Index hospitalization predictors of subsequent readmission for acute myocardial infarction, heart failure, and pneumonia in North Carolina Medicare enrollees

Bryce A. Van Doren,[1,2] Joshua M. Noone,[2] Debosree Roy,[1,2] William Saunders[2,3]

UNIVERSITY OF NORTH CAROLINA at CHARLOTTE

1: Health Services Research PhD Program, 2: College of Health & Human Services, 3: Department of Public Health Science

Section 3025 of the Affordable Care Act established the Hospital Readmissions Reduction Program (HRRP), which has increased attention on hospital outcomes through reductions in inpatient prospective payments to hospitals with excess readmissions for select conditions (Centers for Medicare & Medicaid Services, 2013). Readmissions have become a focus given excessive hospital readmissions are associated with poor quality (Berenson, Paulus, & Kalman, 2012) and higher costs (Friedman & Basu, 2004; Jencks, Williams, & Coleman, 2009). In addition, targeting readmissions helps to offset the unintentional incentive for hospitals to benefit from multiple admissions, as well as pressures hospitals to improve patient outcomes.

Starting in 2012 hospitals have been required to report 30-day readmission rates for three primary conditions, heart failure, myocardial infraction and pneumonia (with the list conditions and procedures to be expanded in future years). For the reporting period ending on September 30, 2013 (or the second year of the HRRP), the average penalty for North Carolina hospitals was 0.33% as compared to a mean penalty of 0.38% for all states (Rau, 2013). Of the 88 North Carolina hospitals included in the HRRP, 66% of them were required to pay penalties, which is consistent with the national average of the number of hospitals paying penalties per a state (Rau, 2013). While, North Carolina, as a state, is performing slightly better than the average state in terms of penalties, the fact that they are incurring penalties implies that 66% of NC hospitals have readmission rates for acute myocardial infarction, heart failure, and pneumonia in excess of the benchmark establish by the Centers for Medicaid and Medicare services. Given this focus on reducing hospital readmissions for acute myocardial infarction, heart failure, and pneumonia, it is important to understand the factors which lead to increased odds of readmission.

Data from the 2010 North Carolina State Inpatient Database (Agency for Healthcare Research & Quality, Healthcare Cost & Utilization Project) were obtained and analyzed for this project. The State Inpatient Database includes a 100% sample of hospital stays at participating community (non-federal) healthcare facilities. The 2010 State Inpatient Database includes a unique patient identifier that allows patients to be tracked between hospitalizations; however, subsequent data-releases (2011 and 2012) have suppressed this patient identifier. To allow for 30-day follow-up with all patients, the dataset was restricted to index (initial) hospitalizations occurring between January and November 2010. Readmissions were identified as any admission occurring within 30 days. Descriptive statistics were used to calculate the frequency, length of stay, and cost of readmissions. Logistic regression was used to calculate the odds of readmission for various factors.

Frequency and cost of readmissions varied by condition. Proportionally, heart failure patients had higher frequency of readmission than acute myocardial infarction and pneumonia patients (16.04%, 11.94%, and 11.88%, respectively). As a result, the total cost of hospital readmission was greatest in heart failure patients than in acute myocardial infarction and pneumonia patients ($128,423,156, $107,338,858, and $105,602,704, respectively); however, the mean cost of a single hospital readmission was highest for acute myocardial infarction patients ($18,967.81 (SD: $17,144.90)) than for heart failure ($8,958.71 (SD: $11,168.85)) and pneumonia ($9,097.41 (SD: $8,713.92)) patients. The average length of stay for readmissions was similar between conditions (approximately 5 days).

Readmissions led to significant health care resource utilization in 2010. These hospitalizations are expensive and, frequently, preventable. Notably, sicker patients are more likely to be readmitted. Increasing scores on the Charlson Comorbidity Index was associated with the greatest odds of readmission for all conditions. Additionally, Medicare enrollees under the age of 65 (i.e., the medically disabled) have significantly greater odds of being readmitted for all three conditions. There were no noted racial or gender disparities in readmissions. Thus, hospitals would benefit from targeting interventions (e.g., intensive follow-up with primary care physician, case management, and medical social work) at the sickest patients. In particular, the Charlson Comorbidity Index should be used as a predictive tool to identify which patients are most likely to be readmitted.

UNC CHARLOTTE
College of Health and Human Services

Corresponding Author:
Bryce A. Van Doren, MA, MPA, MPH
Doctoral Student, Health Services Research
UNC - Charlotte
UNCC 3058
Charlotte, NC 28223
(216) 367-2781
bvandore@uncc.edu

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Background

Section 3025 of the Affordable Care Act established the Hospital Readmissions Reduction Program (HRRP), which has increased attention on hospital outcomes through reductions in inpatient prospective payments to hospitals with excess readmissions for select conditions (Centers for Medicare & Medicaid Services, 2013). Readmissions have become a focus given excessive hospital readmissions are associated with poor quality (Berenson, Paulus, & Kalman, 2012) and higher costs (Friedman & Basu, 2004; Jencks, Williams, & Coleman, 2009). In addition, targeting readmissions helps to offset the unintentional incentive for hospitals to benefit from multiple admissions, as well as pressures hospitals to improve patient outcomes.

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Objectives:

- To characterize the frequency and cost of readmission for acute myocardial infarction, heart failure, and pneumonia.
- To identify patient and hospitalization characteristics which are at increased odds of readmission for acute myocardial infarction, heart failure, and pneumonia.

Methods

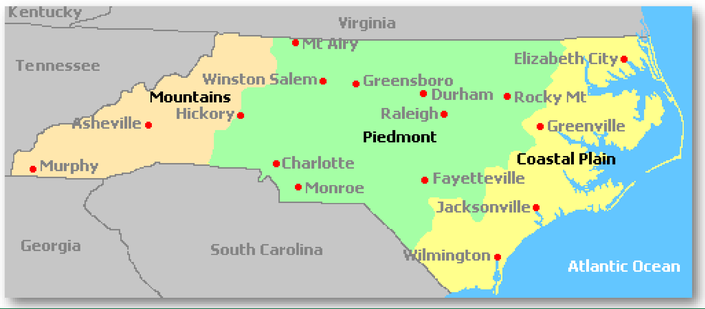
Data from the 2010 North Carolina State Inpatient Database (Agency for Healthcare Research & Quality, Healthcare Cost & Utilization Project) were obtained and analyzed for this project. The State Inpatient Database includes a 100% sample of hospital stays at participating community (non-federal) healthcare facilities. The 2010 State Inpatient Database includes a unique patient identifier that allows patients to be tracked between hospitalizations; however, subsequent data-releases (2011 and 2012) have suppressed this patient identifier. To allow for 30-day follow-up with all patients, the dataset was restricted to index (initial) hospitalizations occurring between January and November 2010. Readmissions were identified as any admission occurring within 30 days. Descriptive statistics were used to calculate the frequency, length of stay, and cost of readmissions. Logistic regression was used to calculate the odds of readmission for various factors.

Inclusion Criteria:

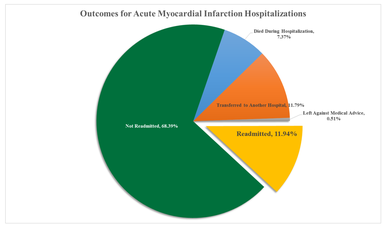
- North Carolina Resident
- Medicare Enrollee
- Admitted between January and November 2010 for acute myocardial infarction, heart failure, or pneumonia.

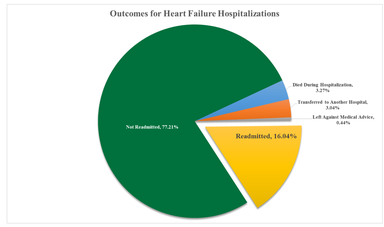
Exclusion Criteria:

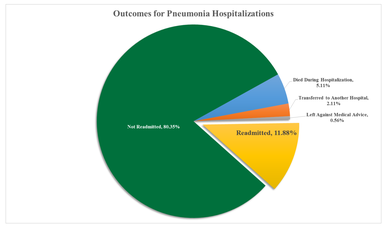
- Out-of-State Resident (to minimize chance that patient was readmitted outside of state and, thus, not included in the dataset)
- Non-Medicare Enrollee
- Missing Patient Identifier
- Missing Diagnosis Code
- Patient Died During Index Hospitalization
- Patient Left Against Medical Advice
- Patient Transferred to Another Hospital (to avoid double counting of patients)

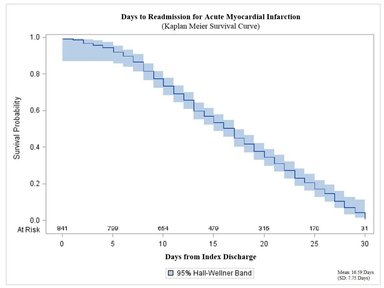


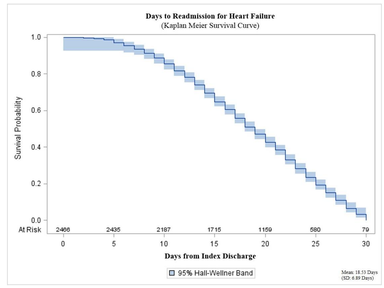
Results

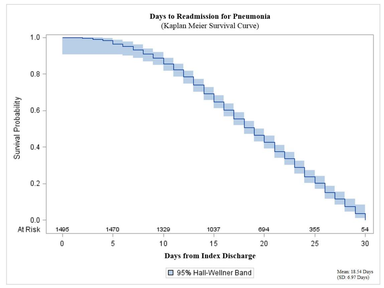












- Total Acute Myocardial Infarction Admissions (2010): 5,660
- Readmissions within 30 Days: 841 (11.94%)
  - Mean Time to Readmission: 16.59 Days (SD: 7.75)
- Total Readmission Hospital Days: 3,915 Hospital Days
  - Mean Readmission Length of Stay: 4.66 Days (SD: 4.72)
- Total Cost of Readmissions: $107,338,858
  - Mean Cost of Readmission: $18,967.81 (SD: $17,144.90)

AMI Readmission Factor	Odds Ratio	Lower Bound	Upper Bound
Age (Reference: 65-69 Years)			
Under 65 Years*	1.814	1.378	2.388
70-74 Years	1.101	0.837	1.449
75-79 Years	0.927	0.693	1.241
80 Years & Over*	0.577	0.438	0.760
Race (Reference: White)			
Black	1.044	0.845	1.291
Other	1.208	0.899	1.624
Gender (Reference: Female)			
Male	0.946	0.810	1.104
Charlson Comorbidity Index (Reference: CCI≤3)			
CCI: 4-5*	1.627	1.114	2.377
CCI: 6-7*	3.135	2.129	4.616
CCI: ≥8*	6.194	4.228	9.074
Index Length of Stay (Reference: ≤1 Day)			
2-3 Days	0.778	0.561	1.078
4-5 Days	0.954	0.685	1.330
6-7 Days	0.822	0.574	1.176
8-14 Days*	0.654	0.456	0.938
Over 14 Days*	0.013	0.002	0.938
OR Procedure During Stay (Reference: No Procedure)			
OR Procedure	0.858	0.726	1.015
Patient Region (Reference: Coastal Region)			
Piedmont*	1.307	1.071	1.594
Mountains	1.268	0.943	1.705
Hospital Location (Reference: Urban, Non-Teaching)			
Rural	0.929	0.759	1.137
Urban, Teaching	1.111	0.925	1.335

- Total Heart Failure Admissions (2010): 14,335
- Readmissions within 30 Days: 2,466 (16.04%)
  - Mean Time to Readmission: 18.53 Days (SD: 6.89)
- Total Length of Stay for Readmissions: 13,531 Hospital Days
  - Mean Readmission Length of Stay: 5.49 Days (SD: 5.21)
- Total Cost of Readmissions: $128,423,156
  - Mean Cost of Readmission: $8,958.71 (SD: $11,168.85)

Heart Failure Readmission Factor	Odds Ratio	Lower Bound	Upper Bound
Age (Reference: 65-69 Years)			
Under 65 Years*	1.556	1.329	1.845
70-74 Years	0.844	0.708	1.006
75-79 Years*	0.781	0.657	0.928
80 Years & Over*	0.574	0.491	0.671
Race (Reference: White)			
Black	1.098	0.985	1.224
Other*	1.274	1.073	1.512
Gender (Reference: Female)			
Male	1.065	0.973	1.166
Charlson Comorbidity Index (Reference: CCI≤3)			
CCI: 4-5	1.155	0.738	1.808
CCI: 6-7*	1.959	1.271	3.019
CCI: ≥8*	3.989	2.599	6.122
Index Length of Stay (Reference: ≤1 Day)			
2-3 Days	0.977	0.830	1.151
4-5 Days	0.953	0.804	1.130
6-7 Days	0.897	0.741	1.085
8-14 Days*	0.589	0.481	0.722
Over 14 Days*	0.020	0.005	0.079
OR Procedure During Stay (Reference: No Procedure)			
OR Procedure*	0.587	0.441	0.780
Patient Region (Reference: Coastal Region)			
Piedmont	1.065	0.958	1.184
Mountains	0.983	0.831	1.164
Hospital Location (Reference: Urban, Non-Teaching)			
Rural	1.003	0.903	1.114
Urban, Teaching	0.919	0.813	1.039

- Total Pneumonia Admissions (2010): 11,610
- Readmissions within 30 Days: 1,495 (11.88%)
  - Mean Time to Readmission: 18.54 Days (SD: 6.97)
- Total Length of Stay for Readmissions: 8,705 Hospital Days
  - Mean Readmission Length of Stay: 5.82 Days (SD: 5.09)
- Total Cost of Readmissions: $105,602,704
  - Mean Cost of Readmission: $9,097.41 (SD: $8,713.92)

Pneumonia Readmission Factor	Odds Ratio	Lower Bound	Upper Bound
Age (Reference: 65-69 Years)			
Under 65 Years*	1.380	1.123	1.696
70-74 Years	0.897	0.726	1.109
75-79 Years	0.871	0.708	1.072
80 Years & Over*	0.422	0.344	0.518
Race (Reference: White)			
Black	0.990	0.846	1.160
Other	1.176	0.943	1.465
Gender (Reference: Female)			
Male	1.031	0.922	1.153
Charlson Comorbidity Index (Reference: CCI≤3)			
CCI: 4-5	1.184	0.899	1.561
CCI: 6-7*	2.193	1.656	2.903
CCI: ≥8*	4.466	3.392	5.881
Index Length of Stay (Reference: ≤1 Day)			
2-3 Days	1.157	0.881	1.518
4-5 Days	1.047	0.796	1.378
6-7 Days	1.082	0.813	1.441
8-14 Days	0.975	0.731	1.301
Over 14 Days*	0.026	0.006	0.106
OR Procedure During Stay (Reference: No Procedure)			
OR Procedure	0.984	0.618	1.568
Patient Region (Reference: Coastal Region)			
Piedmont	1.073	0.932	1.235
Mountains	1.031	0.864	1.230
Hospital Location (Reference: Urban, Non-Teaching)			
Rural	1.076	0.944	1.226
Urban, Teaching	1.044	0.896	1.217

Discussion

- Readmissions resulted in 4,802 additional hospital admissions for acute myocardial infarction, heart failure, and pneumonia, combined, in 2010.
- These readmissions led to 26,151 additional hospital days and cost in excess of $341 million for acute myocardial infarction, heart failure, and pneumonia, combined, in 2010.
- Younger age (<65 years) is associated with significantly greater odds of readmission for acute myocardial infarction, heart failure, and pneumonia.
- However, advanced age (≥80 years) is associated with significantly lower odds of readmission for acute myocardial infarction, heart failure, and pneumonia. This may be because these patients are more likely to be discharged to a nursing home or long-term care facility where they will receive additional medical treatment and monitoring.
- For all 3 conditions, higher scores on the Charlson Comorbidity Index significantly increased the odds of having a readmission.
- Race was not a significant predictor of readmission, with the exception of Other Race for heart failure.
- Stays greater than 1 week were associated with significantly decreased odds of readmission for acute myocardial infarction and heart failure. Stays greater than 2 weeks were associated with significantly decreased odds of readmission for pneumonia.
- OR Procedures during the hospital stay decreased the odds of readmission in heart failure patients.
- Patients admitted for acute myocardial infarction in the Piedmont Region of the state were more likely to be readmitted than on the Coast. Geographic location (i.e., Mountains, Piedmont, and Coastal Regions) did not significantly change the odds of readmission for other conditions.
- There was not a significant difference in odds of readmission between Rural, Urban Non-Teaching, and Urban Teaching hospitals.

Conclusion

Readmissions led to significant health care resource utilization in 2010. These hospitalizations are expensive and, frequently, preventable. Notably, sicker patients are more likely to be readmitted. The Charlson Comorbidity Index was associated with the greatest odds of readmission. Additionally, Medicare enrollees under the age of 65 (i.e., the medically disabled) have significantly greater odds of being readmitted for all three conditions. Thus, hospitals would benefit from targeting interventions (e.g., intensive follow-up with primary care physician, case management, and medical social work) at the sickest patients. In particular, the Charlson Comorbidity Index should be used as a predictive tool to identify which patients are most likely to be readmitted.

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* Statistically Significant Difference in Odds