EE555

Economic Burden of Cardiorespiratory Hospitalizations Associated With RSV Among US Adults, 2017-2019

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BACKGROUND

- The association of respiratory syncytial virus (RSV) infection with cardiorespiratory events in older adults has been previously documented[1,2]
- However, due to lack of routine testing for RSV and limitations of current diagnostic modalities[3], the true burden associated with RSV is under-recognized, especially as it relates to infection-associated sequelae such as cardiorespiratory events[4]

OBJECTIVE

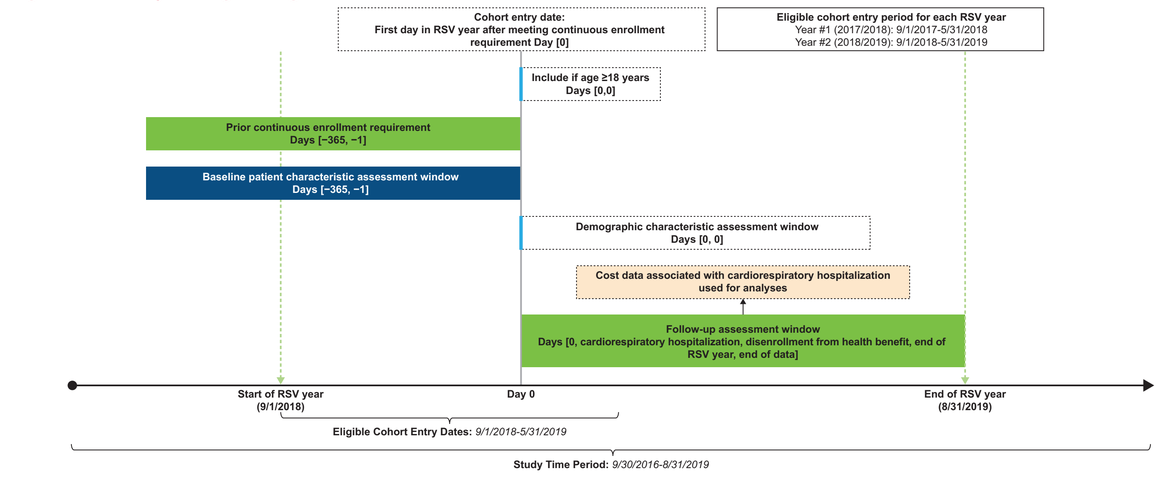
- This study estimated the clinical and economic burden of RSV-associated cardiorespiratory hospitalizations among adults in the US

METHODS

Study Design

- We conducted a retrospective observational cohort study of cardiorespiratory hospitalizations associated with RSV among US adults in 2017-2018 and 2018-2019 (September-August for both years) **(Figure 1)**
  - Individuals aged ≥18 years who were continuously enrolled in insurance benefits in Merative MarketScan claims[5], entered the cohort in September-May of the study year, and were followed until their first cardiorespiratory hospitalization or a censoring event (disenrollment from health benefit, end of RSV year [the RSV year was defined as 9/1/2017-8/31/2018 and 9/1/2018-8/31/2019], or end of data)
  - Patient characteristics were assessed in baseline periods of 242 and 365 days for the 2017-2018 and 2018-2019 RSV study periods, respectively
  - For individuals in the 2017-2018 study cohort, 242 days of enrollment were required prior to the cohort entry date due to the database date range available at the time of this analysis
- Cardiorespiratory hospitalization data from MarketScan claims were combined with laboratory test positivity percentages from the Centers for Disease Control and Prevention's (CDC) National Respiratory and Enteric Virus Surveillance System (NREVSS)[5] to estimate RSV-associated cardiorespiratory hospitalizations **(Table 1)**

Figure 1. Study Design Diagram[a]



RSV, respiratory syncytial virus.
[a]Diagram is an example for the 2018-2019 RSV study period; the same overall design was applied for 2017-2018 year.

Data Sources

Table 1. Data Sources and Measurement of Study Outcomes

Data Source	Description of Database	Purpose
• Closed claims from the following Merative MarketScan claims databases[5]: – CCAE – MDCR – Multi-state Medicaid database	• The annual medical MarketScan databases include private-sector health data from approximately 350 payers, including commercial insurers (e.g., Aetna, Metropolitan Insurance Services, Prudential, and Blue Cross Blue Shield), and third-party administrators. The databases also include data from government and public organizations. – CCAE database includes commercially insured individuals – MDCR database includes individuals enrolled in a Medicare Supplemental plan, representing 20.5% of Medicare-eligible US adults[7] – Multi-state Medicaid database includes individuals enrolled in fee-for-service and/or managed care Medicaid programs in several geographically dispersed states	• To identify weekly person-time at risk for cardiorespiratory hospitalizations, as a parameter in negative binomial regression model • To quantify counts of ICD-10-coded RSV hospitalizations • To quantify mean total costs for cardiorespiratory hospitalizations, to be applied for estimating total RSV-associated cardiorespiratory hospitalization costs • To estimate total ICD-10-coded RSV hospitalization costs
RSV laboratory surveillance data from the CDC's NREVSS[6]	• NREVSS database contains weekly laboratory specimen data from participating US clinical and public health (state and county level) laboratories	• To quantify weekly RSV laboratory test positivity percentages, as a parameter in the negative binomial regression model

Note: Cardiorespiratory hospitalizations were defined using ICD-10 diagnosis codes A37.91, B34x, B97.4, I20x-I22x, I27x, I47x-I50x, J00x-J06x, J09x-J16x, J18x, J20.0-J20.9, J21.0-J22x, J30x-J39x, J41x-J45x, J47x, J80x-J82x, J84x, J96x, J99x, P27x, Q33.4, R05x, R06x, R50x. ICD-10-coded RSV hospitalizations were defined using ICD-10-CM diagnosis codes B97.4, J12.1, J20.5, J21.0. The letter "x" after a code indicates that all subcodes were included.
CCAE, Commercial Claims and Encounters; ICD-10, International Classification of Diseases and Related Disorders, 10th revision; MDCR, Medicare Supplemental and Coordination of Benefits; RSV, respiratory syncytial virus.

Study Periods (analyzed separately) and Study Population

- Data were collected and analyzed in individuals aged ≥18 years who were continuously enrolled in insurance benefits and identified in MarketScan claims between September 1, 2017, and May 31, 2018, for the 2017-2018 RSV study period and between September 1, 2018, and May 31, 2019, for the 2018-2019 RSV study period

Assessment of Clinical Burden of RSV Infection

- Negative binomial regression models were fit for each study year, with the following terms[4]: weekly person-time at risk for cardiorespiratory hospitalizations identified in MarketScan, defined using ICD-10* diagnosis codes; time and periodicity trends; weekly RSV laboratory test positivity percentages from the CDC's NREVSS
- The difference in estimates between excess risk models fit in the presence and absence of RSV represented the number of cardiorespiratory hospitalizations associated with RSV in a given year
- The numbers of ICD-10–coded RSV hospitalizations, based on a diagnosis code in any position, were separately quantified for each study year from MarketScan claims
- The percentages of RSV-associated cardiorespiratory hospitalizations and ICD-10–coded RSV hospitalizations, out of MarketScan-identified cardiorespiratory hospitalizations were quantified

*ICD -10, International Classification of Diseases and Related Disorders, 10th revision.

Assessment of Economic Burden of RSV Infection

- To estimate annual RSV-associated cardiorespiratory hospitalization costs, the number of RSV-associated cardiorespiratory hospitalizations was multiplied by the mean total cost of cardiorespiratory hospitalizations identified in MarketScan; the annual cost of ICD-10–coded RSV hospitalizations was directly summed from MarketScan claims
- Costs were adjusted for 2022 inflation using the Consumer Price Index and reported in $USD[8]

RESULTS

Patient Characteristics

- Approximately 24.4 and 21.4 million adults (mean age, 43.9 years) were assessed in 2017-2018 and 2018-2019, respectively (**Table 2**)

Table 2. Overall Patient Characteristics

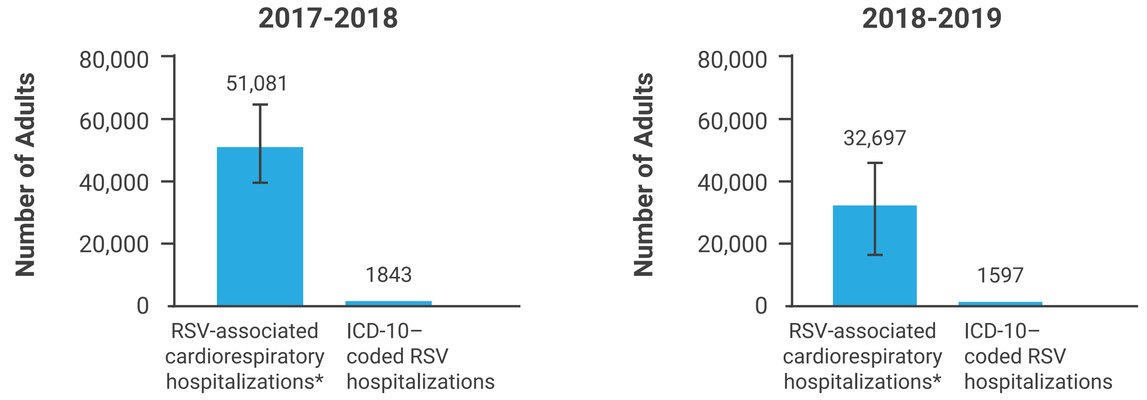
Patient characteristics	2017-2018 N = 24,362,080	2018-2019 N = 21,359,058
Age, mean (SD), years	43.9 (16.5)	43.9 (16.1)
Age <60 years, %	81.4	81.9
Age ≥60 years, %	18.5	18.1
Female, %	55.5	54.9
Commercial payer type, %	70.5	72.7
Medicare supplemental payer type, %	5.5	4.4
Medicaid payer, %	16.8	15.6
Other payer, %	7.2	7.3
History of COPD, %	1.7	2.0
History of asthma, %	2.1	3.5
History of DM, %	7.2	8.3
History of CHF, %	1.1	1.3
History of advanced liver disease, %	1.3	1.9
History of CKD, %	1.6	1.9
History of CAD, %	2.2	2.8
Immunocompromised, %	2.8	3.1

CAD, coronary artery disease; CHF, congestive heart failure; CKD, chronic kidney disease; COPD, chronic obstructive pulmonary disease; DM, diabetes mellitus.
Notes: Percentages may not sum to 100 due to rounding.
Sex was categorized as male and female, and there were no missing values for sex.
Other payer category consists of individuals who were dual eligible for Medicare and Medicaid benefits.
History of comorbid conditions was based on at least 1 inpatient or 2 outpatient claims observed in the baseline period for a study year.
Immunocompromised status is based on Polinski et al.[9]

Burden of RSV

- In 2017-2018 and 2018-2019, respectively, a total of 567,352 and 460,386 cardiorespiratory-related hospitalizations were identified in the MarketScan database. Of these, 1843 and 1597, respectively, were also coded as RSV-related hospitalizations in 2017-2018 and 2018-2019
  - RSV-associated hospitalizations as predicted by the models were 51,081 and 32,697 in 2017-2018 and 2018-2019, respectively
  - Considering mean total costs of cardiorespiratory-related hospitalizations from MarketScan data of $27,867 and $24,490 in 2017-2018 and 2018-2019, respectively, the estimated annual costs amongst the patient population are presented in **Figure 2**

Figure 2. Predicted and ICD-10–Coded Clinical and Economic Burden of RSV Among the Considered MarketScan Patient Population



	2017-2018 All adults N=24,362,080		2018-2019 All adults N=21,359,058	
	RSV-associated cardiorespiratory hospitalizations*	ICD-10–coded RSV hospitalizations	RSV-associated cardiorespiratory hospitalizations*	ICD-10–coded RSV hospitalizations
Annual Cost, US$	1,423,453,795	55,032,822	800,742,337	41,617,966

*Predicted from excess risk model
ICD-10, International Classification of Diseases and Related Disorders, 10th revision; RSV, respiratory syncytial virus.

DISCUSSION

- Our findings are consistent with prior estimates of RSV burden among older adults, based on similar modeling methods used by Bosco et al (2021)[4] in the long-term care setting that demonstrated a significant burden of RSV
- Additionally, our study extends this method to a broader US population and estimates a substantial RSV burden among adults across a wide age range

LIMITATIONS

- Since the MarketScan database does not include individuals insured under Medicare Fee-For-Service (FFS), the most prevalent type of Medicare service, the results of this study might not be generalizable to the larger Medicare population (ie, adults aged ≥65 years). Additional analyses in the Medicare FFS population are warranted
- The MarketScan databases used in our study lacked key demographics known to be associated with healthcare utilization (eg, race, ethnicity, socioeconomic status) for the vast majority (>83%) of the considered patient population. Thus, we were unable to conduct stratified analyses of RSV burden by these factors
- Administrative claims data offer a limited view into patient history based on billable codes for healthcare encounters

CONCLUSIONS

- RSV infection contributes to substantial clinical and economic burden of cardiorespiratory hospitalizations among studied US adults
- Modeling excess risk using viral positivity data can provide a more complete estimation of RSV hospitalization burden and associated costs, compared with relying on ICD-10 diagnosis codes alone
- Future research in other claims databases and study populations is needed to contextualize these results

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Disclosures

DAP, ZAM, AC, AT, and KN are employees at Aetion, Inc. DAP and ZAM are stock option holders of Aetion, Inc. CAP, PG, SSL, and DM are employees of Moderna, Inc., and hold stock/stock options in the company.

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