

Epidemiology of Asthma

In the North-Central Michigan Counties of

Crawford, Oscoda, Otsego and Roscommon

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Not Included: Asthma Mortality

Due to the low number of events for the population of North-Central Michigan, asthma mortality rates are not available and therefore are excluded from this report.

Section 1: Asthma Prevalence

Prevalence is the proportion of individuals in a population who have the disease at a point in time or during a given time period. It is often used to describe the health burden on a given population. Using prevalence estimates of current asthma from the Michigan Behavioral Risk Factor Survey (BRFS), estimates of the number with asthma living in each county are given in this section.

Current asthma prevalence is the proportion of survey respondents who reported that in their lifetime a health care professional told them they have asthma and reported “yes” to the question: Do you still have asthma?

The Michigan BRFS is the source of most estimates of the prevalence of certain health behaviors, conditions, and practices associated with leading causes of death. Data are collected quarterly by telephone interview; a sample of telephone numbers is selected using a list-assisted, random-digit dialed methodology.

From this survey, the prevalence of asthma can be determined for adults (≥ 18 years) and children (< 18 years). Data for children are based on information provided by an adult respondent about children living in their home. Due to small sample size, descriptive information regarding children is limited, precluding prevalence analysis by age, race, and sex strata.

Data from the BRFS are designed to estimate prevalence statewide. However, using asthma prevalence for the State of Michigan, we can approximate the number of individuals with asthma in specific counties and local coalitions. In this report, the number of adults (≥ 18 years) with asthma was calculated using the asthma prevalence rates from the 2003 Michigan Behavioral Risk Factor Survey. The number of children with asthma was calculated from the prevalence rates reported in the 2002 Michigan Behavioral Risk Factor Survey.

Number of Children (aged less than 18 years) [1] and Adults (aged 18 years and older) [2] with Asthma in North-Central Michigan [3] and the State of Michigan.

	Children (<18 Years)	Adults (≥18 Years)
	2002	2003
Crawford	306	1,073
Oscoda	191	694
Otsego	563	1,702
Roscommon	451	1,977
North-Central Michigan	1,510	5,446
Michigan	233,894	701,319

1 Number of children with current asthma was calculated by multiplying the population of children in 2002 by the percentage of adults reporting current asthma for children in the home in the 2002 Michigan BRFSS.

2 Number of adults with current asthma was calculated by multiplying the population of adults in 2003 by the percentage reporting current asthma in the 2003 Michigan BRFSS.

3 North-Central Michigan is defined by the Grayling Asthma Project coverage area (Crawford, Oscoda, Otsego, Roscommon Counties).

Data Source: Behavioral Risk Factor Survey, Michigan, 2002 and 2003

Section 2: Hospitalization for Asthma

Preventable hospitalizations are those where timely and effective ambulatory care can prevent the onset of an illness or condition, control an acute episode of an illness, or manage a chronic disease or condition so that hospitalization is unnecessary. Asthma hospitalizations are considered preventable because patients with asthma should be able to stay out of the hospital if they have and use good asthma management techniques.

Hospitalization data was acquired from the Michigan Inpatient Database for the years 1990 to 2002. All hospital discharges from any of Michigan's reporting acute care hospitals or Michigan residents discharged from reporting acute care hospitals in contiguous states are included in this database. It includes virtually all hospitalizations in Michigan and for Michigan residents during this time period.

There is no confirmed case classification for an asthma hospitalization. In accordance with the case definition for a probable asthma hospitalization recommended by the Council for State and Territorial Epidemiologists (CSTE), all inpatient hospitalizations are selected from the database where asthma was the primary reason for the stay. (Position Statement 1998-EH/CD1) These are hospitalizations with primary discharge diagnosis coded to the International Classification of Disease (ICD) Version-9-CM codes 493.XX.

These data are the number of inpatient hospitalizations for asthma. This is not the same as the number of individual people hospitalized for asthma. An individual can be hospitalized more than once for the same condition during the study period and multiple hospitalizations cannot be distinguished from this data source. From these data, age-adjusted asthma hospitalization rates are calculated and presented per 10,000 population. Rates are age adjusted so that valid comparisons can be made between populations of different age distributions.

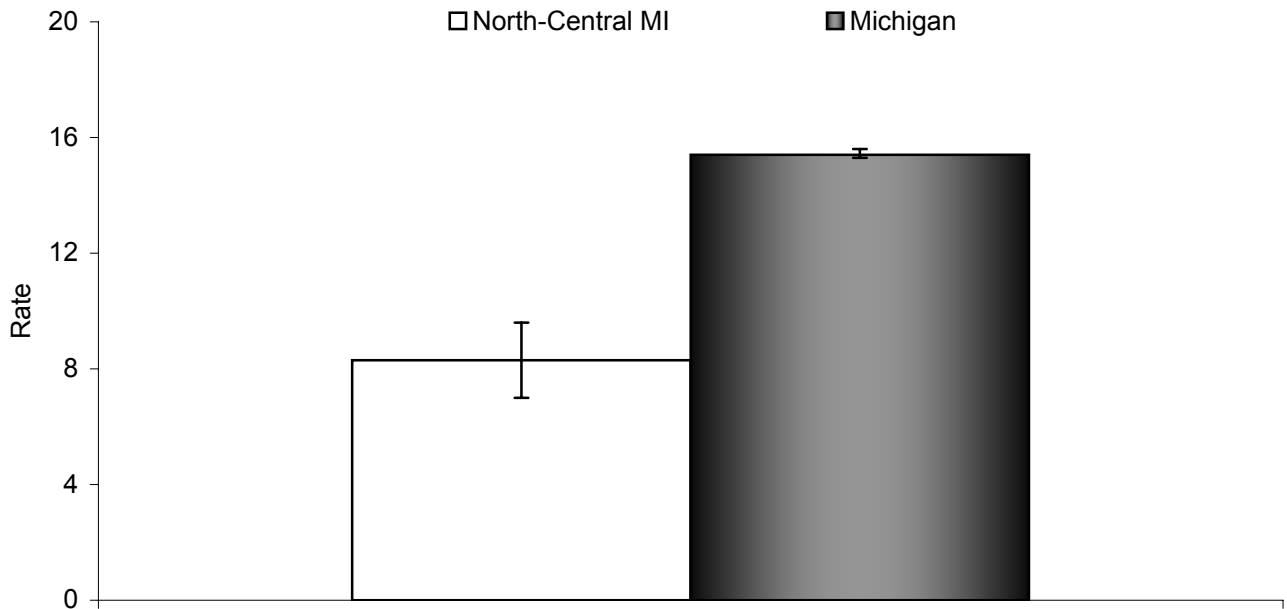
Hospitalization rates for demographic or geographic units with a small number of events (less than or equal to 20 events) or a small population size (less than 5,000 population) are not calculated because these rates are statistically unstable. In addition, to protect the identity of persons who have been hospitalized, counts less than 5 are not presented in this report.

Ninety five percent confidence intervals are computed for hospitalization rates where more than one year of data are combined. The confidence interval estimates the statistical uncertainty of the asthma hospitalization rate and can be used to test whether a specific measure is statistically different between groups. Average asthma hospitalization rates are considered statistically different between groups if their 95% confidence intervals do not overlap. This technique is used to compare rates for demographic subpopulations, such as male versus female, and geographical subpopulations, such as county versus state.

To determine if annual asthma hospitalization rates follow an increasing or decreasing trend over the 13-year period 1990-2002, the Spearman Correlation Coefficient and its accompanying statistical Rank Correlation Test are utilized. This test assesses whether there is a statistically significant monotonic relationship between 2 variables, in this case year and asthma hospitalization rate, without making any assumption about the underlying distribution of the data. This statistical test does not determine the significance of more complex trend patterns. There is no way to know from these statistics if a specific event or series of events caused a change in asthma hospitalization rates.

Due to the low number of events for the black population of North-Central Michigan, asthma hospitalization rates are not available and therefore analyses by race are excluded from this report.

Figure 1. Rates (per 10,000) [1,2] of Hospitalization due to Asthma [3] for North-Central Michigan [4] and the State of Michigan, All Ages, 2000-2002.



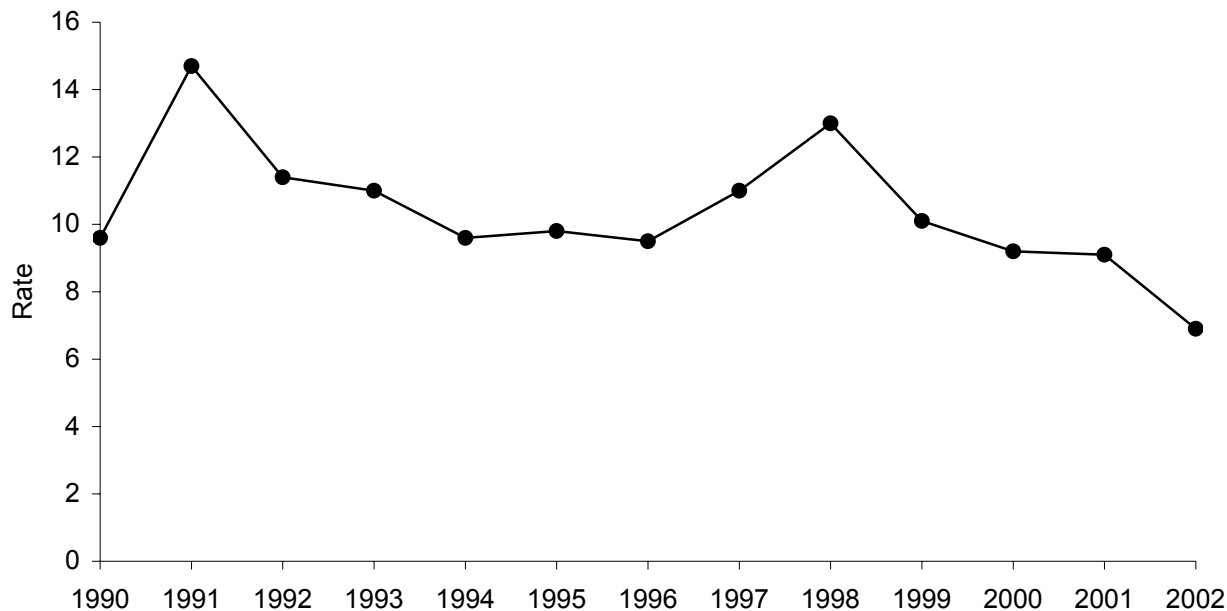
- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 2 Population estimates are taken from the Michigan population estimates for 2001.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
- 4 North-Central Michigan is defined by the Grayling Asthma Project coverage area (Crawford, Oscoda, Otsego, Roscommon Counties).

	Total Population
North-Central MI Rate	8.3
95% CI	7.0 , 9.6
Count	166
Michigan Rate	15.4
95% CI	15.3 , 15.6
Count	45,945

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

- ✧ The average number of hospitalizations due to asthma per year in North-Central Michigan, 2000-2002, is 55.
- ✧ North-Central Michigan has significantly lower asthma hospitalization rates than the State of Michigan as a whole, 2000-2002.

Figure 2. Annual Rates (per 10,000) [1,2] of Asthma [3] Hospitalization, All Ages, for North-Central Michigan [4], 1990-2002.



- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 2 Population estimates are taken from the Michigan population estimates for 1990-2002.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
- 4 North-Central Michigan is defined by the Grayling Asthma Project coverage area (Crawford, Oscoda, Otsego, Roscommon Counties).

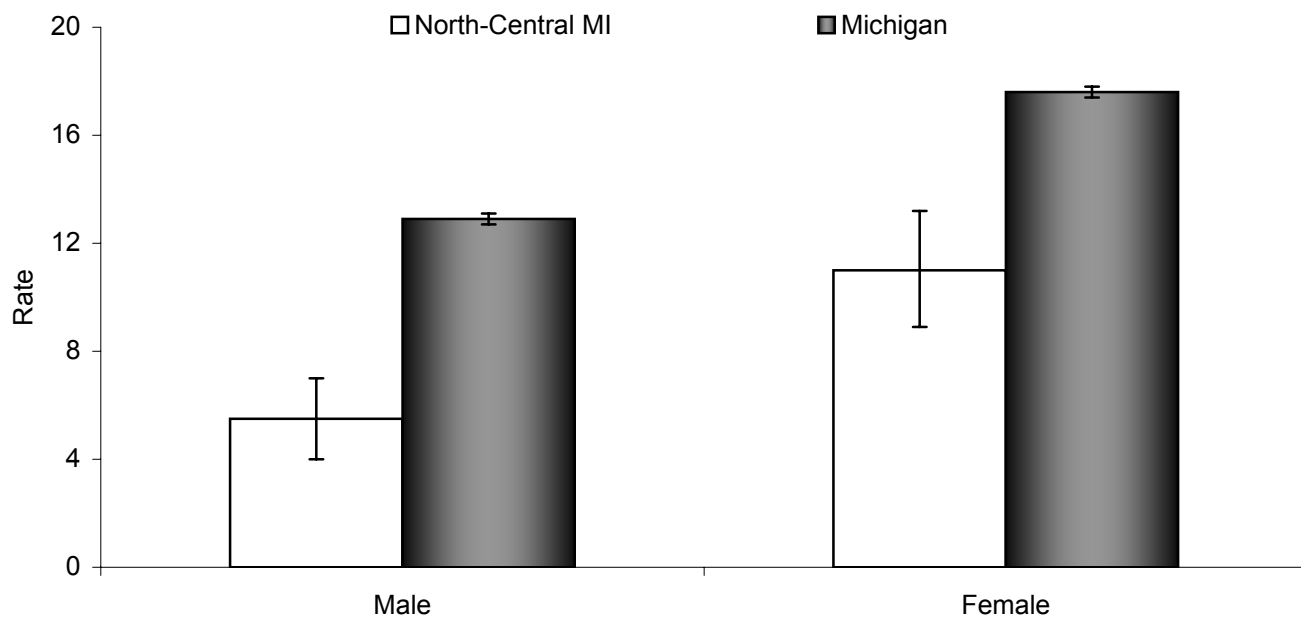
Year	Total Population	
	Rate	Count
1990	9.6	58
1991	14.7	86
1992	11.4	82
1993	11.0	77
1994	9.6	67
1995	9.8	69
1996	9.5	70
1997	11.0	83
1998	13.0	102
1999	10.1	68
2000	9.2	60
2001	9.1	62
2002	6.9	44

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

✧ Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates among persons in North-Central Michigan ($\rho = -0.57$, $p < 0.05$).

See appendix page 23 for supporting data.

Figure 3. Rates (per 10,000) [1,2] of Hospitalization due to Asthma [3] by Sex for North-Central Michigan [4] and the State of Michigan, All Ages, 2000-2002.



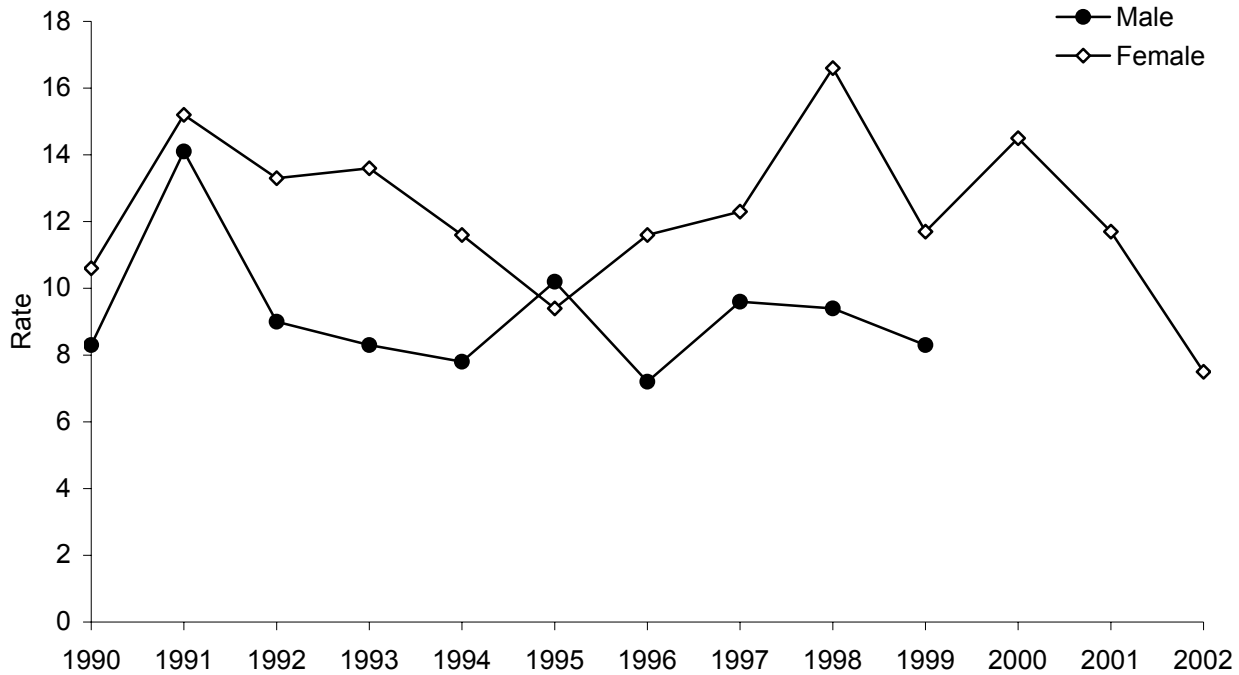
- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 2 Population estimates are taken from the Michigan population estimates for 2001.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
- 4 North-Central Michigan is defined by the Grayling Asthma Project coverage area (Crawford, Oscoda, Otsego, Roscommon Counties).

	Male	Female
North-Central MI Rate	5.5	11.0
95% CI	4.0 , 7.0	8.9 , 13.2
Count	54	112
Michigan Rate	12.9	17.6
95% CI	12.7 , 13.1	17.4 , 17.8
Count	18,987	26,958

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

- ✧ The asthma hospitalization rates for males and females in North-Central Michigan are significantly lower than the respective rates for the State of Michigan as a whole, 2000-2002.
- ✧ In North-Central Michigan and the State of Michigan, females have significantly higher asthma hospitalization rates than males, 2000-2002.

Figure 4. Annual Rates (per 10,000) [1,2] of Asthma [3] Hospitalization by Sex, All Ages, for North-Central Michigan [4], 1990-2002.



- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 2 Population estimates are taken from the Michigan population estimates for 1990-2002.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
- 4 North-Central Michigan is defined by the Grayling Asthma Project coverage area (Crawford, Oscoda, Otsego, Roscommon Counties).

Year	Male		Female	
	Rate	Count	Rate	Count
1990	8.3	25	10.6	33
1991	14.1	39	15.2	47
1992	9.0	33	13.3	48
1993	8.3	28	13.6	49
1994	7.8	27	11.6	40
1995	10.2	34	9.4	35
1996	7.2	25	11.6	45
1997	9.6	36	12.3	47
1998	9.4	36	16.6	66
1999	8.3	26	11.7	42
2000	‡	15	14.5	45
2001	‡	20	11.7	42
2002	‡	19	7.5	25

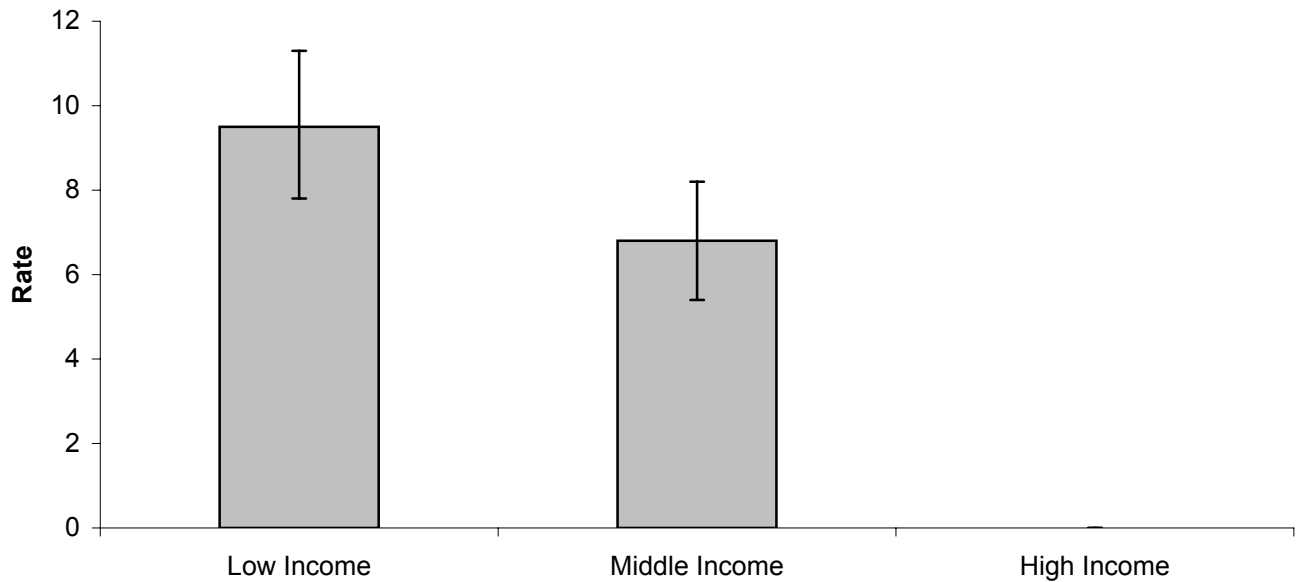
‡ Insufficient data to compute a stable rate (number of events ≤20 or population <5000).

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

✧ Between 1990 and 2002, there has not been a significant trend in asthma hospitalization rates for the female population in North-Central Michigan.

See appendix pages 24 and 25 for supporting data.

Figure 5. Rates (per 10,000) [1,2] of Hospitalization due to Asthma [3] by Income [4] for North-Central Michigan [5], 2000-2002.



- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 2 Populations are taken from the 2000 US Census.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
- 4 High income = top 20% of Michigan's zip code areas, as determined by median household income from Census 2000; Low income = bottom 20% of Michigan's zip code areas, as determined by median household income from Census 2000; all others are considered middle income.
- 5 North-Central Michigan is defined by the Grayling Asthma Project coverage area (Crawford, Oscoda, Otsego, Roscommon Counties).

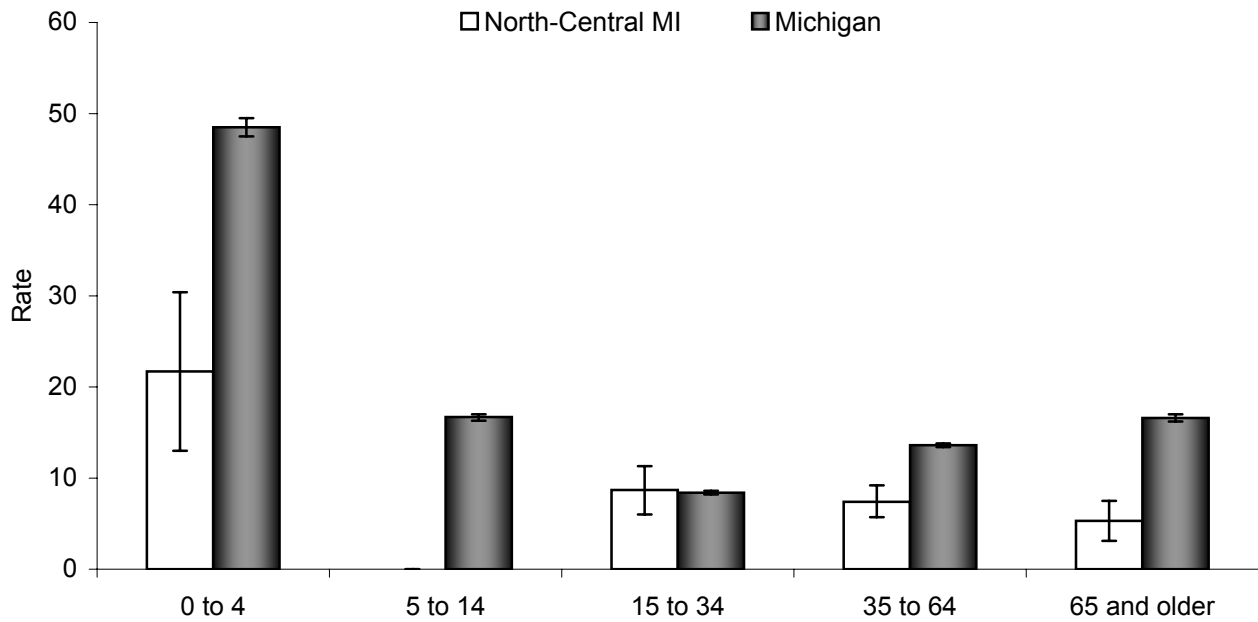
	Low Income	Middle Income	High Income
North-Central MI Rate	9.5	6.8	‡
95% CI	7.8 , 11.3	5.4 , 8.2	‡ , ‡
Count	124	95	~

- ‡ Insufficient data to compute a stable rate (number of events ≤ 20 or population < 5000).
 ~ Number of hospitalizations < 5 .

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

✧ In North-Central Michigan, the asthma hospitalization rate for middle income areas is not significantly different than the rate for low income areas, 2000-2002.

Figure 6. Rates (per 10,000) [1] of Hospitalization due to Asthma [2] by Age Group for North-Central Michigan [3] and the State of Michigan, 2000-2002.



1 Population estimates are taken from the Michigan population estimates for 2001.

2 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

3 North-Central Michigan is defined by the Grayling Asthma Project coverage area (Crawford, Oscoda, Otsego, Roscommon Counties).

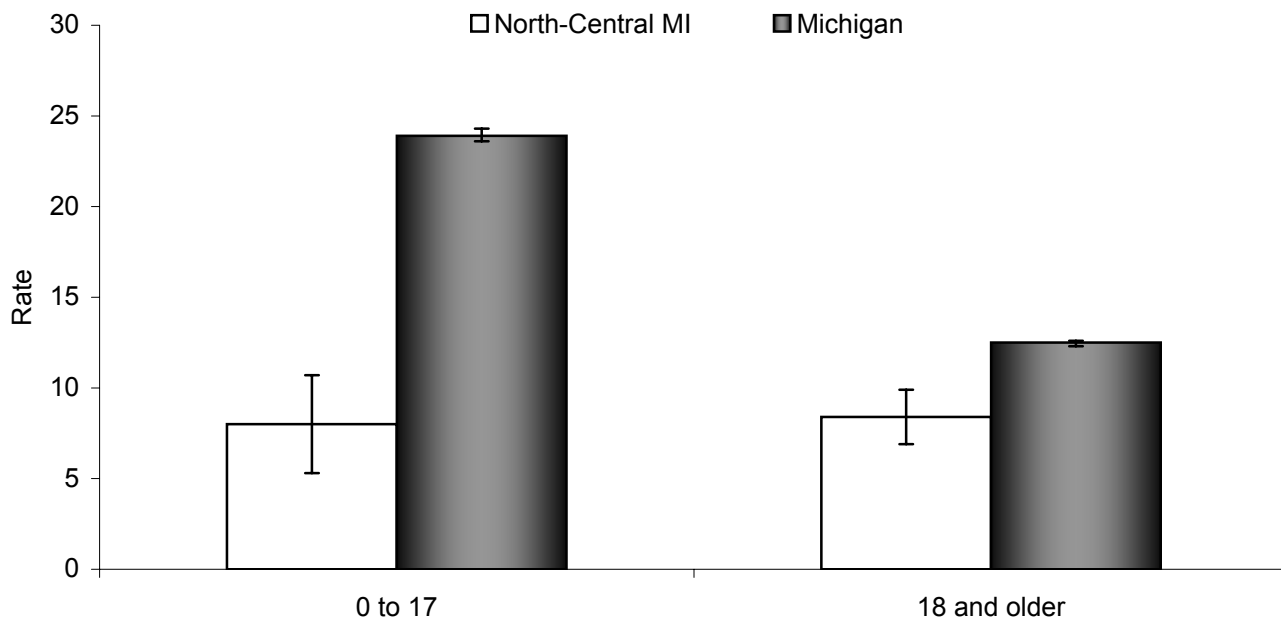
	0 to 4	5 to 14	15 to 34	35 to 64	65 and older
North-Central MI Rate	21.7	†	8.7	7.4	5.3
95% CI	13.0 , 30.4	† , †	6.0 , 11.3	5.7 , 9.2	3.1 , 7.5
Count	24	11	41	68	22
Michigan Rate	48.5	16.7	8.4	13.6	16.6
95% CI	47.5 , 49.5	16.3 , 17.0	8.2 , 8.6	13.4 , 13.8	16.2 , 17.0
Count	9,637	7,375	6,859	15,964	6,110

† Insufficient data to compute a stable rate (number of events ≤20 or population <5000).

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

- ✧ For North-Central Michigan and the State of Michigan, children aged 0 to 4 years have significantly higher rates of asthma hospitalization than all other age groups, 2000-2002.
- ✧ The asthma hospitalization rates for persons aged 0 to 4, 35 to 64, and 65 years and older in North-Central Michigan are significantly lower than respective rates for the State of Michigan as a whole, 2000-2002.

Figure 7. Rates (per 10,000) [1,2] of Hospitalization due to Asthma [3] by Age Group for North-Central Michigan [4] and the State of Michigan, 2000-2002.



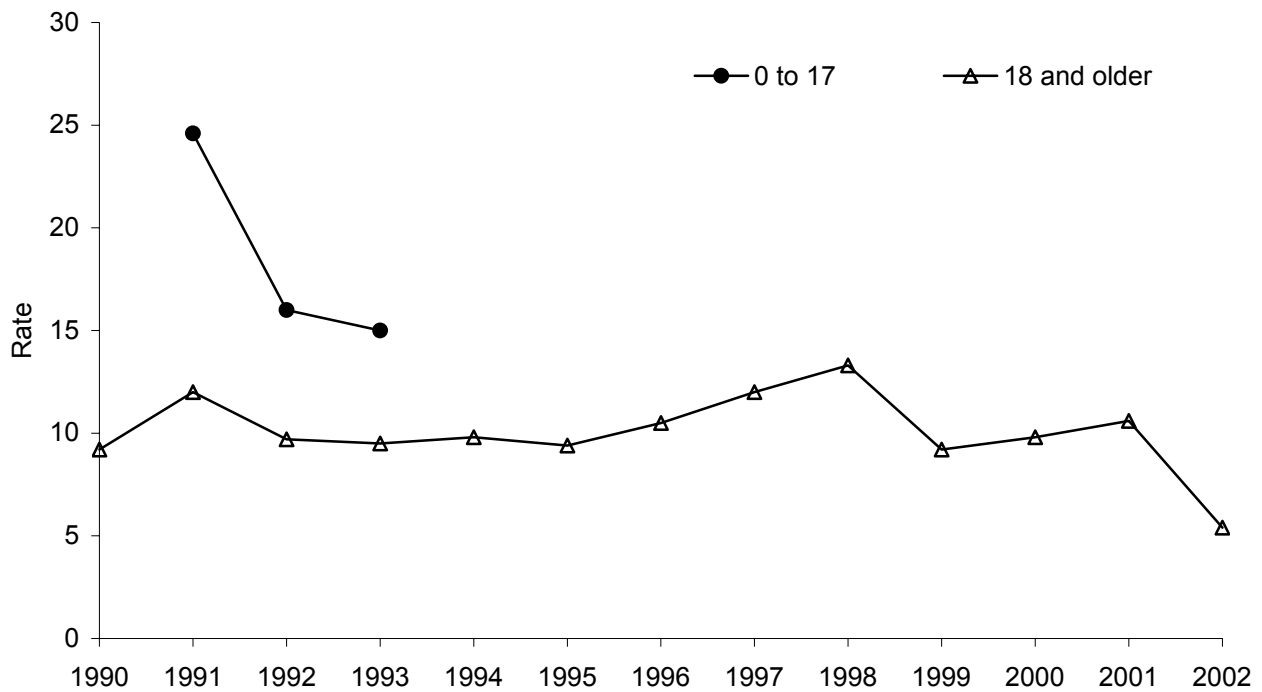
- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 2 Population estimates are taken from the Michigan population estimates for 2001.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
- 4 North-Central Michigan is defined by the Grayling Asthma Project coverage area (Crawford, Oscoda, Otsego, Roscommon Counties).

	0 to 17	18 and Older
North-Central MI Rate	8.0	8.4
95% CI	5.3 , 10.7	6.9 , 9.9
Count	35	131
Michigan Rate	23.9	12.5
95% CI	23.6 , 24.3	12.3 , 12.6
Count	18,141	27,804

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

- ✧ For North-Central Michigan, the rate of asthma hospitalization for children less than 18 years of age is not significantly different than that for adults aged 18 years and older, 2000-2002.
- ✧ The rates of asthma hospitalization for children less than 18 years of age and adults aged 18 years and older in North-Central Michigan are significantly lower than the respective rates for the State of Michigan as a whole, 2000-2002.

Figure 8. Annual Rates (per 10,000) [1,2] of Asthma [3] Hospitalization by Age Group for North-Central Michigan [4], 1990-2002.



- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 2 Population estimates are taken from the Michigan population estimates for 1990-2002.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
- 4 North-Central Michigan is defined by the Grayling Asthma Project coverage area (Crawford, Oscoda, Otsego, Roscommon Counties).

Year	0 to 17		18 and Older	
	Rate	Count	Rate	Count
1990	‡	16	9.2	42
1991	24.6	36	12.0	50
1992	16.0	24	9.7	58
1993	15.0	23	9.5	54
1994	‡	14	9.8	53
1995	‡	17	9.4	52
1996	‡	10	10.5	60
1997	‡	13	12.0	70
1998	‡	19	13.3	83
1999	‡	19	9.2	49
2000	‡	11	9.8	49
2001	‡	7	10.6	55
2002	‡	17	5.4	27

‡ Insufficient data to compute a stable rate (number of events ≤20 or population <5000).

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

✧ Between 1990 and 2002, there has not been a significant trend in asthma hospitalization rates for adults aged 18 years and older in North-Central Michigan.

See appendix pages 31 and 32 for supporting data.

Rates (per 10,000) [1,2] of Hospitalization due to Asthma [3] by Zip Code of Residence, North-Central Michigan [4], All Ages, 2000-2002.

Zip Code	Count	Rate	95% Confidence Interval	
			Lower Limit	Upper Limit
48619	~	‡	‡	‡
48621	6	‡	‡	‡
48624	36	7.2	4.7	9.6
48627	~	‡	‡	‡
48629	27	18.1	11.2	25.0
48630	~	‡	‡	‡
48636	~	‡	‡	‡
48647	8	‡	‡	‡
48651	12	‡	‡	‡
48653	15	‡	‡	‡
48654	6	‡	‡	‡
48656	18	‡	‡	‡
48728	~	‡	‡	‡
48761	~	‡	‡	‡
49730	~	‡	‡	‡
49733	6	‡	‡	‡
49735	29	5.4	3.4	7.4
49738	31	10.0	6.4	13.5
49751	~	‡	‡	‡
49756	6	‡	‡	‡
49795	10	‡	‡	‡
North-Central MI	166	8.3	7.0	9.6

1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.

2 Populations are taken from the 2000 US Census.

3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

4 North-Central Michigan is defined by the Grayling Asthma Project coverage area (Crawford, Oscoda, Otsego, Roscommon Counties).

‡ Insufficient data to compute a stable rate (number of events ≤20 or population <5000).

~ Number of hospitalizations <5.

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

Section 3: *Healthy People 2010* Objectives for Asthma

The U.S. Department of Health and Human Services has developed *Healthy People 2010*, a set of disease prevention and health promotion objectives for the nation to achieve over the first decade of the new century. Although neither the United States nor Michigan have met all the *Healthy People 2010* targets for asthma, Michigan has had some success in reaching particular asthma objectives for some populations. For more information about the *Healthy People 2010* initiative, visit their website: <http://www.healthypeople.gov>.

The following asthma hospitalization figures provide information for Crawford, Oscoda, Otsego, and Roscommon Counties, North-Central Michigan, and the State of Michigan, as compared to the *Healthy People 2010* targets for asthma.

Selected *Healthy People 2010* Objectives Related to Asthma for which North-Central Michigan Data are Available for Comparison.

Objective 1-9a: Reduce hospitalization rates for three ambulatory-care-sensitive conditions: pediatric asthma, uncontrolled diabetes, and immunization preventable pneumonia and influenza.

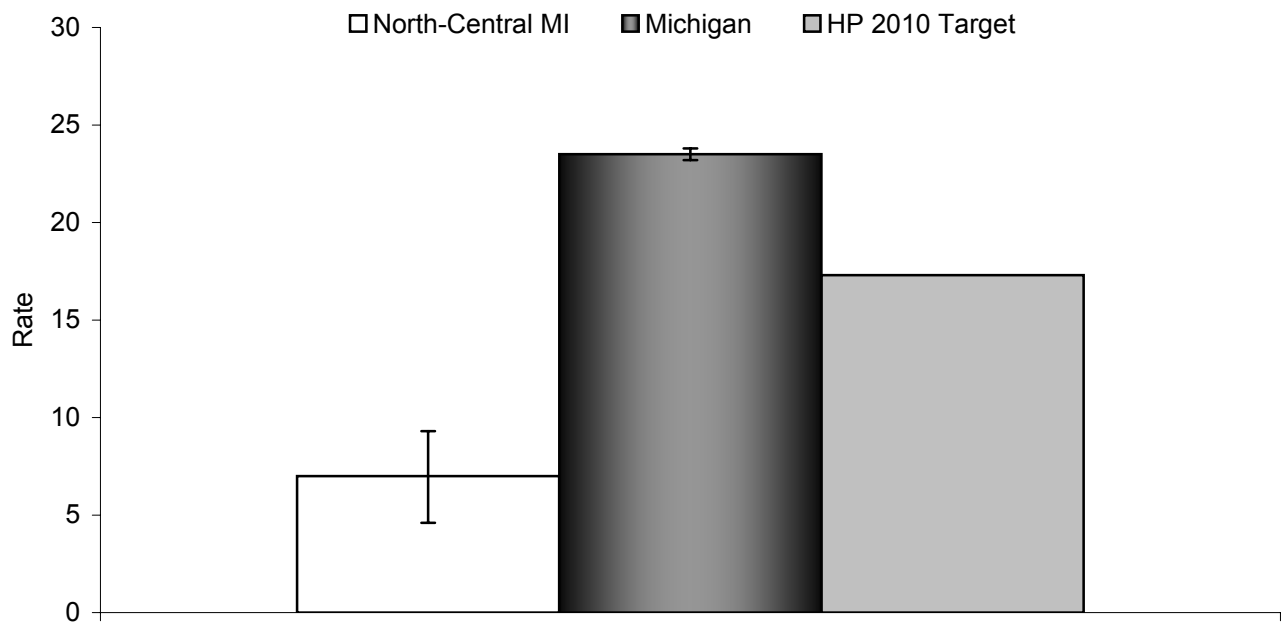
Target: 17.3 per 10,000 (age 0-17 years)

Objective 24-2: Reduce hospitalizations for asthma.

Targets: 25 per 10,000 (age 0-4 years)
7.7 per 10,000 (age 5-64 years*)
11 per 10,000 (age ≥65 years*)

*Age adjusted to the 2000 U.S. standard population.

Figure 9. Rates (per 10,000) [1,2] of Hospitalization due to Asthma [3] for Children (aged less than 18 years) in North-Central Michigan [4] and the State of Michigan, 2000-2002, Compared to the Healthy People 2010 Target (Objective 1-9a).



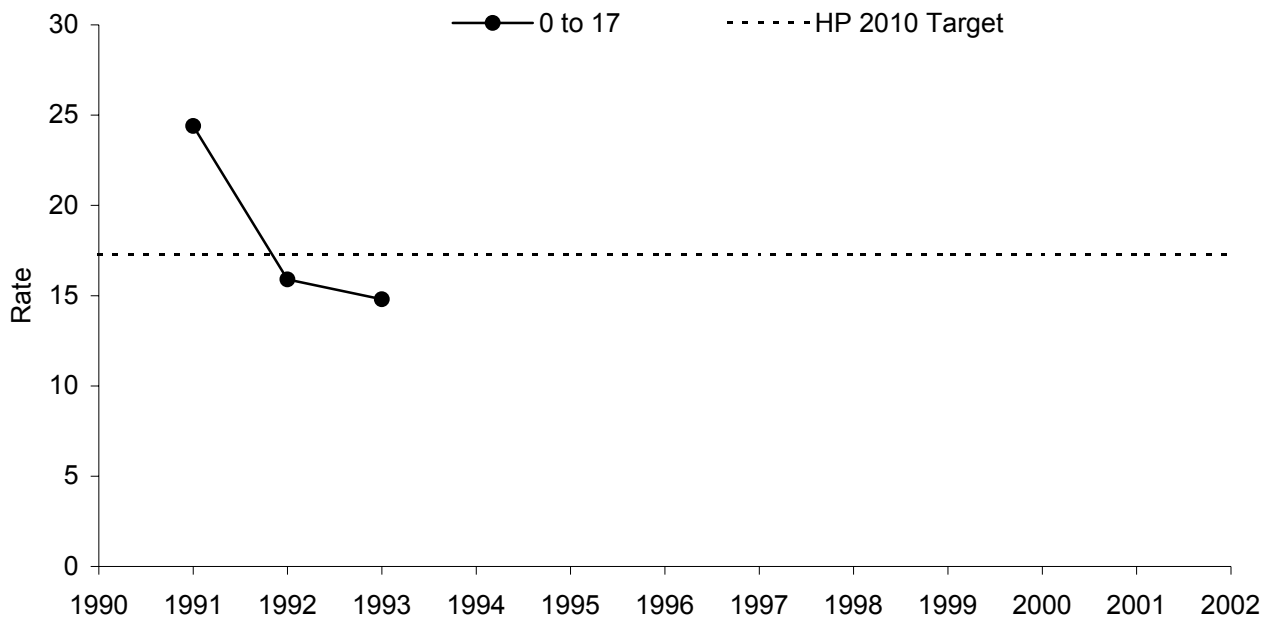
- 1 Population estimates are taken from the Michigan population estimates for 2001.
- 2 Not age adjusted in accordance with analysis prescribed by Healthy People 2010 Objectives.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
- 4 North-Central Michigan is defined by the Grayling Asthma Project coverage area (Crawford, Oscoda, Otsego, Roscommon Counties).

	Total Population
North-Central MI Rate	7.0
95% CI	4.6 , 9.3
Count	35
Michigan Rate	23.5
95% CI	23.2 , 23.8
Count	18,141
HP 2010 Target	17.3

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

- ✧ The average number of hospitalizations due to asthma per year for children aged less than 18 years in North-Central Michigan, 2000-2002, is 12.
- ✧ The rate of asthma hospitalization for children aged less than 18 years in North-Central Michigan, 2000-2002, is significantly lower than the *Healthy People 2010* objective.

Figure 10. Annual Rates (per 10,000) [1,2] of Asthma [3] Hospitalization for Children (aged less than 18 years) in North-Central Michigan [4], 1990-2002, Compared to the Healthy People 2010 Target (Objective 1-9a).



- 1 Population estimates are taken from the Michigan population estimates for 1990-2002.
- 2 Not age adjusted in accordance with analysis prescribed by Healthy People 2010 Objectives.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
- 4 North-Central Michigan is defined by the Grayling Asthma Project coverage area (Crawford, Oscoda, Otsego, Roscommon Counties).

Year	0 to 17	
	Rate	Count
1990	‡	16
1991	24.4	36
1992	15.9	24
1993	14.8	23
1994	‡	14
1995	‡	17
1996	‡	10
1997	‡	13
1998	‡	19
1999	‡	19
2000	‡	11
2001	‡	7
2002	‡	17

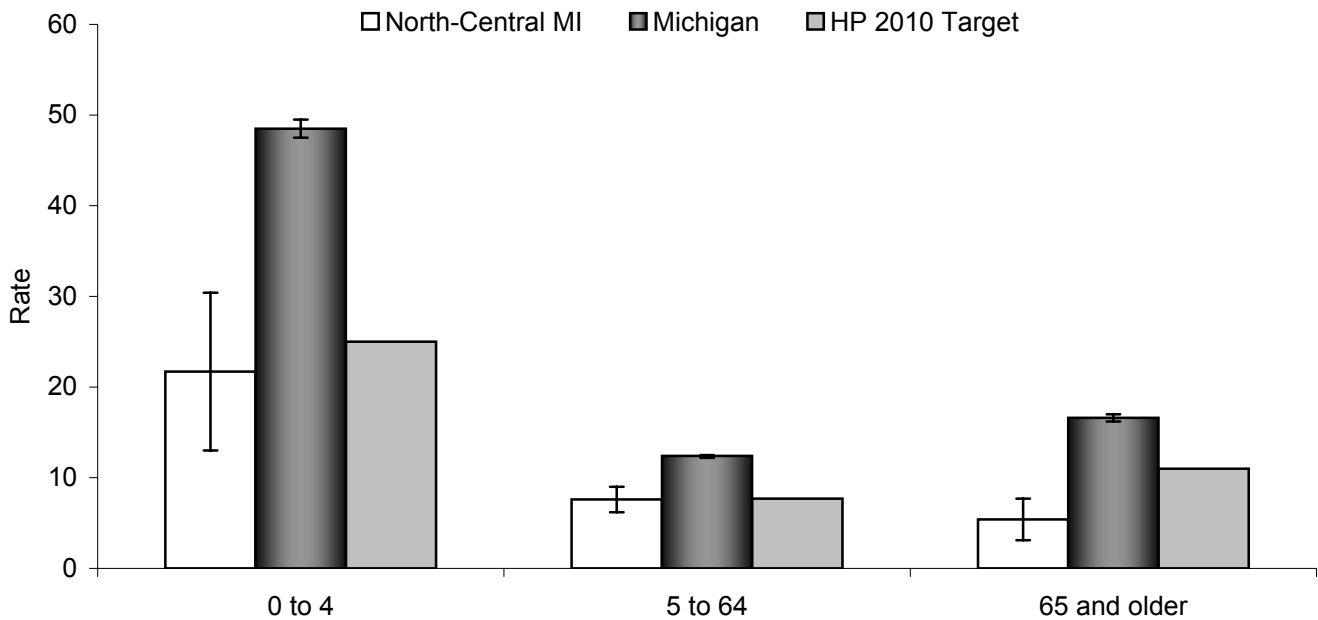
HP 2010 Target	17.3
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‡ Insufficient data to compute a stable rate (number of events ≤20 or population <5000).

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

See appendix page 37 for supporting data.

Figure 11. Rates (per 10,000) [1,2] of Hospitalization due to Asthma [3] by Age Group for North-Central Michigan [4] and the State of Michigan, 2000-2002, Compared to the Healthy People 2010 Targets (Objective 24-2).



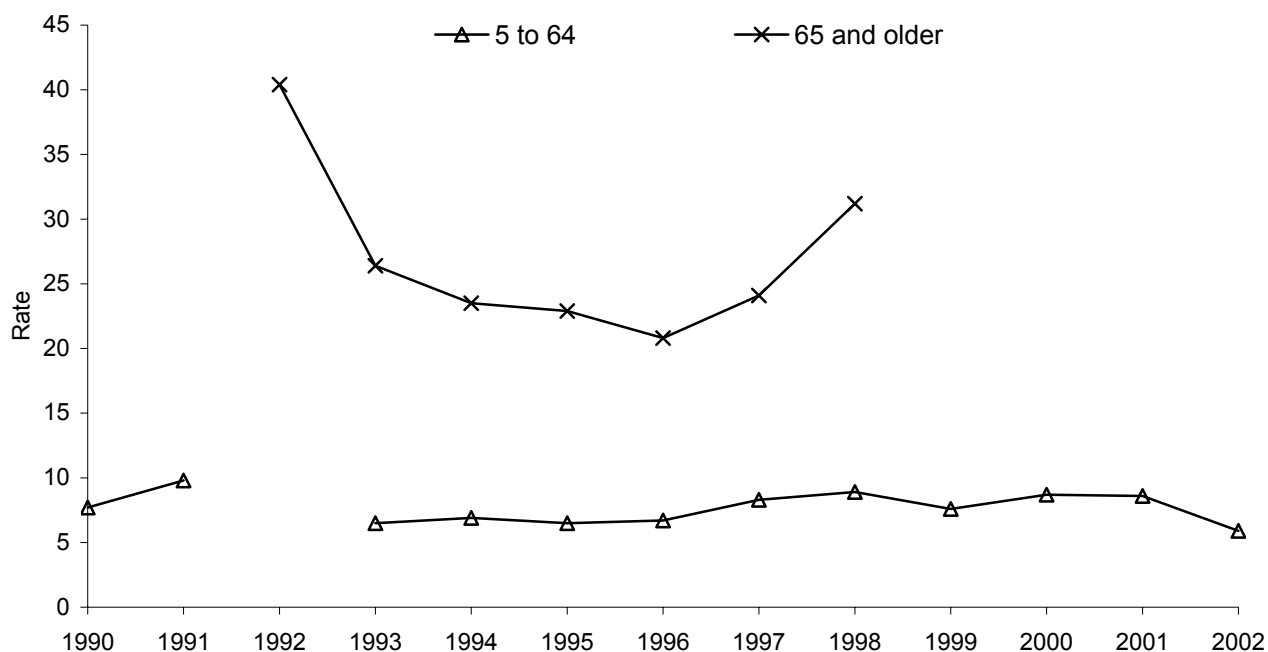
- 1 For age group 5-64 years and age group 65 and older, rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 2 Population estimates are taken from the Michigan population estimates for 2001.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
- 4 North-Central Michigan is defined by the Grayling Asthma Project coverage area (Crawford, Oscoda, Otsego, Roscommon Counties).

	0 to 4	5 to 64	65 and Older
North-Central MI Rate	21.7	7.6	5.4
95% CI	13.0 , 30.4	6.2 , 9.0	3.1 , 7.7
Count	24	120	22
Michigan Rate	48.5	12.4	16.6
95% CI	47.5 , 49.5	12.2 , 12.5	16.2 , 17.0
Count	9,637	30,198	6,110
HP 2010 Target	25.0	7.7	11.0

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

- ✧ The rate of asthma hospitalization in North-Central Michigan is significantly lower than the *Healthy People 2010* Target Rate for persons aged 65 years and older, 2000-2002.
- ✧ The rate of asthma hospitalization in North-Central Michigan is significantly lower than the rate for Michigan as a whole for all age groups, 2000-2002.

Figure 12. Annual Rates (per 10,000) [1,2] of Asthma [3] Hospitalization by Age Group for North-Central Michigan [4], 1990-2002, Compared to the Healthy People 2010 Targets (Objective 24-2).



- 1 For age group 5-64 years and age group 65 and older, rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 2 Population estimates are taken from the Michigan population estimates for 1990-2002.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
- 4 North-Central Michigan is defined by the Grayling Asthma Project coverage area (Crawford, Oscoda, Otsego, Roscommon Counties).

Year	0 to 4		5 to 64		65 and Older	
	Rate	Count	Rate	Count	Rate	Count
1990	‡	6	7.7	33	‡	19
1991	‡	27	9.8	41	‡	18
1992	‡	17	‡	19	40.4	46
1993	‡	14	6.5	32	26.4	31
1994	‡	6	6.9	32	23.5	29
1995	‡	10	6.5	33	22.9	26
1996	‡	8	6.7	37	20.8	25
1997	‡	7	8.3	46	24.1	30
1998	‡	11	8.9	50	31.2	41
1999	‡	15	7.6	39	‡	14
2000	‡	7	8.7	44	‡	9
2001	‡	7	8.6	45	‡	10
2002	‡	10	5.9	31	‡	3
HP 2010 Target	25.0		7.7		11.0	

‡ Insufficient data to compute a stable rate (number of events ≤20 or population <5000).

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

See appendix pages 38 through 40 for supporting data.

Section 4: Appendix

This appendix includes a compilation of supporting data tables presenting annual hospitalization rates for Crawford, Oscoda, Otsego, and Roscommon Counties, North-Central Michigan, and the State of Michigan. It also includes a summary for each North-Central Michigan county of 3-year hospitalization rates by age, race, and sex strata.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year, All Ages, for Crawford, Oscoda, Otsego, and Roscommon Counties, North-Central Michigan [5], and the State of Michigan, 1990-2002.

Year	Crawford		Oscoda		Otsego		Roscommon		North-Central MI		Michigan	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	‡	12	‡	7	‡	15	11.9	24	9.6	58	19.1	17,790
1991	‡	5	‡	11	18.4	33	18.4	37	14.7	86	18.1	16,995
1992	‡	10	‡	13	10.6	21	13.7	38	11.4	82	18.4	17,597
1993	‡	9	‡	9	‡	15	16.2	44	11.0	77	19.8	18,975
1994	‡	7	‡	11	‡	17	13.4	32	9.6	67	18.4	17,609
1995	‡	12	‡	11	‡	19	8.5	27	9.8	69	19.5	18,945
1996	‡	7	‡	17	‡	11	12.6	35	9.5	70	18.5	18,058
1997	‡	11	‡	11	‡	13	15.5	48	11.0	83	17.7	17,320
1998	‡	15	‡	18	‡	18	16.2	51	13.0	102	15.6	15,289
1999	‡	16	‡	13	‡	9	12.7	30	10.1	68	15.6	15,385
2000	‡	11	‡	8	‡	10	16.6	31	9.2	60	16.0	15,886
2001	‡	~	‡	~	‡	18	11.7	27	9.1	62	15.5	15,363
2002	‡	~	‡	~	‡	14	‡	16	6.9	44	14.7	14,696

Spearman's ρ	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	-0.57*	-0.79**
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- 1 Population estimates are taken from the Michigan population estimates for 1990-2002.
- 2 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
- 4 Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.
- 5 North-Central Michigan is defined by the Grayling Asthma Project coverage area (Crawford, Oscoda, Otsego, Roscommon Counties).
- ‡ Insufficient data to compute a stable rate (number of events ≤ 20 or population < 5000).
- ~ Due to a low number of events, data are suppressed.
- * Correlation is statistically significant; p-value < 0.05 .
- ** Correlation is statistically significant; p-value < 0.01 .
- ‡ Insufficient data to compute Spearman Correlation Coefficient.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization in Michigan was 14.7 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates in Michigan.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for MALES All Ages, for Crawford, Oscoda, Otsego, and Roscommon Counties, North-Central Michigan [5], and the State of Michigan, 1990-2002.

Year	Crawford		Oscoda		Otsego		Roscommon		North-Central MI		Michigan	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	‡	~	‡	~	‡	9	‡	10	8.3	25	17.1	7,951
1991	‡	~	‡	~	‡	20	‡	16	14.1	39	15.7	7,345
1992	‡	6	‡	6	‡	7	‡	14	9.0	33	16.1	7,666
1993	‡	~	‡	~	‡	6	‡	14	8.3	28	16.6	7,929
1994	‡	~	‡	~	‡	10	‡	11	7.8	27	15.4	7,339
1995	‡	~	‡	~	‡	12	‡	15	10.2	34	17.1	8,275
1996	‡	~	‡	~	‡	~	‡	14	7.2	25	15.9	7,725
1997	‡	~	‡	~	‡	8	‡	19	9.6	36	15.4	7,546
1998	‡	~	‡	~	‡	11	‡	19	9.4	36	12.7	6,199
1999	‡	~	‡	~	‡	7	‡	13	8.3	26	12.7	6,229
2000	‡	~	‡	~	‡	~	‡	7	‡	15	13.7	6,745
2001	‡	~	‡	~	‡	7	‡	9	‡	20	12.8	6,271
2002	‡	6	‡	~	‡	8	‡	~	‡	19	12.2	5,971

Spearman's ρ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	-0.82**
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- 1 Population estimates are taken from the Michigan population estimates for 1990-2002.
- 2 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
- 4 Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.
- 5 North-Central Michigan is defined by the Grayling Asthma Project coverage area (Crawford, Oscoda, Otsego, Roscommon Counties).
- ‡ Insufficient data to compute a stable rate (number of events ≤ 20 or population < 5000).
- ~ Due to a low number of events, data are suppressed.
- ** Correlation is statistically significant; p-value < 0.01 .
- Ψ Insufficient data to compute Spearman Correlation Coefficient.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among males in Michigan was 12.2 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates for males in Michigan.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for FEMALES, All Ages, for Crawford, Oscoda, Otsego, and Roscommon Counties, North-Central Michigan [5], and the State of Michigan, 1990-2002.

Year	Crawford		Oscoda		Otsego		Roscommon		North-Central MI		Michigan	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	‡	8	‡	5	‡	6	‡	14	10.6	33	20.6	9,834
1991	‡	~	‡	~	‡	13	21.5	21	15.2	47	20.0	9,648
1992	‡	~	‡	~	‡	14	18.0	23	13.3	48	20.3	9,927
1993	‡	~	‡	~	‡	9	23.4	30	13.6	49	22.6	11,043
1994	‡	5	‡	7	‡	7	19.2	21	11.6	40	20.9	10,269
1995	‡	8	‡	8	‡	7	‡	12	9.4	35	21.6	10,668
1996	‡	~	‡	14	‡	~	13.1	21	11.6	45	20.8	10,333
1997	‡	7	‡	6	‡	5	19.0	29	12.3	47	19.6	9,774
1998	‡	13	‡	14	‡	7	21.1	32	16.6	66	18.1	9,089
1999	‡	12	‡	~	‡	~	‡	17	11.7	42	18.1	9,155
2000	‡	7	‡	6	‡	8	27.3	24	14.5	45	18.0	9,141
2001	‡	~	‡	~	‡	11	‡	18	11.7	42	17.8	9,092
2002	‡	~	‡	~	‡	6	‡	13	7.5	25	16.9	8,725

Spearman's ρ	Ψ	Ψ	Ψ	Ψ	Ψ	-0.11	-0.76**
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- 1 Population estimates are taken from the Michigan population estimates for 1990-2002.
- 2 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
- 4 Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.
- 5 North-Central Michigan is defined by the Grayling Asthma Project coverage area (Crawford, Oscoda, Otsego, Roscommon Counties).
- ‡ Insufficient data to compute a stable rate (number of events ≤ 20 or population < 5000).
- ~ Due to a low number of events, data are suppressed.
- ** Correlation is statistically significant; p-value < 0.01 .
- Ψ Insufficient data to compute Spearman Correlation Coefficient.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among females in Michigan was 16.9 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates for females in Michigan.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for CHILDREN Aged 0 to 4 Years, for Crawford, Oscoda, Otsego, and Roscommon Counties, North-Central Michigan [5], and the State of Michigan, 1990-2002.

Year	Crawford		Oscoda		Otsego		Roscommon		North-Central MI		Michigan	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	‡	~	‡	~	‡	5	‡	~	‡	6	66.1	4,712
1991	‡	~	‡	~	‡	9	‡	15	‡	27	57.1	4,106
1992	‡	~	‡	~	‡	8	‡	6	‡	17	64.4	4,638
1993	‡	~	‡	~	‡	6	‡	7	‡	14	59.6	4,291
1994	‡	~	‡	~	‡	~	‡	~	‡	6	53.2	3,783
1995	‡	~	‡	~	‡	5	‡	~	‡	10	63.9	4,457
1996	‡	~	‡	~	‡	~	‡	~	‡	8	59.6	4,092
1997	‡	~	‡	~	‡	~	‡	~	‡	7	59.2	4,019
1998	‡	~	‡	~	‡	6	‡	~	‡	11	40.5	2,734
1999	‡	5	‡	~	‡	~	‡	6	‡	15	40.6	2,725
2000	‡	~	‡	~	‡	~	‡	~	‡	7	48.8	3,257
2001	‡	~	‡	~	‡	~	‡	~	‡	7	50.5	3,341
2002	‡	~	‡	~	‡	5	‡	~	‡	10	45.8	3,039

Spearman's ρ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	-0.76**
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¹ Population estimates are taken from the Michigan population estimates for 1990-2002.

² Rates are not age adjusted. Hospitalization records with missing age are excluded.

³ Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

⁴ Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

⁵ North-Central Michigan is defined by the Grayling Asthma Project coverage area (Crawford, Oscoda, Otsego, Roscommon Counties).

‡ Insufficient data to compute a stable rate (number of events ≤ 20 or population < 5000).

~ Due to a low number of events, data are suppressed.

** Correlation is statistically significant; p-value < 0.01 .

Ψ Insufficient data to compute Spearman Correlation Coefficient.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among children 0 to 4 years in Michigan was 45.8 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates for children 0 to 4 years in Michigan.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for CHILDREN Aged 5 to 14 Years, for Crawford, Oscoda, Otsego, and Roscommon Counties, North-Central Michigan [5], and the State of Michigan, 1990-2002.

Year	Crawford		Oscoda		Otsego		Roscommon		North-Central MI		Michigan	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	‡	~	‡	~	‡	~	‡	~	‡	9	20.9	2,826
1991	‡	~	‡	~	‡	~	‡	~	‡	~	19.4	2,666
1992	‡	~	‡	~	‡	~	‡	~	‡	6	18.5	2,571
1993	‡	~	‡	~	‡	~	‡	~	‡	8	21.1	2,972
1994	‡	~	‡	~	‡	~	‡	~	‡	5	17.1	2,418
1995	‡	~	‡	~	‡	~	‡	~	‡	5	21.9	3,152
1996	‡	~	‡	~	‡	~	‡	~	‡	~	21.4	3,113
1997	‡	~	‡	~	‡	~	‡	~	‡	5	22.1	3,244
1998	‡	~	‡	~	‡	~	‡	~	‡	5	16.8	2,491
1999	‡	~	‡	~	‡	~	‡	~	‡	~	16.8	2,497
2000	‡	~	‡	~	‡	~	‡	~	‡	~	20.4	3,010
2001	‡	~	‡	~	‡	~	‡	~	‡	~	16.0	2,363
2002	‡	~	‡	~	‡	~	‡	~	‡	7	13.7	2,002

Spearman's ρ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	-0.48
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¹ Population estimates are taken from the Michigan population estimates for 1990-2002.

² Rates are not age adjusted. Hospitalization records with missing age are excluded.

³ Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

⁴ Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

⁵ North-Central Michigan is defined by the Grayling Asthma Project coverage area (Crawford, Oscoda, Otsego, Roscommon Counties).

‡ Insufficient data to compute a stable rate (number of events ≤ 20 or population < 5000).

~ Due to a low number of events, data are suppressed.

ψ Insufficient data to compute Spearman Correlation Coefficient.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among children 5 to 14 years in Michigan was 13.7 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, a significant overall trend in asthma hospitalization rates has not been observed for children 5 to 14 years in Michigan.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for CHILDREN/ADULTS Aged 15 to 34 Years, for Crawford, Oscoda, Otsego, and Roscommon Counties, North-Central Michigan [5], and the State of Michigan, 1990-2002.

Year	Crawford		Oscoda		Otsego		Roscommon		North-Central MI		Michigan	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	‡	~	‡	~	‡	~	‡	~	‡	8	9.1	2,709
1991	‡	~	‡	~	‡	16	‡	~	17.8	26	8.9	2,628
1992	‡	~	‡	~	‡	~	‡	~	‡	5	9.8	2,839
1993	‡	~	‡	~	‡	~	‡	~	‡	6	11.7	3,352
1994	‡	~	‡	~	‡	6	‡	~	‡	10	10.9	3,081
1995	‡	~	‡	~	‡	7	‡	~	‡	12	11.8	3,341
1996	‡	~	‡	~	‡	~	‡	~	‡	7	11.5	3,220
1997	‡	~	‡	~	‡	~	‡	5	‡	13	10.6	2,959
1998	‡	~	‡	~	‡	~	‡	~	‡	11	10.0	2,755
1999	‡	~	‡	~	‡	6	‡	~	‡	12	9.2	2,526
2000	‡	~	‡	~	‡	~	‡	10	‡	13	9.2	2,502
2001	‡	~	‡	~	‡	10	‡	5	‡	17	8.2	2,253
2002	‡	~	‡	~	‡	~	‡	7	‡	11	7.7	2,104

Spearman's ρ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	-0.31
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- ¹ Population estimates are taken from the Michigan population estimates for 1990-2002.
- ² Rates are not age adjusted. Hospitalization records with missing age are excluded.
- ³ Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
- ⁴ Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.
- ⁵ North-Central Michigan is defined by the Grayling Asthma Project coverage area (Crawford, Oscoda, Otsego, Roscommon Counties).
- ‡ Insufficient data to compute a stable rate (number of events ≤ 20 or population < 5000).
- ~ Due to a low number of events, data are suppressed.
- Ψ Insufficient data to compute Spearman Correlation Coefficient.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among children and adults 15 to 34 years in Michigan was 7.7 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, a significant overall trend in asthma hospitalization rates has not been observed for children and adults 15 to 34 years in Michigan.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for ADULTS Aged 35 to 64 Years, for Crawford, Oscoda, Otsego, and Roscommon Counties, North-Central Michigan [5], and the State of Michigan, 1990-2002.

Year	Crawford		Oscoda		Otsego		Roscommon		North-Central MI		Michigan	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	‡	5	‡	~	‡	~	‡	6	‡	16	14.8	4,694
1991	‡	~	‡	~	‡	~	‡	6	‡	11	15.0	4,838
1992	‡	~	‡	~	‡	~	‡	~	‡	8	14.5	4,795
1993	‡	~	‡	~	‡	~	‡	10	‡	18	15.9	5,369
1994	‡	~	‡	~	‡	~	‡	13	‡	17	16.0	5,509
1995	‡	~	‡	5	‡	~	‡	6	‡	16	15.6	5,493
1996	‡	~	‡	5	‡	~	‡	17	10.9	29	15.0	5,401
1997	‡	~	‡	5	‡	~	‡	17	10.1	28	13.8	5,065
1998	‡	~	‡	6	‡	~	‡	20	11.9	34	14.2	5,275
1999	‡	~	‡	6	‡	~	‡	12	7.8	23	14.7	5,547
2000	‡	9	‡	~	‡	~	‡	13	8.8	27	13.6	5,264
2001	‡	8	‡	~	‡	~	‡	11	9.2	28	13.8	5,383
2002	‡	~	‡	~	‡	~	‡	5	‡	13	13.5	5,317

Spearman's ρ	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	-0.70**
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¹ Population estimates are taken from the Michigan population estimates for 1990-2002.

² Rates are not age adjusted. Hospitalization records with missing age are excluded.

³ Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

⁴ Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

⁵ North-Central Michigan is defined by the Grayling Asthma Project coverage area (Crawford, Oscoda, Otsego, Roscommon Counties).

‡ Insufficient data to compute a stable rate (number of events ≤20 or population <5000).

~ Due to a low number of events, data are suppressed.

** Correlation is statistically significant; p-value < 0.01.

‡ Insufficient data to compute Spearman Correlation Coefficient.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among adults 35 to 64 years in Michigan was 13.5 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates for adults 35 to 64 years in Michigan.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for ADULTS Aged 65 Years and Older, for Crawford, Oscoda, Otsego, and Roscommon Counties, North-Central Michigan [5], and the State of Michigan, 1990-2002.

Year	Crawford		Oscoda		Otsego		Roscommon		North-Central MI		Michigan	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	‡	~	‡	~	‡	~	‡	9	‡	19	25.7	2,849
1991	‡	~	‡	~	‡	~	‡	10	‡	18	24.4	2,757
1992	‡	~	‡	11	‡	~	43.3	23	39.5	46	23.9	2,754
1993	‡	~	‡	5	‡	~	42.1	23	26.0	31	25.6	2,991
1994	‡	~	‡	8	‡	~	‡	12	23.9	29	23.8	2,818
1995	‡	~	‡	~	‡	~	‡	16	20.9	26	20.9	2,502
1996	‡	~	‡	7	‡	~	‡	13	19.7	25	18.5	2,232
1997	‡	~	‡	~	‡	~	41.2	24	23.2	30	16.8	2,033
1998	‡	~	‡	8	‡	~	42.5	25	31.2	41	16.8	2,034
1999	‡	~	‡	~	‡	~	‡	9	‡	14	17.2	2,090
2000	‡	~	‡	~	‡	~	‡	3	‡	9	15.2	1,853
2001	‡	~	‡	~	‡	~	‡	7	‡	10	16.5	2,023
2002	‡	~	‡	~	‡	~	‡	~	‡	~	18.1	2,234

Spearman's ρ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	-0.88**
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¹ Population estimates are taken from the Michigan population estimates for 1990-2002.

² Rates are not age adjusted. Hospitalization records with missing age are excluded.

³ Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

⁴ Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

⁵ North-Central Michigan is defined by the Grayling Asthma Project coverage area (Crawford, Oscoda, Otsego, Roscommon Counties).

‡ Insufficient data to compute a stable rate (number of events ≤ 20 or population < 5000).

~ Due to a low number of events, data are suppressed.

** Correlation is statistically significant; p-value < 0.01 .

Ψ Insufficient data to compute Spearman Correlation Coefficient.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among adults 65 years and older in Michigan was 18.1 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates for adults 65 years and older in Michigan.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for CHILDREN Aged Less Than 18 Years, for Crawford, Oscoda, Otsego, and Roscommon Counties, North-Central Michigan [5], and the State of Michigan, 1990-2002.

Year	Crawford		Oscoda		Otsego		Roscommon		North-Central MI		Michigan	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	‡	~	‡	~	‡	6	‡	6	‡	16	31.7	8,063
1991	‡	~	‡	~	‡	13	‡	18	24.6	36	28.3	7,254
1992	‡	~	‡	~	‡	11	‡	9	16.0	24	29.9	7,735
1993	‡	~	‡	~	‡	11	‡	10	15.0	23	30.5	7,875
1994	‡	~	‡	~	‡	8	‡	5	‡	14	26.2	6,757
1995	‡	~	‡	~	‡	9	‡	~	‡	17	31.9	8,221
1996	‡	~	‡	~	‡	~	‡	~	‡	10	30.2	7,769
1997	‡	6	‡	~	‡	~	‡	~	‡	13	30.1	7,742
1998	‡	5	‡	~	‡	9	‡	~	‡	19	21.8	5,594
1999	‡	8	‡	~	‡	~	‡	7	‡	19	21.6	5,546
2000	‡	~	‡	~	‡	~	‡	5	‡	11	26.3	6,693
2001	‡	~	‡	~	‡	~	‡	~	‡	7	24.1	6,089
2002	‡	6	‡	~	‡	6	‡	~	‡	17	21.3	5,359

Spearman's ρ	ψ	ψ	ψ	ψ	ψ	ψ	-0.68*
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¹ Population estimates are taken from the Michigan population estimates for 1990-2002.

² Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.

³ Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

⁴ Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

⁵ North-Central Michigan is defined by the Grayling Asthma Project coverage area (Crawford, Oscoda, Otsego, Roscommon Counties).

‡ Insufficient data to compute a stable rate (number of events ≤20 or population <5000).

~ Due to a low number of events, data are suppressed.

* Correlation is statistically significant; p-value < 0.05.

ψ Insufficient data to compute Spearman Correlation Coefficient.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among children less than 18 years in Michigan was 21.3 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates for children less than 18 years in Michigan.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for ADULTS Aged 18 Years and Older, for Crawford, Oscoda, Otsego, and Roscommon Counties, North-Central Michigan [5], and the State of Michigan, 1990-2002.

Year	Crawford		Oscoda		Otsego		Roscommon		North-Central MI		Michigan	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	‡	9	‡	6	‡	9	‡	18	9.2	42	14.7	9,727
1991	‡	~	‡	~	‡	20	‡	19	12.0	50	14.5	9,741
1992	‡	7	‡	12	‡	10	11.2	29	9.7	58	14.5	9,862
1993	‡	~	‡	9	‡	~	13.9	34	9.5	54	16.1	11,100
1994	‡	6	‡	11	‡	9	14.3	27	9.8	53	15.7	10,852
1995	‡	10	‡	9	‡	10	8.5	23	9.4	52	15.2	10,724
1996	‡	5	‡	15	‡	9	13.6	31	10.5	60	14.5	10,289
1997	‡	5	‡	8	‡	12	18.8	45	12.0	70	13.3	9,578
1998	‡	10	‡	16	‡	9	19.7	48	13.3	83	13.4	9,695
1999	‡	8	‡	11	‡	7	11.2	23	9.2	49	13.5	9,839
2000	‡	10	‡	7	‡	6	18.0	26	9.8	49	12.5	9,193
2001	‡	~	‡	~	‡	17	12.3	23	10.6	55	12.5	9,274
2002	‡	~	‡	~	‡	8	‡	13	5.4	27	12.5	9,337

Spearman's ρ	ψ	ψ	ψ	ψ	ψ	0.00	-0.80**
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- ¹ Population estimates are taken from the Michigan population estimates for 1990-2002.
- ² Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- ³ Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
- ⁴ Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.
- ⁵ North-Central Michigan is defined by the Grayling Asthma Project coverage area (Crawford, Oscoda, Otsego, Roscommon Counties).
- ‡ Insufficient data to compute a stable rate (number of events ≤ 20 or population < 5000).
- ~ Due to a low number of events, data are suppressed.

** Correlation is statistically significant; p-value < 0.01 .
 ψ Insufficient data to compute Spearman Correlation Coefficient.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among adults 18 years and older in Michigan was 12.5 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates for adults 18 years and older in Michigan.

Crawford County

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] for Crawford County, 2000-2002.

		Count	Rate	95% Confidence Interval	
				Lower Limit	Upper Limit
Total Population		35	8.3	5.5	11.2
Sex	Male	14	‡	‡	‡
	Female	21	9.5	5.4	13.7
Race ⁵	White	34	8.2	5.4	11.1
	Black	~	‡	‡	‡
Sex and Race ⁵	White Male	13	‡	‡	‡
	White Female	21	9.7	5.5	13.9
	Black Male	~	‡	‡	‡
	Black Female	~	‡	‡	‡
Age (unadjusted)	0-4 Years	6	‡	‡	‡
	5-14 Years	~	‡	‡	‡
	15-34 Years	~	‡	‡	‡
	35-64 Years	21	11.6	6.7	16.6
	65+ Years	~	‡	‡	‡
Age	<18 Years	9	‡	‡	‡
	18+ Years	26	7.7	4.7	10.7

For comparison, State of Michigan and North-Central Michigan 3-year rates are located within the Hospitalization section of this report.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] for Crawford County, 2000-2002, Comparable to the Healthy People 2010 Targets.

		Count	Rate	95% Confidence Interval	
				Lower Limit	Upper Limit
Age	0-4 Years ⁶	6	‡	‡	‡
	5-64 Years	25	7.1	4.3	10.0
	65+ Years	~	‡	‡	‡
	<18 Years ⁶	9	‡	‡	‡

For comparison, State of Michigan and North-Central Michigan 3-year rates are located within the Healthy People 2010 section of this report.

1 Unless otherwise noted, rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.

2 Population estimates are taken from the Michigan population estimates for 2001.

3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

4 Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

5 For records that are missing data for race, race was assigned based on the 1990 census population for Michigan.

6 Not age adjusted in accordance with analysis prescribed by Healthy People 2010 Objectives.

‡ Insufficient data to compute a stable rate (number of events ≤20 or population <5000).

~ Number of hospitalizations <5.

Oscoda County

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] for Oscoda County, 2000-2002.

		Count	Rate	95% Confidence Interval	
				Lower Limit	Upper Limit
Total Population		15	‡	‡	‡
Sex	Male	~	‡	‡	‡
	Female	11	‡	‡	‡
Race ⁵	White	15	‡	‡	‡
	Black	~	‡	‡	‡
Sex and Race ⁵	White Male	~	‡	‡	‡
	White Female	11	‡	‡	‡
	Black Male	~	‡	‡	‡
	Black Female	~	‡	‡	‡
Age (unadjusted)	0-4 Years	~	‡	‡	‡
	5-14 Years	~	‡	‡	‡
	15-34 Years	~	‡	‡	‡
	35-64 Years	7	‡	‡	‡
	65+ Years	~	‡	‡	‡
Age	<18 Years	~	‡	‡	‡
	18+ Years	12	‡	‡	‡

For comparison, State of Michigan and North-Central Michigan 3-year rates are located within the Hospitalization section of this report.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] for Oscoda County, 2000-2002, Comparable to the Healthy People 2010 Targets.

		Count	Rate	95% Confidence Interval	
				Lower Limit	Upper Limit
Age	0-4 Years ⁶	~	‡	‡	‡
	5-64 Years	11	‡	‡	‡
	65+ Years	~	‡	‡	‡
	<18 Years ⁶	~	‡	‡	‡

For comparison, State of Michigan and North-Central Michigan 3-year rates are located within the Healthy People 2010 section of this report.

1 Unless otherwise noted, rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.

2 Population estimates are taken from the Michigan population estimates for 2001.

3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

4 Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

5 For records that are missing data for race, race was assigned based on the 1990 census population for Michigan.

6 Not age adjusted in accordance with analysis prescribed by Healthy People 2010 Objectives.

‡ Insufficient data to compute a stable rate (number of events ≤20 or population <5000).

~ Due to a low number of events, data are suppressed.

Otsego County

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] for Otsego County, 2000-2002.

		Count	Rate	95% Confidence Interval	
				Lower Limit	Upper Limit
Total Population		42	6.2	4.3	8.1
Sex	Male	17	‡	‡	‡
	Female	25	7.0	4.2	9.7
Race ⁵	White	42	6.3	4.4	8.2
	Black	~	‡	‡	‡
Sex and Race ⁵	White Male	17	‡	‡	‡
	White Female	25	7.1	4.3	9.9
	Black Male	~	‡	‡	‡
	Black Female	~	‡	‡	‡
Age (unadjusted)	0-4 Years	8	‡	‡	‡
	5-14 Years	~	‡	‡	‡
	15-34 Years	15	‡	‡	‡
	35-64 Years	11	‡	‡	‡
	65+ Years	5	‡	‡	‡
Age	<18 Years	11	‡	‡	‡
	18+ Years	31	6.1	3.9	8.3

For comparison, State of Michigan and North-Central Michigan 3-year rates are located within the Hospitalization section of this report.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] for Otsego County, 2000-2002, Comparable to the Healthy People 2010 Targets.

		Count	Rate	95% Confidence Interval	
				Lower Limit	Upper Limit
Age	0-4 Years ⁶	8	‡	‡	‡
	5-64 Years	29	5.3	3.3	7.2
	65+ Years	5	‡	‡	‡
	<18 Years ⁶	11	‡	‡	‡

For comparison, State of Michigan and North-Central Michigan 3-year rates are located within the Healthy People 2010 section of this report.

1 Unless otherwise noted, rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.

2 Population estimates are taken from the Michigan population estimates for 2001.

3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

4 Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

5 For records that are missing data for race, race was assigned based on the 1990 census population for Michigan.

6 Not age adjusted in accordance with analysis prescribed by Healthy People 2010 Objectives.

‡ Insufficient data to compute a stable rate (number of events ≤20 or population <5000).

~ Due to a low number of events, data are suppressed.

Roscommon County

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] for Roscommon County, 2000-2002.

		Count	Rate	95% Confidence Interval	
				Lower Limit	Upper Limit
Total Population		74	11.8	8.9	14.6
Sex	Male	19	‡	‡	‡
	Female	55	18.1	13.0	23.2
Race ⁵	White	74	12.0	9.1	14.9
	Black	~	‡	‡	‡
Sex and Race ⁵	White Male	19	‡	‡	‡
	White Female	55	18.4	13.3	23.6
	Black Male	~	‡	‡	‡
	Black Female	~	‡	‡	‡
Age (unadjusted)	0-4 Years	8	‡	‡	‡
	5-14 Years	~	‡	‡	‡
	15-34 Years	22	15.5	9.0	22.0
	35-64 Years	29	8.9	5.7	12.2
	65+ Years	11	‡	‡	‡
Age	<18 Years	12	‡	‡	‡
	18+ Years	62	12.5	9.2	15.9

For comparison, State of Michigan and North-Central Michigan 3-year rates are located within the Hospitalization section of this report.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] for Roscommon County, 2000-2002, Comparable to the Healthy People 2010 Targets.

		Count	Rate	95% Confidence Interval	
				Lower Limit	Upper Limit
Age	0-4 Years ⁶	8	‡	‡	‡
	5-64 Years	55	11.4	8.3	14.6
	65+ Years	11	‡	‡	‡
	<18 Years ⁶	12	‡	‡	‡

For comparison, State of Michigan and North-Central Michigan 3-year rates are located within the Healthy People 2010 section of this report.

1 Unless otherwise noted, rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.

2 Population estimates are taken from the Michigan population estimates for 2001.

3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

4 Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

5 For records that are missing data for race, race was assigned based on the 1990 census population for Michigan.

6 Not age adjusted in accordance with analysis prescribed by Healthy People 2010 Objectives.

‡ Insufficient data to compute a stable rate (number of events ≤20 or population <5000).

~ Due to a low number of events, data are suppressed.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for CHILDREN Aged Less Than 18 Years, for Crawford, Oscoda, Otsego, and Roscommon Counties, North-Central Michigan [5], and the State of Michigan, 1990-2002, Compared to the Healthy People 2010 Target (Objective 1-9a).

Year	HP 2010 Objective	Crawford		Oscoda		Otsego		Roscommon		North-Central MI		Michigan	
		Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	17.3	‡	~	‡	~	‡	6	‡	6	‡	16	32.8	8,063
1991	17.3	‡	~	‡	~	‡	13	‡	18	24.4	36	29.2	7,254
1992	17.3	‡	~	‡	~	‡	11	‡	9	15.9	24	30.9	7,735
1993	17.3	‡	~	‡	~	‡	11	‡	10	14.8	23	31.2	7,875
1994	17.3	‡	~	‡	~	‡	8	‡	5	‡	14	26.6	6,757
1995	17.3	‡	~	‡	~	‡	9	‡	~	‡	17	32.1	8,221
1996	17.3	‡	~	‡	~	‡	~	‡	~	‡	10	30.1	7,769
1997	17.3	‡	6	‡	~	‡	~	‡	~	‡	13	30.0	7,742
1998	17.3	‡	5	‡	~	‡	9	‡	~	‡	19	21.7	5,594
1999	17.3	‡	8	‡	~	‡	~	‡	7	‡	19	21.4	5,546
2000	17.3	‡	~	‡	~	‡	~	‡	5	‡	11	26.0	6,693
2001	17.3	‡	~	‡	~	‡	~	‡	~	‡	7	23.7	6,089
2002	17.3	‡	6	‡	~	‡	6	‡	~	‡	17	20.8	5,359
Spearman's ρ		ψ		ψ		ψ		ψ		ψ		-0.79**	

¹ Population estimates are taken from the Michigan population estimates for 1990-2002.

² Rates are not age adjusted. Hospitalization records with missing age are excluded.

³ Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

⁴ Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

⁵ North-Central Michigan is defined by the Grayling Asthma Project coverage area (Crawford, Oscoda, Otsego, Roscommon Counties).

‡ Insufficient data to compute a stable rate (number of events ≤20 or population <5000).

~ Due to a low number of events, data are suppressed.

** Correlation is statistically significant; p-value < 0.01.

ψ Insufficient data to compute Spearman Correlation Coefficient.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among children less than 18 years in Michigan was 20.8 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates for children less than 18 years in Michigan.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for CHILDREN Aged 0 to 4 Years, for Crawford, Oscoda, Otsego, and Roscommon Counties, North-Central Michigan [5], and the State of Michigan, 1990-2002, Compared to the Healthy People 2010 Target (Objective 24-2).

Year	HP 2010 Objective	Crawford		Oscoda		Otsego		Roscommon		North-Central MI		Michigan	
		Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	25.0	‡	~	‡	~	‡	5	‡	~	‡	6	66.1	4,712
1991	25.0	‡	~	‡	~	‡	9	‡	15	‡	27	57.1	4,106
1992	25.0	‡	~	‡	~	‡	8	‡	6	‡	17	64.4	4,638
1993	25.0	‡	~	‡	~	‡	6	‡	7	‡	14	59.6	4,291
1994	25.0	‡	~	‡	~	‡	~	‡	~	‡	6	53.2	3,783
1995	25.0	‡	~	‡	~	‡	5	‡	~	‡	10	63.9	4,457
1996	25.0	‡	~	‡	~	‡	~	‡	~	‡	8	59.6	4,092
1997	25.0	‡	~	‡	~	‡	~	‡	~	‡	7	59.2	4,019
1998	25.0	‡	~	‡	~	‡	6	‡	~	‡	11	40.5	2,734
1999	25.0	‡	5	‡	~	‡	~	‡	6	‡	15	40.6	2,725
2000	25.0	‡	~	‡	~	‡	~	‡	~	‡	7	48.8	3,257
2001	25.0	‡	~	‡	~	‡	~	‡	~	‡	7	50.5	3,341
2002	25.0	‡	~	‡	~	‡	5	‡	~	‡	10	45.8	3,039
Spearman's ρ		ψ		ψ		ψ		ψ		ψ		-0.76**	

¹ Population estimates are taken from the Michigan population estimates for 1990-2002.

² Rates are not age adjusted. Hospitalization records with missing age are excluded.

³ Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

⁴ Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

⁵ North-Central Michigan is defined by the Grayling Asthma Project coverage area (Crawford, Oscoda, Otsego, Roscommon Counties).

‡ Insufficient data to compute a stable rate (number of events ≤20 or population <5000).

~ Due to a low number of events, data are suppressed.

** Correlation is statistically significant; p-value < 0.01.

ψ Insufficient data to compute Spearman Correlation Coefficient.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among children 0 to 4 years in Michigan was 45.8 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates for children 0 to 4 years in Michigan.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for CHILDREN/ADULTS Aged 5 to 64 Years, for Crawford, Oscoda, Otsego, and Roscommon Counties, North-Central Michigan [5], and the State of Michigan, 1990-2002, Compared to the Healthy People 2010 Target (Objective 24-2).

Year	HP 2010 Objective	Crawford		Oscoda		Otsego		Roscommon		North-Central MI		Michigan	
		Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	7.7	‡	9	‡	~	‡	~	‡	14	7.7	33	14.0	10,229
1991	7.7	‡	~	‡	~	‡	20	‡	12	9.8	41	13.7	10,132
1992	7.7	‡	~	‡	~	‡	~	‡	9	‡	19	13.6	10,205
1993	7.7	‡	~	‡	~	‡	9	‡	14	6.5	32	15.5	11,693
1994	7.7	‡	~	‡	~	‡	9	‡	17	6.9	32	14.5	11,008
1995	7.7	‡	6	‡	6	‡	12	‡	9	6.5	33	15.5	11,986
1996	7.7	‡	5	‡	9	‡	5	‡	18	6.7	37	15.0	11,734
1997	7.7	‡	8	‡	7	‡	8	11.6	23	8.3	46	14.2	11,268
1998	7.7	‡	10	‡	8	‡	7	12.8	25	8.9	50	13.2	10,521
1999	7.7	‡	10	‡	7	‡	7	‡	15	7.6	39	13.2	10,570
2000	7.7	‡	10	‡	5	‡	5	16.5	24	8.7	44	13.3	10,776
2001	7.7	‡	~	‡	~	‡	16	‡	16	8.6	45	12.3	9,999
2002	7.7	‡	~	‡	~	‡	8	‡	15	5.9	31	11.5	9,423
Spearman's ρ		ψ		ψ		ψ		ψ		ψ		ψ	-0.63*

¹ Population estimates are taken from the Michigan population estimates for 1990-2002.

² Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.

³ Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

⁴ Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

⁵ North-Central Michigan is defined by the Grayling Asthma Project coverage area (Crawford, Oscoda, Otsego, Roscommon Counties).

‡ Insufficient data to compute a stable rate (number of events ≤20 or population <5000).

~ Due to a low number of events, data are suppressed.

* Correlation is statistically significant; p-value < 0.05.

ψ Insufficient data to compute Spearman Correlation Coefficient.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among children and adults 5 to 64 years in Michigan was 11.5 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates for children and adults 5 to 64 years in Michigan.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for ADULTS Aged 65 Years and Older, for Crawford, Oscoda, Otsego, and Roscommon Counties, North-Central Michigan [5], and the State of Michigan, 1990-2002, Compared to the Healthy People 2010 Target (Objective 24-2).

Year	HP 2010 Objective	Crawford		Oscoda		Otsego		Roscommon		North-Central MI		Michigan	
		Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	11.0	‡	~	‡	~	‡	~	‡	9	‡	19	25.8	2,849
1991	11.0	‡	~	‡	~	‡	~	‡	10	‡	18	24.3	2,757
1992	11.0	‡	~	‡	11	‡	~	41.0	23	40.4	46	23.9	2,754
1993	11.0	‡	~	‡	5	‡	~	43.7	23	26.4	31	25.5	2,991
1994	11.0	‡	~	‡	8	‡	~	‡	12	23.5	29	23.9	2,818
1995	11.0	‡	~	‡	~	‡	~	‡	16	22.9	26	20.9	2,502
1996	11.0	‡	~	‡	7	‡	~	‡	13	20.8	25	18.6	2,232
1997	11.0	‡	~	‡	~	‡	~	43.9	24	24.1	30	16.8	2,033
1998	11.0	‡	~	‡	8	‡	~	41.6	25	31.2	41	16.8	2,034
1999	11.0	‡	~	‡	~	‡	~	‡	9	‡	14	17.2	2,090
2000	11.0	‡	~	‡	~	‡	~	‡	~	‡	9	15.2	1,853
2001	11.0	‡	~	‡	~	‡	~	‡	7	‡	10	16.5	2,023
2002	11.0	‡	~	‡	~	‡	~	‡	~	‡	~	18.1	2,234
Spearman's ρ		ψ		ψ		ψ		ψ		ψ		-0.87**	

- ¹ Population estimates are taken from the Michigan population estimates for 1990-2002.
- ² Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- ³ Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
- ⁴ Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.
- ⁵ North-Central Michigan is defined by the Grayling Asthma Project coverage area (Crawford, Oscoda, Otsego, Roscommon Counties).
- ‡ Insufficient data to compute a stable rate (number of events ≤20 or population <5000).
- ~ Due to a low number of events, data are suppressed.

** Correlation is statistically significant; p-value < 0.01.
 ψ Insufficient data to compute Spearman Correlation Coefficient.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among adults 65 years and older in Michigan was 18.1 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates for adults 65 years and older in Michigan.

Section 5: Data Sources

Name: Michigan Behavioral Risk Factor Surveillance System

Acronym: BRFSS

Basic Purpose and History: The BRFSS is a source of estimates of the prevalence of certain health behaviors, conditions, and practices associated with leading causes of death. Michigan has conducted the BRFSS survey since 1987. Asthma related questions were added to the survey in 2000.

Data Collection Process: Annual estimates are based on data collected from a random-digit dial telephone survey of a sample of Michigan households. It is a population-based representative sample of non-institutionalized Michigan residents. The data are weighted to represent estimates for the general adult population. BRFSS interviewers use a Computer Assisted Telephone Interviewing (CATI) system, which provides the interviewer with prompts. The interviewer types the respondent's responses directly onto the computer screen, providing quality control and minimizing interviewer error.

Population Included: A record is a completed telephone interview. The selected respondent must be a Michigan resident, 18 years of age or older who lives in a private residence and has a telephone. One randomly selected adult from a household is interviewed.

Asthma Data: There are two core questions dedicated to estimating asthma prevalence for the general population of adults. Michigan has opted to include the asthma module questions that include information about child prevalence and disease management/control. Finally, Michigan has also developed questions regarding work-related asthma. The following are the questions included on the Michigan BRFSS survey in 2001 regarding asthma:

Asthma Prevalence Questions for Adults:

- Have you ever been told by a doctor, nurse, or other health professional that you had asthma?
- Do you still have asthma?

Asthma Prevalence Questions for Children in the Household:

- Earlier you said there were <number> children, age 17 or younger, living in your household. How many of these children have ever been diagnosed with asthma?
- How many of these children/does this child still have asthma?

Additional Information: For more information about the BRFSS and national data for comparison, visit <http://www.cdc.gov/brfss/index.htm>. For a complete report of the Michigan BRFSS Survey, visit <http://www.michigan.gov/mdch/0,1607,7-132--12702--,00.html>.

Name: Michigan Inpatient Database

Acronym: MIDB

Basic Purpose and History: These data help support the State of Michigan health planning activities and are used by facilities themselves for internal evaluation. The Michigan Department of Community Health (MDCH) has purchased data since 1982.

Data Collection Process: Data are collected throughout a patient hospital stay by clinical and administrative staff and filed within a medical record. Hospital medical record personnel ascertain and keypunch information from these records. Some small hospitals complete data collection forms and send these directly to Michigan Health and Hospital Association (MHHA)

for processing. Depending on the facility, data are submitted on a voluntary basis monthly, quarterly, or annually to MHHA. Because data formats often differ by hospital, all coding is converted into standard formats at MHHA. The public use file provided to MDCH is stripped of all patient, provider, and hospital identifiers.

Population Included: Records include all hospital discharges from any of Michigan's reporting acute care hospitals or Michigan residents discharged from acute care hospitals in contiguous states. It includes virtually all hospitalizations in Michigan and for Michigan residents.

Asthma Data: The MIDB includes information on discharge diagnoses, which in the case of asthma includes the International Classification of Disease, Version 9, Clinical Modification (ICD-9-CM) codes 493.00-493.99. Procedure codes for treatments administered during the inpatient stay are also maintained in the dataset.

Additional Information: For the 2003 report on the *Michigan Hospital Profiles Project* published by MHHA, visit <http://www.michiganhospitalprofiles.org/>. For the latest data regarding preventable hospitalizations in Michigan, visit <http://www.mdch.state.mi.us/pha/osr/chi/hosp/frame.html>. The National Hospital Discharge Survey (NHDS) collects national data comparable to the MIDB. For more information about the NHDS and data for comparison, visit <http://www.cdc.gov/nchs/about/major/hdasd/nhds.htm>.

Name: Michigan Resident Death Files

Acronym: MRDF

Basic Purpose and History: The death certificate database is a high quality computerized data set containing demographic and cause of death information for all Michigan residents (out of state deaths included) and non-Michigan residents dying in Michigan. Death certificates are one of public health's vital records for monitoring the health of citizens. Death certificates have been collected in Michigan since 1897.

Data Collection Process: A funeral director, or another individual responsible for disposing of the body, completes the demographic and disposition components of the death certificate. When applicable, an attending physician or other hospital medical staff completes the portion of the death certificate describing the death (time, date, place, and immediate/underlying cause). A county medical examiner completes this section in all unexpected deaths including fatal injuries. The death certificate is then sent to the local registrar who verifies that the document has been properly filled out. If not, it is returned to the appropriate person for revision. Certificates for Michigan residents dying out-of-state are provided by those states (primarily Indiana, Ohio, and Wisconsin). Instructional materials to complete the death certificate are available at the state and local level for doctors, hospitals, medical examiners, and funeral directors. Michigan funeral director training also includes an annual seminar on death certificate completion.

Population Included: All in-state occurrences regardless of the state of residence and all Michigan residents regardless of location of death are included.

Asthma Data: The MRDF includes information on causes of death, which in the case of asthma includes the International Classification of Disease (ICD), Version 9 codes 493 (1990-1998) and Version 10 codes J45 and J46 (1999-present).

Additional Information: For more data regarding Michigan mortality, visit <http://www.mdch.state.mi.us/pha/osr/index.asp?ld=4>. The National Center for Health Statistics maintains the National Vital Statistics System that provides a natural comparison to the MRDF. For more information, visit <http://www.cdc.gov/nchs/about/major/dvs/mortdata.htm>.

Section 6: Methods

Topic 1: Prevalence

Prevalence is the proportion of individuals in a population who have the disease at a point in time or during a given time period. It is often used to describe the health burden on a given population.

Prevalence is computed by dividing the number of existing cases at a particular point or period in time by the total population from which the cases came. It is often multiplied by 100 and expressed as a percent.

$$\text{Prevalence} = \frac{\text{number of existing cases of disease}}{\text{total population}}$$

In this report, prevalence estimates are generated in the analysis of data from the Behavioral Risk Factor Surveillance System.

Topic 2: Incidence Rate

The incidence rate expresses the rate at which events occur in a population at risk at any given point in time during a defined time period. Rates presented in this report are used to estimate annual incidence for aggregates of individuals, defined by geographic area and demographic characteristics, over a given time period.

The numerator of the incidence rate is the number of new events in the population during a given time period. The denominator is the average population estimated for that same time period multiplied by the number of years in the interval. The use of this denominator assumes that the population and its demographic composition are relatively stable.

The population at the midpoint of a given time interval is used to estimate the average population over the entire interval. This is then multiplied by the number of years in the interval so that an *annual* rate is generated. For example, to compute a rate of asthma hospitalizations for 1998 through 2000, the population in 1999 (midpoint) multiplied by 3 is used as the denominator. Rates for single years are calculated using the estimated population for that year.

$$\text{Annual Incidence Rate} = \frac{\text{number of new events during given time period}}{\text{average population X number of years in time period}}$$

Incidence rates are generally multiplied by a factor of 10 so that they can be better understood in terms of a population. For asthma hospitalizations, rates are multiplied by 10,000, whereas for asthma deaths, rates are multiplied by 1,000,000.

In this report, incidence rates are generated in the analysis of data from the Michigan Inpatient Database, Michigan Resident Death File.

Topic 3: Age Adjustment by Direct Standardization

Populations often differ in their distribution of age, which may in turn affect the overall rate of events in that population. For example, if one population has a larger number of young children than another, it could demonstrate a higher asthma hospitalization rate simply due to its age structure. Therefore, when comparing rates of events in populations of different age distributions, it is important to account for those differences. In this report, age structure differences are accounted for in overall rates using direct standardization methodology to compute age-adjusted rates. Rates that are not age adjusted are referred to as crude rates.

An age-adjusted rate is a weighted average of age group specific rates in the population under study. The age group specific rates are weighted by the number of people in each age group of a selected *standard* population. When two or more age-adjusted rates are computed using the same *standard* population, they may be compared. Age-adjusted rates are presented in this report so that comparisons can be made between geographic subgroups (ex. County vs. County) and demographic subgroups (ex. White vs. Black). The *standard* population used in the calculation of age-adjusted rates in this report is the 2000 United States Standard Population.

To compute an age-adjusted incidence rate, the first step is to compute the comprising age specific rates. These are then multiplied by the corresponding age specific weight, i.e. the proportion of people in a particular age strata in the *standard* population. The products of these calculations are then summed and divided by the sum of all the age specific weights.

$$\text{Age-Adjusted Incidence Rate} = \frac{\text{Sum of (age specific rate X age specific weight)}}{\text{Sum of age specific weights}}$$

In this report, age-adjusted rates are generated in the analysis of data from the Michigan Inpatient Database and the Michigan Resident Death File.

Topic 4: Confidence Interval

The purpose of a confidence interval (CI) is to estimate the statistical uncertainty around a particular measure. For example, the *estimated* prevalence of asthma among Michigan adults is 8.8%, with a 95% confidence interval of 7.8% to 9.8%; we are 95% confident that the *true* prevalence in the population is no less than 7.8% and no greater than 9.8%.

In this report, 95% confidence intervals are provided for average annual incidence rates.

The confidence interval formula for a crude incidence rate is based on the Poisson distribution. The upper and lower limits are often multiplied by an appropriate factor of 10: 10,000 for asthma hospitalization rates and 1,000,000 for asthma mortality rates.

$$\text{Crude Incidence Rate CI} = \text{IR}_c \pm 1.96 \times \left(\frac{\text{IR}_c}{n} \right)^{1/2}$$

Where IR_c = crude incidence rate
 n = denominator of the rate

The confidence interval formula for an age-adjusted incidence rate is based on the Poisson distribution. The upper and lower limits are often multiplied by an appropriate factor of 10 – 10,000 for asthma hospitalization rates and 1,000,000 for asthma mortality rates.

$$\text{Age-Adjusted Incidence Rate CI} = \text{IR}_a \pm 1.96 \times \left(\frac{\text{Sum } (W^2 \times I)}{(\text{Sum } W)^2} \right)^{1/2}$$

Where IR_a = age-adjusted incidence rate
 W = age specific weights from the *standard* population
 I = variance of crude age specific rates

Confidence intervals can be used as a method to test whether a specific measure is statistically different between groups. For example, in comparing a county specific asthma hospitalization rate with that of the State of Michigan, they are considered statistically different if their confidence intervals do not overlap.

Topic 5: Data Suppression

Incidence rate estimates calculated with a small number of events or population sizes are statistically unstable. They exhibit wide confidence intervals indicative of great variability. In this report, data suppression rules are enforced so that the data presented are reliable. For demographic or geographic subgroups where there is less than or equal to 20 hospitalizations or less than 5000 population, asthma hospitalization rates are not presented. Mortality rates are suppressed when there is less than 5 deaths or less than 5000 population. In addition, to protect the identity of persons who have been hospitalized or died, counts less than 5 are not presented in this report.

Topic 6: Trend Analysis

To determine if there is an overall trend in annual asthma hospitalization and mortality rates over time, the Spearman Correlation Coefficient and its accompanying statistical Rank

Correlation Test were utilized. This test assesses whether there is a statistically significant monotonic relationship between 2 variables, in this case year and rate.

The Spearman Correlation Coefficient (ρ) ranges from -1.0 to 1.0 . If the coefficient equals -1.0 , it indicates a perfect negative correlation, where each year has a lower hospitalization rate than the previous year. If the coefficient equals 1.0 , it indicates a perfect positive correlation, where each year has a higher hospitalization rate than the previous year. As the correlation coefficient approaches 0.0 , from either direction, the relationship between the 2 variables weakens. For example, a correlation coefficient of 0.90 indicates a stronger positive relationship between 2 variables than a coefficient of 0.50 .

The p-value of the Rank Correlation test ranges from 0.0 to 1.0 and gives the probability of finding a significant overall monotonic trend in the asthma hospitalization rate data when, in reality, no trend exists. Again, the standard used to assess the significance of a statistical test is $p\text{-value} = 0.05$. A p value less than or equal to 0.05 indicates that there is at most a 5% chance of observing a trend, given that, in reality, rates are stable. In this case, the result is considered statistically significant. If the p value is greater than 0.05 , chance cannot be excluded as a likely explanation for the observed trend, so the result is not considered statistically significant.

From this, it follows that:

- If there is a statistically significant **increase** in asthma hospitalization rates over time, the Spearman Correlation Coefficient will be **positive** and the p-value for the test will be **less** than 0.05 .
- If there is a statistically significant **decrease** in asthma hospitalization rates over time, the Spearman Correlation Coefficient will be **negative** and the p-value for the test will be **less** than 0.05 .

IMPORTANT: This is a crude analysis that simply identifies whether there is an **overall** increase or decrease in the asthma hospitalization or mortality rates. This statistical test does not determine the significance of more complex trend patterns. There is no way to know from these statistics if a specific event or series of events caused an observed change in rates.

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