The Anne Burnett School of Medicine
at TCU

30 Day Readmission Rates After Cardiac Surgery, a Single-Center QI Study

Prospectus Project in Cardiac Surgery

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Abstract

Research Question: Are there significant demographic differences between patients aged 18-90 who were readmitted within 30 days after discharge from cardiac surgery, and are there any specific systemic changes that can be made to potentially decrease rates of readmission?

We predict that follow up with a provider within 30 days of discharge will have a significant negative correlation with readmission.

Background, Significance, and Rationale for the Question: Readmission after cardiac surgery is common across the nation and associated with significant morbidity and healthcare-associated cost to the patient and the hospital. We explored the potential risk factors associated with increased likelihood of readmission in a single-center review with the hope of modifying current hospital practices to decrease readmission rates in the future.

Materials and Methods: Using administrative data, we identified patients readmitted to the same institution within 30 days of cardiac surgery over a 36-month period (n = 61). Time-matched patients meeting the same inclusion criteria were the control group (n = 487). Cardiac surgery included valve replacement surgery, aortic surgery, coronary artery bypass grafting (CABG), or any combination of these procedures. We performed a standardized review of readmitted patients' medical records to evaluate timing and potential risk factors for readmission including comorbidities, emergent status, type of procedure, and whether they had followed up with a physician prior to readmission. We evaluated timing of readmission by procedure and tested for univariate associations between characteristics of readmitted patients and non-readmitted patients in our clinical registry. Patient demographics and perioperative comorbidities were evaluated by univariate analyses. Logistic regression analysis identified independent risk factors for readmission.

Results: Following 548 hospitalizations for cardiac surgery, 61 patients were readmitted to the index hospital within 30 days for a readmission rate of 11.13%. Median time to readmission was 11.5 days. There was no significant difference in readmission rates between different types of surgery ($p = 0.26$) or emergent status ($p = 0.402$). However, follow up with a physician after discharge was negatively correlated with readmission ($p = <0.001$). There were no statistically significant effects of comorbidities on readmission status in this population.

Discussion/Conclusions: Using univariate analysis and logistic regression, there were no significant differences between the readmission and nonreadmission groups except for follow up status ($p <0.001$). This confirms our hypothesis of early follow up being the major predictor of readmission within 30 days.

Introduction, Significance, and Rationale

Introduction

Reducing hospital readmission has been a Medicare priority in the effort to improve patient care as well as to reduce health expenditures.[1] The rate of unplanned rehospitalizations within 30 days after discharge has been estimated to be approximately 20% with over $12 billion in associated costs per year among US Medicare patients.[2] Although the use of hospital readmissions as a legitimate marker for the quality of care provided by hospitals is controversial, the passage of the Patient Protection and Affordable Care Act has placed reducing readmissions at the forefront of most hospital administrations, as hospital reimbursement is tied to 30-day readmission rates.[1]

These initial efforts in reducing readmissions have targeted common conditions such as congestive heart failure (CHF), acute myocardial infarction, and pneumonia, but an interest in using a hospital's 30-day readmission rate as a metric for quality performance amongst surgical patients has only recently been explored.[3] Cardiac surgery receives considerable scrutiny due to the cost associated with its procedures as well as the high risk patient population.[4]

Significance

Readmission after surgery of any kind significantly increases morbidity, mortality, and both hospital and patient costs.[5]

The conclusions that are drawn from this study could help shape evidence-based practices regarding post-hospitalization follow up procedures as well as identification of high-risk patients to help reduce readmission rates. These conclusions are applicable to the population at this hospital but could be extrapolated to similar populations at other institutions.

Rationale

There have been previous studies done assessing readmission rates following cardiac surgery in other large centers, mostly focusing on patients who have undergone CABG. Increased readmission rates following cardiac surgery has been linked to increased cost, greater morbidity, and for patients undergoing CABG, increased mortality [5]. Our study is focused on a single center and includes multiple cardiac surgeries including CABG, valve replacement, aortic repair, and any combination of those surgeries.

This study seeks to determine if there are any comorbidities that significantly impact rates of readmission, as well as to test the hypothesis that early follow up with a provider is negatively correlated with readmission rates. We hope to be able to apply these lessons to our practice to identify high-risk patients and improve our rates of readmission.

Materials and Methods

General Study Details and Resources

Subjects who had undergone either valve replacement (open and minimally invasive), CABG, aortic repair, or any combination of the procedures were selected. The subjects all had their operations at Baylor Scott and White Hospital in Fort Worth, TX over a 36-month period in the years 2018-2020. This hospital uses the Epic EHR system.

Subject Identification

Study participants were identified within the EHR by utilizing ICD 10 codes. Patients who had undergone valve replacement, CABG, or aortic repair were audited. Inclusion and exclusion criteria were applied to potential study participants during the initial identification processes within the EHR. Inclusion criteria included patients who are 18-105 years old, underwent any 3 of the previously outlined cardiac surgeries, and were admitted to the Baylor Scott and White Fort Worth Hospital. Exclusion criteria included those who did not undergo these cardiac-specific procedures and those whose records could not be found in the EHR.

The subjects were then separated into two groups: those who were readmitted and those who were not.

Additional Subject Stratification

Study subjects were further divided into secondary groups within their respective primary group. This is based on biologic sex (female vs male), procedure type (aortic repair, valve repair, CABG, or a combination), and emergent status (emergent, urgent, or elective). This is important for separating data collection. All subjects were initially be recorded on the secure collection site with their medical record number (MRN) as an identifier, to add a layer of patient privacy superior to subject names, while retaining the ability to access necessary information within Epic in the interest of the study survey recruitment.

Retrospective Secondary Endpoint Data Collection and Basic Recording

Patients meeting study inclusion criteria and readmission or non-readmission group criteria were included in this portion of the study. Upon identification, each subject was evaluated retrospectively, to obtain the following data markers: procedure type, emergent status, readmission day (0-30), follow up status, cardiac comorbidities, renal comorbidities, pulmonary comorbidities, and metabolic comorbidities.

I. *Procedure Type*

- *a.* Procedures were divided into 4 different umbrellas: valve alone, aortic alone, CABG, and combination. Valve alone procedures include both open and minimally invasive aortic valve replacement, aortic valve repair, mitral valve replacement, mitral valve repair, tricuspid valve replacement, and tricuspid valve repair. Aortic alone included thoracic aortic aneurysm repair. The CABG group includes 1 to 4 vessel procedures. The combination group includes any patient who underwent more than one category of procedure in the same operation.

II. *Emergent Status*

a. Each procedure is coded based on emergent status. Elective cases were scheduled in the outpatient clinic. Surgeries deemed as "emergent" are considered surgeries for a condition which are immediately life threatening. "Urgent" surgeries are considered for a condition that is potentially life-threatening.

III. *Follow-up Status*

a. The adherence of patients to post-discharge follow-up appointments was noted. These follow up appointments must be within 30 days of discharge to be included.

IV. *Readmission Day*

a. The day of readmission was noted through EHR chart review. Patients readmitted on the same date of discharge is considered day 0. Dates up to day 30 after discharge were included.

V. *Cardiac Comorbidities*

a. Comorbidities includes disease processes that are not addressed with surgery, and the number of comorbidities were tallied and displayed as a whole number. Comorbidities that were corrected with surgery were excluded. Cardiac comorbidities include: hypertension, arrhythmias, pulmonary hypertension, congenital structural heart disease, coronary artery disease, peripheral vascular disease, congestive heart failure, valvular disease, current pacemaker, cardiomyopathy, and left ventricular hypertrophy.

VI. *Metabolic Comorbidities*

a. Comorbidities include disease processes that are not addressed with surgery, and the number of comorbidities were tallied and displayed as a whole number. Comorbidities that were corrected with surgery were excluded. Metabolic comorbidities include obesity, hyperthyroidism, hypothyroidism, hyperlipidemia, cirrhosis, cancer (active), and anorexia.

VII. *Renal Comorbidities*

a. Comorbidities include disease processes that are not addressed with surgery, and the number of comorbidities were tallied and displayed as a whole number. Comorbidities that were corrected with surgery were excluded. Renal comorbidities include chronic kidney disease (CKD), history of renal transplant, end stage renal disease (ESRD), and polycystic kidney disease.

VIII. *Pulmonary Comorbidities*

a. Comorbidities include disease processes that are not addressed with surgery, and the number of comorbidities were tallied and displayed as a whole number. Comorbidities that were corrected with surgery were excluded. Pulmonary comorbidities include chronic obstructive pulmonary disease (COPD), asthma, obstructive sleep apnea (OSA), current smoker, idiopathic pulmonary fibrosis, pneumoconiosis, chronic respiratory failure

Statistical Analysis

The data was first analyzed using univariate analysis to determine if there was any statistically significant difference in age, sex, or procedure type between the readmission and non-readmission groups. These groups had no statistically significant difference in demographics. Finally, a linear regression model was used to determine if there were any statistically significant differences in comorbidity status or follow up status between the readmission and non-readmission groups.

All statistical analyses were conducted with a significance level of alpha = 0.05.

Results

Procedure Type

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	CABG alone	209	38.1	38.1	38.1
	Valve alone	220	40.1	40.1	78.3
	Aortic alone	19	3.5	3.5	81.8
	Combination	100	18.2	18.2	100.0
	Total	548	100	100.0	

a) In the pool of 548 included patients, 38.1% underwent a CABG, 40.1% underwent a valve procedure alone, 3.5% underwent an aortic procedure alone, and 18.2% underwent a combination of procedures.

Emergent Status

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Elective	299	54.5	54.6	54.6
	Urgent	178	32.4	32.5	87.0
	Emergent	71	12.9	13.0	100.0
	Total	548	99.8	100.0	

b) 54.5% of included procedures were considered elective, 32.4% considered urgent, and 13.0% considered emergent.

		N	Correlation	Significance	
				One-Sided p	Two-Sided p
Pair 1	Readmission Status & Age	548	-.031	.236	.472

c) Using a paired samples correlation, there is no significant difference in ages of patients between the readmission and nonreadmission groups

Univariate Analysis Between Readmission vs. Nonreadmission Groups

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.272	.101		2.685	.007
	Age	-.002	.001	-.059	-1.394	.164
	Sex	.030	.027	.047	1.121	.263
	Procedure Type	.016	.012	.056	1.333	.183
	Emergent Status	-.006	.019	-.012	-.292	.770
	Follow Up	-.233	.041	-.238	-5.731	<.001
	Cardiac Comorbidity	-.052	.079	-.158	-.649	.516
	Renal Comorbidity	-.023	.081	-.033	-.289	.773
	Pulmonary Comorbidity	-.106	.077	-.216	-1.381	.168
	Metabolic Comorbidity	-.072	.079	-.212	-.919	.358
	Total Comorbidity	.095	.077	.518	1.226	.221

a. Dependent Variable: Readmission Status. There were no statistically significant differences between the readmission and nonreadmission groups besides the follow up status ($p < 0.001$).

Chai square analyses

I. Readmission Status * Procedure Type

Crosstab

Count

		Procedure Type				
		CABG alone	Valve alone	Aortic alone	Combination	Total
Readmission Status	No	195	186	17	89	487
	Yes	14	34	2	11	61
Total		209	220	19	100	548

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	8.317[a]	3	.040
Likelihood Ratio	8.534	3	.036
Linear-by-Linear Association	1.269	1	.260
N of Valid Cases	548		

II. Readmission Status * Emergent Status

Crosstab

Count

		Emergent Status			
		Elective	Urgent	Emergent	Total
Readmission Status	No	267	160	60	487
	Yes	32	18	11	61
Total		299	178	71	548

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1.608[a]	2	.448
Likelihood Ratio	1.483	2	.476
Linear-by-Linear Association	.703	1	.402
N of Valid Cases	548		

III. **Readmission Status * Cardiac Comorbidity**

Crosstab

Count

		Cardiac Comorbidity						
		0	1	2	3	4	5	Total
Readmission Status	No	50	218	141	65	12	1	487
	Yes	4	15	24	14	4	0	61
Total		54	233	165	79	16	1	548

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	14.595[a]	5	.012
Likelihood Ratio	14.293	5	.014
Linear-by-Linear Association	11.722	1	<.001
N of Valid Cases	548		

IV. **Readmission Status * Renal Comorbidity**

Crosstab

Count

		Renal Comorbidity			
		0	1	2	Total
Readmission Status	No	379	107	1	487
	Yes	38	22	1	61
Total		417	129	2	548

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	9.347[a]	2	.009
Likelihood Ratio	7.684	2	.021
Linear-by-Linear Association	8.147	1	.004
N of Valid Cases	548		

V. **Readmission Status * Pulmonary Comorbidity**

Crosstab

Count

		Pulmonary Comorbidity					
		0	1	2	3	4	Total
Readmission Status	No	334	120	30	2	1	487
	Yes	41	16	3	1	0	61
Total		375	136	33	3	1	548

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1.829[a]	4	.767
Likelihood Ratio	1.496	4	.827
Linear-by-Linear Association	.051	1	.822
N of Valid Cases	548		

VI. **Readmission Status * Metabolic Comorbidity**

Crosstab

Count

		Metabolic Comorbidity					
		0	1	2	3	4	Total
Readmission Status	No	96	221	127	38	5	487
	Yes	14	20	16	8	3	61
Total		110	241	143	46	8	548

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	9.684[a]	4	.046
Likelihood Ratio	7.750	4	.101
Linear-by-Linear Association	2.336	1	.126
N of Valid Cases	548		

VII. **Readmission Status * Total Comorbidity**

Crosstab

Count

		Total Comorbidity										
		0	1	2	3	4	5	6	7	8	9	Total
Readmission Status	No	11	43	113	99	106	59	34	15	5	2	487
	Yes	1	2	7	7	18	16	5	1	2	2	61
Total		12	45	120	106	124	75	39	16	7	4	548

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	25.817[a]	9	.002
Likelihood Ratio	22.844	9	.007
Linear-by-Linear Association	13.798	1	<.001
N of Valid Cases	548		

VIII. **Readmission Status * Sex**

Crosstab

Count

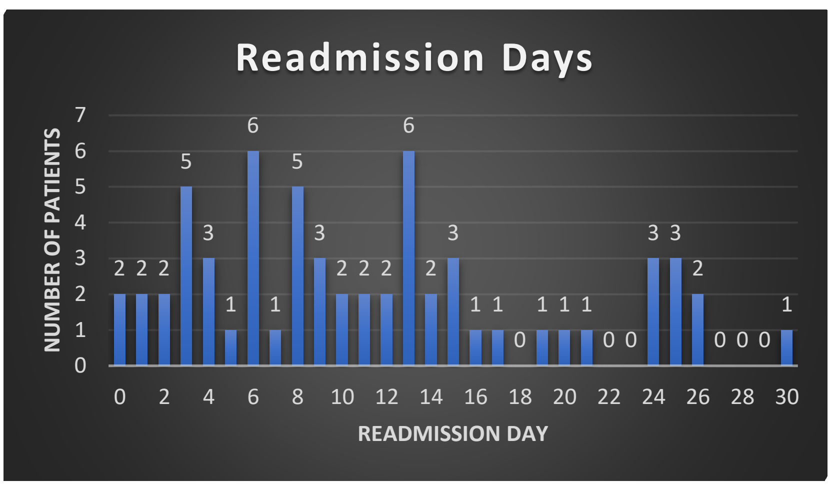
		Sex		
		Female	Male	Total
Readmission Status	No	187	300	487
	Yes	21	40	61
Total		208	340	548

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.363[a]	1	.547		
Continuity Correction[b]	.214	1	.644		
Likelihood Ratio	.367	1	.544		
Fisher's Exact Test				.579	.324
Linear-by-Linear Association	.363	1	.547		
N of Valid Cases	548				

Readmission Day

a) The average number of days between discharge and readmission. Discharge day is considered day "0". The mean was 11.3 days and 72.1% of patients were readmitted within the first 14 days after discharge



Discussion & Future Directions

This investigation confirms the initial hypothesis that prompt follow up with a provider following discharge significantly decreases rates of readmission after cardiac surgery. A previous study done by Maniar et.al had similar conclusions regarding follow up with a provider, particularly if done within 14 days of discharge from the initial hospitalization.[1] Additional studies have shown that contact with the patient early in the post-operative period, even if by telephone, has decreased rates of readmission through improved outpatient follow up, decreased patient anxiety, early medication adjustments, and improved medication compliance. [6,7]

Many of these previous studies have been on Medicare patients alone, with the intention of reducing medical costs both to the patient and the government. This study does not differentiate patients based on insurance status. There are many factors that could influence the patient's ability to follow up with a provider in a timely fashion including socioeconomic constraints, physician scheduling, and transportation.[1] The results from this investigation will be used to inform improved discharge guidelines for cardiac patients and reduce 30 day readmission rates at this center.

Previous studies have shown specific comorbidities such as COPD, diminished EF, or CKD are more likely to be readmitted. [1] While this study also sought to investigate any comorbidities that could be associated with increased risk of readmission, there were limitations which prevented adequate statistical power. This particular question should be investigated further to determine if there are any specific comorbidities that could be targeted as a means of reducing readmissions.

Conclusions

Using univariate analysis and logistic regression, there were no significant differences between the readmission and nonreadmission groups except for follow up status ($p < 0.001$). This confirms our hypothesis of early follow up being the major predictor of readmission within 30 days. Additionally, this study is limited in its ability to discern specific comorbidities which may increase the risk of readmission. This aspect of readmission is deserving of its own further study which may provide insights into additional methods of decreasing readmission and accurately identifying patients who are high risk for readmission within 30 days of discharge.

Compliance

This project includes human data which required IRB approval. This group submitted an IRB request under a retrospective study umbrella protocol which was been approved by the hospital IRB. I have completed all required CITI Training at this time.

References

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