day readmission and mortality rates; this would likely be due to both differences in patient illness at presentation as well as disparities in hospital resources and treatment utilization.

## Methods

### Data source

The 1998-2010 National Cancer Data Base (NCDB) Participant User File for rectal cancer was queried for this analysis. The NCDB is a joint project of the Commission on Cancer of the American College of Surgeons and the American Cancer Society. This database collects registry data from over 1500 facilities accredited by the Commission on Cancer. The NCDB includes approximately 70% of all newly diagnosed cancer cases in the United States, as well as data on diagnosis, treatment, and outcomes.<sup>13</sup>

### Safety-net burden

To study the effect of safety-net status on utilization of cancer care, a safety-net burden for rectal cancer care was assigned to each hospital as previously described.<sup>6,14</sup> Hospitals ( $n = 1676$ ) were assigned a safety-net burden, defined as the proportion of all patients who were insured by Medicaid or not insured. Hospitals were then stratified into groups of safety-net burden: low-burden (LBH) were in the first quartile (0.0%-2.9%); medium-burden (MBH) in the second and third quartiles (2.9%-8.9%), and high-burden hospitals (HBH) in the fourth quartile (>9.0%).

### Patient population

For this study, we analyzed patients with the American Joint Committee on Cancer stage I-IV tumors diagnosed between 1998-2010 ( $n = 64,465$ ). We excluded patients with unknown clinical or pathologic stage from the analysis. We then gathered information about hospital volume (classified by quartiles of overall number of patients per hospital) and patient demographics including age, sex, race, insurance type, income, and education. Pertinent patient information such as Charlson–Deyo score, tumor grade, tumor size, and the American Joint Committee on Cancer clinical and pathologic stage was also analyzed.

For the analysis of treatment and outcomes, only patients with stage I-III cancers who received surgery were included

( $n = 50,741$ ), excluding patients with metastatic disease. The following variables for this cohort were analyzed: type of surgery received, appropriate number (greater than 12<sup>15,16</sup>) of lymph nodes examined, the proportion of those nodes identified as positive, and receipt of radiation therapy if indicated. Appropriate use of adjuvant or neoadjuvant therapy was also analyzed and defined according to the National Comprehensive Cancer Network guidelines as follows: underutilization was defined as patients with stage II or III cancers who did not receive adjuvant or neoadjuvant therapy. The primary outcome of interest was overall survival. Secondary outcomes of interest were length of stay, 30-day readmissions, postoperative mortality, and surgical margins.

### Statistical analysis

An alpha level of 0.05 was used for all significance tests and all reported *P* values are two-tailed. Chi-square tests were used to compare categorical variables. Wilcoxon Rank Sum tests were used to compare continuous variables, as appropriate. A Kaplan–Meier survival analysis was used to compare survival between safety-net hospital groups. A Cox proportional hazards model was used to model long-term overall survival. Covariates in this model included hospital volume and safety-net burden, Charlson–Deyo score, tumor grade, tumor size, pathologic stage, surgical margins, and appropriate use of adjuvant/neoadjuvant therapy. We also used a random-effects model to adjust for patient clustering within centers. Statistical analysis was performed using SAS 9.4 statistical software (SAS Institute, Cary, NC) and SPSS Statistics (IBM Corporation, Endicott, NY). The University of Cincinnati’s Institutional Review Board approved this study.

## Results

### Patient demographics

The patient demographics based on safety-net burden status are shown in [Table 1](#). From the entire patient cohort, 16.8% of patients ( $n = 49,703$ ) were treated at LBH, 59.8% ( $n = 177,133$ ) at MBH, and 23.4% ( $n = 69,193$ ) at HBH. Compared to LBHs, HBHs encountered patients who were more likely to be younger, black, insured by Medicaid or uninsured, and in the lowest quartiles of income and education. In addition, HBH patients were more likely to present with larger tumors (median tumor size in cm; interquartile range, HBH: 3.5; 2.3-5.0, LBH: 3.5; 2.1-5.0, MBH: 3.5; 2.2-5.0,  $P = 0.008$ ) and more advanced clinical (stage IV, HBH: 17.6%, LBH: 15.4%, MBH: 15.5%,  $P < 0.001$ ) and pathologic stages (stage IV, HBH: 13.1%, LBH: 11.4%, MBH: 11.6%,  $P < 0.001$ ).

### Processes of care

Differences in oncologic treatment between hospital groups were examined in [Table 2](#). The majority of patients with stage I-III cancer underwent surgical treatment, and although rates of surgery did vary with safety-net burden, HBH did not offer the lowest proportion (surgery rate, HBH: 96.7%, LBH: 94.9%, MBH: 98.2%,  $P < 0.001$ ). Among patients who received surgery,

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