MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH Asthma-Related Hospitalizations in Massachusetts







Asthma is one of the most common chronic diseases in the United States.¹

Asthma affects people of all ages and is a significant public health problem. Although asthma is a condition that is largely controllable with appropriate management and the need for Hospitalizations can be considered preventable, many people are not able to adequately keep their condition under control. As a result, asthma is among the top seven conditions that contributes to high costs and emergency room expenditures in the Commonwealth. On average, for asthma patients in Massachusetts \$58,600 in medical expenditures are incurred annually per person.²



in medical expenses are incurred annually per asthma patient in Massachusetts. Asthma management is dependent on being able to minimize exposure to asthma triggers in the environment, understanding and taking medications as prescribed, and recognizing the signs of asthma and knowing what to do if it gets worse.

Social determinants of health play an important role in asthma outcomes. Exposures and conditions where people live, work, learn or play can affect their asthma. Low levels of environmental pollution, quality living conditions, education and linguistic competency, access to quality medical care and information are necessary to support adequate asthma management. Given that these necessary conditions are not equitably distributed, it is not surprising that there are also dramatic inequities in people's ability to successfully manage their asthma. In fact, in Massachusetts, although the percent of adults who have ever been told by a health care provider that they have asthma does not differ significantly by race/ethnicity, there are stark racial/ethnic disparities in emergency department visits (ED) and hospitalizations.³

WHAT IS ASTHMA?

Asthma is a chronic inflammation of the airways.

Airways become constricted with swelling and excessive mucous production, making it difficult to breathe. Symptoms of asthma are wheezing, coughing, chest tightness, and nighttime or early morning coughing. It can have a significant effect on guality of life. Sometimes the symptoms become so severe, they result in an asthma attack that requires immediate medical treatment. Asthma affects individuals differently, resulting in differing severity, presentation of symptoms, and responsiveness to treatment. When not treated, asthma can cause disability and even death. Asthma control status varies by age, gender, race/ethnicity, and socioeconomic status. Increasing rates of hospital treatment due to asthma may indicate increasing prevalence or severity within the population.

Asthma is largely controllable with appropriate primary and ongoing asthma management, if patients and their families are adequately educated about the disease, and have access to high quality health care, the need for Hospitalizations can usually be prevented. However, differences in rates of Hospitalizations for asthma suggest that there is significant room for improvement in caring for the condition.



Content:

The content of this report includes:

- State-wide trends related to asthma-related
 - hospitalizations and inequities by gender, age, sex vs gender, race, and geography from 2002–2018;
- Seasonal patterns of asthma-related hospitalizations;
- Average length of stay;
- Costs associated with asthma-related hospitalizations.



In this brief, a statewide data source is used to describe asthma-related hospitalizations in Massachusetts — the Hospital Inpatient Discharge Database managed by the Center for Health Information and Analysis (CHIA).

The discharge-level inpatient diagnostic data describe:

socio-demographic characteristics of the patient; the reason for the admission; treatment and services provided to the patient; associated charges; and the duration of the patient's stay. Findings presented here for asthma-related hospitalizations begin with a time trend using all years of data available. These data are followed by a more detailed examination of trends over time from the year 2002 onward. Cross sectional findings are based on the most recent data available and in most instances multiple years of data are aggregated to derive more stable estimates, where possible.



At-risk based rates of asthma-related hospitalizations were calculated to assess the rate of hospitalizations among Massachusetts residents with current asthma.

Massachusetts Behavioral Risk Factor Surveillance System (BRFSS) 2007–2018 data were used to calculate these at-risk rates, which provide additional understanding of changes over time in different hospital services during a period of increasing prevalence. BRFSS data are used to estimate the denominators for these at-risk rates.

This brief also includes data on hospital charges for asthma-related hospitalizations. In interpreting these findings on charges, readers should be aware of several data considerations. First, the charges for service are not reflective of the actual cost of care, nor are they reflective of what was reimbursed to the hospital by the payer. Second, some of the charges do not include costs associated with the longterm effects of asthma, such as lost time from work and household duties or reduced quality of life. Asthma-related Emergency Department Visits (ED) will be reported separately.

Definitions:

Diagnosis Code

The International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) is a morbidity classification published by the United States National Center for Health Statistics (NCHS) for classifying diagnoses and reason for visits in all health care settings. The ICD-10-CM is based on the ICD-10, the statistical classification of disease published by the World Health Organization (WHO). The transition from ICD-9-CM to ICD-10-CM occurred on October 1, 2015. The ICD-CM codes for asthma have changed from 493.00–493.99 in ICD-9-CM to J45.0–J45.998 in ICD-10-CM.

Hospitalizations

Hospitalizations are defined as the inpatient treatment of asthma usually lasting more than one day (>24 hours). An asthma-related Hospitalizations is one for which the primary discharge diagnosis was coded as J45 (for asthma, using ICD-10 code). Hospitalizations statistics are calculated from data reported quarterly from Massachusetts hospitals to the CHIA. The information provided includes various characteristics of the patient population and charges for services provided. The data below present information on inpatient asthma-related hospitalizations in Massachusetts. Moreover, all of the trend analyses presented in the report did not include any data from 2015 and after due to ICD code conversion.

Data Definitions:

Crude rate

A rate that represents the actual number of events due to asthma per 10,000 residents over a given time period.

Age-adjusted rate

A summary rate (per 10,000 residents) calculated by weighting age-specific event rates for a given year to the 2010 United States standard population in order to minimize the effect of different age distributions in populations when comparing rates.

Age-specific rate

A rate (per 100 residents) estimated as the number of events due to asthma in a specified age group per total residents within that age group for a particular time period.

At-risk rate

Calculated as the number of events (e.g. hospitalizations) due to asthma among adults with current asthma at that time. This rate (per 100 at-risk residents) can be used to determine if the changes over time may be explained by the increase in asthma prevalence.

Note: In tables and figures below, estimates based on ICD-9-CM and ICD-10-CM are separated by a dashed line. Due to the use of the new ICD-CM code, data from 2015 on cannot be aggregated with years prior to 2015 for analysis. Findings are compared to national estimates where possible.

BURDEN IN ASTHMA-RELATED

Rates of Asthma-Related Hospitalizations

Compared to the U.S., Massachusetts tended to have higher age-adjusted rates of asthma-related hospitalizations in all years (*Figure 1*). However, statistical significance could not be determined because confidence intervals were not provided for national estimates.





Data Source: CY2002–2018 Massachusetts Hospitalization Discharge Database, Massachusetts Center for Health Information and Analysis; United States: CY2002–2017 Healthcare Cost and Utilization Project. Agency for Healthcare Research and Quality (http://www.hcup-us.ahrq.gov).



FROM 2002 THROUGH 2018:

FROM 2002 THROUGH 2009:

FROM 2002 THROUGH 2014:



Massachusetts asthma-related hospitalizations



in Massachusetts hospitalizations



At-risk rate

From 2002 through 2018, there were over 144,000 asthma-related hospitalizations among Massachusetts residents. This is equivalent to an average of 8,500 asthmarelated hospitalizations per year or 23 per day. From 2002 through 2009, the Massachusetts age-adjusted rate of asthma-related hospitalizations increased 26% from 12.7 to 16.0 per 10,000 residents. However, the rate decreased 22% from 16.0 to 12.4 per 10,000 residents during 2009 to 2014. The rate is stable after 2016 (*Figure 2*).

From 2002 through 2014, the at-risk rate increased from 1.5 asthma-related hospitalizations per 100 residents in 2007 to 1.7 hospitalizations per 100 persons in 2008 then continuously decreased to 1.1 hospitalizations per 100 persons in 2014 (*Figure 2*).



FIGURE 2. Number and Age-Adjusted Rates of Asthma-Related Hospitalizations, Massachusetts Residents, 2002–2018



Data Source: CY2002–2018 Massachusetts Hospitalizations Discharge Database, Massachusetts Center for Health

		UNITED STATES				
YEAR	NO.	CRUDE RATE ¹	AGE-ADJUSTED RATE ^{1,2}	95% Cl ³	AT-RISK RATE⁴	AGE-ADJUSTED RATE ^{1,2}
2002	8,100	12.6	12.7	12.4 – 13.0	NA	13.6
2003	9,865	15.3	15.4	15.1 – 15.7	NA	15.7
2004	8,888	13.8	13.8	13.5 – 14.1	NA	13.9
2005	9,117	14.2	14.0	13.7 – 14.3	NA	14.5
2006	9,473	14.7	14.7	14.4 – 15.0	NA	13.6
2007	9,399	14.6	14.7	14.4 – 15.0	1.5	12.9
2008	10,301	15.9	15.9	15.6 – 16.2	1.7	12.9
2009	10,626	16.1	16.0	15.7 – 16.3	1.6	14.1
2010	10,169	15.5	15.6	15.3 – 15.9	1.5	13.0
2011	9,942	15.1	15.2	14.9 – 15.5	1.4	11.8
2012	8,809	13.5	13.4	13.2 – 13.7	1.3	11.9
2013	8,000	12.2	12.1	11.8 – 12.4	1.1	11.0
2014	8,172	12.5	12.4	12.1 – 12.6	1.1	10.7
2015	7,687	11.7	11.6	11.3 – 11.9	1.1	9.2
2016	5,272	8.1	8.3	8.1 – 8.6	0.8	5.8
2017	5,335	8.1	8.4	8.2 - 8.7	0.7	5.6
2018	5,233	8.0	8.2	8.0 - 8.4	0.8	5.5

TABLE. Age-Adjusted Rates of Asthma-Related Hospitalizations, Massachusetts Residents, 2002–2018

Trend Analysis⁵

Slope:⁶ -0.07

P-Value:⁷ 0.506

¹ Rate of asthma-related hospitalizations per 10,000 residents.

² Age-adjusted to United States 2010 population.

³ 95% confidence interval.

- ⁴ Rate of residents at risk of asthma-related hospitalizations per 100 residents.
- ⁵ Trend analysis was performed using 2002–2014 data only due to ICD-9-CM diagnosis code changed to ICD-10-CM diagnosis code in October 2015 and after.
- ⁶ Slope (slope of the best line of fit calculated using JoinPoint Software) = the average age-adjusted rate increase or decrease per year (e.g. a slope of 1.0 indicates that the age-adjusted rate increased on average one per 10,000 residents per year).

95% CI:³ -0.3 - 0.1

⁷ P-value < 0.05 is considered statistically significant because it means that there is at most a 5% chance of observing a trend, given that, in reality, rates are stable. NA: Data was not available due to Child BRFSS starting in 2007. Data Source: CY2002–2018 Massachusetts Hospitalizations Discharge Database, Massachusetts Center of Health Information and Analysis Information and Analysis: CY2007–2018 Massachusetts BRFSS, Massachusetts Department of Public Health;

United States: CY2002–2017 Healthcare Cost and Utilization Project. Agency for Healthcare Research and Quality (http://www.hcup-us.ahrq.gov).

Hospitalizations-associated Charges

The charges incurred for asthma-related hospitalizations in Massachusetts from 2002–2018 totaled \$1.5 billion, which averages about \$91 million in asthma-related hospitalizations costs each year. During the 2002–2014 time period, the total charges for hospitalizations increased 85% from \$57.3 million in 2002 and \$106.0 million in 2014 (*Figure 3*).

FIGURE 3. Total Charges for Asthma-Related Hospitalizations, Massachusetts Residents, 2002–2018



Data Source: CY2002–2018 Massachusetts Hospitalizations Discharge Database, Massachusetts Center for Health Information and Analysis.

TABLE. Total Charges for Asthma-Related Hospitalizations, Massachusetts Residents, 2002–2018

YEAR	TOTAL CHARGES	MEAN CHARGES	MEDIAN CHARGES
2002	\$57,252,240	\$7,068	\$4,942
2003	\$72,941,353	\$7,395	\$5,258
2004	\$72,653,978	\$8,175	\$5,893
2005	\$80,309,450	\$8,809	\$6,484
2006	\$89,103,248	\$9,404	\$6,802
2007	\$91,874,336	\$9,775	\$7,183
2008	\$105,610,665	\$10,252	\$7,705
2009	\$116,319,937	\$11,009	\$8,052
2010	\$112,836,710	\$11,096	\$7,911
2011	\$110,174,784	\$11,082	\$8,113
2012	\$100,295,602	\$11,386	\$8,277
2013	\$103,977,879	\$12,997	\$9,114
2014	\$106,027,463	\$12,936	\$9,455
2015	\$102,927,339	\$13,390	\$9,637
2016	\$69,494,971	\$13,182	\$9,396
2017	\$76,625,650	\$14,363	\$9,994
2018	\$80,549,455	\$15,393	\$10,942

Trend Analysis⁴

Slope:¹ 3.95

P-Value:³ 0.0003

95% Cl:² 2.4 - 5.5

¹ Slope (slope of the best line of fit calculated using JoinPoint Software) = the average millions of total charges increase or decrease per year (e.g. a slope of 1.0 indicates that the 1 millions of total charges increased per year).

² 95% Confidence Interval.

³ P-value < 0.05 is considered statistically significant because it means that there is at most a 5% chance of observing a trend, given that, in reality, total charges are stable.

⁴ Trend analysis was performed using 2002–2014 data only due to ICD-9-CM diagnosis code changing to ICD-10-CM diagnosis code in October 2015 and after.

Data Source: CY2002–2018 Massachusetts Hospitalizations Discharge Database, Massachusetts Center for Health Information and Analysis.

Seasonal Pattern of Asthma-Related Hospitalizations

The seasonal pattern for the number of asthma-related hospitalizations was similar regardless of year. Fall months tended to have the highest number of hospital admissions for asthma, while summer months tended to have the lowest (*Figure 4*).

FIGURE 4. Number of Asthma-Related Hospitalizations by Month of Admission, Massachusetts Residents, 2016–2018



Data Source: CY2016–2018 Massachusetts Hospitalizations Discharge Database, Massachusetts Center for Health Information and Analysis.

TABLE. Number of Asthma-Related Hospitalizations by Month of Admission, Massachusetts Residents, 2016–2018

MONTH	2016	2017	2018
January	446	485	482
February	442	435	471
March	528	560	489
April	403	497	493
May	477	555	438
June	389	325	322
July	272	219	249
August	340	281	265
September	509	515	573
October	518	481	538
November	481	501	406
December	487	481	507
TOTAL	5,272	5,335	5,233

Data Source: CY2016–2018 Massachusetts Hospitalizations Discharge Database, Massachusetts Center for Health Information and Analysis.



Length of Hospital Stay

In 2018, the average length of stay for an asthma-related Hospitalizations varied with age from 1.7 days among children ages 0–4 years to 3.9 days among adults ages 65 and over. Adults ages 65 and over had the longest length of stay (*Figure 5*). Length of stay steadily increased with age and is the highest among those 65 and over.



FIGURE 5. Length of Asthma-Related Hospital Stay, Massachusetts Residents, 2018

Data Source: CY2018 Massachusetts Hospitalizations Discharge Database, Massachusetts Center for Health Information and Analysis.

TABLE. Length of Asthma-Related Hospital Stay, Massachusetts Residents, 2018

		L	ENGTH OF STAY (DAY	S)	
AGE GROUP	N	MEAN	MEDIAN	МІЛІМИМ	MAXIMUM
0–4	879	1.7	1	1	16
5–11	643	2.1	2	1	8
12–17	242	2.4	2	1	11
18–24	253	2.7	2	1	18
25–34	435	2.8	2	1	19
35–44	531	3.0	2	1	24
45–54	695	3.2	3	1	21
55–64	627	3.7	3	1	29
65+	928	3.9	3	1	56

Data Source: CY2018 Massachusetts Hospitalizations Discharge Database, Massachusetts Center for Health Information and Analysis.

DISPARITIES IN ASTHMA-RELATED HOSPITALIZATION RATES

Asthma-Related Hospitalization Rate by Race/Ethnicity

From 2002 through 2018, Black, Non-Hispanic and Hispanic residents consistently had higher age-adjusted rates of asthma-related hospitalizations than those who were White, Non-Hispanic. During this time period, Asian/Pacific Islander, Non-Hispanic residents consistently had lowest age-adjusted rates compared to White,

Non-Hispanic residents. In 2018, the age-adjusted rate among Black, Non-Hispanic residents was 3.6 times greater and Hispanic residents was 4.2 times greater than the rate among White, Non-Hispanic residents (*Figure 6*).

FIGURE 6. Age-Adjusted Rates of Asthma-Related Hospitalizations, Massachusetts Residents, 2002–2018



Data Source: CY2002–2018 Massachusetts Hospitalizations Discharge Database, Massachusetts Center for Health Information and Analysis.

TABLE. Age-Adjusted Rates of Asthma-Related Hospitalizations, Massachusetts Residents, 2002–2018

	В	LACK, NON-HISPAN	lic		HISPANIC	
YEAR	NO.	RATE ^{1,2}	95% Cl ³	NO.	RATE ^{1,2}	95% Cl³
2002	1,218	33.5	31.6 – 35.5	1,207	34.5	32.1 – 36.9
2003	1,353	36.8	34.8 - 38.9	1,414	35.8	33.5 – 38.1
2004	1,206	32.4	30.5 - 34.3	1,238	31.5	29.4 - 33.6
2005	1,212	32.8	30.9 - 34.7	1,186	30.1	28.1 – 32.1
2006	1,299	33.6	31.7 – 35.5	1,181	29.1	27.2 - 31.1
2007	1,458	37.6	35.6 – 39.6	1,322	31.1	29.2 - 33.1
2008	1,592	41.3	39.2 - 43.4	1,554	33.7	31.7 – 35.6
2009	1,581	38.7	36.7 – 40.6	1,782	37.3	35.3 - 39.3
2010	1,486	37.1	35.2 - 39.0	1,847	36.5	34.5 - 38.4
2011	1,389	32.2	30.5 - 33.9	1,738	32.6	30.8 - 34.4
2012	1,250	27.6	26.1 – 29.2	1,634	29.5	27.8 - 31.1
2013	1,145	28.9	27.2 - 30.5	1,443	29.5	27.9 - 31.0
2014	1,177	29.6	27.9 - 31.2	1,497	29.9	28.4 - 31.5
2015	1,027	25.9	24.3 – 27.5	1,447	28.9	27.4 - 30.3
2016	822	20.1	18.7 – 21.4	1,100	20.2	19.0 - 21.4
2017	791	19.1	17.8 – 20.4	1,147	21.0	19.8 – 22.2
2018	795	18.9	18.4 – 21.1	1,225	23.2	21.9 - 24.5

Trend Analysis⁴

Slope:⁵ -0.42

P-Value:⁶ 0.1755 **95%** (

95% Cl:³ -1.0 – 0.2 **Si**

Slope:⁵ -0.21

P-Value:⁶ 0.3415

95% Cl:³ -0.6 - 0.2

¹ Rate of asthma-related hospitalizations per 10,000 residents.

² Age-adjusted to United States 2010 population.

³ 95% Confidence Interval.

⁴ Trend analysis was performed using 2002–2014 data only due to ICD-9-CM diagnosis code changing to ICD-10-CM diagnosis code in October 2015 and after.

- ⁵ Slope (slope of the best line of fit calculated using JoinPoint Software) = the average age-adjusted rate increase or decrease per year (e.g. a slope of 1.0 indicates that the age-adjusted rate increased on average one per 10,000 residents per year).
- ⁶ P-value < 0.05 is considered statistically significant because it means that there is at most a 5% chance of observing a trend, given that, in reality, rates are stable. **Data Source:** CY2002–2018 Massachusetts Hospitalizations Discharge Database, Massachusetts Center for Health Information and Analysis.

	w	HITE, NON-HISPAN	lic	ASIAN/ PAC	IFIC ISLANDER, NO	N-HISPANIC
YEAR	NO.	RATE ^{1,2}	95% Cl ³	NO.	RATE ^{1,2}	95% Cl ³
2002	5,134	9.6	9.3 – 9.8	147	6.1	5.0 - 7.2
2003	6,549	12.3	12.0 - 12.6	176	7.3	6.1 – 8.5
2004	5,930	10.9	10.6 – 11.2	164	6.4	5.3 - 7.4
2005	6,206	11.3	11.0 - 11.6	155	6.5	5.4 - 7.6
2006	5,796	10.8	10.5 – 11.0	198	8.1	6.9 – 9.3
2007	5,801	10.9	10.6 – 11.2	163	5.9	4.9 - 6.9
2008	6,510	12.2	11.9 – 12.5	229	8.5	7.3 – 9.7
2009	6,590	12.1	11.8 – 12.4	246	8.8	7.6 – 10.0
2010	6,191	11.6	11.3 – 11.9	238	7.8	6.8 - 8.9
2011	6,129	11.7	11.4 – 12.0	249	8.1	7.0 – 9.1
2012	5,352	10.1	9.8 - 10.4	227	7.0	6.0 - 7.9
2013	4,844	8.9	8.6 – 9.1	181	6.4	5.5 - 7.4
2014	4,929	9.0	8.8 - 9.3	196	6.9	5.9 - 7.8
2015	4,691	8.5	8.3 - 8.8	165	5.9	5.0 - 6.8
2016	2,866	5.8	5.6 - 6.0	133	4.2	3.5 – 4.9
2017	2,866	5.8	5.6 - 6.0	179	5.8	5.0 - 6.6
2018	2,787	5.5	5.3 – 5.8	163	5.6	4.8 - 6.5

TABLE. Age-Adjusted Rates of Asthma-Related Hospitalizations, Massachusetts Residents, 2002–2018

Trend Analysis⁴

Slope:⁵ -0.11

P-Value:⁶ 0.2300 95% C

95% Cl:³ -0.3 – 0.1

Slope:⁵ 0.05

P-Value:⁶ 0.4648

95% Cl:³ -0.1 – 0.2

¹ Rate of asthma-related hospitalizations per 10,000 residents.

² Age-adjusted to United States 2010 population.

³ 95% Confidence Interval.

⁴ Trend analysis was performed using 2002–2014 data only due to ICD-9-CM diagnosis code changing to ICD-10-CM diagnosis code in October 2015 and after.

⁵ Slope (slope of the best line of fit calculated using JoinPoint Software) = the average age-adjusted rate increase or decrease per year (e.g. a slope of 1.0 indicates that the age-adjusted rate increased on average one per 10,000 residents per year).

⁶ P-value < 0.05 is considered statistically significant because it means that there is at most a 5% chance of observing a trend, given that, in reality, rates are stable.
Data Source: CY2002–2018 Massachusetts Hospitalizations Discharge Database, Massachusetts Center for Health Information and Analysis.

Asthma-Related Hospitalization Rate by Age

From 2016 through 2018, the Massachusetts age-specific rates of asthma-related hospitalizations were highest among children 0–9 years and adults ages 65 and older. The rates tended to decrease with increasing age group until teenage (ages 10–14) years and then tended to increase with increasing age group throughout adulthood (*Figure 7*).

Although rates of hospitalizations were highest among the youngest populations, length of stay steadily increased with age, and was longest for those 65+ (*Figure 5*). The results showed that children under 10 were most likely to become hospitalized, they also were discharged relatively more quickly compared to older adults.

2016 2017 2018 30 HOSPITALIZATIONS PER 10,000 RESIDESNTS 25 20 15 10 5 0 5–9 0 - 415 - 1920 - 2430 - 3435 - 3945-49 50-54 55-59 60-64 65 +10 - 1425 - 2940-44 AGE GROUP (YEARS)

FIGURE 7. Age-Specific Rates of Asthma-Related Hospitalizations, Massachusetts Residents, 2016–2018

Data Source: CY2016–2018 Massachusetts Hospitalizations Discharge Database, Massachusetts Center for Health Information and Analysis.

Asthma-Related Hospitalization Rate by Sex

For each year 2002 through 2018, the age-adjusted asthma-related hospitalization rate was consistently higher among females than males. Among males, the rate increased 5.9% from 10.1 in 2002 to 10.7 in 2014 hospitalizations per 10,000 residents.

Among females, the rate decreased 7.4% from 14.8 in 2002 to 13.7 in 2014 hospitalizations per 10,000 residents, but this change was not significant (*Figure 8*).

FIGURE 8. Age-Adjusted Rates of Asthma-Related Hospitalizations, by Sex, Massachusetts Residents, 2002–2018



Data Source: CY2002–2018 Massachusetts Hospitalizations Discharge Database, Massachusetts Center for Health Information and Analysis.

	MALES					FEMALES		
YEAR	NO.	CRUDE RATE ^{1,2}	AGE-ADJUSTED RATE ^{1,2}	95% Cl³	NO.	CRUDE RATE ^{1,2}	AGE-ADJUSTED RATE ^{1,2}	95% Cl³
2002	3,055	9.8	10.1	9.8 - 10.5	5,045	15.2	14.8	14.4 – 15.2
2003	3,904	12.5	12.9	12.5 – 13.3	5,961	17.9	17.4	17.0 – 17.9
2004	3,468	11.1	11.5	11.1 – 11.9	5,420	16.3	15.7	15.2 – 16.1
2005	3,400	10.9	11.3	10.9 – 11.6	5,717	17.2	16.3	15.9 – 16.7
2006	3,655	11.7	12.3	11.9 – 12.7	5,818	17.5	16.8	16.4 – 17.2
2007	3,744	12.0	12.7	12.2 – 13.1	5,655	17.0	16.4	15.9 – 16.8
2008	4,155	13.2	14.0	13.5 – 14.4	6,146	18.4	17.5	17.1 – 18.0
2009	4,155	13.0	13.5	13.1 – 13.9	6,471	19.1	18.1	17.6 – 18.5
2010	4,052	12.8	13.5	13.1 – 13.9	6,117	18.1	17.2	16.8 – 17.7
2011	4,017	12.6	13.3	12.9 – 13.8	5,925	17.4	16.7	16.3 – 17.1
2012	3,544	11.2	11.7	11.3 – 12.1	5,266	15.6	14.8	14.4 – 15.2
2013	3,166	10.0	10.4	10.1 – 10.8	4,834	14.3	13.5	13.1 – 13.8
2014	3,268	10.3	10.7	10.4 - 11.1	4,928	14.5	13.7	13.3 - 14.0
2015	2,883	9.1	9.5	9.2 - 9.8	4,804	14.2	13.3	13.0 – 13.8
2016	2,098	7.1	6.6	6.3 - 6.9	3,174	9.4	9.4	9.1 – 9.7
2017	2,123	6.7	7.2	6.9 – 7.5	3,212	9.5	9.5	9.2 - 9.8
2018	2,075	6.6	7.0	6.7 – 7.3	3,158	9.3	9.2	8.9 – 9.5

TABLE. Age-Adjusted Rates of Asthma-Related Hospitalizations, by Sex, Massachusetts Residents, 2002–2018

Trend Analysis⁴

Slope:⁵ 0.01 **P-Value:**⁶ 0.9493

95% CI:³ -0.1 – 0.2

Slope:⁵ -0.14

P-Value:⁶ 0.2042

95% Cl:³ -0.3 - 0.1

¹ Rate of asthma-related hospitalizations per 10,000 residents.

² Age-adjusted to United States 2010 population.

³ 95% Confidence Interval.

⁴ Trend analysis was performed using 2002–2014 data only due to ICD-9-CM diagnosis code changed to ICD-10-CM diagnosis code in October 2015 and after.

⁵ Slope (slope of the best line of fit calculated using JoinPoint Software) = the average age-adjusted rate increase or decrease per year (e.g. a slope of 1.0

indicates that the age-adjusted rate increased on average one per 10,000 residents per year).

⁶ P-value < 0.05 is considered statistically significant because it means that there is at most a 5% chance of observing a trend, given that, in reality, rates are stable. **Data Source:** CY2002–2018 Massachusetts Hospitalizations Discharge Database, Massachusetts Center for Health Information and Analysis.

Asthma-Related Hospitalization Rate by Age and Sex

In 2018, the asthma-related hospitalization rate varied by age group and sex: among those aged 0–4 years, the rate among males was nearly two times higher than the rate among females. In the 0–4, 5–9, and 10–14 age groups, males had higher rates compared to females. Starting with 15–19 years old and for each adult age group, the rates were higher among females than males (*Figure 9*).

FIGURE 9. Age-Sex-Specific Rates of Asthma-Related Hospitalizations, Massachusetts Residents, 2018



Data Source: CY2018 Massachusetts Hospitalizations Discharge Database, Massachusetts Center for Health Information and Analysis.



TABLE. Age-Sex-Specific Rates of Asthma-Related Hospitalizations, Massachusetts Residents, 2018

		MALEC			FEMALES	
		MALES			FEMALES	
YEAR	NO.	RATE ¹	95% Cl ²	NO.	CRUDE RATE ¹	95% Cl²
00–04	592	31.6	29.0 - 34.1	287	16.0	14.1 – 17.8
05–09	289	14.7	13.0 - 16.4	236	12.5	10.9 - 14.1
10–14	129	6.2	5.1 – 7.3	119	6.0	4.9 - 7.1
15–19	84	3.6	2.8 - 4.3	103	4.5	3.6 - 5.4
20–24	59	2.5	1.9 – 3.1	119	5.0	4.1 – 5.9
25–29	78	3.6	2.8 - 4.4	124	5.6	4.6 - 6.5
30–34	90	4.5	3.6 - 5.5	143	7.0	5.8 - 8.1
35–39	79	3.9	3.0 - 4.7	172	8.0	6.8 - 9.2
40–44	95	4.2	3.3 – 5.0	185	7.7	6.6 - 8.8
45–49	120	4.8	3.9 – 5.6	217	8.2	7.1 – 9.3
50–54	111	4.6	3.7 – 5.4	247	9.7	8.5 – 10.9
55–59	80	3.8	3.0 - 4.7	244	10.9	9.5-12.2
60–64	78	4.4	3.4 - 5.4	225	11.6	10.1 – 13.1
65+	191	5.1	4.4 - 5.4	737	14.0	13.0 – 15.0
All Ages	2,075	7.0	6.7 – 7.3	3,158	9.2	8.9 – 9.5

¹ Rate of asthma-related hospitalizations per 10,000 residents.

² Age-adjusted to US 2010 population.

Data Source: CY2018 Massachusetts Hospitalizations Discharge Database, Massachusetts Center for Health Information and Analysis.

Asthma-Related Hospitalization Rate by Geography

The overall Massachusetts three-year average annual age-adjusted rate was 8.3 hospitalizations per 10,000 residents. The rates varied across the 202 Massachusetts cities/towns for which data were

available (Data were not available for 149 Massachusetts cities/ towns.). 21 cities /towns had rates that were statistically significantly higher than the statewide rate.

TABLE 1. Top 10 Cities/Towns with the Highest Three-Year Average Annual Age-Adjusted Rate of Asthma-Related Hospitalizations in Massachusetts, 2016–2018

TOWN	2016-2018 TOTAL CASES	AVERAGE ANNUAL AGE-ADJUSTED RATE PER 10,000	95% Cl¹	
Holyoke	321	27.34	24.35	30.34
Springfield	900	20.17	18.85 21.49	
Lawrence	431	18.98	17.19	20.77
Southbridge	90	18.33	14.54	22.12
Chelsea	184	17.97	15.38	20.57
New Bedford	490	17.77	16.20	19.34
Brockton	463	16.32	14.84	17.81
Lynn	403	15.10	13.62	16.57
Boston	2,120	14.08	13.48 14.68	
Fall River	378	14.02	12.61 15.44	

¹ 95% Confidence Interval.

Data Source: CY2016–2018 Massachusetts Hospitalizations Discharge Database, Massachusetts Center for Health Information and Analysis.

MAP 1. Three-Year Average Annual Age-Adjusted Rates of Asthma-Related Hospitalizations among Massachusetts Residents, by City/Town of Residence, 2016–2018



Data Source: CY2016–2018 Massachusetts Hospitalizations Discharge Database, Massachusetts Center for Health Information and Analysis.

DISPARITIES IN ASTHMA-RELATED HOSPITALIZATIONS BY POPULATION DEMOGRAPHICS —

Asthma-Related Hospitalizations by Race Distribution:

Black, Non-Hispanic and Hispanic residents accounted for a disproportionate share of the asthma-related hospitalizations in Massachusetts.

of Massachusetts residents are Hispanic, which account for 23.4% of hospitalizations.

6.8%

of Massachusetts residents are Black, Non-Hispanic, which account for 15.2% of hospitalizations.

In 2018, although Hispanic residents comprised only 11.6% of the Massachusetts population, Hispanic residents accounted for 23.4% of asthma-related hospitalizations. (*Figure 10*).

11.6

In 2018, although Black, Non-Hispanic residents comprised only 6.8% of the Massachusetts population, Black, Non-Hispanic residents accounted for 15.2% of the asthma-related hospitalizations. (*Figure 10*).

FIGURE 10. Percent Distribution of Asthma-Related Hospitalizations, by Race/Ethnicity, Massachusetts Residents, 2018



	ASTHMA-RELATED HOSPITALIZATIONS		2014-2018 POPULATI	
RACE/ ETHNICITY	NO.	%	NO.	%
White, Non-Hispanic	2,787	53.5%	4,930,412	72.2%
Black, Non-Hispanic	795	15.2%	463,796	6.8%
Hispanic	1,225	23.4%	789,127	11.6%
Asian/Pacific Islander	163	3.1%	442,034	6.5%

Note: The numbers may not add up to the total since race/ethnicity was missing for some visits.

Data Source: CY2018 Massachusetts Hospitalizations Discharge Database, Massachusetts Center for Health Information and Analysis (CHIA); 2014–2018 Population data: <u>https://datacommon.mapc.org/browser/datasets/6</u>.

Asthma-Related Hospitalizations by Age Distribution:

In 2018, 16.6% of asthma-related hospitalizations in Massachusetts occurred among those ages 65 years and over, an age group that comprised 15.8% of Massachusetts population (*Figure 11*).

FIGURE 11. Percent Distribution of Asthma-Related Hospitalizations, by Age, Massachusetts Residents, 2018



	ASTHMA- HOSPITAL	RELATED IZATIONS	2014–2018 P	OPULATION
AGE GROUP	NO.	%	NO.	%
0–4	702	13.4%	362,681	5.3%
5–17	885	16.9%	1,017,216	14.9%
18–34	688	13.1%	1,665,134	24.3%
35–64	1,853	35.4%	2,706,929	39.6%
65+	869	16.6%	1,078,224	15.8%
TOTAL	5,233		6,830,193	

Note: The numbers may not add up to the total since race/ethnicity was missing for some visits.

Data Source: CY2018 Massachusetts Hospitalizations Discharge Database, Massachusetts Center for Health Information and Analysis; 2014–2018 Population data: https://datacommon.mapc.org/browser/datasets/363.

Asthma-Related Hospitalizations by Sex Distribution:

Females, a group that comprises 51.5% of the Massachusetts population, accounted for a disproportionate number of asthma-related hospitalizations in Massachusetts reported in 2018 – 60.3% of hospitalizations (*Figure 12*).

FIGURE 12. Percent Distribution of Asthma-Related Hospitalizations, Massachusetts Residents by Sex, 2018



	ASTHMA-RELATED HOSPITALIZATIONS		2014-2018 P	OPULATION
SEX	NO.	%	NO.	%
Males	2,075	39.7%	3,313,979	48.5%
Females	3,158	60.3%	3,516,214	51.5%
TOTAL	5,233		6,830,193	

Data Source: CY2018 Massachusetts Hospitalizations Discharge Database, Massachusetts Center for Health Information and Analysis; 2014–2018 Population data: https://datacommon.mapc.org/browser/datasets/363.



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