

# Hospitalizations and Emergency Department Visits for Respiratory Syncytial Virus Among Infants Aged <1 year in the United States: An Analysis of Nationwide Inpatient and Emergency Room Data

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## Background

Respiratory syncytial virus (RSV) can cause serious lower respiratory tract infections (LRTI), particularly among infants and children. Among infants aged <1 year, RSV is the leading cause of bronchiolitis and pneumonia in the United States (US) (Rha et al. 2020).

Inpatient hospital discharge data are useful to characterize trends in severe disease caused by RSV and related diseases (Doucette et al. 2016). In comparison, analyses of RSV based on emergency department (ED) visits are sparse.

The Healthcare Cost and Utilization Project (HCUP) is a family of healthcare databases sponsored by the Agency for Healthcare Research and Quality (AHRQ) in the US. HCUP includes both inpatient hospitalization and ED visit data. These databases are the largest collection of longitudinal hospital care data in the US (HCUP, 2020).

## Objective

Characterize the burden of respiratory syncytial virus (RSV) and all-cause bronchiolitis (ACB) inpatient hospitalizations and ED visits in US infants aged <1 year.

## Methods

**Study Design:** This study is a retrospective, observational cohort study of US infants aged <1 year in the HCUP data sets.

**Data Sources:** Two large national all-payer administrative datasets were used:

- HCUP National (Nationwide) Inpatient Sample (NIS)
- HCUP Nationwide Emergency Department Sample (NEDS)

NIS data from 2016 were used to estimate overall burden. To explore potential effect of ages in month, NIS data from 2011 (most recent year available) were used. For NEDS, age in month data were not available. NEDS data from 2016 were used to estimate overall burden.

**Case Identification:** RSV and ACB were identified using ICD-9-CM and ICD-10-CM codes (Table 1). Patient-level records were not contained in the data; no patient identifiers were revealed to the study investigators.

**Statistical Analyses:** The percent of hospitalized or ED visits due to RSV and ACB among the total number of hospitalizations or ED visits, respectively, among infants aged <1 year (excluding newborns) were determined. Results were reported by calendar month to characterize severity and seasonality patterns. Stratification variables by age in months and admission month were reported using NIS 2011 data. SAS 9.4 was used for the analyses.

**Table 1.** ICD codes for respiratory syncytial virus (RSV) and all-cause bronchiolitis (ACB).

	ICD-9-CM Codes	ICD-10-CM Codes	Diagnosis
RSV	480.1	J12.1	Pneumonia due to RSV
	466.11	J21.0	Acute bronchiolitis due to RSV
	079.6	B97.4	RSV
ACB	079.6, 466.11, 466.19, 480.1	J20.5, J21.1, J21.8, J21.9	Acute bronchitis due to RSV
		B97.4, J12.1, J21.0, J20.5, J21.1, J21.8, J21.9	RSV and unspecified bronchiolitis

**Table 2.** Weighted frequencies of hospitalizations and ED visits for respiratory syncytial virus (RSV), all-cause bronchiolitis (ACB), and total for US infants aged <1 year in NIS (2011 and 2016) and NEDS (2016).

Database	Year	RSV	ACB	Total
NIS	2011	60,187	95,410	446,651
NIS	2016	54,250	89,935	437,160
NEDS	2016	127,979	333,392	3,496,238

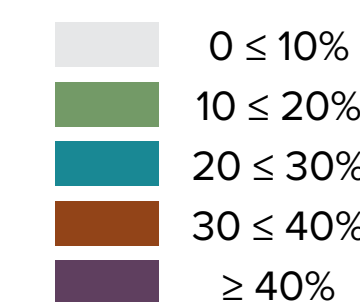
**Table 3.** Respiratory syncytial virus (RSV) as a percent of all infant hospitalizations\* by age (months) and by admission month, for US infants aged <1 year in the NIS (2011\*\*).

Ages in Month	Admission Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	11.7	14.5	14.1	5.1	1.2	--	--	--	--	0.6	2.0	6.3
1	34.7	44.1	38.1	17.9	5.4	--	--	--	1.8	4.2	8.0	22.4
2	38.2	44.7	40.5	19.9	7.1	2.6	--	--	--	4.0	11.4	25.8
3	40.2	45.9	37.3	17.3	3.6	--	--	--	--	--	12.2	25.8
4	33.2	40.2	29.1	18.5	7.9	--	--	--	--	--	10.1	24.8
5	36.0	39.5	29.9	15.5	--	--	--	--	--	--	11.8	23.8
6	37.5	34.5	30.5	11.7	5.1	--	--	--	--	--	10.3	23.6
7	27.5	36.1	27.1	10.8	--	--	--	--	--	--	6.5	20.4
8	30.2	36.2	27.5	10.0	4.5	--	--	--	--	--	9.0	25.8
9	24.2	35.4	21.8	9.5	--	--	--	--	--	--	5.7	17.5
10	22.7	32.4	24.6	7.4	--	--	--	--	--	--	6.9	20.5
11	29.2	23.2	26.3	6.7	--	--	--	--	--	--	10.7	15.8

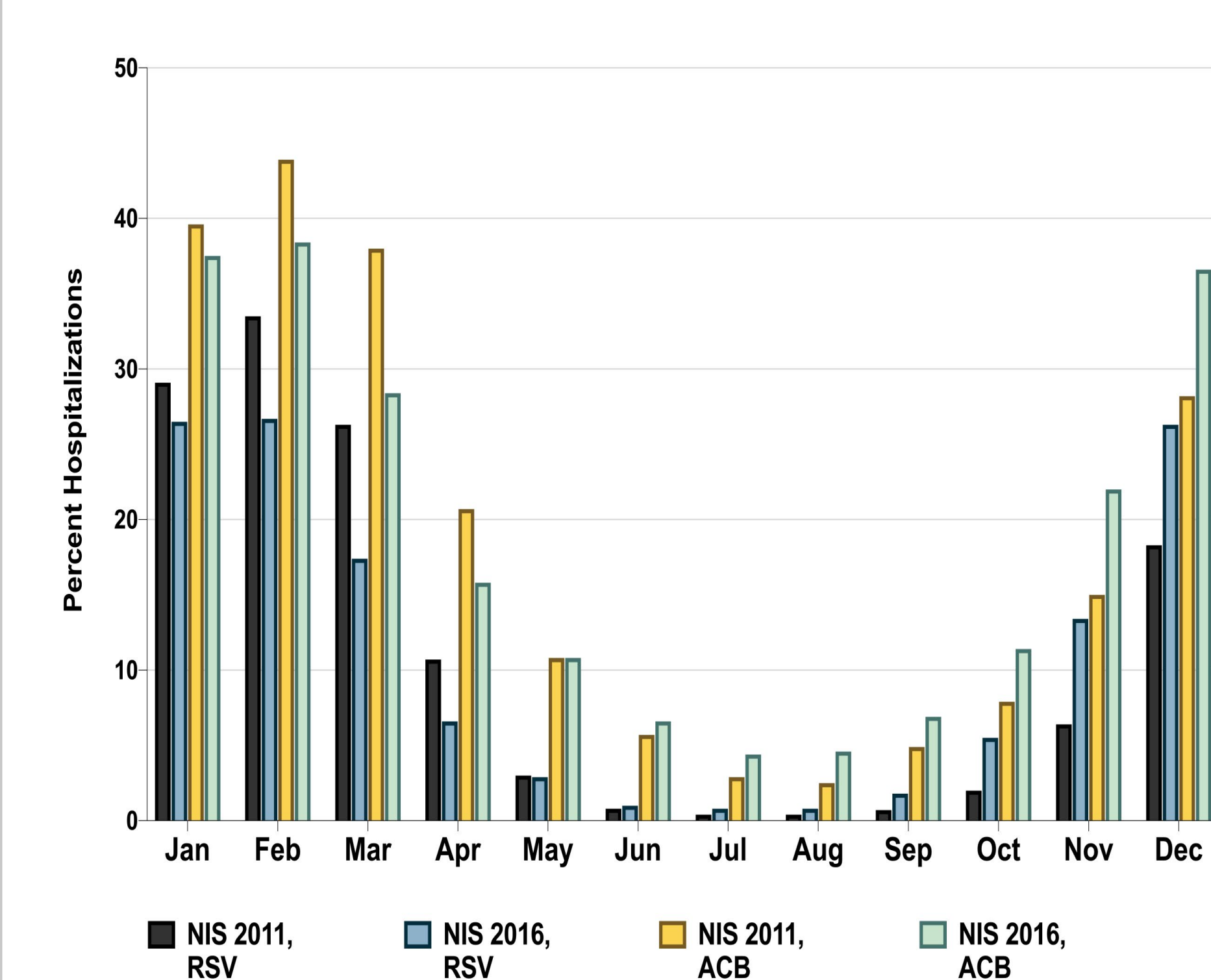
\* Excluded hospitalization with any ICD code indicating newborn birth, ICD-9-CM V30.XX - V39.XX or ICD-10-CM Z38.00, Z38.01, Z38.2, Z38.30, Z38.31, Z38.5, Z38.61, Z38.62, Z38.63, Z38.64, Z38.65, Z38.66, Z38.68, Z38.69, or Z38.8.

\*\* 2011 is the most recent NIS database with age in month information.

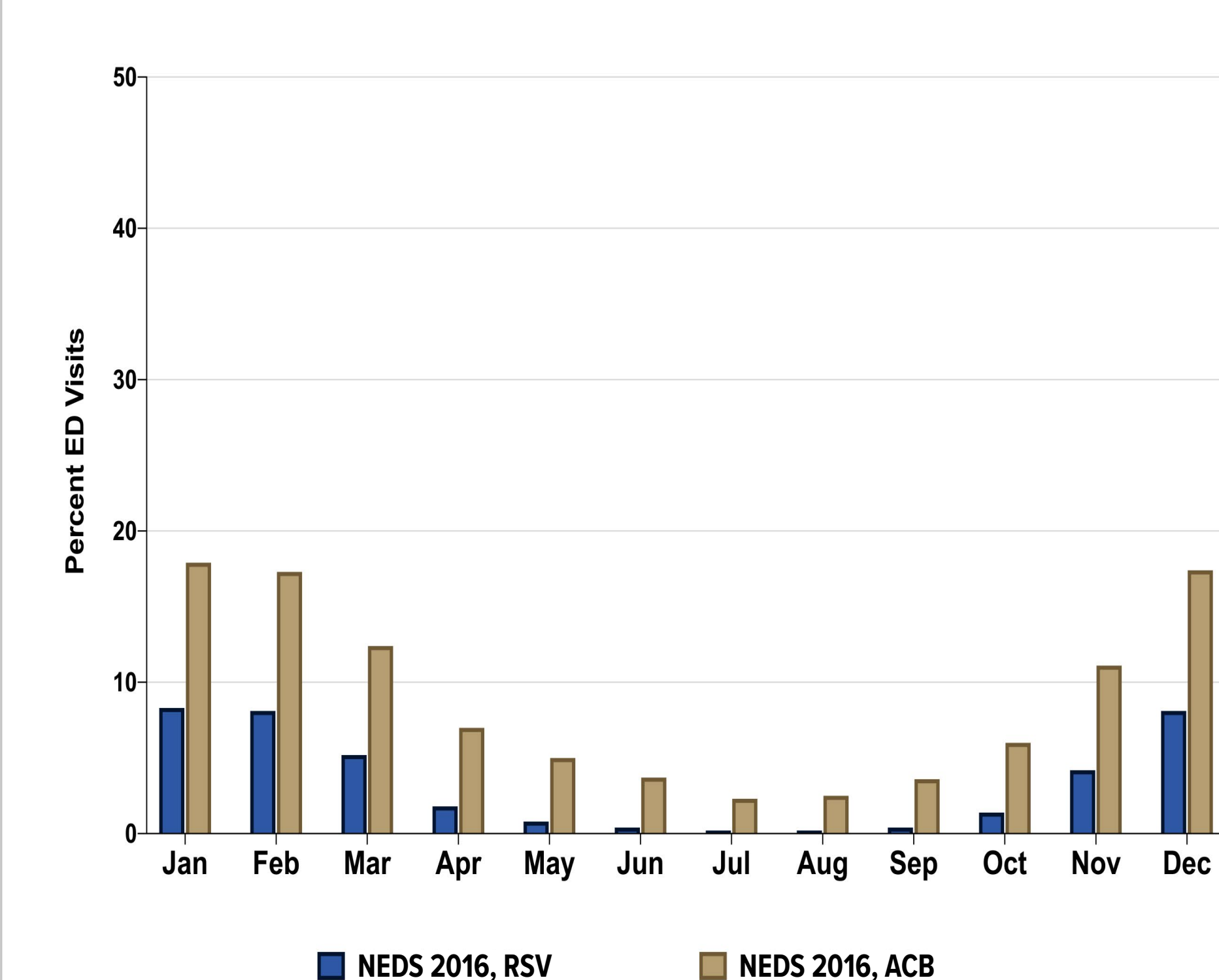
-- Sample size <math>\leq 10</math> was not reported, in accordance to the HCUP reporting instructions.



**Figure 1.** Respiratory syncytial virus (RSV) and all-cause bronchiolitis (ACB) hospitalizations among US infants aged <1 year.



**Figure 2.** ED visits due to respiratory syncytial virus (RSV) and all-cause bronchiolitis (ACB) among US infants aged <1 year.



## Results

- In 2011, 60,187 RSV hospitalizations and 95,410 ACB hospitalizations were identified in the NIS (Table 2). In 2016, 54,250 RSV hospitalizations and 89,935 ACB hospitalizations were identified in the NIS (Table 2). In 2016, 127,979 ED visits due to RSV and 333,392 ED visits due to ACB were identified in the NEDS (Table 2).
- In these large national data sets, RSV and ACB hospitalizations (NIS 2011 and 2016) and RSV and ACB ED visits (NEDS 2016) peaked in Dec-Mar (Figures 1 and 2).
- Greater than 20% of hospitalizations were due to RSV from Dec-Mar, with peak RSV hospitalizations (>40%) in Feb for ages 1-4 months in 2011 (Table 3).
- For ACB, 2011 hospitalizations were also highest in the younger age groups, reaching 59% of hospitalizations in Feb for infants aged 3 months. From Dec-Mar, ACB hospitalizations reached 50% of hospitalizations in some groups and 40% in others (results not shown).
- In 2016, RSV was a leading cause of ED visits in Jan (8.3%), Feb (8.1%), and Dec (8.1%) among US infants aged <1 year (Figure 2). This was consistent with trends in RSV and ACB ED visits from 2013-2015 (results not shown).

## Conclusions

- RSV and ACB are leading causes of infant hospitalizations and emergency department visits during the RSV season in the US.
- It is apparent that RSV and ACB place considerable burdens on US hospitals and emergency departments during the RSV season.
- Current policy does not support routine RSV laboratory testing of medically-attended LRTIs among US infants. In that context, ACB can be considered an upper bound and RSV can be considered a lower bound of the true proportion of hospitalizations and emergency department visits associated with RSV LRTI visits in these settings.
- The strengths of our study include the cohort design, large sample size, and the multiple-hospital approach using data from the nationally-representative NIS and NEDS databases.

<sup>1</sup> Rha B, Curns AT, Lively JY, et al. Respiratory Syncytial Virus-Associated Hospitalizations Among Young Children: 2015-2016. Pediatrics. 2020 Jul;146(1). DOI: 10.1542/peds.2019-3611.

<sup>2</sup> Doucette A, Jiang X, Fryzek J, Coalson J, McLaurin K, Ambrose CS. Trends in Respiratory Syncytial Virus and Bronchiolitis Hospitalization Rates in High-Risk Infants in a United States Nationally Representative Database, 1997-2012. PLoS One. 2016 Apr 6;11(4):e0152208. doi: 10.1371/journal.pone.0152208.

<sup>3</sup> HCUP Overview. Healthcare Cost and Utilization Project (HCUP). Agency for Healthcare Research and Quality, Rockville, MD. www.hcup-us.ahrq.gov/overview.jsp.