

# Preparing for Participation in the Centers for Medicare and Medicaid Services' Bundle Care Payment Initiative – Advanced (BPCI-A) for Major Bowel Surgery

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## Research

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# Abstract

## Background

As healthcare costs rise, there is increasing emphasis on alternative payment models to improve care efficiency. Bundled payment represents an alternative reimbursement model gaining popularity within the surgical sphere. We aimed to assess where the largest opportunities for care improvement lay and how best to identify patients at high-risk of suffering costly complications.

## Methods

We utilized itemized CMS claims data for a historical group of 252 bundled payment patients and performed a cost analysis to identify opportunities for improved care efficiency. Based on the results of this cost analysis, we identified readmissions as a target for improvement. We then assessed whether the ACS NSQIP surgical risk calculator could accurately identify patients within our bundled payment population who were at high-risk of readmission using a logistic regression model.

## Results

Readmissions accounted for 12.8% of the average total care episode cost with a coefficient of variation of 2.72, thereby representing the most substantial, non-fixed cost for our bundled payment patients. Patients readmitted within their 90-day care episode were 2.53 times more likely to be high-cost (>\$60,000) than patients not readmitted. However, the ACS NSQIP surgical risk calculator did not accurately predict patients at high-risk of readmission within the first 30-days with an AUROC of 0.58.

## Conclusions

Our study highlights the importance of reducing readmissions as a central component to improving care for bowel surgery bundled payment patients. Preventing such readmissions requires accurate identification of patients at high-risk of readmission; however, current risk prediction models lack the adaptability necessary for this task.

## Introduction

The annual cost of surgical care in the United States is a staggering \$400 billion, and it is projected that surgical expenditures will reach 7.3% of the national gross domestic product by the year 2025.<sup>1,2</sup> Over the past decade, there has been an effort to implement alternative payment models to combat the rising cost of healthcare in the U.S. In 2010, the Centers for Medicare and Medicaid Innovation (CMMI) proposed the Bundled Payment for Care Improvement Initiative (BPCI), in which one fixed payment is delivered to cover hospital, professional, and additional services for particular diagnoses or procedures during a single care episode.<sup>3,4</sup> Unlike the current fee-for-service model which lacks incentives for providers to limit costs, this model shifts more financial responsibility for a patient's total care costs onto hospitals and providers. In the event that a hospital is able to improve the quality and value of care

delivered during the 90-day program window following surgery, the savings are shared between the hospital and the Centers for Medicare and Medicaid Services (CMS). Alternatively, if the hospital fails to improve patient care, then the hospital will incur a financial penalty.

Although the program began as a voluntary initiative, the bundled payment model has become mandatory for certain procedures like joint replacements, where the association between BPCI and healthcare improvement has been well studied.<sup>5</sup> Hospitals have had the option to participate in BPCI for major bowel surgery since 2013. However, there are limited reports in the literature about hospitals' experiences, and several researchers have continued to question the feasibility of bundled payment for major bowel surgery given the heterogeneity and increased complexity of this patient population.<sup>2, 6</sup>

The University of California, San Francisco (UCSF) Health was one of five large, academic medical centers that elected to participate in the second iteration of the program—BPCI-Advanced (BPCI-A) Major Bowel Bundle Program—which launched at UCSF in October 2018. We elected to participate in the program as a way of preparing for the inevitable changes in surgical care delivery that will be coming over the next decade. As one of our first goals of participation in the bundled payment program, we sought to identify tools to preoperatively risk-stratify our patients in order to effectively direct patient navigation and social services to patients at high-risk of utilizing excessive healthcare resources. Due to the wide adoption, repeated validation, and robust nature of the American College of Surgeons' National Surgical Quality Improvement Program surgical risk calculator (ACS NSQIP SRC), we hypothesized that it could be an effective tool for risk stratification for the UCSF BPCI-A Major Bowel Bundle Program patients.<sup>7-11</sup>

## Methods

### Study Overview

As part of our planned participation in the major bowel bundled payment program, CMS provided data on a cohort of patients at our institution who were treated between 2014 and 2016 and who would have met the criteria for inclusion in the BPCI-A program. This time period represented our "baseline" performance and was used by CMS to calculate price targets. We utilized these data to identify areas for improvement prior to program initiation. The BPCI-A program for major bowel includes patients undergoing intra-abdominal operations that involve some element of a bowel resection and fall into the qualifying Medicare Severity Diagnosis Related Groups (MS-DRGs 329, 330, and 331). As such, the patients included in our study underwent either elective or emergent small bowel, colon, and/or rectal procedures for acute conditions (e.g. ischemia, obstruction, or perforation), colorectal cancer, benign disease, and inflammatory bowel disease. All included patients had Medicare as their primary insurer and were enrolled in Medicare Part A & B. Patients who were enrolled in Medicare Advantage were excluded from the CMS program.

CMS provided itemized claims data that included all costs within the 90-day care episode, which began when each patient was admitted for a procedure that fell within a designated DRG. Data included every hospitalization within the 90-day episode, including the “Anchor Stay” (the initial acute care hospitalization) and any readmissions following the Anchor Stay. All claims related to professional fees, outpatient clinic visits, durable medical goods, hospice, pharmacy, rehabilitation or skilled nursing service, and home service (including home health, physical therapy, and ostomy) claims after the index hospitalization were provided. For analysis, contributions from less frequent cost categories were aggregated into an “Other” category and included inpatient psychiatry, inpatient rehabilitation, transfer, physical therapy, and hospice costs.

The preoperative and procedure-related information was abstracted from the electronic health record for each patient and was entered into the ACS NSQIP SRC to determine the predicted risk of readmission. The ACS NSQIP SRC is a well-validated tool used in hospitals around the United States, which utilizes 20 patient variable inputs as well as the planned procedure to predict 30-day outcomes in patients (including readmission risk) following surgery.

This study was deemed exempt by the Institutional Review Board at UCSF.

## **Statistical Analysis**

Itemized claims data were aggregated for the cohort by calculating the mean across each claims category for all patients. Variability of cost within each category was analyzed and compared by calculating the coefficient of variation ( $c_v$ )—a standardized measure of dispersion—for each cost category. A relative risk was calculated to quantify the increased likelihood of having a high-cost care episode based on whether the patient was readmitted. A logistic regression model was used to assess the predictive performance of the NSQIP SCR’s anticipated readmission risk with the actual 30-day readmission rate realized in the data. All participants were included in the logistic regression model. The area under the receiver operator curve (AUROC), also known as the c-statistic, was calculated to assess the discrimination ability of the model. All hypothesis tests were two-sided, and the significance threshold was set to 0.05. The statistical analyses were performed using R Studio<sup>12</sup>—an open access programming platform for statistical computing.

## **Results**

### **Population Demographics and Comorbidities**

Our study cohort included 252 patients treated at UCSF between 2014-2016 who met inclusion criteria for the Major Bowel Bundled Payment Program (Table 1). The mean patient age was 70.1 years, and 54% (n = 137) of the cohort were female. Approximately 56.7% (n=143) of patients were designated as American Society of Anesthesiologists (ASA) class 3 at the time of their operation. An emergency procedure was performed for 13.9% (n=35) of patients. The surgical approach was open for 43.7% of procedures. The patient population was complex, with 50.8% (n=128) carrying a diagnosis of hypertension requiring

medication and 20.2% (n=51) with diabetes (both insulin and non-insulin dependent). Nearly 20% (n=50) of patients had disseminated cancer at the time of surgery. The median length of stay was 6 days (range: 0-39 days), and the 90-day readmission cumulative incidence rate was 36.5%.

Table 1  
Patient Demographics and Comorbidities

	<b>Mean (SD*)</b>	<b>Range</b>
Age (years)	70.1 (11.1)	27-98
BMI	25.6 (6.38)	14.7-50.0
	<b>N (Total = 150)</b>	<b>Percent (%)</b>
<b>Gender</b>		
Female	137	54.4
Male	115	45.6
<b>Functional Status</b>		
Independent	240	95.2
Partially Dependent	7	2.8
Totally Dependent	5	2
<b>ASA Class</b>		
ASA 1	2	0.8
ASA 2	98	38.9
ASA 3	143	56.7
ASA 4	9	3.6
ASA 5	0	0
<b>Emergency Case</b>		
No	217	86.1
Yes	35	13.9
<b>Hypertension Requiring Medication</b>		
No	124	49.2
Yes	128	50.8
<b>Diabetes</b>		
No	201	79.8
Non-Insulin Dependent	40	15.9

*SD – Standard Deviation
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	Mean (SD*)	Range
Insulin Dependent	11	4.3
Disseminated Cancer		
No	202	80.2
Yes	50	19.8
Steroid Use		
No	226	89.7
Yes	26	10.3
History of Severe COPD <sup>†</sup>		
No	234	92.9
Yes	18	7.1
Dyspnea		
No	233	92.5
Moderate Exertion	18	7.1
At Rest	1	0.4
Smoker within One Year		
No	241	95.6
Yes	11	4.4
Ascites		
No	247	98
Yes	5	2
Sepsis within 48 Hours		
No	245	97.2
Yes	7	2.8
CHF <sup>‡</sup> Exacerbation or Diagnosis within 30 Days		
No	250	99.2

\*SD – Standard Deviation

	Mean (SD*)	Range
Yes	2	0.8
Ventilator Dependence		
No	252	100
Yes	0	0
Acute Renal Failure		
No	252	100
Yes	0	0
Dialysis		
No	252	100
Yes	0	0
*SD – Standard Deviation		

## Care Episode Claims Analysis

The itemized CMS claims data for all patients in the bundled payment cohort were averaged across each cost category (Figure 1) and their respective coefficient of variation was calculated. For reference, the  $c_v$  ranged from 0.73 to 5.05. The combined anchor stay and professional fee (physician services) claims accounted for 68.8% of the average care episode cost. The  $c_v$  for these payments was 0.73, suggesting a relatively fixed payment amount across patients. Readmission payments represented the next highest cost category at 12.8% of the average care episode cost but demonstrated high variability across patients ( $c_v = 2.72$ ). Although the  $c_v$  was higher for the durable medical equipment ( $c_v = 4.03$ ) and the “other” ( $c_v = 5.05$ ) cost categories, they both represented a relatively small overall component of the total care episode costs on average (3.1% and 0.8%, respectively). Given both the high coefficient of variation and the significant contribution to the average total care episode cost, we identified readmissions as a prime target for intervention to improve care efficiency for BPCI-A patients.

## Readmissions

When looking closer at readmissions across the 90-day timeline, the first week following discharge from the hospital represented the highest risk time for readmission in the care episode. If a patient was readmitted, there was a 24% chance that the readmission would occur in the first week after discharge from the hospital. Overall, 49.4% (n=43) of all readmissions to the hospital occurred in the first 30 days of the 90-day care episode (Figure 2). The other half of the readmissions were evenly distributed across the remaining 31-90 days of the care episode. Patients who were readmitted during their 90-day care episode were more likely to subsequently have a high-cost total care episode (defined as an episode over the pre-

defined target of \$60,000 agreed upon by CMS and UCSF) when compared to individuals who were not readmitted (RR = 2.53, 95% CI: 1.86-3.43, p < 0.001) (Table 2a). With each additional readmission during the care episode, the likelihood that the patient would fall within the high-cost category also increased (Table 2b).

Table 2

a. 90-day readmissions are significantly associated with high-cost outcomes in major bowel bundled payment patients.

		Cost		
		Low	High*	Total
<b>90-Day Readmission Status</b>	<b>Not Readmitted</b>	138	47	<b>185</b>
	<b>Readmitted</b>	24	43	<b>67</b>
	<b>Total</b>	<b>162</b>	<b>90</b>	<b>252</b>
*High Cost – Total care episode cost exceeding \$60,000 (in US dollars)				
		<b>Relative Risk Ratio</b>	<b>95% CI</b>	<b>P-Value</b>
		2.53	(1.86-3.43)	<0.001

Table 2

b. Total care episode costs progressively increase with each additional 90-day readmission in major bowel bundled payment patients.

Number of Readmissions in 90-Day Episode	Percentage of Patients in High-Cost* Category
0	25.40%
1	54.20%
2	84.60%
3	100%
*High-Cost – Total care episode cost exceeding \$60,000 (in US dollars)	

## ACS NSQIP Surgical Risk Calculator Evaluation

Recognizing that readmissions would be an essential target for improvement to succeed in the program, the ACS NSQIP SRC 30-day readmission risk was compared with actual hospital readmissions for our cohort of patients using logistic regression. The overlapping distribution of SRC readmission risk scores between patients who were readmitted compared to those who were not readmitted demonstrates the poor discriminative capability of the SRC for readmission in this cohort (Figure 3a). The resulting AUROC

was 0.58, suggesting that the ASC NSQIP SRC predicted readmission only slightly better than chance (Figure 3b).

## Discussion

As healthcare spending continues to rise in the United States, there is a strong push to mitigate healthcare costs and incentivize quality and efficiency by moving away from the classic fee-for-service model. The CMS BPCI-A alternative payment model represents an innovative approach to payment restructuring that may be necessary to meet the rising cost of healthcare. Under the BPCI model, all episodes of care have a fixed cost, with both savings and penalties placed on the hospital.<sup>3</sup> However, surgery is nuanced, and patient needs and healthcare utilization can vary widely from one procedural area to another. Our analysis demonstrates that the major driver of 90-day healthcare utilization and costs in major bowel bundle patients is readmission at an acute care hospital during the bundle window. In contrast, the published experiences with comprehensive joint replacement found that much of the utilization was related to use of inpatient rehabilitation after discharge from an acute hospital.<sup>13–16</sup>

Based on our analysis of the major bowel bundled payment cohort, the greatest opportunity for improvement would be to reduce readmissions by accurately identifying patients who were high-risk for readmission and thus more likely to have high-cost care episodes. The ACS NSQIP SCR is a well-validated and widely available tool that has been studied in a number of broad surgical scenarios to predict readmission.<sup>17, 18</sup> However, the calculator was unable to predict readmission risk or total care episode cost in our bundled payment patient cohort. There are several factors that may account for this failure. While the risk calculator was calibrated and validated for patients encompassing a wide range of ages, co-morbidities, and surgical conditions, our population was more complex and heterogeneous than the population utilized for the calculator.<sup>19, 20</sup> In particular, our major bowel bundle surgical cohort was older, had higher ASA scores, higher rates of emergency surgery, and were more likely to have disseminated cancer compared to the ACS NSQIP population of colorectal surgery patients.<sup>21</sup> The SRC might be useful for counseling a patient about their risk of various outcomes based on their co-morbidities when compared to the average NSQIP patient at the average NSQIP-affiliated hospital, but the SRC lacks the specificity and modifiability needed to risk stratify patients within specific contexts—such as single-institution bundled payment programs.<sup>22</sup>

An important caveat to the use of risk calculators concerns *how* these scores are used. While a score that quantifies the possibility of increased risk and cost would ideally be used to direct appropriate care and services to these patients, it also could be used to limit access to surgical care over the concern for penalties in a bundled payment model, as suggested by Tsai et. al.<sup>16</sup> It is essential that appropriate risk adjustment techniques be employed to adjust for utilization of both in-hospital and post-discharge resources by high-risk patients. This recommendation is in line with the “Whole Person Care” approach that has been adopted by Medi-Cal, which might elucidate additional strategies for the management of patients who are more likely to incur high healthcare costs.<sup>23, 24</sup> Assessing the impact of better

integration and coordination of medical, behavioral, and social services to address the needs of high-cost patients warrants further study.

There are a number of limitations in the current study that are the result of retrospective data analysis. Miscoding or under-coding of medical conditions and complications may have occurred during the process of administrative data collection. Inaccurate or absent documentation within the electronic medical record also remains a concern. In the end, our analysis was performed on a unique but relatively small cohort, which increases the possibility for sampling bias and limits statistical power and generalizability. However, given the dearth of actual hospital experience with the Major Bowel Bundled Payment program and the accelerated integration of alternative payment models in the surgical landscape, the findings highlight the need for better study of the CMS bundle eligible general surgery patients with an emphasis on development of predictive risk models. Such models will be essential for hospitals to succeed in developing targeted interventions for those patients most at need of additional support for their transition from acute hospitalization back to the community.

## **Conclusion**

Many of the alternative payment models, including bundled payment, compel providers to consider all of the facets that contribute to severity and complexity of disease. The change in reimbursement-related incentives will require a concomitant paradigm shift in how surgeons approach the care of their patients, including those at risk for incurring high healthcare costs. With 90-day long care episodes, adequate long-term support of patients' chronic medical conditions and home environment becomes just as important as excellent peri-operative care. CMS and other payors have committed to evolve reimbursement strategies, and surgeons need to be engaged around participating in alternative payment models and stringently evaluating their feasibility. While the SRC is an effective tool for counseling patients about their expected course after surgery, it is not effective in predicting outcomes in the select BPCI-A major bowel surgery population. We urgently need more sophisticated and adaptive risk stratification tools to improve care efficiency and survive within a value-based payment structure.

## **Abbreviations**

CMMI, BPCI, CMS, UCSF, BPCI-A, ASC NSQIP SRC or NSQIP SRC or SRC, MS-DRG or DRG, AUROC, ASA.

## **Declarations**

### **Disclaimer**

The statements contained in this document are solely those of the authors and do not necessarily reflect the views or policies of CMS. The authors assume responsibility for the accuracy and completeness of the information contained in this document.

Ethics Approval and Consent to Participate: This study was deemed exempt by the Institutional Review Board at UCSF IRB. Consent was not obtained from participants due to the retrospective nature of the study and exempt IRB status.

Consent for Publication: Not applicable.

Availability of Data and Material: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing Interests: The authors declare that they have no competing interests.

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Authors’ Contributions: CC, MA, AS, and EW designed the original study. Acquisition and analysis of the data was performed by CC, MA, and AS. All authors contributed substantially to interpretation of the data. CC, MA, and EW largely drafted the work. JAS, GI and AS substantively revised the article. All authors have seen and approved the final version of the manuscript being submitted. All authors have also agreed to be personally accountable for their contributions and to ensure that questions related to the accuracy or integrity of any part of the work are appropriately investigated, resolved, and the resolution documented in the literature.

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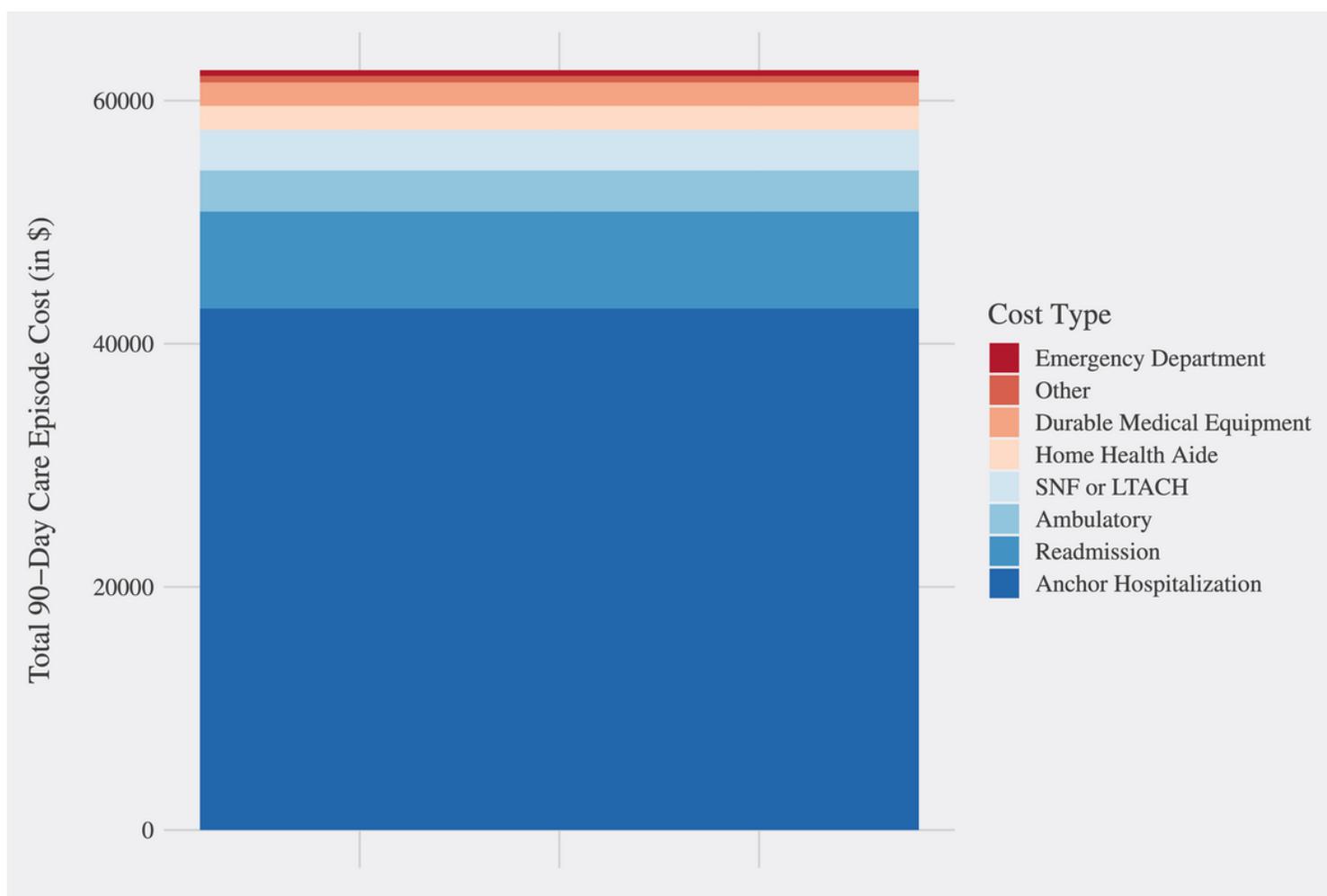
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## Figures



**Figure 1**

Average total care episode cost color-coded by cost type

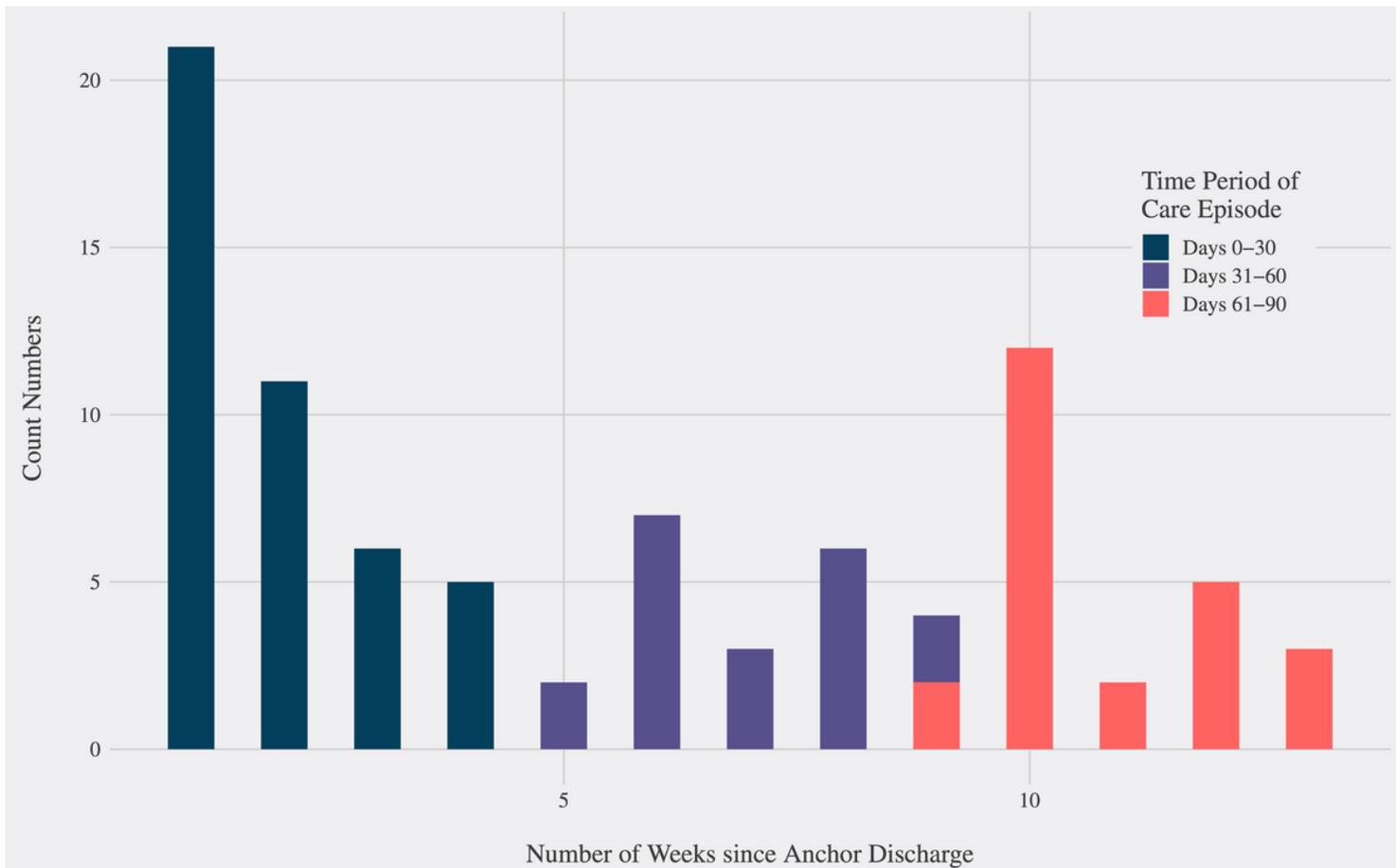


Figure 2

Histogram of readmission time course

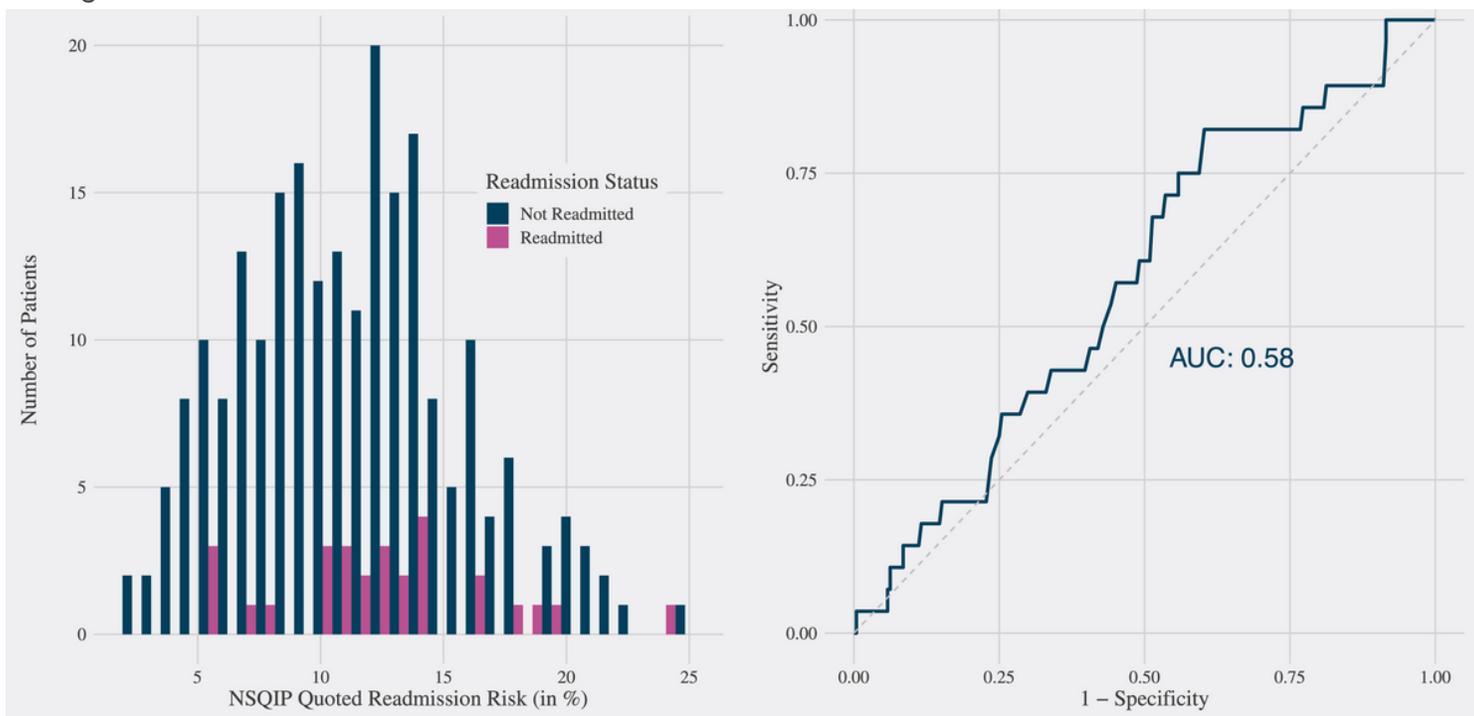


Figure 3

a. Distribution of NSQIP calculated readmission risk scores color-coded by true 30-day readmission status. b. ROC curve for readmission risk score