Impact of Demographics and Social Determinants of Health on Hospitalization Costs in US Adults with Respiratory Syncytial Virus

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BACKGROUND

- Respiratory Syncytial Virus (RSV) is a common cause of acute respiratory illness and can be severe in infants, young children, older adults, and individuals with select underlying comorbidities.[1]
- In 2023, two RSV vaccines have been authorized and recommended by the US Advisory Committee for adults ≥60 years old.[2]
- Identifying risk factors for severe RSV outcomes has historically centered around age and certain underlying medical conditions; less attention has been focused on the role of social determinants of health (SDOH) for RSV outcomes and impact on costs.[2]

OBJECTIVES

- To describe the impact of demographics and SDOH on hospitalization costs and length of stay among insured US adults hospitalized with RSV.

METHODS

Study Design

- A retrospective cohort study utilizing de-identified patient-level administrative claims from Inovalon's Closed Claims (ICC), a warehouse of claims data sourced from 140+ Commercial, Medicare Advantage, and Managed Medicaid health plans operating in all 50 states in the US.
- Enhanced with Inovalon's Social Drivers of Health Data Warehouse with SDOH information, aggregated data from public and proprietary commercial data sources.
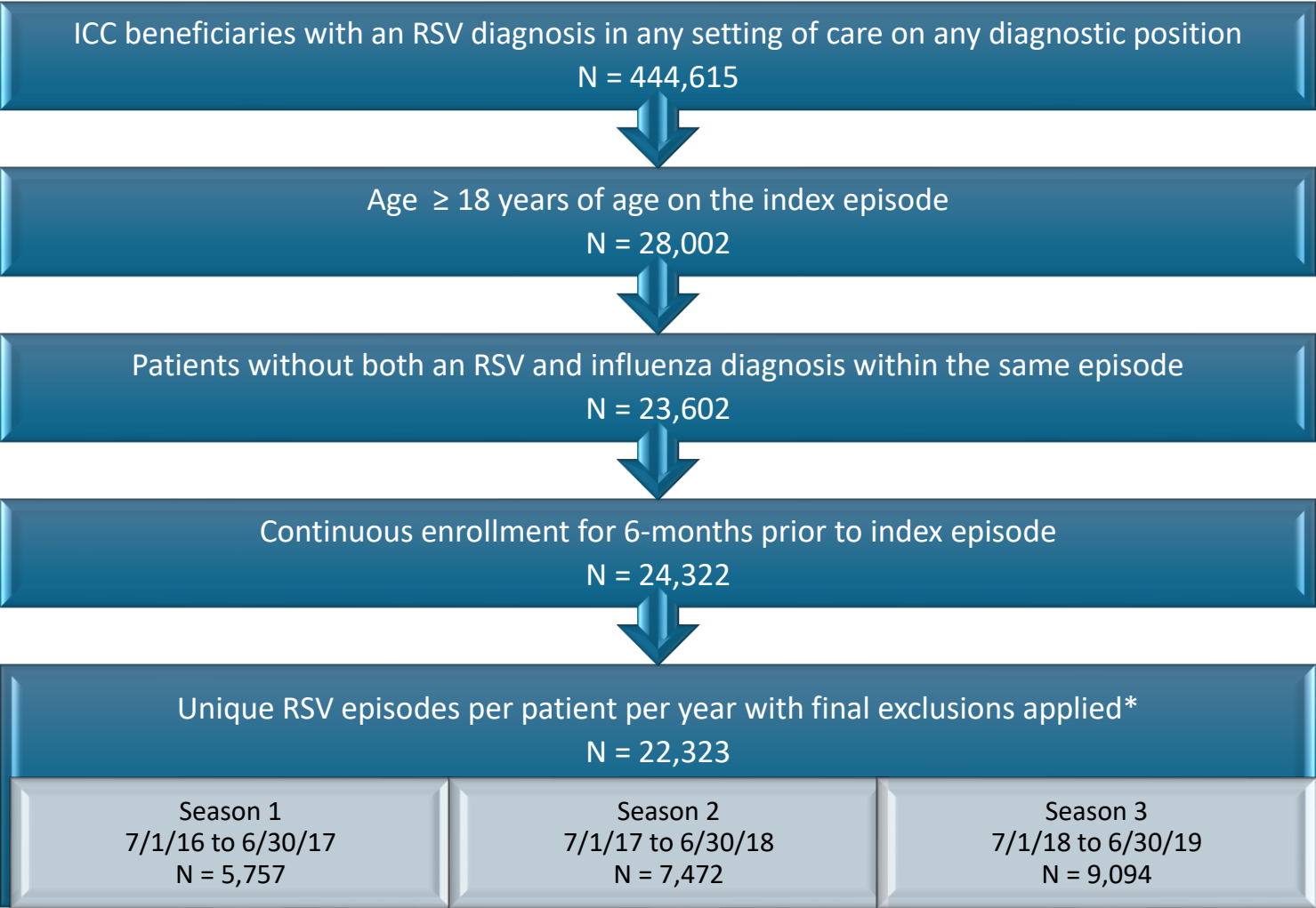
Study Variables

- Patient demographics, clinical characteristics, and SDOH were measured at baseline.
  - Demographics: age, sex, payer type, race/ethnicity, census region
  - Clinical: Charlson Comorbidity Index (CCI)
  - SDOH variables: median income, education level, rurality, primary care shortage area, household size, education attainment, English proficiency

Analysis

- Evaluated the first RSV episode per patient each season based on inpatient or outpatient claim with RSV in any diagnostic position, spanning three seasons from July 1, 2016 to June 30, 2019.
  - RSV episodes are defined from the index diagnosis to the final claim, with at least 90-day gap.
- Data summarized by descriptive statistics including means, medians, standard deviations (SD), frequencies and percentages.
- Analysis of variance (ANOVA) evaluated group differences, with a significance level at p < 0.05.
- Mapped patients to SDOH data using their corresponding 9-digit ZIP code via a secure process based on their street address from payer enrollment records and de-identified.
- Inpatient costs were standardized to Medicare rates and adjusted to 2022 values.

Figure 1: Patient Attrition and Selection

ICC beneficiaries with an RSV diagnosis in any setting of care on any diagnostic position
N = 444,615

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Age ≥ 18 years of age on the index episode
N = 28,002

↓

Patients without both an RSV and influenza diagnosis within the same episode
N = 23,602

↓

Continuous enrollment for 6-months prior to index episode
N = 24,322

↓

Unique RSV episodes per patient per year with final exclusions applied*
N = 22,323

Season 1 7/1/16 to 6/30/17 N = 5,757	Season 2 7/1/17 to 6/30/18 N = 7,472	Season 3 7/1/18 to 6/30/19 N = 9,094

*Excluded episodes that: 1. Missing SDOH information; 2. Have a length of stay > 0 days but report $0.00 in costs; 3. Have a total cost less than $1.00.

RESULTS

Table 1: Baseline Characteristics

Baseline Characteristics	Year 1 N = 5,757	Year 2 N = 7,472	Year 3 N = 9,094
Age at index date, Mean (SD)	48.2 (17.0)	49.1 (17.8)	48.6 (17.3)
Sex, n (%)			
Male	2,163 (37.6)	2,785 (37.3)	3,290 (36.2)
Female	3,594 (62.4)	4,687 (62.7)	5,804 (63.8)
Race/Ethnicity, n (%)			
Asian	155 (2.7)	205 (2.7)	161 (1.8)
Black	621 (10.8)	960 (12.8)	1,023 (11.2)
Hispanic	410 (7.1)	624 (8.4)	674 (7.4)
White	1,644 (28.6)	2,355 (31.5)	2,659 (29.2)
Unknown/Other	2,927 (50.8)	3,328 (44.5)	4,577 (50.3)
Payer, n (%)			
Commercial	3,519 (61.1)	3,984 (53.3)	5,330 (58.6)
Managed Medicaid	1,249 (21.7)	2,037 (27.3)	2,172 (23.9)
Medicare Advantage	989 (17.2)	1,451 (19.4)	1,592 (17.5)
Census Region, n (%)			
Northeast	1,988 (34.7)	2,429 (32.5)	2,326 (25.6)
Midwest	1,167 (20.3)	1,605 (21.5)	1,870 (20.6)
South	1,468 (25.5)	2,038 (27.3)	3,067 (33.7)
West	1,124 (19.5)	1,400 (18.7)	1,831 (20.1)
Charlson Comorbidity Index (CCI) score, Mean (SD)	1.9 (2.8)	2.2 (2.9)	2.0 (2.9)

Table 2: SDOH Factors

SDOH Variables	Year 1 N = 5,757	Year 2 N = 7,472	Year 3 N = 9,094
Annual Household Income (USD), Mean (SD)	66,443 (33,319)	62,941 (33,343)	64,147 (33,820)
Rurality, n (%)			
Urban	4,732 (82.2)	6,166 (82.5)	7,321 (80.5)
Suburban	482 (8.4)	633 (8.5)	838 (9.2)
Large Rural Town	296 (5.1)	358 (4.8)	507 (5.6)
Small Town/Isolated Rural	247 (4.3)	315 (4.2)	428 (4.7)
Primary Care Shortage Area, n (%)			
No Shortage	298 (5.2)	442 (5.9)	570 (6.3)
Full Shortage	174 (3.0)	231 (3.1)	382 (4.2)
Partial Shortage	5,285 (91.8)	6,799 (91.0)	8,142 (89.5)
2+ Household Size, n (%)	4,681 (81.3)	5,848 (78.3)	7,157 (78.7)
More College Education Attainment, n (%)	2,879 (50.0)	3,807 (51.0)	4,718 (51.9)
Higher English Proficiency, n (%)	3,047 (52.9)	3,755 (50.3)	4,961 (54.6)

Table 3. Inpatient Costs by Demographics and SDOH Factors

Independent Variable	Year 1 N = 602 Mean RSV-Related Inpatient Cost per Episode	p-value[1]	Year 2 N = 1,184 Mean RSV-Related Inpatient Cost per Episode	p-value[1]	Year 3 N = 1,246 Mean RSV-Related Inpatient Cost per Episode	p-value[1]
Age Category[†]		0.2071		0.3679		0.7999
18-59	$11,927.61		$12,138.90		$11,302.86	
60+	$11,044.03		$11,683.24		$11,416.15	
Gender[†]		0.2798		0.3324		0.0455*
Female	$11,236.24		$11,724.88		$11,027.02	
Male	$12,019.59		$12,233.88		$11,955.69	
Race/Ethnicity[†,¶]		0.9842		0.7973		0.4321
Asian	$12,793.73		$13,934.19		$14,039.60	
Black	$11,308.82		$12,307.99		$11,722.51	
Hispanic	$11,542.60		$12,101.40		$11,623.23	
Other	$10,744.25		$12,102.38		$10,829.26	
Unknown	$11,807.29		$11,651.90		$11,372.28	
White	$11,444.83		$11,735.94		$11,057.36	
Region[†,¶]		0.8424		0.0051*		0.0885
Midwest	$11,514.60		$12,228.64		$11,231.90	
Northeast	$11,224.20		$10,595.45		$10,961.63	
South	$11,247.20		$12,130.74		$12,346.21	
West	$12,014.82		$13,057.39		$10,893.99	
Rurality[†,¶]		0.2967		0.0130*		0.9272
Urban	$11,236.31		$11,818.73		$11,317.55	
Suburban	$13,446.19		$10,496.33		$11,762.57	
Large Rural Town	$12,478.09		$14,360.71		$11,576.74	
Small Town/Isolated Rural	$12,632.42		$14,948.28		$11,056.41	
Primary Care Shortage Area[†]		0.5830		0.2431		0.3692
No Shortage	$11,462.73		$10,517.63		$12,186.20	
Full Shortage	$13,873.13		$13,399.15		$12,730.08	
Partial Shortage	$11,466.82		$11,989.65		$11,270.57	
Household Size[§]		0.9798		0.0226*		0.3453
Less than 2	$11,540.33		$10,908.76		$11,724.51	
2 or More	$11,518.12		$12,242.68		$11,239.90	
Education Attainment[§]		0.0542		0.5966		0.4225
More College Educated	$10,757.87		$11,769.83		$11,155.72	
Less College Educated	$12,111.74		$12,038.12		$11,517.44	
Median Income[§]		0.2395		0.6266		0.5576
< $30,000	$10,936.77		$11,871.86		$11,141.13	
$30,000 - $39,999	$12,720.82		$11,011.02		$11,168.58	
$40,000 - $49,999	$10,414.87		$12,376.34		$12,012.73	
$50,000 - $74,999	$12,460.32		$11,852.92		$11,812.29	
$75,000+	$11,132.68		$12,253.95		$10,975.16	
English Proficiency[§]		0.6970		0.1163		0.0257*
Higher	$11,391.86		$11,525.49		$10,905.64	
Lower	$11,664.02		$12,320.25		$11,904.13	
Total	$11,522.51		$11,911.46		$11,362.41	

*<0.05; [1]P-value assessed via ANOVA; [†]Assessed at the patient level; [§]Assessed at the neighborhood level; [¶]Overall counts impacted where information is unknown/unreported

Table 4: Length of Stay by Demographics and SDOH Factors

Independent Variable	Year 1 N = 602 Mean RSV-Related Length of Stay per Episode	p-value[1]	Year 2 N = 1,184 Mean RSV-Related Length of Stay per Episode	p-value[1]	Year 3 N = 1,246 Mean RSV-Related Length of Stay per Episode	p-value[1]
Age Category[†]		0.0316*		0.3254		0.4639
18-59	7.2		8.5		8.0	
60+	8.4		8.1		8.4	
Gender[†]		0.6259		0.2757		0.0963
Female	7.6		8.1		7.9	
Male	7.9		8.6		8.7	
Race/Ethnicity[†,¶]		0.0938		0.0344*		0.0060*
Asian	6.4		9.0		12.1	
Black	8.1		8.0		8.2	
Hispanic	5.8		10.1		9.2	
Other	8.2		6.5		8.7	
Unknown	7.6		7.6		7.1	
White	8.3		8.3		8.3	
Region[†,¶]		0.0138*		0.0171*		0.0014*
Midwest	7.9		8.0		7.3	
Northeast	8.5		7.4		8.5	
South	8.5		8.9		9.4	
West	6.3		9.3		7.5	
Rurality[†,¶]		0.1695		0.0510		0.1127
Urban	7.6		8.3		8.4	
Suburban	7.6		7.0		7.8	
Large Rural Town	7.4		8.0		6.4	
Small Town/Isolated Rural	10.7		11.4		7.1	
Primary Care Shortage Area[†]		0.2393		0.4703		0.5187
No Shortage	8.4		7.3		8.2	
Full Shortage	10.5		7.7		9.6	
Partial Shortage	7.6		8.4		8.2	
Household Size[§]		0.9900		0.5576		0.6832
Less than 2	7.7		8.1		8.4	
2 or More	7.7		8.4		8.2	
Education Attainment[§]		0.0810		0.8355		0.6579
More College Educated	7.2		8.2		8.3	
Less College Educated	8.2		8.3		8.1	
Median Income[§]		0.0146*		0.8941		0.8597
< $30,000	6.8		8.7		8.1	
$30,000 - $39,999	9.3		7.9		8.3	
$40,000 - $49,999	8.1		8.2		8.7	
$50,000 - $74,999	8.6		8.3		8.3	
$75,000+	6.9		8.2		7.9	
English Proficiency[§]		0.3286		0.0078*		0.0039*
Higher	8.0		7.7		7.7	
Lower	7.5		8.9		8.9	
Total	7.7		8.3		8.3	

*<0.05; [1]P-value assessed via ANOVA; [†]Assessed at the patient level; [§]Assessed at the neighborhood level; [¶]Overall counts impacted where information is unknown/unreported

CONCLUSIONS

- Adults hospitalized with RSV on average experience 7-8 days stay, incurring high episode costs.
- Sub-populations, particularly males, individuals with lower English proficiency or those living in areas with primary care shortages, face higher inpatient costs and longer hospital stays, indicating potential disparities in healthcare access and navigation.
- Unadjusted results reveal both demographic and SDOH factors significantly influences RSV hospitalization costs and lengths of stay, highlighting the need for focused interventions.

LIMITATIONS

- Administrative claims data are subject to data coding and documentation limitations, there is potential for misclassification of disease status and study outcomes
- This study was limited to patients with Commercial insurance; results may not be generalizable to uninsured patients or those with other insurance types.
- This was a descriptive study and did not adjust for confounding effects. No statistical comparisons were made

DISCLOSURES

REFERENCES

1. Ludlow M. Respiratory syncytial virus infection in the modern era. Curr Opin Infect Dis. 2023;36(3):155-163. doi:10.1097/QCO.0000000000000917
2. Melgar M, Britton A, Roper LE, et al. Use of Respiratory Syncytial Virus Vaccines in Older Adults: Recommendations of the Advisory Committee on Immunization Practices - United States, 2023. MMWR Morb Mortal Wkly Rep. 2023;72(29):793-801. Published 2023 Jul 21. doi:10.15585/mmwr.mm7229a4

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