

# Surgical Site Infections Among Colorectal Cancer Patients – Louisiana, 2015-2022

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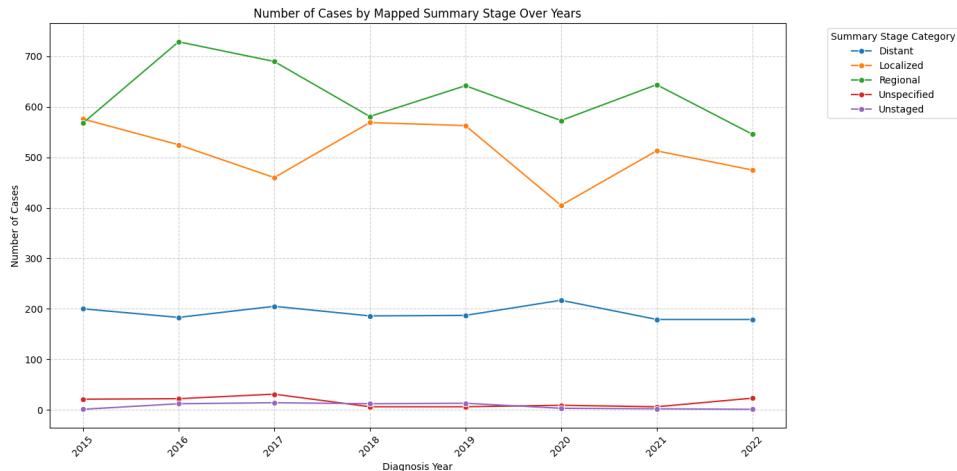


Fig. 1. Colorectal cancer surgeries by stage at diagnosis and year.

**Abstract**— This report initiates research on colorectal cancer (CRC) patients in Louisiana who underwent surgery, and to determine their likelihood of developing colorectal surgical site infections (SSIs). The present gap in literature that this research will fill is to understand individual-level, hospital-level, and community-level factors that are associated with colorectal SSIs among CRC patients. Study sites are acute care hospitals in Louisiana that conducted and reported colon surgeries to the Louisiana Hospital Inpatient Discharge Database (LAHIDD) during the study period. The primary exposure of colon surgeries and the primary outcome of colorectal SSIs and a secondary outcome of death. The general hypothesis is that colorectal cancer patients identified with SSIs post-colorectal surgery, who have advanced disease stages, and live in neighborhoods with high deprivation indexes, will be identified more frequently in comparison to persons without advanced CRC and do not live in areas with high deprivation indexes. Results showed a general decrease in CRC infections over time and interactions with covariates such as body mass index, poverty, and insurance type. Outcomes of this research will integrate cancer stage risks, facility capacity to mitigate infection risks, and neighborhood factors. Conclusions may be used to prevent SSIs attributed to colorectal surgery. The code and user guide are publicly available at <https://github.com/ericajwashington/datavizreport.git>.

**Index Terms**—Infectious disease, cancer, hospitals.

## INTRODUCTION

Colorectal cancer (CRC) begins as polyps that form inside of the colorectum, which is part of the digestive system. Colorectal cancer treatments can include surgery, radiation therapy, chemotherapy, and immunotherapy.<sup>1</sup> The five-year survival rate for persons first diagnosed with CRC is 91%, 73%, and 13% for stage 1, stages 2-3, and stage 4, respectively.<sup>1</sup> Surgery is the main treatment for CRC that is detected in early stages. CRC patients with advanced stage were recommended to have chemotherapy after surgical resection. Side effects of chemotherapy treatments can include neutropenia, which decreases the body's white blood cell count. Neutropenia affects the body in its defenses against infection.<sup>2</sup>

According to the Centers for Disease Control and Prevention (CDC), SSIs account for 20% of all healthcare-associated infections (HAI) reported to the CDC Louisiana Hospital Inpatient Discharge Database (LAHIDD). These infections may be associated with a 2- to 11-fold increase in risk of mortality across all surgery types where 75% of SSI-associated

deaths were directly attributable to the SSI. Additional burdens include increased lengths of hospitalization.<sup>3</sup>

This eight-year retrospective cohort research aims to demonstrate infection burden among CRC patients who receive surgical treatments. The goal of this research is to determine if persons diagnosed with CRC have disproportionate surgical site infection (SSI) outcomes if they undergo surgery as a form of treatment.

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## RELATED WORK

Louisiana cancer patients diagnosed with colorectal cancer (CRC) between 2015 and 2002 are the study population. Patients diagnosed with *in situ* (stage 0) CRC as well as patients diagnosed with Lynch syndrome are excluded from this study. Persons with Lynch syndrome have hereditary nonpolyposis colorectal cancer. Polyposis describes adenomas that increase risk of developing colorectal cancer. Lynch syndrome patients have genetic conditions that increase their risk of cancer diagnosis before age 50. Lynch syndrome is characterized by genetic mutations largely located at MLH1 and MSH2. Amongst Cajuns (descendants of French Canadians who reside in the south-central region of Louisiana), the MLH1 pathogenic genetic variant lends to higher prevalence of CRC amongst that population.

According to Karlitz, et. al. (2021), 83.3% of Cajuns with early-onset CRC had Lynch Syndrome. Patients with MLH1 tumors have an approximate 24% likelihood of cancer recurrence. The genetic predisposition to CRC and Lynch Syndrome amongst Cajuns supports their exclusion from this proposal, wherein the relationship between the exposure and outcome could potentially be distorted.

Long-standing interventions, both preoperative and perioperative, have been demonstrated to protect patients from bacterial contamination during operative procedures. Previous literature describes a number of interventions that seek to prevent the likelihood of acquiring a SSI after colorectal surgery, such as surgical bundles and antimicrobial skin preparations. A surgical care bundle describes infection prevention and safety methods wherein all materials needed for patient care are packaged to effectively treat patients. Surgical bundles consist of evidence-based tools and methods and are used to improve patient outcomes.<sup>4</sup> Surgery is conducted for CRC patients to remove growth of abnormal cells.<sup>5</sup> In addition to surgery, CRC can be treated in combination with chemotherapy and radiation to reduce the risk of spread and recurrence.

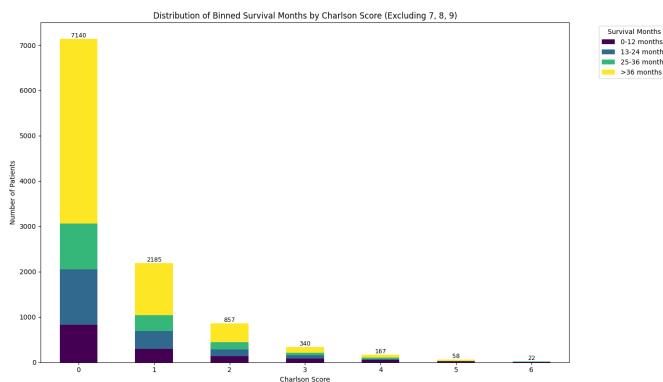


Fig. 2. No. of Patients by Charlson Score and Survival Months

A number of authors have described the relationship between colorectal surgery and SSIs attributed to the surgical procedure. Han, et. al. (2023) investigated the incidence of SSIs following colorectal surgery and risk factors affecting the relationship between the exposure and outcome. This nine-year retrospective study demonstrated that having colostomies and ileostomies increased the incidence of postoperative SSIs.<sup>6</sup> A colostomy is a surgery wherein a portion of the colon is diverted to an artificial opening in the abdominal wall in order to bypass a damaged piece of the colon. Similarly, an ileostomy is a surgery wherein a piece of the ileum is diverted to an artificial opening in the abdominal wall. Limitations with this study included the

potential for selection bias and selecting a single institution from which to sample data. Data collected in Louisiana's LAHIDD group will allow access to patients that received colorectal surgeries at 69 acute care hospitals. CMS defines "acute care hospital" as a hospital that provides inpatient medical care and other related services for surgery, acute medical conditions, or injuries (usually for a short-term illness or condition).<sup>7</sup>

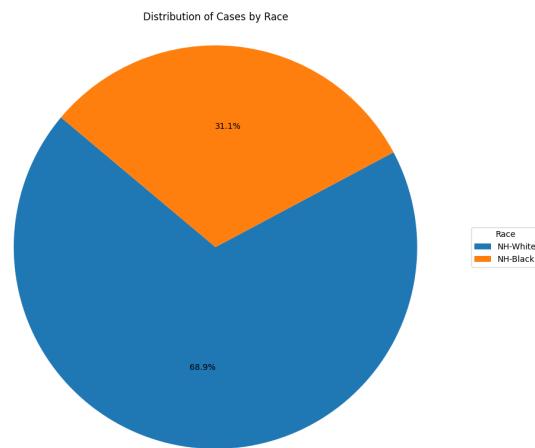


Fig 3. CRC Surgeries by Race

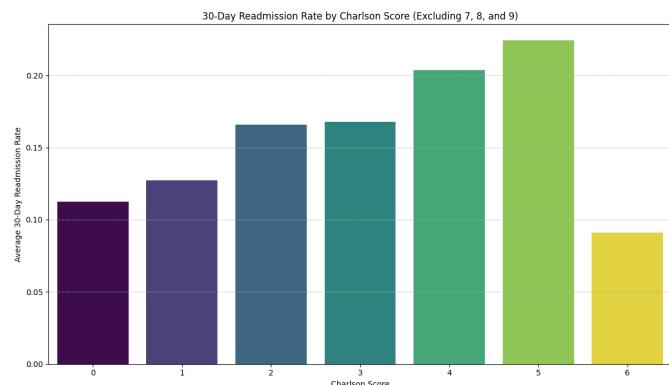


Fig. 4. Charlson Score by 30-Day Readmission Rate

## METHODS

The primary exposure of interest is having a colorectal surgery procedure performed on the digestive organs and in the abdomen for the purpose of cancer excision amongst patients of any stage at CRC diagnosis. Patients without the primary exposure are those who underwent anorectal surgery performed to excise cancer excision amongst patients at any stage of CRC diagnosis.

Surgical site infections are tracked in the Louisiana Hospital Inpatient Discharge Database (LAHIDD) by acute care hospitals that are reimbursed by the Centers for Medicare and Medicaid (CMS) and other insurers for services in the United States.

Acute care hospitals are defined as short-term inpatient healthcare facilities that provide care for medical care or other related services for surgery, acute medical conditions or injuries. The likelihood of acquiring a SSI can be affected by a host of factors, including health of the patient, whether a scope was used, wound class, emergency, and obesity status of the patient.

State cancer profiles are published in five-year increments by the National Institutes of Health (NIH) and CDC. These data

describe incidence and other statistics describing burden and risks for major cancers in the United States. Data published on the website statecancerprofiles.cancer.gov are compiled by National Program of Cancer Registries Cancer Surveillance System, CDC, and NIH's Surveillance, Epidemiology, and End Results (SEER) Program. From 2016-2020, parish-level CRC incidence in Louisiana was generally stable with 20 of 64 parishes (31.2%) identified with falling incidence rates.

Two data sources will be linked for the purpose of this research: LAHIDD and LTR. Since 1998, LAHIDD has tracked discharge data from hospitals in Louisiana. Acute care hospitals have had to document colorectal surgeries in LAHIDD. Infections are tracked in the database and are defined as conditions that arise from such infections within 30-days of the surgical procedure. In addition to capturing patient-level data on surgeries and infections, facility-level data are tracked in LAHIDD through annual reports documenting facility-type, surveillance methods, teaching capacities and affiliations, and more.

The LAHIDD relies on standardized definitions for documenting infections and patients at risk of developing HAIs. Several facility types (e.g., acute care hospitals and critical access hospitals) are able to track infections in the database. Most facility reporting patterns are motivated by CMS reporting rules.<sup>19</sup> CMS reporting rules are part of CMS's Quality Reporting Program (QRP): a component of the National Quality Strategy (NQS). The NQS aims to promote quality outcomes and safe care for all patients.<sup>20</sup> The QRP is outlined in the federal register and indicates reimbursement and value-based purchasing guidelines for hospital-based surveillance reporting.

The power of LAHIDD lies in its comprehensive summary of variables of interest for this research. The LAHIDD may also stratify outcomes according to such metrics as facility type (e.g., general hospital, medical teaching facility), length of surgery, surgery type, and ICD-9 procedure code. Infections that are identified subsequent to, and associated with, surgical procedures are termed "surgical site infections" by LAHIDD. Such infections will be identified within 30 days per standard surveillance protocol as defined by the CDC National Healthcare Safety Network (NHSN). Colorectal surgeries documented in NHSN have specific criteria for documentation per the patient safety protocol.

## RESULTS

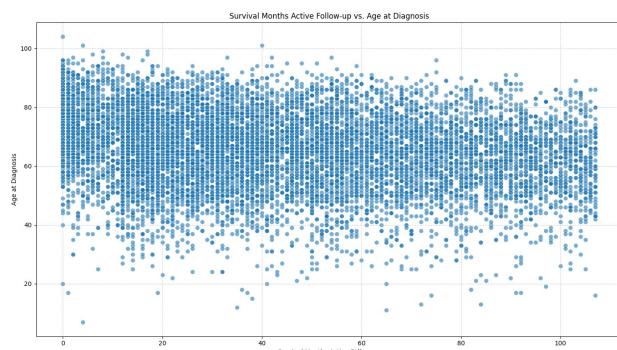


Fig. 5. Survival Months by Age at Diagnosis

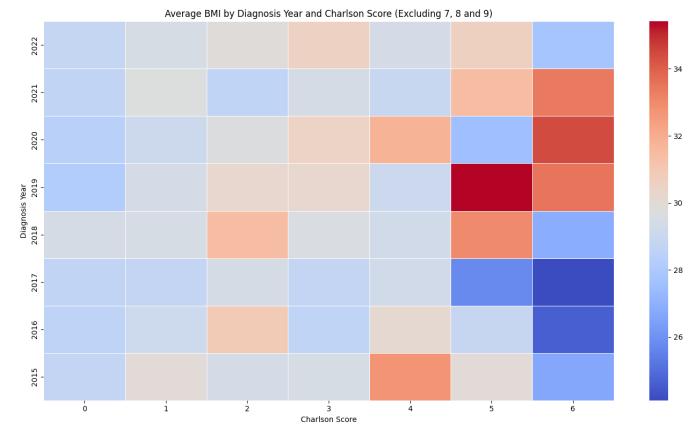


Fig. 6. Charlson Score by BMI and Year.

General associations between covariates and the outcome were investigated for this report. For data transparency, Charlson scores 7-9 were deleted from visualizations as they represented unknown, unstated, and missing categories, respectively. Overall, persons who are sicker at the time of surgery have a lower survival (Fig. 7); however, it is noteworthy that the majority of patients in the set are not extremely moribund (Fig. 2).

Colorectal cancer incidence rates in Louisiana are significantly higher for white and black men and black women in comparison to U.S. rates. Overall cases of CRC patients who underwent surgery in this dataset are summarized by race in Fig. 3.

As referenced previously, the survival rate for CRC has vastly improved in recent years. Survival months by age at diagnosis is demonstrated in Fig. 5. While there appears to be a slight downward trend, overall length of survival appears good for patients diagnosed with CRC and undergo surgery across all age continuums.

## DISCUSSION

A number of health equity issues may be investigated through this dataset, ranging from patient race, insurance type, rural status of the patients, BMI, and age. Missing data must be investigated for the dataset. This can largely be attributed to the improved survival status for patients who are diagnosed with colorectal cancer. Environmental factors, such as diet, urban and rural status of the patient, stage at diagnosis, and age at diagnosis, may influence survival. In the dataset, only a few persons acquired an infection after surgery; therefore, investigation of the covariates lent to more fruitful discussions herein.

The Charlson Score lent to the most investigatory work here. A graph showing 30-day readmission requires much contextualization. There may be a number of factors that may affect a person's readmission, such as their health at the time of surgery and pre-existing conditions (Fig. 6-8). There are a number of categorical variables in this set that may be mapped according to the continuous outcome of survival. Figure 7 provides a good depiction of survival. As persons are sicker at the time of diagnosis, their probability of 30-day readmission increases with the exception of Charlson Score 6, which describes the most moribund patients who are not likely to survive.

Congestive heart failure also presents an opportunity for reviewing associations and potential collinearity with the outcome. Congestive heart failure as well as peripheral vascular disease show that survival of patients is poor among those who have surgery as CRC patients (Fig. 8).

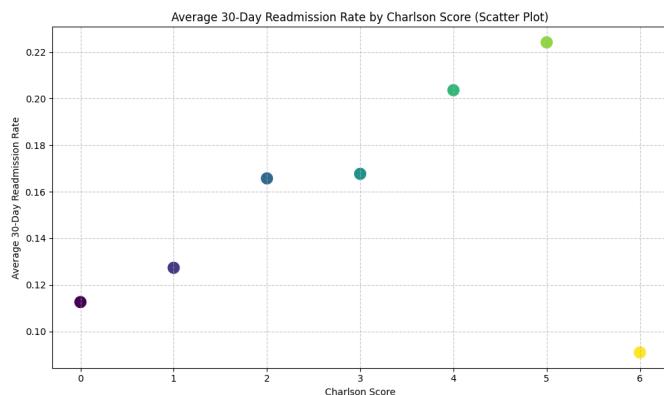


Fig. 7. Average 30-Day Readmission Rate by Charlson Score

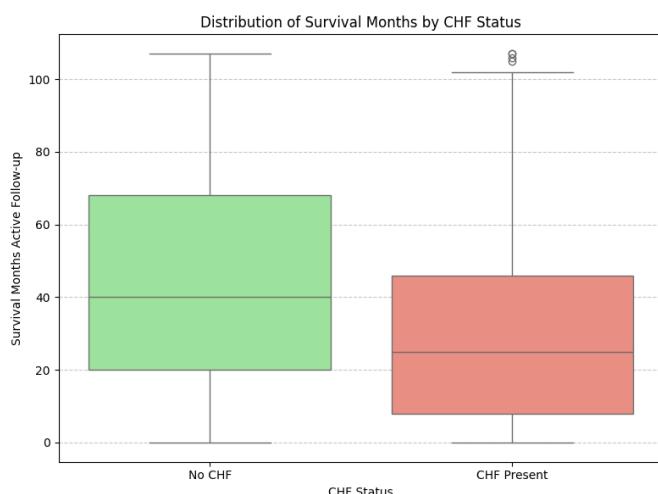


Fig. 8. Survival Months and Congestive Heart Failure Status

## FUTURE WORK

Understanding the role to which social vulnerabilities play in the health of populations has been elevated in recent years. Diaz, et. al. (2021) investigated the association of U.S. county-level social vulnerabilities and elective versus non-elective colorectal surgery. In the study, the association between the primary exposure of patient's county of residence and primary outcome of non-elective colon resection was contextualized by social vulnerability indices (SVI). Future work will investigate predictors for survival among patients who undergo CRC surgery and make recommendations for screening and hospital care.

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