**Readmission Risk Factors of CABG Surgery: Role of surgeon and hospital workload**

Readmission of patients for the same diagnosis implies poor quality of health care and is often expensive. Nearly 20% of Medicare patients are readmitted within 30 days of discharge. Frequent patient readmissions pose a significant financial burden to the U.S health care system. Hence, there is an urgent need to identify factors that drive short-term readmissions and develop appropriate interventions, in order to reduce readmissions and avoid financial penalties incurred due to the Hospital Readmissions Reduction Program (HRRP), as administered by the Centers for Medicare and Medicaid Services (CMS).

The HRRP penalizes hospitals with reductions in reimbursement for excessive 30-day readmissions, and increases hospitals’ financial accountability for preventable readmissions. Hospitals with higher-than-expected readmission rates may experience a reduction up to 5% of their total Medicare reimbursements. More than 3,400 hospitals are currently subject to the HRRP, and over 76% received reduced reimbursements in fiscal 2016 with the combined penalty estimated to be approximately $420 million. In 2017, CMS expanded the set of conditions, to include Coronary Artery Bypass Graft (CABG) surgery. Hence, hospitals and healthcare providers need to develop a better understanding of the determinants of short-term readmissions of CABG patients and develop appropriate interventions.

We focus on CABG surgery patients in our study because CABG is the most common type of open-heart surgery in the U.S., with more than 500,000 surgeries performed every year. It is also one of the most expensive procedures with an average cost of $100,000 (American Heart Association, 2009), and characterized by high 30-day readmission rates (Hannan et al. 2003). Hence, it is important to conduct a comprehensive study based on a large data set of patient visits
across multiple hospitals, in order to identify patient- and provider-specific risk factors that are associated with readmission risk. In this research, we investigate how short-term, surgical case volume (i.e. during the last 30 days prior to a patient’s surgery date), at the hospital- and surgeon-level, may affect the readmission risk of CABG patients.

We argue that it is essential to understand how hospital and surgeon *case volume*, as measured by the number of surgeries performed within a 30-day period, may affect patient health care outcomes. Specifically, we explore the impact of variations in the case volume of CABG surgeries performed by surgeons and hospitals on the readmission risk, as well as the number of readmissions among these patients. Although the operations and clinical literatures have studied the impact of case volume on patient mortality risk, there have been relatively few studies on their impact on readmission risk, primarily due to data limitations. Our study is based on analysis of patients’ complete readmission records across multiple hospitals within a large geographic region, and enables us to develop more accurate models to predict risk factors associated with readmissions of CABG patients.

Our data was drawn from two unique data sets, based on patient-level data that were integrated using a unique patient identifier. The first data set was provided by the Texas Quality Initiative, which collects detailed information on CABG patients with a rich longitudinal history of their surgical procedures, treatment, and care plans. The TQI data set consists of 9,123 patients who underwent CABG surgery during a three-year period from July 2011 through June 2014. These patients were operated upon by 67 cardiothoracic surgeons across 27 hospitals in North Texas. The second data set was obtained from the Dallas Fort Worth Hospital Council Research Foundation and includes patients’ hospital admission records, based on administrative claims data submitted by the same hospitals during this time period. We integrated the TQI and
DFWHC data sets using a patient identifier, which allows us to track their hospital visits across the entire metropolitan region. The integrated data set consists of 14,487 admission records, incurred by 7,874 unique patients, who underwent CABG surgery during our study period.

Our results, as shown in the Appendix, indicate that patient demographic characteristics, insurance type, length of hospital stay during surgery, and comorbidities are critical predictors of CABG readmission risk. Similarly, pre-operative risk factors, such as creatinine level prior to surgery and previous cardiac interventions, are significant predictors of 30-day readmission probability and frequency. With respect to our research questions of interest, we find that hospitals with higher case volume are likely to exhibit lower readmission risk (coeff. = -0.018, p < 0.01), whereas surgeons with higher case volume are more likely to exhibit higher patient readmission rates (coeff. = 0.018, p < 0.01). These nuanced results suggest that hospitals may benefit from organizational learning associated with experience accumulated from dealing with a higher caseload, while individual surgeons may suffer from fatigue due to higher surgical volume, resulting in higher readmission risk. Further, hospitals with higher case volume exhibit a lower number of 30-day readmissions in the future, compared to hospitals with lower volume.

Our study represents one of the first studies to conduct a comprehensive investigation of the risk factors associated with readmissions related to CABG surgery. Our study underscores the importance of hospital and surgeon caseload as significant determinants of readmission risk. By developing a better understanding of patient readmissions, hospitals can more accurately profile patients who exhibit higher readmission risk and implement preventive measures to target these patients effectively.