Characteristics of Hospitalized Patients With Community-Acquired Bacterial Pneumonia (CABP) at Greatest Risk for Prolonged Hospital Length of Stay in an Integrated Delivery Network

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INTRODUCTION

Hospitalization of patients with CABP places a major burden on the US healthcare system. While there are increasing efforts to reduce hospital length of stay (LOS), limited data exist on CABP populations at increased risk for prolonged LOS.

METHODS

A retrospective study of hospitalized patients with CABP in the Geisinger IDN medical encounter 2010-2015 database was performed. Inclusion criteria: (1) age ≥ 18 years, (2) primary diagnosis for CABP, (3) ≥ 1-year enrollment before index CABP hospitalization, (4) received ceftriaxone IV with macrolide or a fluoroquinolone on hospitalization day 1 or 2 and continued for ≥ 2 days. Patient severity was assessed using the CURB-65 scale, a composite measurement of patient confusion and breath rate. Also used was the Charlson Comorbidity Index (CCI), a scale based on the presence of comorbid conditions such as heart disease, AIDS, or cancer (a total of 22 conditions), which predicts the one-year mortality for a patient. The primary outcome was LOS ≥ 8 days. Stepwise logistic regression was used to develop a multivariate model to identify patient characteristics independently associated with prolonged LOS (defined as LOS ≥ 8 days). Statistical significance for stepwise variable entry into the multivariate model was $P<0.1$ and $P>0.05$ to be kept in the model.

RESULTS

Table 1. Demographic and clinical characteristics of 1,357 hospitalized CABP patients (mean age, 72) who received ceftriaxone IV with macrolide or a fluoroquinolone IV on hospitalization day 1 or 2 and continued for ≥ 2 days (groups with less than 4 cases were not included in this table)

Characteristics	All		LOS < 8 Days		LOS ≥ 8 days		*P* for difference
	n	%	n	%	n	%	
Overall	1,357	100	1,030	100	327	100	
Gender							0.5091
Male	698	51.4	535	51.9	163	49.8	
Female	659	48.6	495	48.1	164	50.2	
Age Group							0.3456
18-64	465	34.3	360	35	105	32.1	
65+	892	65.7	670	65	222	67.9	
Race							0.2294
White	1,329	97.9	1,011	98.2	318	97.2	
Black	21	1.5	15	1.5	6	1.8	
Hispanic/ Asian/ Others	7	0.5	4	0.4	3	0.9	
Smoking status							0.4813
Never smoking	457	33.7	351	34.1	106	32.4	
Current smoking + past smoking	873	64.3	660	64.1	213	65.1	
Others/Unknown	27	2.0	19	1.8	8	2.4	
BMI categories							0.0849
BMI ≤ 30	897	66.1	668	64.9	229	70	
BMI > 30	460	33.9	362	35.1	98	30	
12-month baseline comorbidity							
CABP (not including current CABP)	31	2.3	21	2	10	3.1	0.2825
Asthma	33	2.4	27	2.6	6	1.8	0.4212
Cancer	116	8.5	93	9	23	7	0.2608
Cerebrovascular disease	69	5.1	54	5.2	15	4.6	0.6383
Congestive heart failure	126	9.3	94	9.1	32	9.8	0.7203
Chronic pulmonary disease	252	18.6	187	18.2	65	19.9	0.4853
COPD/ bronchitis	205	15.1	153	14.9	52	15.9	0.6448
Other chronic pulmonary disease	70	5.2	50	4.9	20	6.1	0.3688
Coronary heart disease	293	21.6	217	21.1	76	23.2	0.4053
MI	29	2.1	18	1.7	11	3.4	0.0783
Dementia	49	3.6	41	4	8	2.4	0.1952
Hemiplegia/Paraplegia	11	0.8	5	0.5	6	1.8	0.0177
Immunocompromising conditions	128	9.4	103	10	25	7.6	0.2044
Other immunocompromising conditions	36	2.7	27	2.6	9	2.8	0.8979
Neutropenia, leukocytopenia	17	1.3	9	0.9	8	2.4	0.0259
Liver disease	19	1.4	13	1.3	6	1.8	0.4425
Non-severe liver disease	11	0.8	9	0.9	2	0.6	0.6451
End-stage liver disease (e.g. ascites, hepatic encephalopathy)	8	0.6	4	0.4	4	1.2	0.0858
Malnutrition	14	1	8	0.8	6	1.8	0.0990
Rheumatoid Arthritis	19	1.4	15	1.5	4	1.2	0.7547
Peptic ulcer disease	8	0.6	8	0.8	0	0	
Peripheral vascular disease	33	2.4	24	2.3	9	2.8	0.6659
Dialysis	4	0.3	1	0.1	3	0.9	0.0171
Diabetes	153	11.3	120	11.7	33	10.1	0.4375
With chronic complications	40	2.9	30	2.9	10	3.1	0.8922
Without chronic complications	113	8.3	90	8.7	23	7	0.3312
Empyema	2	0.1	1	0.1	1	0.3	0.3913
Pancreatitis	8	0.6	5	0.5	3	0.9	0.3740
Pseudotumor cerebri	1	0.1	1	0.1	0	0	
Seizure	28	2.1	19	1.8	9	2.8	0.3145
SLE or lupus-like syndrome	3	0.2	3	0.3	0	0	
Other infections noted during admission (including Bacteremia, UTI, IAI)	73	5.4	57	5.5	17	5.2	0.8923
Bacteremia	5	0.4	3	0.3	2	0.6	0.4048
UTI	68	5	54	5.2	14	4.3	0.4875
12-month baseline Charlson Comorbidity Index (CCI) Score							0.5937
CCI ≤ 1	756	55.7	578	56.1	178	54.4	
CCI ≥ 2	601	44.3	452	43.9	149	45.6	
Pre-index hospitalizations							
12-month pre-index hospitalizations	386	28.4	284	27.6	102	31.2	0.2062
6-month pre-index hospitalizations	269	19.8	191	18.5	78	23.9	0.0359
3-month pre-index hospitalizations	188	13.9	130	12.6	58	17.7	0.0197
1-month pre-index hospitalizations	101	7.4	71	6.9	30	9.2	0.1709
Pre-index ER visits							
12-month pre-index ER visits	379	27.9	288	28	91	27.8	0.9629
6-month pre-index ER visits	269	19.8	201	19.5	68	20.8	0.6128
3-month pre-index ER visits	175	12.9	128	12.4	47	14.4	0.3604
1-month pre-index ER visits	104	7.7	72	7	32	9.8	0.0978
12-month pre-index hospital based outpatient visits	304	22.4	227	22	77	23.5	0.5687
12-month baseline (not including index date) systemic steroid use	381	28.1	293	28.4	88	26.9	0.5904
Index culture drawn in ER	996	73.4	741	71.9	255	78	0.0313
Pre-admission characteristics							
Prior location, including LTAC, nursing homes	26	1.9	15	1.5	11	3.4	0.0284
Surgery without implant in prior month	39	2.9	31	3	8	2.4	0.5954
Surgery involving implant in prior 6 months	0	0	0	0	0	0	
CABP severity grades (CURB-65)							0.1242
Grade 0-1	926	68.2	705	68.4	221	67.6	
Grade 2	331	24.4	262	25.4	69	21.1	
Grade ≥ 3	100	7.4	63	6.1	37	11.3	
Oral antibiotics within 30 days prior to index admissions							
Cephalosporins	20	1.5	17	1.7	3	0.9	0.3379
Quinolones	56	4.1	41	4	15	4.6	0.6309
Tmp-Smz (Co-Trimoxazole/Bactrim)	21	1.5	15	1.5	6	1.8	0.6290
Macrolides	2	0.1	2	0.2	0	0	
Clindamycin	6	0.4	5	0.5	1	0.3	0.6697
Levofloxacin	39	2.9	29	2.8	10	3.1	0.8191
Cephalexin	16	1.2	14	1.4	2	0.6	0.2752
Ciprofloxacin	17	1.3	12	1.2	5	1.5	0.6061

RESULTS

Table 2. Factors, including CCI and CURB-65, associated with the prolonged length of hospital stay ≥ 8 days 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
3-month pre-index hospitalizations (Yes vs No)	1.53	1.08	2.16	0.0155
CABP severity grades (CURB-65)				
CURB-65=0-1 (reference)	1.00			
CURB-65=2	0.89	0.65	1.22	0.4653
CURB-65 ≥3	1.99	1.29	3.08	0.0020

*Variables in Table 1 were considered for inclusion into the full multivariate model if they were present in ≥5% of the sample. 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. Factors, including CCI and CURB-65 components, associated with the prolonged length of hospital stay ≥ 8 days 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
3-month pre-index hospitalizations (Yes vs No)	1.60	1.13	2.25	0.0073
CURB-65 Components				
Breath rate > 30/min (Yes vs. No)	1.84	1.20	2.81	0.0052
Confusion (Yes vs. No)	1.69	1.11	2.56	0.0140

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

Figure 1. Odds ratios and 95% CIs for factors associated with the prolonged length of hospital stay ≥ 8 days in the multivariate model using CCI and CURB-65 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

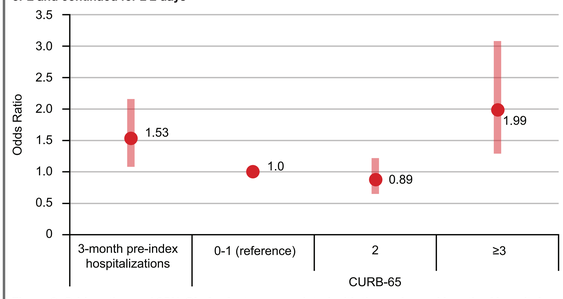


Figure 2. Odds ratios and 95% CIs for factors associated with the prolonged length of hospital stay ≥ 8 days in the multivariate model using CCI and CURB-65 components for the cohort of 1,357 hospitalized CABP patients who received ceftriaxone IV with macrolide or a fluoroquinolone IV on hospitalization day 1 or 2 and continued for ≥ 2 days

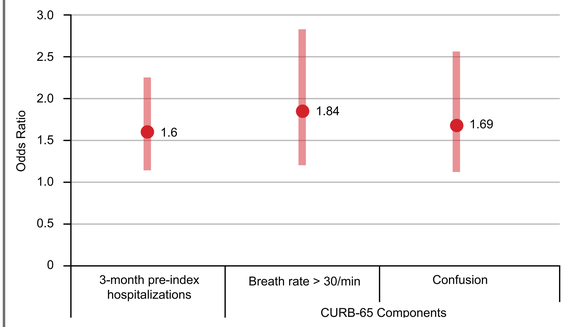


Figure 3. Distributions of demographic and clinical characteristics of 1,357 hospitalized CABP patients who received ceftriaxone IV with macrolide or a fluoroquinolone IV on hospitalization day 1 or 2 and continued for ≥ 2 days by lengths of hospital stays

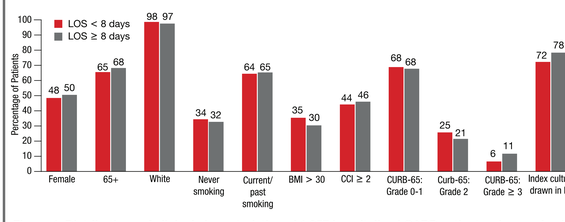
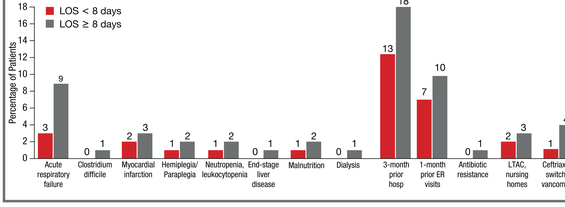


Figure 4. Distributions of clinical characteristics of 1,357 hospitalized CABP patients who received ceftriaxone IV with macrolide or a fluoroquinolone IV on hospitalization day 1 or 2 and continued for ≥ 2 days by lengths of hospital stays



CONCLUSIONS

- During the study period, 1,357 patients met study criteria. The mean age was 72 years. The geometric mean (SD) and median LOS were 5.4 (1.7) and 6.3 days, respectively
- Overall, 327 of the 1,357 (24.1%) CABP patients who received ceftriaxone IV with macrolide, or fluoroquinolone IV on hospitalization day 1 or 2 and continued for ≥ 2 days had a prolonged hospital length of stay ≥ 8 days
- Patients with a CURB-65 score ≥ 3 had a higher risk of prolonged LOS ≥ 8 days vs. those with CURB-65 score ≤ 1 (37% vs. 23.9%)
- Although patients with dialysis and neutropenia/leukocytopenia in the study were limited to 4 and 17, respectively, prolonged LOS ≥ 8 days was significantly higher for patients with vs without dialysis (75% vs. 23.9%), and neutropenia/ leukocytopenia (47.1% vs. 23.8%)
- The bivariate analyses indicated prolonged length of stay was significantly associated with coronary heart disease, hemiplegia/paraplegia, neutropenia/leukocytopenia, dialysis, 6 month pre-index hospitalizations, 3 month pre-index hospitalizations, having an index culture drawn in ER, and location prior to hospitalization
- **The results of the multivariate model with CCI and CURB-65 indicated that 3-month pre-index hospitalizations, and CURB-65 severity (3+ vs 0-1) significantly increased the odds of prolonged length of stay**
- **The results of the multivariate model with CCI and CURB-65 components indicated that 3-month pre-index hospitalizations, breath rate of greater than 30 times per minute, and confusion all significantly increased the odds of prolonged length of stay**

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