Patient Populations at Greatest Risk for Hospital Readmission or Repeat ED Visit within 30 Days of Hospital Discharge among Hospitalized Patients with Community-Acquired Bacterial Pneumonia (CABP)

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ABSTRACT

Background: United States Medicare penalizes hospitals when readmission rates among patients with pneumonia exceed benchmarks. While there is increased effort across healthcare facilities to reduce 30-day readmissions among hospitalized pneumonia patients, patients at greatest risk for readmission or repeat ED visits are not well described in studies. This study identified hospitalized patients with CABP treated with ceftriaxone with a macrolide or a fluoroquinolone who are at greatest risk for readmission within 30 days of hospital discharge.

Methods: A retrospective study of hospitalized patients with a primary diagnosis for CABP in the Geisinger IDN medical encounter 2010-2015 database was performed. Adult patients (age ≥ 18 years) who were 1) hospitalized with primary diagnosis for CABP, 2) had ≥ 1-year enrollment in the IDN before index CABP hospitalization, and 3) received ceftriaxone with a macrolide or a fluoroquinolone on day 1 or 2 of hospitalization and continued treatment for at least 2 days were included in the study. Only the first hospitalization during the study period was considered. Outcomes of interest were readmission within 30 days of hospitalization. Associations between baseline demographics, clinical characteristics, and prognosis and disease severity (measured by Charlson comorbidity index [CCI] score and CURB-65 score) and 30-day readmission were examined.

Results: Of 1,357 hospitalized patients in the final cohort, 58 (4.3%) had a 30-day readmission or repeat ED visit. Populations with 30-day readmissions had greater percentages than those without 30-day readmissions of current or past smoking (77.6% vs 63.7%), CCI ≥ 2 (48.3% vs 44.1%), 12-month pre-index ER visits (32.8% vs 27.7%), and 12-month pre-index systemic steroid use (39.7% vs 27.6%). Additionally, patients with 30-day readmissions had higher percentages of CURB-65 scores ≥ 3 compared to patients without 30-day readmissions (10.3% vs 7.2%), suggesting increased disease severity in those experiencing 30-day readmission. In the final multivariate model, controlling for other covariates, 12-month pre-index systemic steroid use was significantly associated with increased odds of 30-day readmissions (OR=1.6; 95% CI: 1.1-2.3).

Conclusions: Patient populations with 12-month pre-index systemic steroid use were found to be at elevated risk for readmission within 30 days of hospital discharge. Patient populations with CABP are often considered to be at increased risk for adverse outcomes, though only one covariate was found to be significantly predictive of an increased risk for 30-day readmission. These findings highlight the need to better delineate patient populations at greatest risk for these outcomes. This information is critical to identifying treatments that can effectively reduce hospital re-admissions.

INTRODUCTION

- United States Medicare penalizes hospitals when readmission rates among patients with pneumonia exceed benchmarks
- While there is increased effort across healthcare facilities to reduce 30-day readmissions among hospitalized pneumonia patients, patients at greatest risk for readmission or repeat ED visits are not well described in studies
- This study identified hospitalized patients with CABP treated with ceftriaxone with a macrolide or a fluoroquinolone who are at greatest risk for readmission within 30 days of hospital discharge

RESULTS

- The final cohort contained 1,357 hospitalized patients
- Demographic and clinical characteristics of 1,357 hospitalized CABP patients who received ceftriaxone IV with macrolide or a fluoroquinolone IV on hospitalization day 1 or 2 and continued for ≥ 2 days by readmission within 30 days of hospital discharge are shown in **Table 1**
  - The majority of patients were age 65 or older (65.7%), white (97.9%), and current or past smokers (64.3%)
- Of the 1,357 patients, 58 (4.3% of the final cohort) experienced hospital readmission within 30 days of hospital discharge
- Bivariate association between baseline characteristics and occurrence of 30-day readmissions are displayed in **Table 1**
  - Patients with 30-day admissions had greater occurrence of the following:
    - Current or past smoking (77.6% vs 63.7%)
    - CCI ≥ 2 (48.3% vs 44.1%)
    - 12-month pre-index ER visits (32.8% vs 27.7%)
    - 12-month pre-index systemic steroid use (39.7% vs 27.6%)
    - CURB-65 scores ≥ 3 (10.3% vs 7.2%)
- In the final multivariate model (**Table 2**), 2-month pre-index systemic steroid use was significantly associated with increased odds of 30-day readmissions (OR=1.6; 95% CI: 1.1-2.3)
- Populations with 12-month pre-index systemic steroid use had greater prevalence of prior CABP (not including current CABP), asthma, chronic pulmonary diseases, COPD/bronchitis, immunocompromising conditions, cancer, rheumatoid arthritis, Charlson Comorbidity Index Score 2+, 12-month pre-index hospitalizations and 12-month pre-index ER visits of 30-day readmission (**Table 3**)
- Multivariate analysis that excluded prior steroid use did not produce any predictive variables for 30-day readmission

Table 1. Demographic and clinical characteristics of 1,357 hospitalized CABP patients who received ceftriaxone IV with macrolide or a fluoroquinolone IV on hospitalization day 1 or 2 and continued for ≥ 2 days by readmission within 30 days of hospital discharge

	All		Readmission within 30 days of hospital discharge				
			No		Yes		p for
Characteristics	n	%	n	%	n	%	difference
Overall	1,357	100.0	1,299	95.7	58	4.3	
Gender							0.5607
Male	698	51.4	666	51.3	32	55.2	
Female	659	48.6	633	48.7	26	44.8	
Age group							0.8046
18-64	465	34.3	446	34.3	19	32.8	
65+	892	65.7	853	65.7	39	67.2	
Race							
White	1,329	97.9	1,273	98.0	56	96.6	0.4194
Black	21	1.5	20	1.5	1	1.7	
Hispanic/Asian/Others	7	0.5	6	0.5	1	1.7	
Smoking Status							
Never smoking	457	33.7	444	34.2	13	22.4	0.0766
Current smoking + past smoking	873	64.3	828	63.7	45	77.6	
Others/Unknown	27	2.0	27	2.1	0	0	
BMI group							0.2993
BMI ≤ 30	897	66.1	855	65.8	42	72.4	
BMI 31+	460	33.9	444	34.2	16	27.6	
Payer							
Commercial	605	44.6	582	44.8	23	39.7	0.4498
Medicare	646	47.6	614	47.3	32	55.2	
Others/Unknown	106	7.8	103	7.9	3	5.2	

RESULTS

	All		Readmission within 30 days of hospital discharge				
			No		Yes		p for
Characteristics	n	%	n	%	n	%	difference
12 Month Comorbidities							
CABP (not including current CABP)	31	2.3	31	2.4	0	0	0.2340
Asthma	33	2.4	32	2.5	1	1.7	0.7206
Burns	1	0.1	1	0.1	0	0	N/A
Cerebrovascular disease	69	5.1	63	4.8	6	10.3	0.0624
Congestive heart failure	126	9.3	123	9.5	3	5.2	0.2700
Chronic pulmonary diseases	252	18.6	243	18.7	9	15.5	0.5411
COPD/Bronchitis	205	15.1	197	15.2	8	13.8	0.7752
Acute respiratory failure	55	4.1	51	3.9	4	6.9	0.2617
Clostridium difficile	5	0.4	5	0.4	0	0	N/A
Coronary heart disease	293	21.6	280	21.6	13	22.4	0.8764
MI	29	2.1	27	2.1	2	3.4	0.4803
Unstable cardiac disease	220	16.2	213	16.4	7	12.1	0.3815
Other coronary heart disease	148	10.9	137	10.5	11	19.0	0.0442
Dementia	49	3.6	47	3.6	2	3.4	0.9459
Hemiplegia/Paraplegia	11	0.8	11	0.8	0	0	N/A
Immunocompromising conditions	128	9.4	121	9.3	7	12.1	0.4826
Cancer	116	8.5	109	8.4	7	12.1	0.3270
Other immunocompromising conditions	36	2.7	35	2.7	1	1.7	0.6528
Neutropenia, leukocytopenia	17	1.3	17	1.3	0	0	N/A
Liver disease	19	1.4	18	1.4	1	1.7	0.8300
Non-severe liver disease	11	0.8	10	0.8	1	1.7	0.4278
End-stage liver disease (eg, ascites, hepatic encephalopathy)	8	0.6	8	0.6	0	0	N/A
Malnutrition	14	1.0	11	0.8	3	5.2	0.0014
Rheumatoid Arthritis	19	1.4	18	1.4	1	1.7	0.8300
Peptic ulcer disease	8	0.6	8	0.6	0	0	N/A
Peripheral vascular disease	33	2.4	31	2.4	2	3.4	0.6075
Acute renal failure	67	4.9	63	4.8	4	6.9	0.4815
Dialysis	4	0.3	4	0.3	0	0	N/A
Severe renal disease	25	1.8	25	1.9	0	0	N/A
Diabetes	153	11.3	145	11.2	8	13.8	0.5354
Diabetes without complications	113	8.3	109	8.4	4	6.9	0.6869
Diabetes with complications	40	2.9	36	2.8	4	6.9	0.0692
Empyema	2	0.1	1	0.1	1	1.7	0.0014
Bursitis	2	0.1	2	0.2	0	0	N/A
Pancreatitis	8	0.6	8	0.6	0	0	N/A
Pseudotumor cerebri	1	0.1	1	0.1	0	0	N/A
Seizure	28	2.1	26	2.0	2	3.4	0.4483
SLE or lupus-like syndrome	3	0.2	3	0.2	0	0	N/A
Other infections (Bacteremia, UTI, IAI)							
Bacteremia	5	0.4	5	0.4	0	0	N/A
UTI	68	5.0	68	5.2	0	0	N/A
Intra-abdominal Infections	2	0.1	1	0.1	1	1.7	0.0014
Total	73	5.4	72	5.5	1	1.7	0.2073
Charlson Comorbidity Index Scores							0.5321
0-1	756	55.7	726	55.9	30	51.7	
2+	601	44.3	573	44.1	28	48.3	
Pre-Index Hospitalizations							
12-month pre-index hospitalizations	386	28.4	370	28.5	16	27.6	0.8822
6-month pre-index hospitalizations	269	19.8	257	19.8	12	20.7	0.8657
3-month pre-index hospitalizations	188	13.9	180	13.9	8	13.8	0.9890
1-month pre-index hospitalizations	101	7.4	98	7.5	3	5.2	0.5007
Pre-Index ER Visits							
12-month pre-index ER visits	379	27.9	360	27.7	19	32.8	0.4021
6-month pre-index ER visits	269	19.8	255	19.6	14	24.1	0.3995
3-month pre-index ER visits	175	12.9	163	12.5	12	20.7	0.0703
1-month pre-index ER visits	104	7.7	98	7.5	6	10.3	0.4328
12-month pre-index hospital based outpatient visits	304	22.4	292	22.5	12	20.7	0.7492
12-month pre-index antibiotic resistance identified	3	0.2	3	0.2	0	0	N/A
12-month baseline (not including index date) systemic steroid use	381	28.1	358	27.6	23	39.7	0.0449

RESULTS

	All		Readmission within 30 days of hospital discharge				
			No		Yes		p for
Characteristics	n	%	n	%	n	%	difference
Pre-Admission Characteristics							
Prior location, including LTAC, nursing homes	26	1.9	26	2.0	0	0	N/A
Solid organ/bone marrow transplant in past month	2	0.1	2	0.2	0	0	N/A
Surgery without implant in prior month	39	2.9	35	2.7	4	6.9	0.0609
CABP severity grades (CURB-65)							
CURB-65=0-1	926	68.2	885	68.1	41	70.7	0.4696
CURB-65=2	331	24.4	320	24.6	11	19.0	
CURB-65=3-4	100	7.4	94	7.2	6	10.3	
Admission Source							
Admit from ED	1,219	89.8	1,165	89.7	54	93.1	0.6052
Routine Admission	13	1.0	13	1.0	0	0	
Others	125	9.2	121	9.3	4	6.9	
Oral Antibiotics Within 30 Days Prior to Index							0.1899
Quinolones	56	4.1	53	4.1	3	5.2	0.6824
Cephalosporines	20	1.5	19	1.5	1	1.7	0.8716
Macrolides	2	0.1	2	0.2	0	0	N/A
Bactrim	21	1.5	19	1.5	2	3.4	0.2307
Ceftriaxone switch to Vancomycin during inpatient stay	25	1.8	25	1.9	0	0	N/A
LOS ≥ 8 days	327	24.1	308	23.7	19	32.8	0.1149

Table 2. Factors, associated with readmission within 30 days of hospital discharge in the final model for the cohort of 1,357 hospitalized CABP patients who received ceftriaxone IV with macrolide or a fluoroquinolone IV on hospitalization day 1 or 2 and continued for ≥ 2 days*

Characteristics	Odds Ratio	95% Wald Confidence Limits	p values
12-month baseline (not including index date) systemic steroid use	1.56	1.08-2.26	0.0182

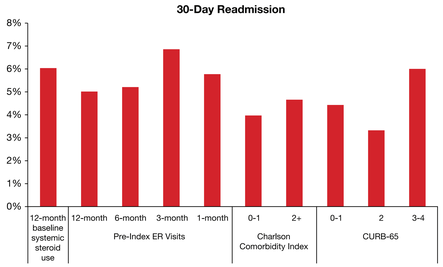
*Variables in Table 1 were considered for inclusion into the full multivariate model if they were present in ≥5% of the sample and subject matter knowledge. Factors remained in the final multivariate model by stepwise variable selection method, p for entry = 0.2, and p for stay = 0.05.

Table 3. Selected clinical characteristics of 1,357 hospitalized CABP patients who received ceftriaxone IV with macrolide or a fluoroquinolone IV on hospitalization day 1 or 2 and continued for ≥ 2 days by 12-month pre-index systemic steroid use

	All		12-month pre-index systemic steroid use			
			No		Yes	
Characteristics	n	%	n	%	n	%
Overall	1,357	100.0	976	100.0	381	100.0
CABP (not including current CABP)	31	2.3	14	1.4	17	4.5
Asthma	33	2.4	19	1.9	14	3.7
Chronic pulmonary diseases	252	18.6	135	13.8	117	30.7
COPD/Bronchitis	205	15.1	109	11.2	96	25.2
Immunocompromising conditions	128	9.4	52	5.3	76	19.9
Cancer	116	8.5	50	5.1	66	17.3
Rheumatoid Arthritis	19	1.4	8	0.8	11	2.9
Charlson Comorbidity Index Score 2+	601	44.3	372	38.1	229	60.1
12-month pre-index hospitalizations	386	28.4	184	18.9	202	53.0
12-month pre-index ER visits	379	27.9	216	22.1	163	42.8

RESULTS

Figure 1. Clinical characteristics of 58 hospitalized CABP patients who received ceftriaxone IV with macrolide or a fluoroquinolone IV on hospitalization day 1 or 2 and continued for ≥ 2 days and were readmitted within 30 days of hospital discharge vs total 1,357 patients (%)



CONCLUSIONS

- Patient populations with CABP are often considered to be an increased risk for adverse outcomes, though only one covariate was found to be significantly predictive of an increased risk for 30-day readmission
  - Patient populations with 12-month pre-index systemic steroid use were found to be at elevated risk for readmission within 30 days of hospital discharge
- Populations with 12-month pre-index systemic steroid use had greater prevalence than those without pre-index systemic steroid use of prior CABP, asthma, chronic pulmonary diseases, COPD/bronchitis, immunocompromising conditions, cancer, rheumatoid arthritis, Charlson Comorbidity Index Score 2+, 12-month pre-index hospitalizations and 12-month pre-index ER visits
- Multivariate analysis that excluded prior steroid use did not produce any predictive variables for 30-day readmission
- These findings highlight the need to better delineate patient populations at greatest risk for these outcomes
- This information is critical to identifying treatments that can effectively reduce hospital readmissions

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