

Epidemiology of Asthma

In the East-Central Michigan Counties of

Bay, Midland, and Saginaw

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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 East-Central Michigan [3] and the State of Michigan.

	Children (<18 Years)	Adults (≥18 Years)
	2002	2003
Bay	2,373	7,786
Midland	1,981	5,881
Saginaw	4,980	14,456
East-Central Michigan	9,333	28,124
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 BRFs.

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 BRFs.

3 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw 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.

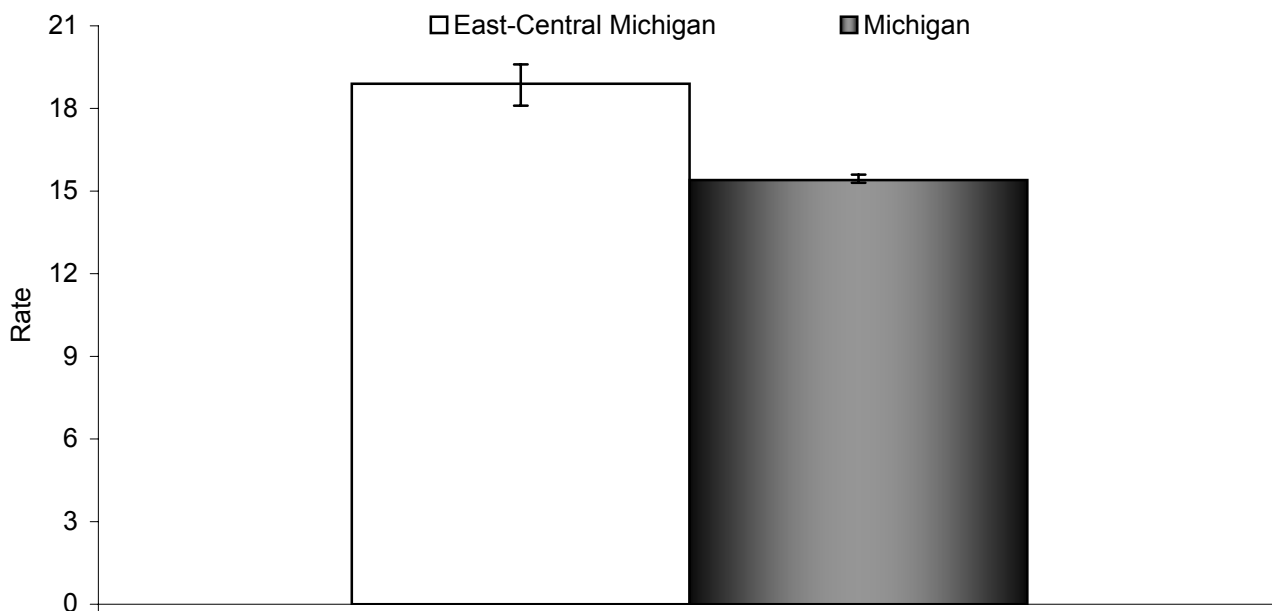
These data are the number of inpatient hospitalizations for asthma. This is not the same as the number of individual people hospitalized for asthma. An individual can be hospitalized more than once for the same condition during the study period and multiple hospitalizations cannot be distinguished from 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.

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



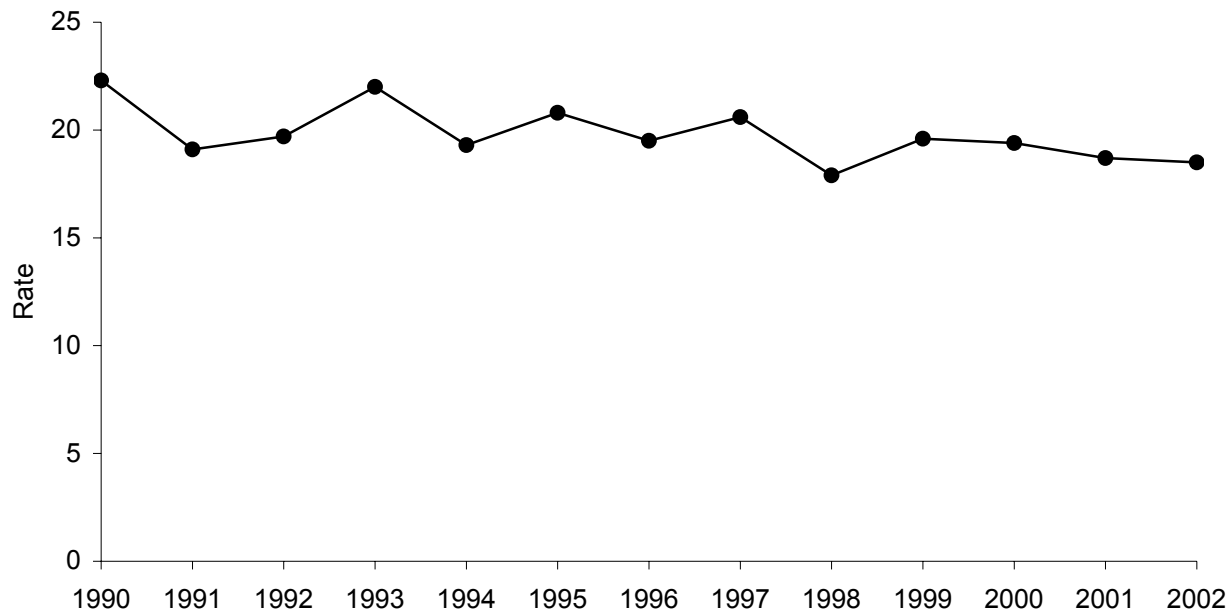
- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 2 Population estimates are taken from the Michigan population estimates for 2001.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis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

	Total Population
East-Central MI Rate	18.9
95% CI	18.1 , 19.6
Count	2,282
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 East-Central Michigan, 2000-2002, is 761.
- ✧ East-Central Michigan has significantly higher 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 East-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 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

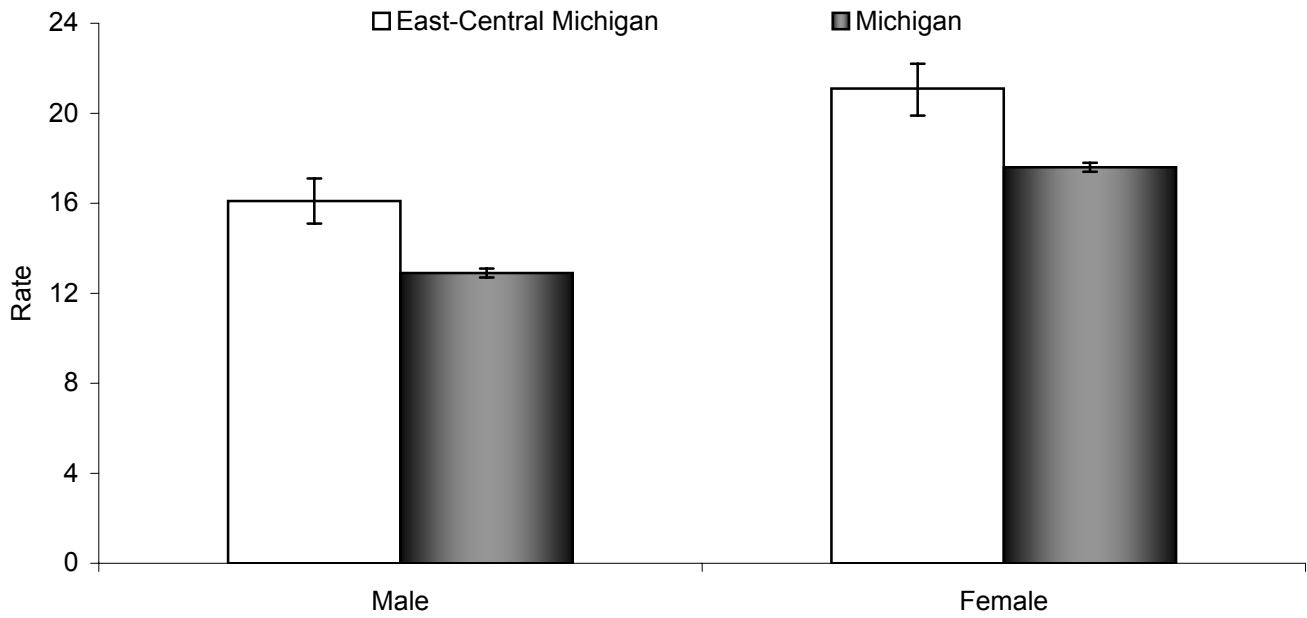
Year	Total Population	
	Rate	Count
1990	22.3	905
1991	19.1	781
1992	19.7	811
1993	22.0	895
1994	19.3	781
1995	20.8	848
1996	19.5	788
1997	20.6	833
1998	17.9	724
1999	19.6	788
2000	19.4	779
2001	18.7	752
2002	18.5	751

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 East-Central Michigan ($\rho = -0.57$, $p < 0.05$).

See appendix page 36 for supporting data.

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



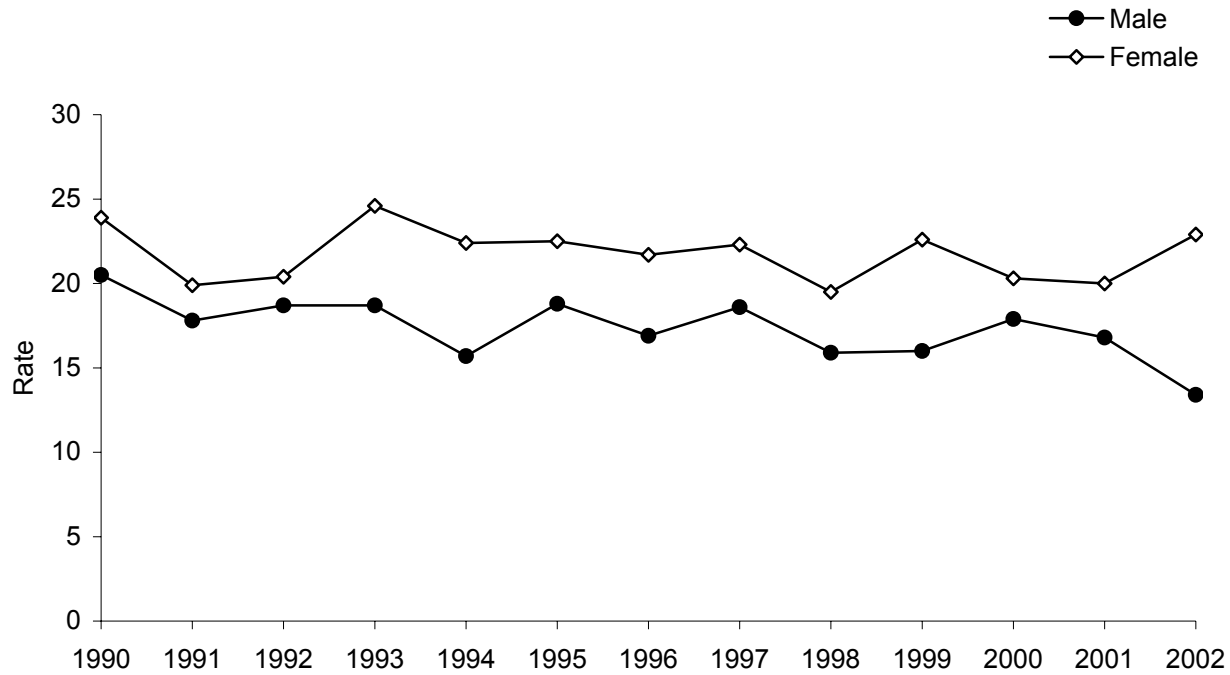
- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 2 Population estimates are taken from the Michigan population estimates for 2001.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis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

	Male	Female
East-Central MI Rate	16.1	21.1
95% CI	15.1 , 17.1	19.9 , 22.2
Count	941	1,341
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 East-Central Michigan are significantly higher than the respective rates for the State of Michigan as a whole, 2000-2002.
- ✧ In the East-Central Michigan and the State of Michigan as a whole, 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 East-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 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

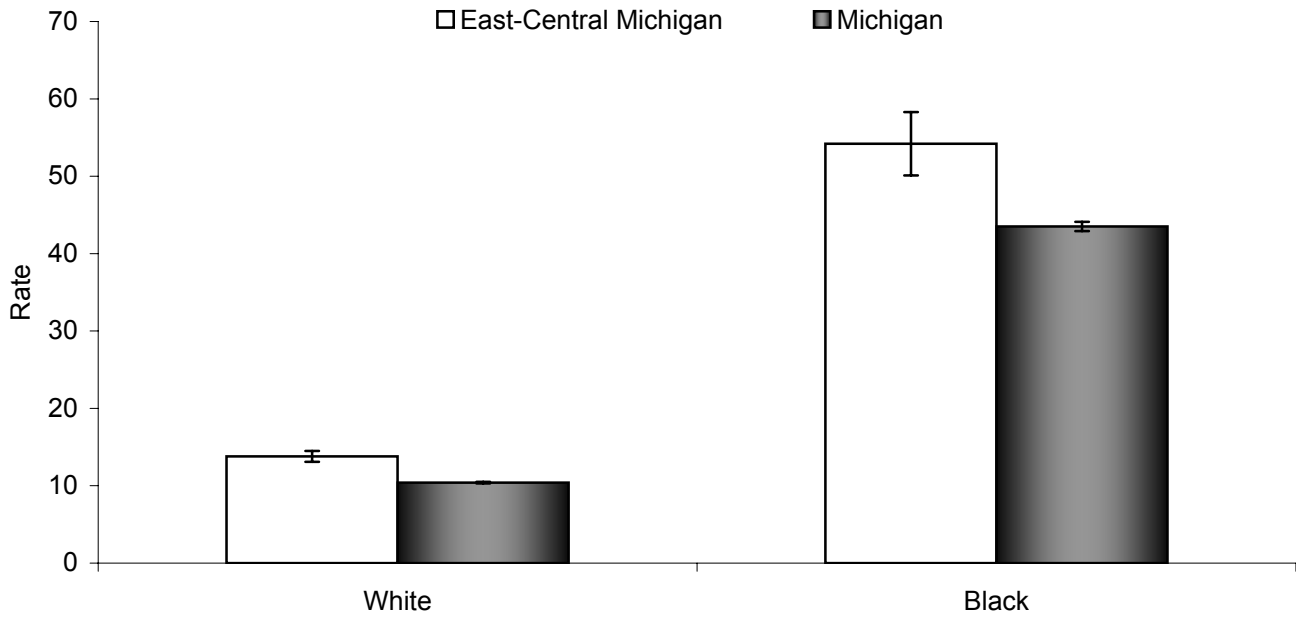
Year	Male		Female	
	Rate	Count	Rate	Count
1990	20.5	415	23.9	490
1991	17.8	369	19.9	412
1992	18.7	386	20.4	425
1993	18.7	381	24.6	514
1994	15.7	316	22.4	465
1995	18.8	381	22.5	467
1996	16.9	337	21.7	451
1997	18.6	375	22.3	458
1998	15.9	318	19.5	406
1999	16.0	314	22.6	474
2000	17.9	353	20.3	426
2001	16.8	328	20.0	424
2002	13.4	260	22.9	491

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

✧ Between 1990 and 2001, there has been a significant overall decrease in asthma hospitalization rates among the male population in East-Central Michigan ($\rho = -0.62$, $p < 0.05$).

See appendix pages 37 and 38 for supporting data.

Figure 5. Rates (per 10,000) [1,2] of Hospitalization due to Asthma [3] by Race [4] for East-Central Michigan [5] and the State of Michigan, All Ages, 2000-2002.



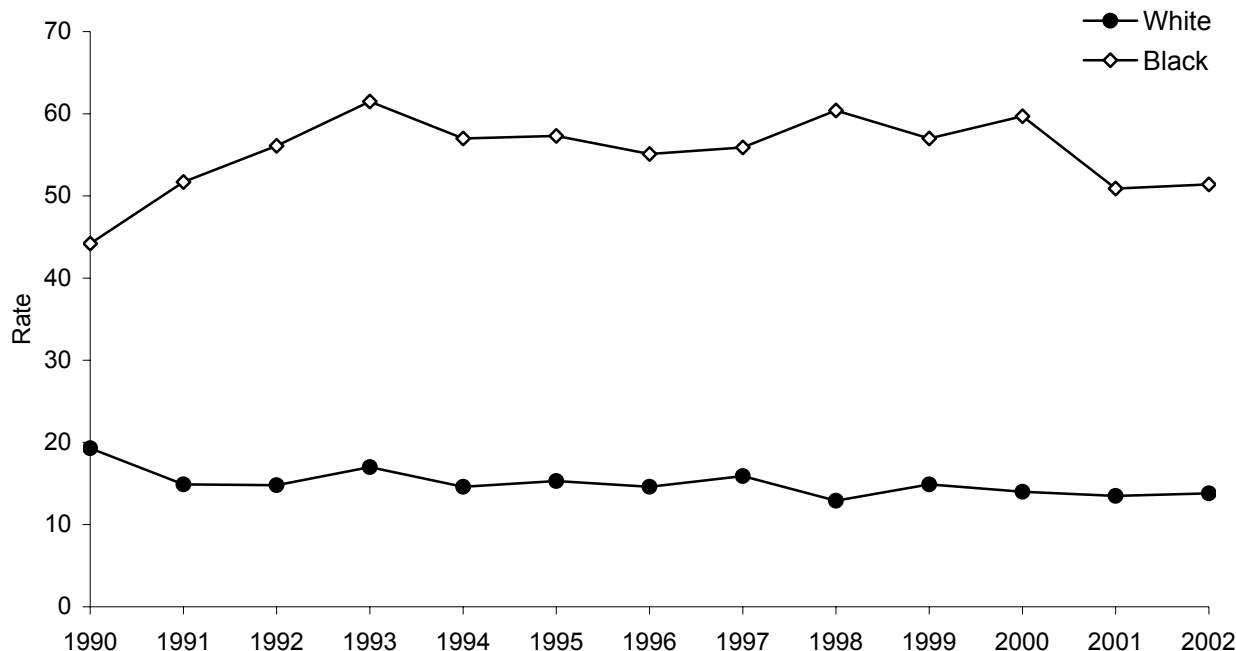
- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 2 Population estimates are taken from the Michigan population estimates for 2001.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
- 4 For records that are missing data for race, race was assigned based on the 1990 census population for Michigan.
- 5 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

	White	Black
East-Central MI Rate	13.8	54.2
95% CI	13.1 , 14.5	50.1 , 58.3
Count	1,463	738
Michigan Rate	10.4	43.5
95% CI	10.3 , 10.5	42.9 , 44.1
Count	25,455	19,685

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

- ✧ In East-Central Michigan and the State of Michigan, white persons have significantly lower asthma hospitalization rates than black persons, 2000-2002.
- ✧ While black persons in the State of Michigan have a higher asthma hospitalization rate, white persons experience the greatest absolute burden of asthma hospitalization.

Figure 6. Annual Rates (per 10,000) [1,2] of Asthma [3] Hospitalization by Race [4], All Ages, for East-Central Michigan [5], 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 For records that are missing data for race, race was assigned based on the 1990 census population for Michigan.
- 5 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

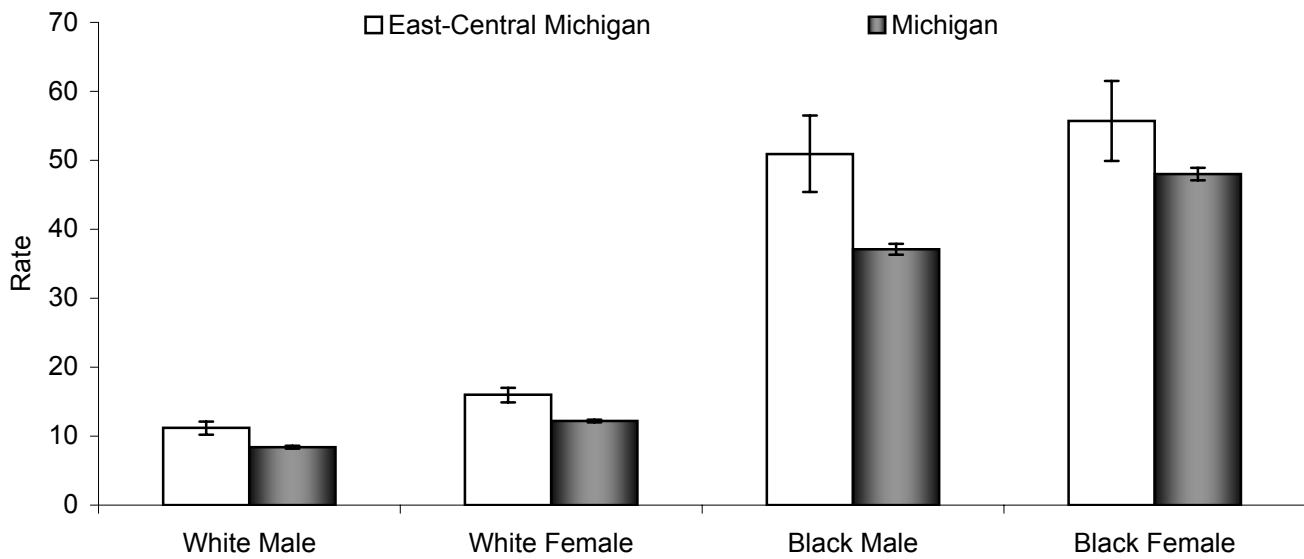
Year	White		Black	
	Rate	Count	Rate	Count
1990	19.3	688	44.2	202
1991	14.9	532	51.7	233
1992	14.8	531	56.1	264
1993	17.0	605	61.5	273
1994	14.6	517	57.0	254
1995	15.3	542	57.3	281
1996	14.6	515	55.1	254
1997	15.9	553	55.9	270
1998	12.9	454	60.4	269
1999	14.9	524	57.0	255
2000	14.0	491	59.7	280
2001	13.5	479	50.9	234
2002	13.8	493	51.4	224

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 white persons in East-Central Michigan ($\rho = -0.68$, $p < 0.05$).

See appendix pages 39 and 40 for supporting data.

Figure 7. Rates (per 10,000) [1,2] of Hospitalization due to Asthma [3] by Sex and Race [4] for East-Central Michigan [5] and the State of Michigan, All Ages, 2000-2002.



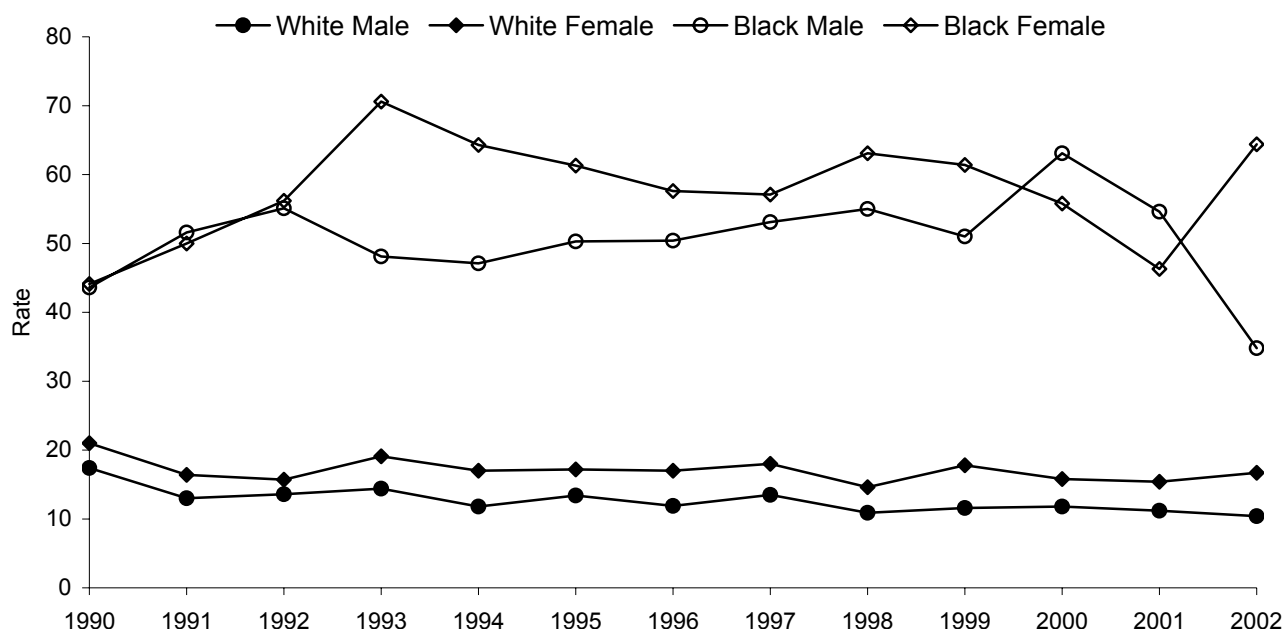
- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 2 Population estimates are taken from the Michigan population estimates for 2001.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
- 4 For records that are missing data for race, race was assigned based on the 1990 census population for Michigan.
- 5 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

	White Male	White Female	Black Male	Black Female
East-Central MI Rate	11.2	16.0	50.9	55.7
95% CI	10.2 , 12.1	14.9 , 17.0	45.4 , 56.5	49.9 , 61.5
Count	558	905	363	375
Michigan Rate	8.4	12.2	37.1	48.0
95% CI	8.2 , 8.6	12.0 , 12.4	36.3 , 37.9	47.1 , 48.9
Count	9,916	15,539	8,702	10,983

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

✧ In East-Central Michigan, the asthma hospitalization rate for black persons is significantly higher than the rate among white persons, 2000-2002, regardless of sex.

Figure 8. Annual Rates (per 10,000) [1,2] of Asthma [3] Hospitalization by Sex and Race [4], All Ages, for East-Central Michigan [5], 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 For records that are missing data for race, race was assigned based on the 1990 census population for Michigan.
- 5 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

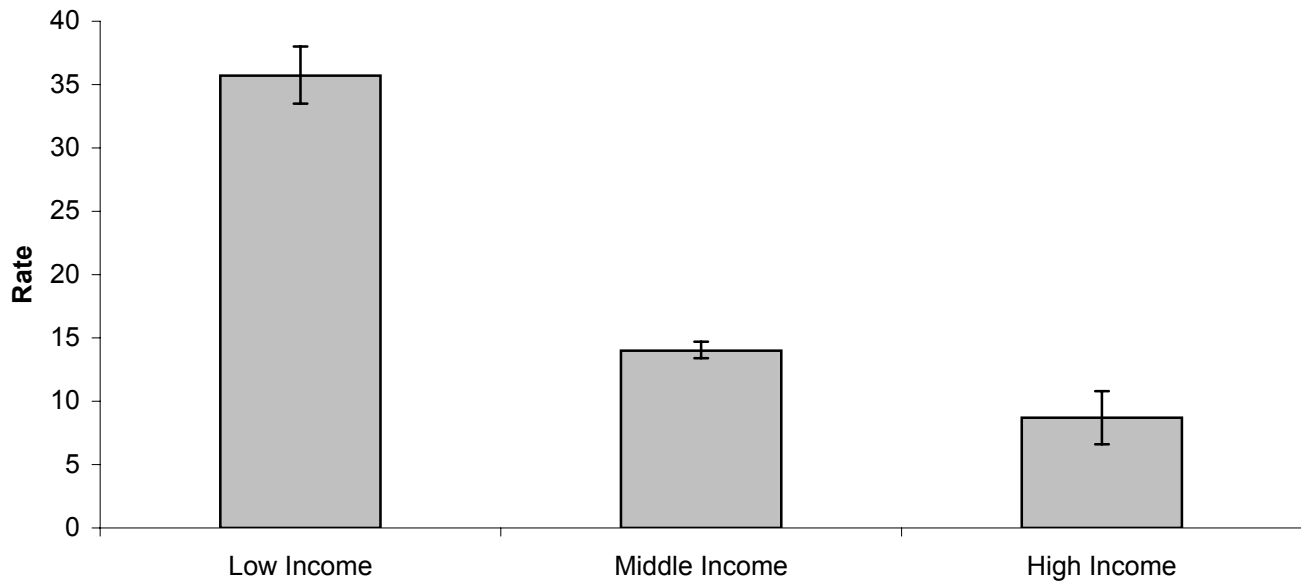
Year	White Male		White Female		Black Male		Black Female	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	17.4	305	21.0	383	43.6	102	44.1	100
1991	13.0	230	16.4	302	51.6	131	50.0	102
1992	13.6	241	15.7	290	55.1	138	56.2	126
1993	14.4	251	19.1	354	48.1	119	70.6	154
1994	11.8	202	17.0	315	47.1	112	64.3	142
1995	13.4	229	17.2	313	50.3	140	61.3	141
1996	11.9	201	17.0	314	50.4	126	57.6	128
1997	13.5	230	18.0	323	53.1	140	57.1	130
1998	10.9	185	14.6	269	55.0	133	63.1	136
1999	11.6	192	17.8	332	51.0	116	61.4	139
2000	11.8	197	15.8	294	63.1	152	55.8	128
2001	11.2	188	15.4	291	54.6	131	46.3	103
2002	10.4	173	16.7	320	34.8	80	64.4	144

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 the white male population in East-Central Michigan ($\rho = -0.82$, $p < 0.01$).

See appendix pages 41 through 44 for supporting data.

Figure 9. Rates (per 10,000) [1,2] of Hospitalization due to Asthma [3] by Income [4] for East-Central Michigan [5], 2000-2002.



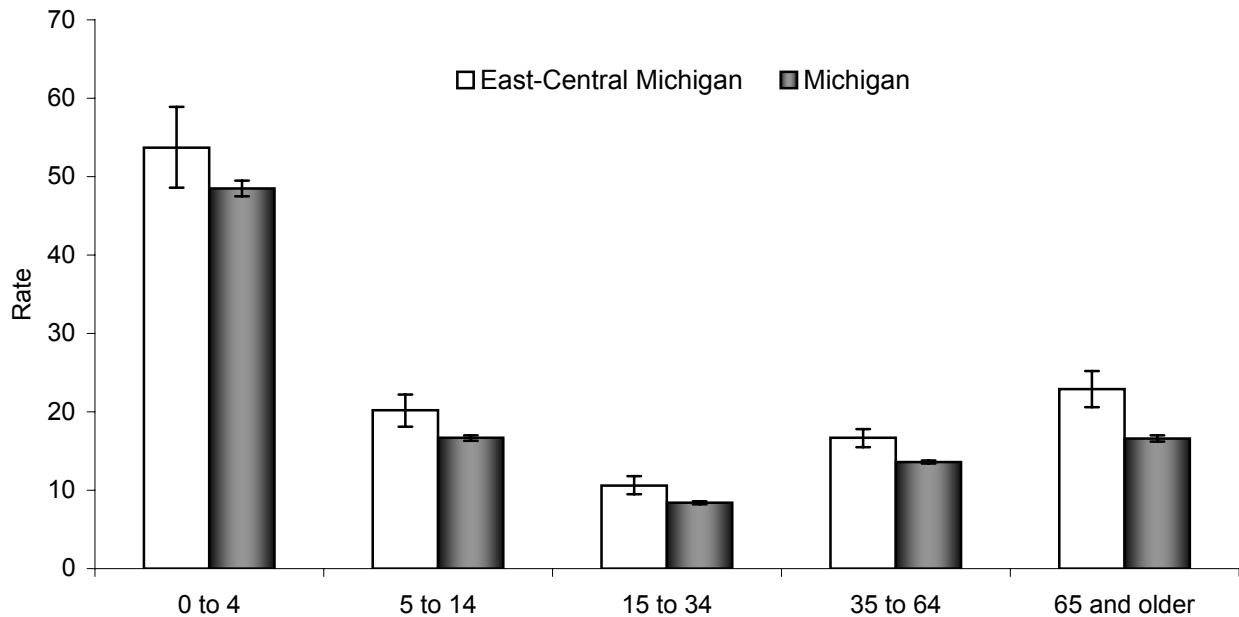
- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 2 Populations are taken from the 2000 US Census.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
- 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 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

	Low Income	Middle Income	High Income
East-Central MI Rate	35.7	14.0	8.7
95% CI	33.5 , 38.0	13.4 , 14.7	6.6 , 10.8
Count	969	1,572	66

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

- ✧ Low income areas of East-Central Michigan have significantly higher asthma hospitalization rates than both the middle income and high income areas, 2000-2002.
- ✧ Middle income areas of East-Central Michigan have significantly higher asthma hospitalization rates than high income areas, 2000-2002.

Figure 10. Rates (per 10,000) [1] of Hospitalization due to Asthma [2] by Age Group for East-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.

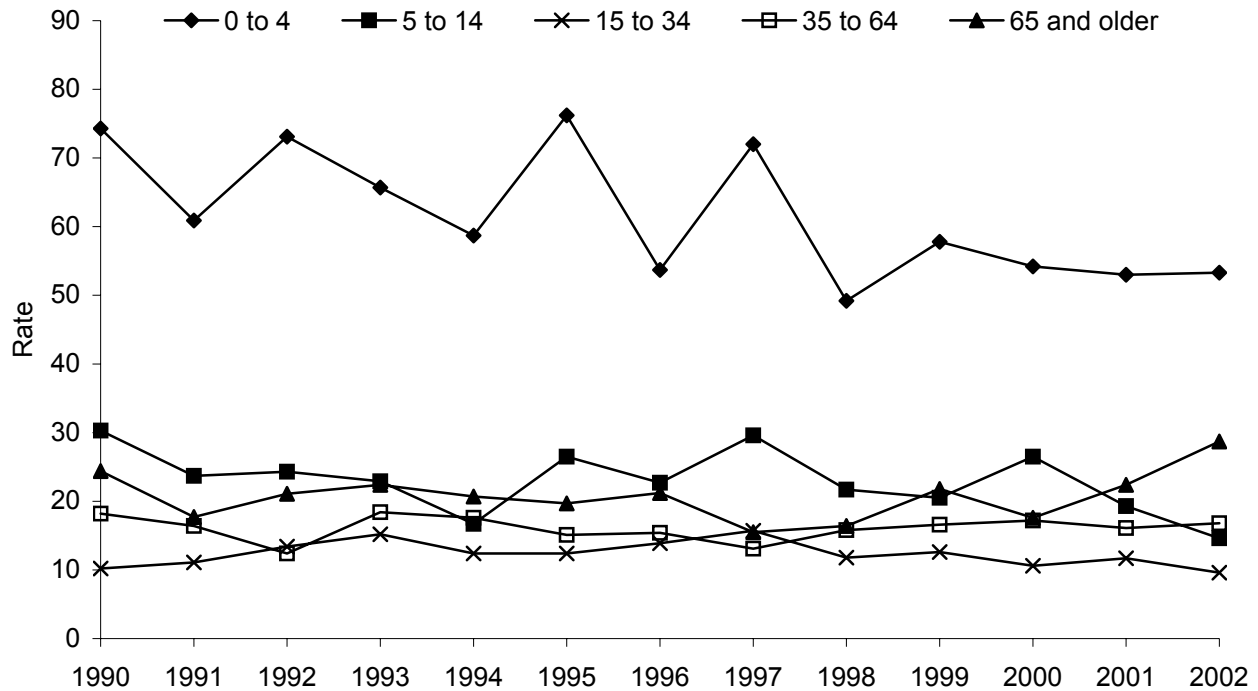
3 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

	0 to 4	5 to 14	15 to 34	35 to 64	65 and older
East-Central MI Rate	53.7	20.2	10.6	16.7	22.9
95% CI	48.6 , 58.9	18.1 , 22.2	9.5 , 11.8	15.5 , 17.8	20.6 , 25.2
Count	414	360	330	800	378
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

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

- ✧ For East-Central Michigan and the State of Michigan as a whole, children aged 0 to 4 years have significantly higher rates of asthma hospitalization than all other age groups, 2000-2002.
- ✧ For East-Central Michigan and the State of Michigan as a whole, persons aged 15 to 34 years have significantly lower rates of asthma hospitalization than all other age groups, 2000-2002.

Figure 11. Annual Rates (per 10,000) [1] of Asthma [2] Hospitalization by Age Group for East-Central Michigan [3], 1990-2002.



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

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

3 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

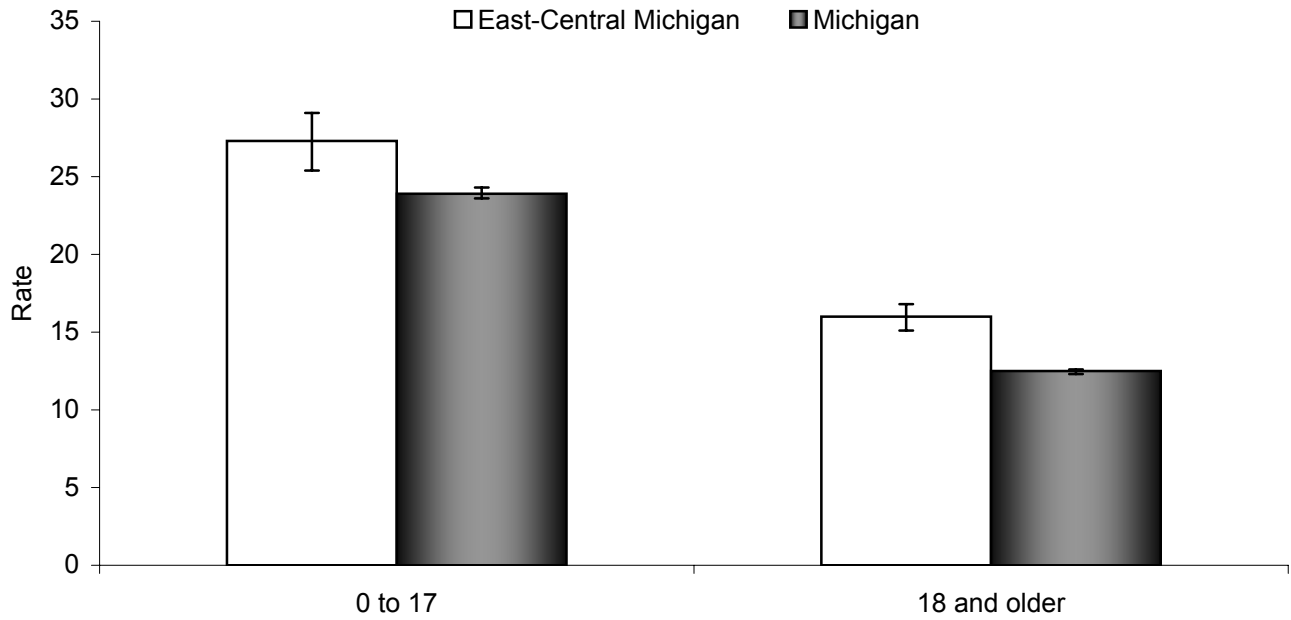
Year	0 to 4		5 to 14		15 to 34		35 to 64		65 and older	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	74.3	226	30.3	184	10.2	124	18.2	253	24.4	118
1991	60.9	185	23.7	145	11.1	132	16.4	232	17.7	87
1992	73.1	221	24.3	149	13.4	157	12.4	178	21.1	106
1993	65.7	197	22.9	141	15.2	174	18.4	269	22.4	114
1994	58.7	172	16.7	102	12.4	140	17.6	260	20.7	107
1995	76.2	217	26.5	163	12.4	138	15.1	227	19.7	103
1996	53.7	149	22.7	139	13.9	153	15.4	235	21.2	112
1997	72.0	196	29.6	182	15.7	170	13.1	202	15.5	83
1998	49.2	132	21.7	133	11.8	126	15.8	245	16.4	88
1999	57.8	153	20.5	125	12.6	132	16.6	260	21.8	118
2000	54.2	141	26.5	159	10.6	110	17.2	273	17.6	96
2001	53.0	136	19.3	115	11.7	121	16.1	257	22.4	123
2002	53.3	137	14.6	86	9.6	99	16.8	270	28.7	159

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 children aged 0 to 4 years in East-Central Michigan ($\rho = -0.73$, $p < 0.01$).

See appendix pages 45 through 49 for supporting data.

Figure 12. Rates (per 10,000) [1,2] of Hospitalization due to Asthma [3] by Age Group for East-Central Michigan [4] and the State of Michigan, 2000-2002.



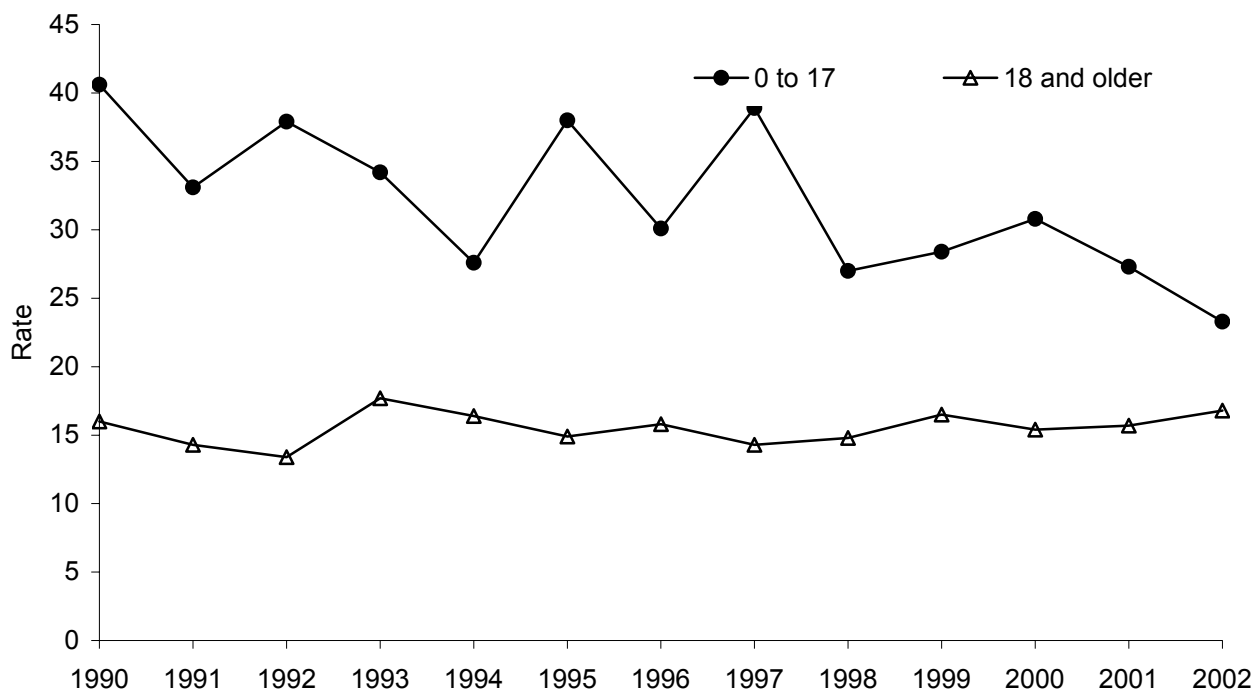
- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 2 Population estimates are taken from the Michigan population estimates for 2001.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis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

	0 to 17	18 and Older
East-Central MI Rate	27.3	16.0
95% CI	25.4 , 29.1	15.1 , 16.8
Count	819	1,463
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 East-Central Michigan and the State of Michigan, the rates of asthma hospitalization for children less than 18 years of age are significantly higher than those 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 East-Central Michigan are significantly higher than the respective rates for the State of Michigan as a whole, 2000-2002.

Figure 13. Annual Rates (per 10,000) [1,2] of Asthma [3] Hospitalization by Age Group for East-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 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

Year	0 to 17		18 and Older	
	Rate	Count	Rate	Count
1990	40.6	449	16.0	456
1991	33.1	366	14.3	415
1992	37.9	418	13.4	393
1993	34.2	378	17.7	517
1994	27.6	301	16.4	480
1995	38.0	409	14.9	439
1996	30.1	320	15.8	468
1997	38.9	411	14.3	422
1998	27.0	282	14.8	442
1999	28.4	293	16.5	495
2000	30.8	314	15.4	465
2001	27.3	274	15.7	478
2002	23.3	231	16.8	520

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 aged less than 18 years in East-Central Michigan ($\rho = -0.68$, $p < 0.05$).

See appendix pages 50 and 51 for supporting data.

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

Zip Code	Count	Rate	95% Confidence Interval	
			Lower Limit	Upper Limit
48415	36	13.2	8.8	17.6
48417	12	‡	‡	‡
48457	24	9.3	5.6	13.1
48460	6	‡	‡	‡
48601	728	49.8	46.2	53.5
48602	258	25.8	22.6	28.9
48603	179	14.7	12.5	17.0
48604	85	24.1	19.0	29.3
48607	52	64.0	46.4	81.5
48609	30	7.8	4.9	10.6
48611	20	‡	‡	‡
48612	33	11.7	7.6	15.7
48613	9	‡	‡	‡
48614	~	‡	‡	‡
48615	11	‡	‡	‡
48616	28	12.4	7.7	17.0
48618	17	‡	‡	‡
48620	~	‡	‡	‡
48623	29	8.2	5.1	11.2
48626	22	12.8	7.4	18.3
48628	6	‡	‡	‡
48631	16	‡	‡	‡
48634	10	‡	‡	‡
48637	14	‡	‡	‡
48640	136	14.0	11.6	16.3
48642	69	7.6	5.8	9.4
48649	11	‡	‡	‡
48650	17	‡	‡	‡
48652	7	‡	‡	‡
48655	25	13.7	8.3	19.1
48657	34	15.3	9.8	20.8
48658	36	20.4	13.7	27.1
48659	8	‡	‡	‡
48662	9	‡	‡	‡
48706	183	15.4	13.2	17.7
48708	156	18.1	15.2	20.9
48722	9	‡	‡	‡
48724	5	‡	‡	‡

Note: Table continued on next page.

(continued from previous page)

48732	56	15.9	11.7	20.1
48734	14	‡	‡	‡
48747	5	‡	‡	‡
48757	6	‡	‡	‡
48807	~	‡	‡	‡
48831	8	‡	‡	‡
48841	~	‡	‡	‡
48858	128	14.1	11.6	16.6
48880	27	13.0	8.0	18.0
48883	23	10.3	6.1	14.5
East-Central MI	2,282	18.9	18.1	19.6

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 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw 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: Asthma Mortality

Successful asthma management reduces symptoms and improves quality of life. Failure to maintain good control of the disease results in a higher risk of mortality. Death due to asthma is a rare and preventable event, indicative of difficulty in self-management and/or access to care.

Mortality data are acquired from the Michigan Resident Death Files for the years 1990 to 2003. This database includes all deaths in Michigan and deaths of Michigan residents where the death occurred out-of-state. As recommended by the Council for State and Territorial Epidemiologists (Position Statement 1998-EH/CD 1), deaths where asthma is primary cause are selected from these data. From 1990 to 1998, these are deaths with primary cause coded to International Classification of Disease (ICD) Version-9 codes 493.XX. Deaths occurring from 1999 to 2003 are classified according to ICD Version 10; ICD-10 codes for asthma are J45 and J46. The ICD-10 coding scheme is different and more detailed than its predecessor, ICD-9. Deaths coded with ICD-10 are not directly comparable to deaths coded with ICD-9.

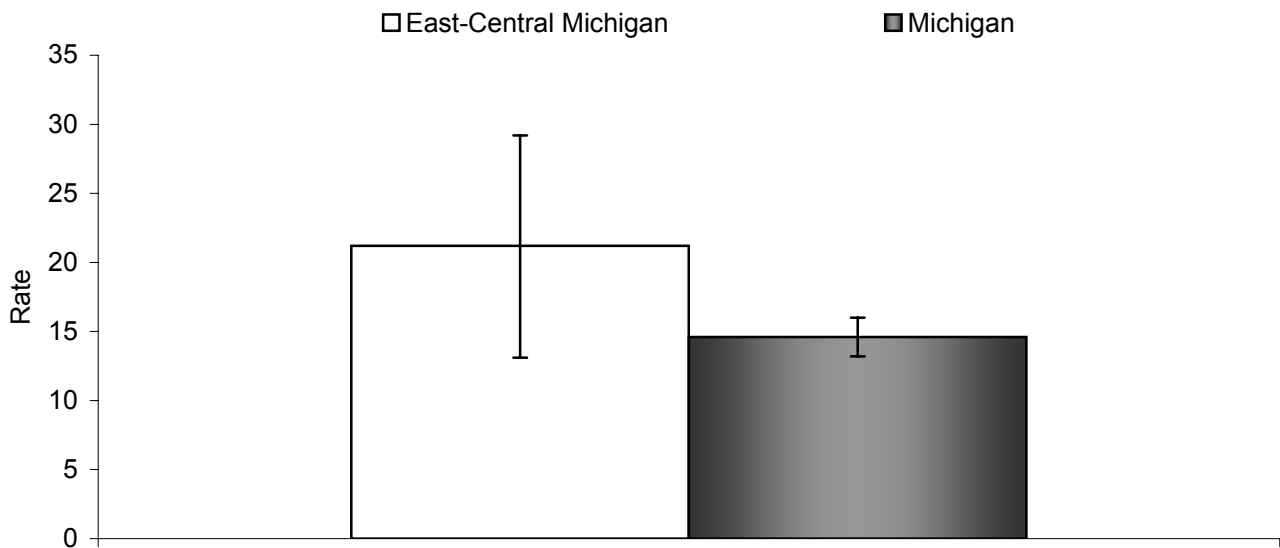
While a comparability ratio between ICD-9 and ICD-10 exists for asthma (0.8938; that is, for every 100 asthma deaths coded with ICD-9, only 89.38 would be coded as asthma using ICD-10), the analysis presented here does not attempt to compare pre-1999 data with asthma death occurring since 1999. (Anderson RN, *et al.* National Vital Statistics Reports; 49(2). 2001)

Age-adjusted asthma mortality rates are calculated and presented per 1,000,000 population. Rates are age adjusted so that valid comparisons can be made between populations of different age distributions. Mortality rates for demographic units with a small number of events (less than 5 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 the deceased, counts less than 5 are not presented in this report.

Ninety five percent confidence intervals are computed for asthma mortality rates where more than one year of data are combined. The confidence interval estimates the statistical uncertainty of the mortality rate and can be used to test whether rates are statistically different between groups. Average asthma mortality 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.

Due to the difference in asthma mortality coding between pre-1999 and 1999-present data, trend analyses were not conducted.

Figure 14. Rates (per 1,000,000) [1,2] of Mortality due to Asthma [3] for East-Central Michigan [4] and the State of Michigan, All Ages, 2001-2003.



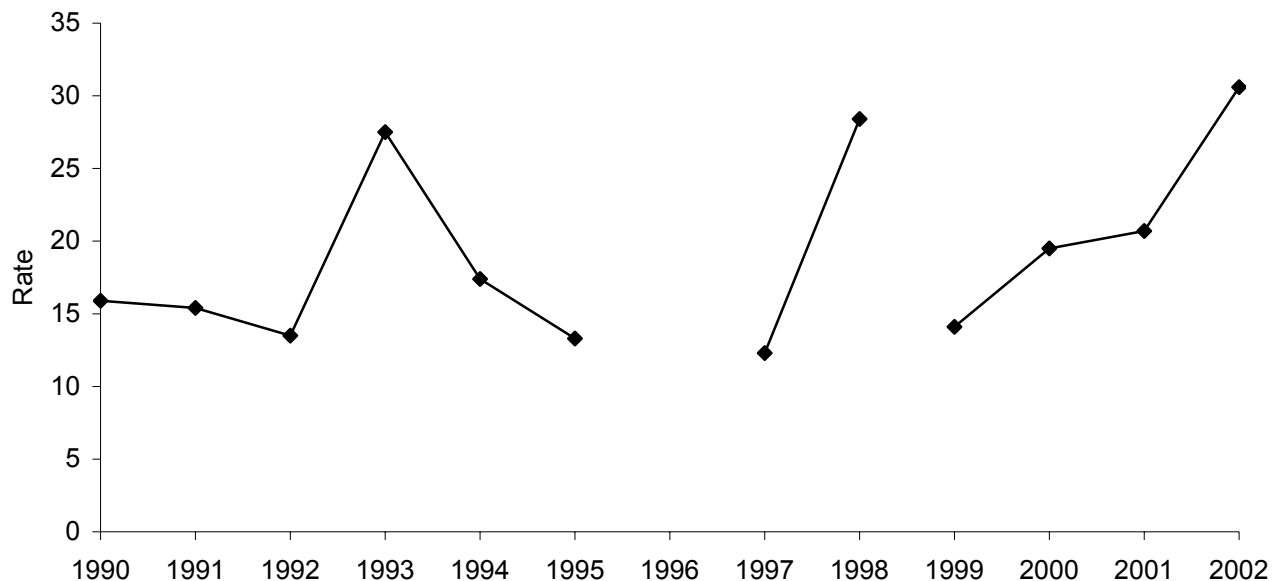
- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method.
- 2 Population estimates are taken from the Michigan population estimates for 2002.
- 3 Asthma death is defined as a primary cause of death as asthma, ICD-10=J45 or J46.
- 4 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

	Total Population
East-Central MI Rate	21.2
95% CI	13.1 , 29.2
Count	27
Michigan Rate	14.6
95% CI	13.2 , 16.0
Count	441

Data Source: Michigan Resident Death Files, Bureau of Epidemiology, MDCH.

- ✧ The average number of deaths due to asthma per year in Michigan, 2001-2003, is 147.
- ✧ The rate of asthma mortality in East-Central Michigan is not significantly different than the rate for the State of Michigan as a whole, 2001-2003.

Figure 15. Annual Rates (per 1,000,000) [1,2] of Mortality due to Asthma [3], All Ages, for East-Central Michigan [4], 1990-2002 [5].



- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method.
- 2 Population estimates are taken from the Michigan population estimates for 1990-2002.
- 3 Asthma death is defined as a primary cause of death as asthma, ICD-9=493.XX and ICD-10=J45 or J46.
- 4 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).
- 5 Due to a change in coding for asthma deaths beginning in 1999, rates calculated for 1999-2002 are not comparable to rates calculated for 1990-1998.

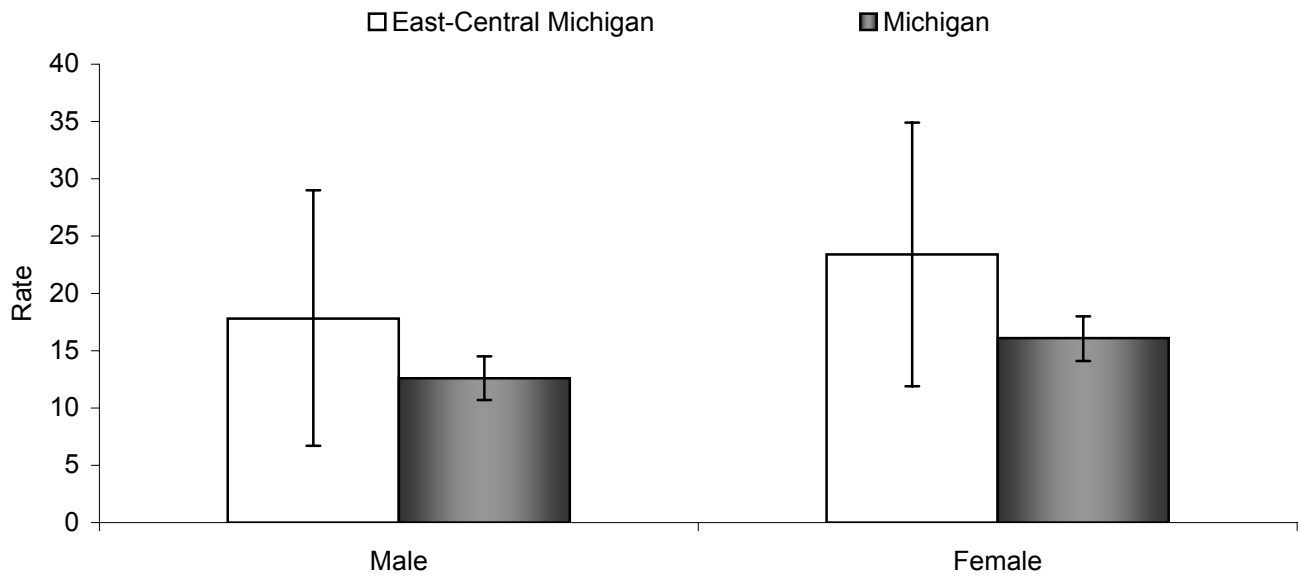
Year	Total Population	
	Rate	Count
1990	15.9	6
1991	15.4	6
1992	13.5	5
1993	27.5	11
1994	17.4	7
1995	13.3	5
1996	‡	~
1997	12.3	5
1998	28.4	12
1999	14.1	6
2000	19.5	8
2001	20.7	9
2002	30.6	13

- ‡ Insufficient data to compute a stable rate (number of events <5 or population <5000).
 ~ Due to a low number of events (<5), results are suppressed to protect the identity of the deceased.

Data Source: Michigan Resident Death Files, Bureau of Epidemiology, MDCH.

See appendix page 55 for supporting data.

Figure 16. Rates (per 1,000,000) [1,2] of Mortality due to Asthma [3] by Sex for East-Central Michigan [4] and the State of Michigan, All Ages, 2001-2003.



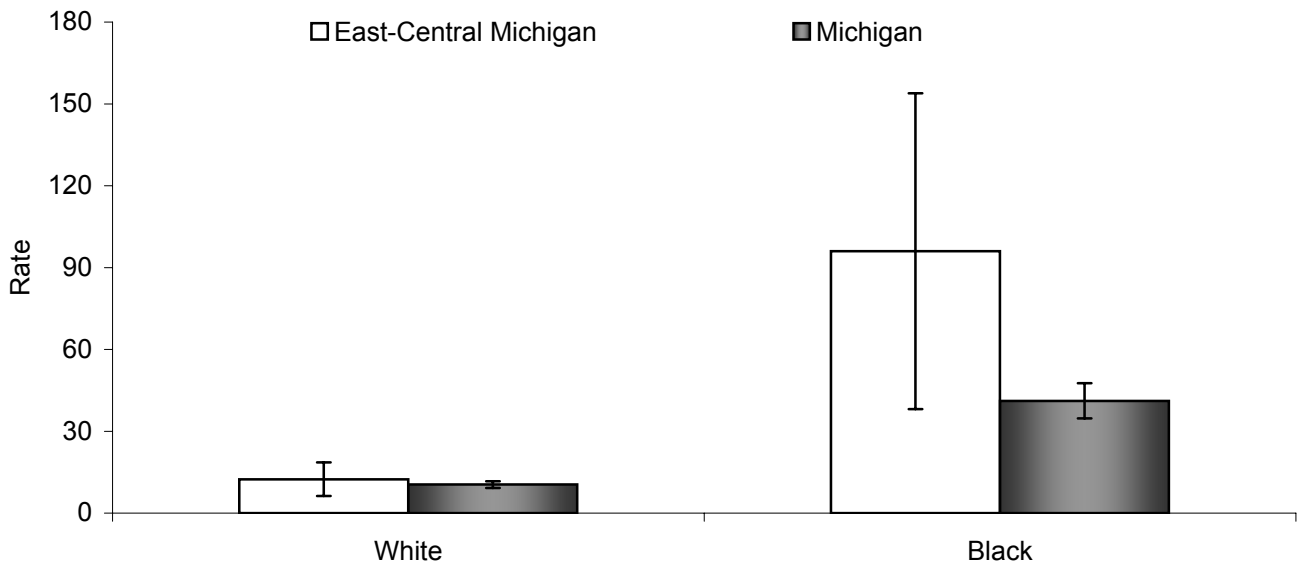
- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method.
- 2 Population estimates are taken from the Michigan population estimates for 2002.
- 3 Asthma death is defined as a primary cause of death as asthma, ICD-10=J45 or J46.
- 4 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

	Male	Female
East-Central MI Rate	17.8	23.4
95% CI	6.7 , 29.0	11.9 , 34.9
Count	10	17
Michigan Rate	12.6	16.1
95% CI	10.7 , 14.5	14.1 , 18.0
Count	171	270

Data Source: Michigan Resident Death Files, Bureau of Epidemiology, MDCH.

- ✧ There is no significant difference between the rates of asthma mortality for males and females in East-Central Michigan, 2001-2003.
- ✧ For the State of Michigan, the rate of asthma mortality for females is not significantly different than the rate for males, 2001-2003.

Figure 17. Rates (per 1,000,000) [1,2] of Mortality due to Asthma [3] by Race for East-Central Michigan [4] and the State of Michigan, All Ages, 2001-2003.



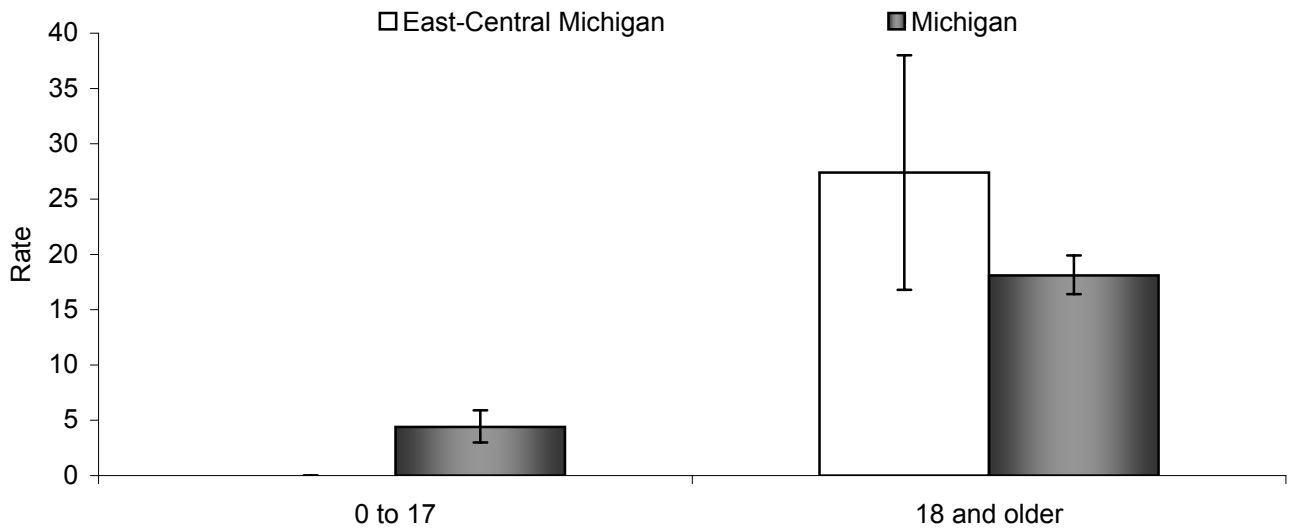
- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method.
- 2 Population estimates are taken from the Michigan population estimates for 2002.
- 3 Asthma death is defined as a primary cause of death as asthma, ICD-10=J45 or J46.
- 4 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

	White	Black
East-Central MI Rate	12.4	96.0
95% CI	6.3 , 18.6	38.1 , 153.9
Count	16	11
Michigan Rate	10.5	41.1
95% CI	9.2 , 11.7	34.7 , 47.6
Count	273	163

Data Source: Michigan Resident Death Files, Bureau of Epidemiology, MDCH.

- ✧ While black persons in the State of Michigan have a significantly higher asthma mortality rate, white persons experience more asthma related deaths, 2001-2003.
- ✧ The rates of asthma mortality for whites and blacks in East-Central Michigan are not significantly different than the respective rates for the State of Michigan as a whole, 2001-2003.

Figure 18. Rates (per 1,000,000) [1,2] of Mortality due to Asthma [3] by Age Group for East-Central Michigan [4] and the State of Michigan, 2001-2003.



- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method.
- 2 Population estimates are taken from the Michigan population estimates for 2002.
- 3 Asthma death is defined as a primary cause of death as asthma, ICD-10=J45 or J46.
- 4 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

	0 to 17	18 and Older
East-Central MI Rate	‡	27.4
95% CI	‡ , ‡	16.8 , 38.0
Count	~	26
Michigan Rate	4.4	18.1
95% CI	3.0 , 5.9	16.4 , 19.9
Count	35	406

- ‡ Insufficient data to compute a stable rate (number of events <5 or population <5000).
 ~ Due to a low number of events (<5), results are suppressed to protect the identity of the deceased.

Data Source: Michigan Resident Death Files, Bureau of Epidemiology, MDCH.

✧ The asthma mortality rate in the State of Michigan is significantly higher for individuals aged 18 years and older than for individuals aged less than 18 years, 2001-2003.

Section 4: *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 and mortality figures provide information for Bay, Midland, and Saginaw Counties, East-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 East-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 24-1: Reduce asthma deaths.

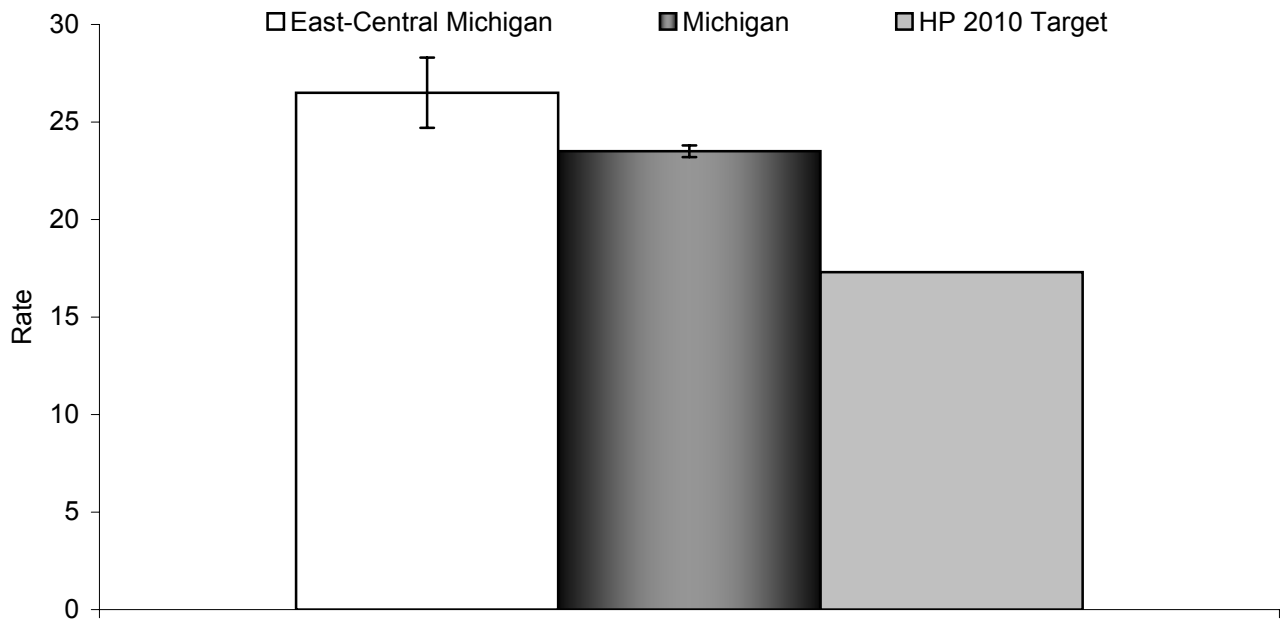
Targets: 1 per 1,000,000 (age 0-4 years)
1 per 1,000,000 (age 5-14 years)
2 per 1,000,000 (age 15-34 years)
9 per 1,000,000 (age 35-64 years)
60 per 1,000,000 (age ≥65 years)

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



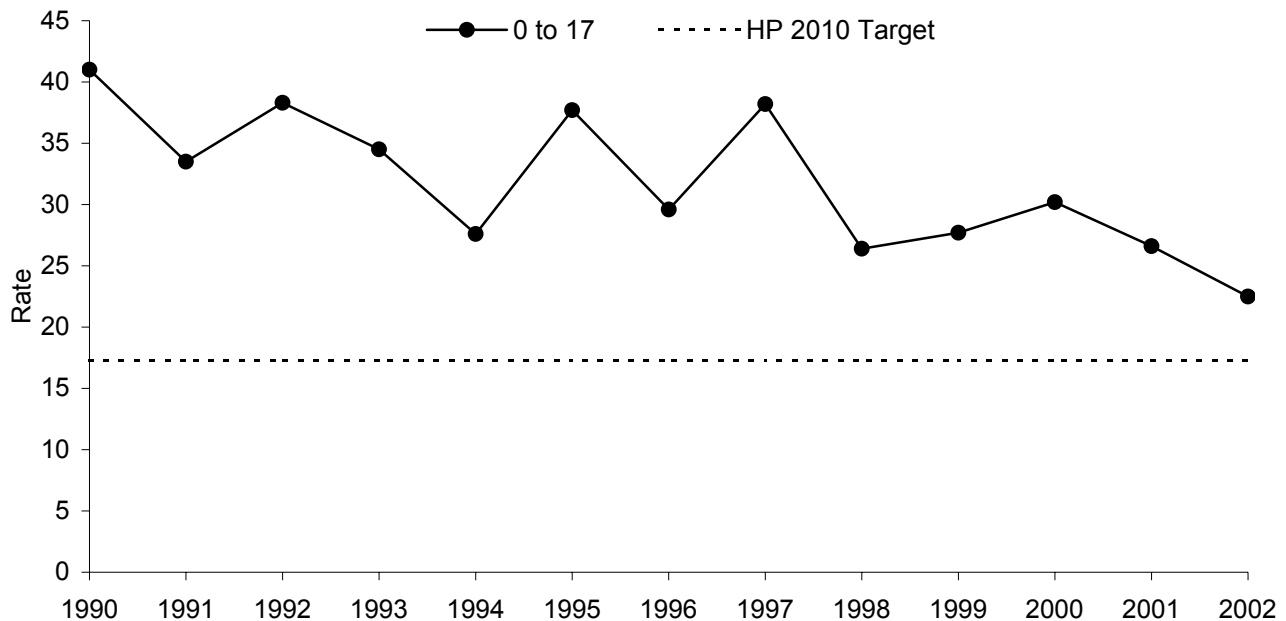
- 1 Population estimates are taken from the Michigan population estimates for 2001.
- 2 Not age adjusted in accordance with analysis prescribed by Healthy People 2010 Objectives.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
- 4 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

	Total Population
East-Central MI Rate	26.5
95% CI	24.7 , 28.3
Count	819
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 East-Central Michigan, 2000-2002, is 273.
- ✧ The rate of asthma hospitalization for children aged less than 18 years in East-Central Michigan, 2000-2002, is significantly higher than the *Healthy People 2010* objective.

Figure 20. Annual Rates (per 10,000) [1,2] of Asthma [3] Hospitalization for Children (aged less than 18 years) in East-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 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

Year	0 to 17	
	Rate	Count
1990	41.0	449
1991	33.5	366
1992	38.3	418
1993	34.5	378
1994	27.6	301
1995	37.7	409
1996	29.6	320
1997	38.2	411
1998	26.4	282
1999	27.7	293
2000	30.2	314
2001	26.6	274
2002	22.5	231

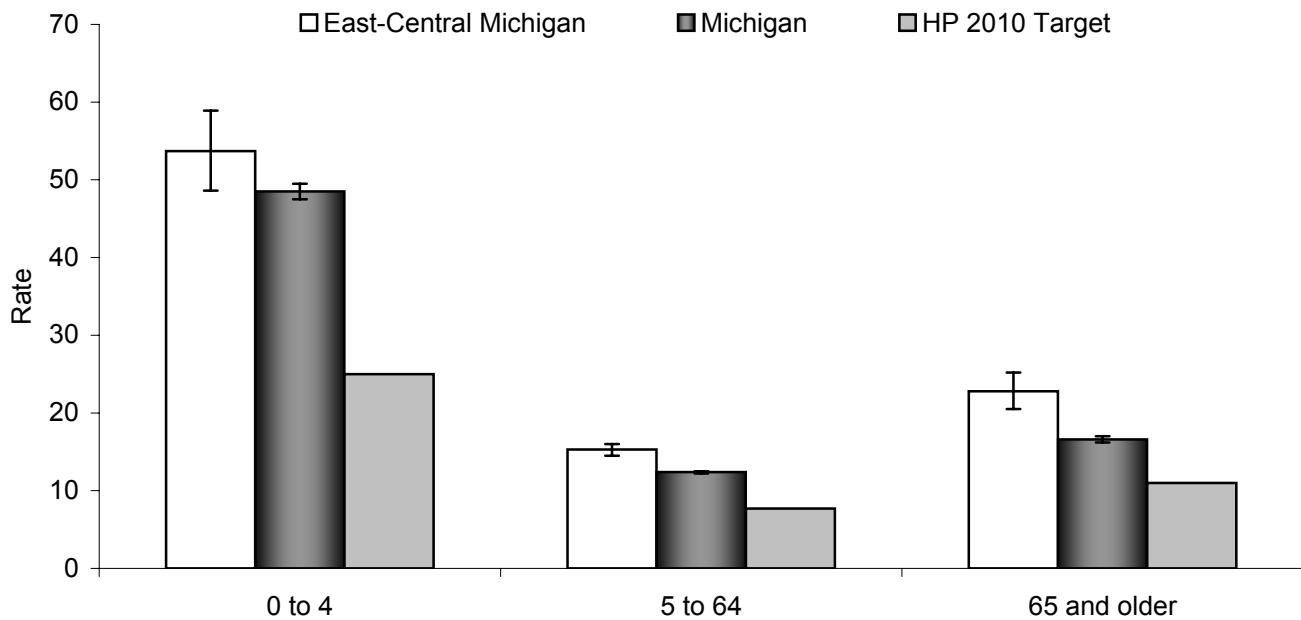
HP 2010 Target	17.3
-----------------------	-------------

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 aged less than 18 years in East-Central Michigan ($\rho = -0.73$, $p < 0.01$).

See appendix page 56 for supporting data.

Figure 21. Rates (per 10,000) [1,2] of Hospitalization due to Asthma [3] by Age Group for East-Central Michigan [4] and the State of Michigan, 2000-2002, Compared to the Healthy People 2010 Targets (Objective 24-2).



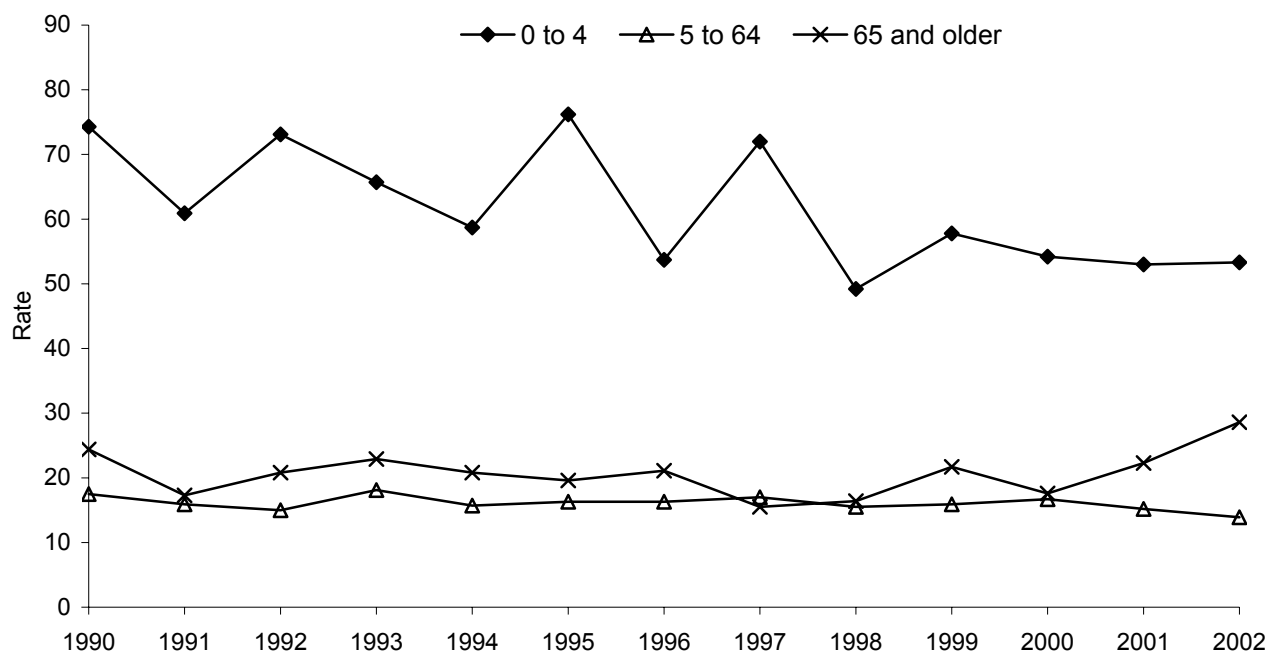
- 1 For age group 5-64 years and age group 65 and older, rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 2 Population estimates are taken from the Michigan population estimates for 2001.
- 3 Asthma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

	0 to 4	5 to 64	65 and Older
East-Central MI Rate	53.7	15.3	22.8
95% CI	48.6 , 58.9	14.5 , 16.0	20.5 , 25.2
Count	414	1,490	378
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 East-Central Michigan is significantly higher than the *Healthy People 2010* Target Rates for all age groups, 2000-2002.
- ✧ The rate of asthma hospitalization in East-Central Michigan is significantly higher than the rate for Michigan as a whole for the 5 to 64 year and 65 years and older age groups, 2000-2002.

Figure 22. Annual Rates (per 10,000) [1,2] of Asthma [3] Hospitalization by Age Group for East-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 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

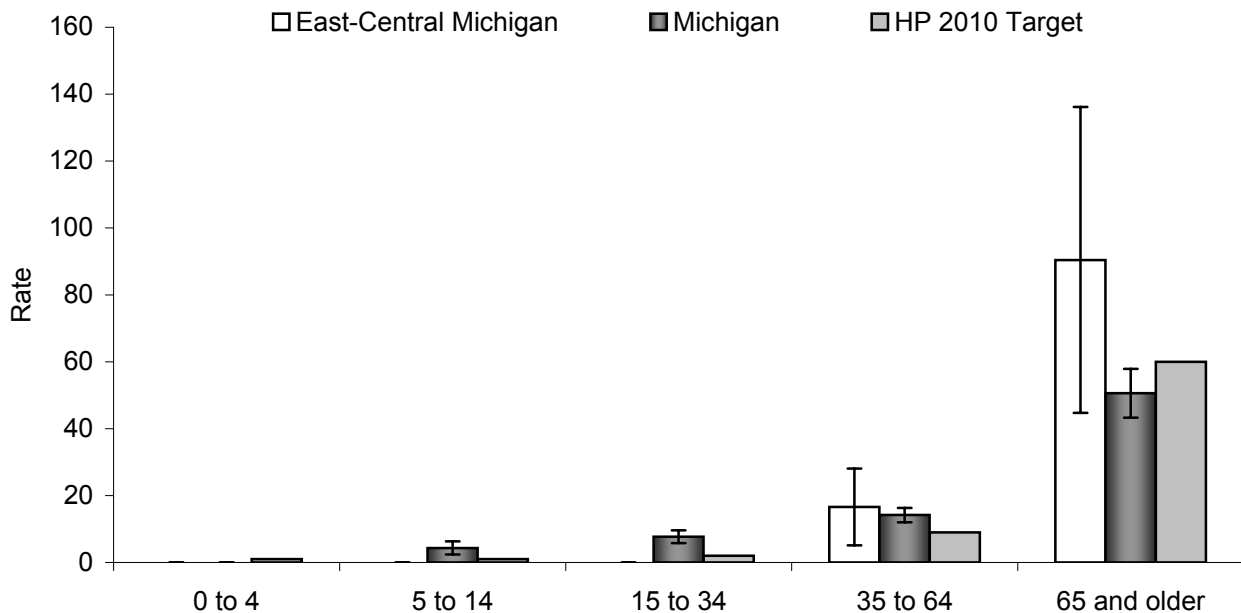
Year	0 to 4		5 to 64		65 and Older	
	Rate	Count	Rate	Count	Rate	Count
1990	74.3	226	17.5	561	24.4	118
1991	60.9	185	15.9	509	17.3	87
1992	73.1	221	15.0	484	20.8	106
1993	65.7	197	18.1	584	22.9	114
1994	58.7	172	15.7	502	20.8	107
1995	76.2	217	16.3	528	19.6	103
1996	53.7	149	16.3	527	21.1	112
1997	72.0	196	17.0	554	15.5	83
1998	49.2	132	15.5	504	16.4	88
1999	57.8	153	15.9	517	21.7	118
2000	54.2	141	16.7	542	17.6	96
2001	53.0	136	15.2	493	22.3	123
2002	53.3	137	13.9	455	28.6	159
HP 2010 Target	25.0		7.7		11.0	

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 children aged 0 to 4 years in East-Central Michigan ($\rho = -0.73$, $p < 0.01$).

See appendix pages 57 through 59 for supporting data.

Figure 23. Rates (per 1,000,000) [1] of Mortality due to Asthma [2] by Age Group for East-Central Michigan [3] and the State of Michigan, 2001-2003, Compared to the Healthy People 2010 Targets (Objective 24-1).



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

2 Asthma death is defined as a primary cause of death as asthma, ICD-10=J45 or J46.

3 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

	0 to 4	5 to 14	15 to 34	35 to 64	65 and Older
East-Central MI Rate	‡	‡	‡	16.6	90.4
95% CI	‡, ‡	‡, ‡	‡, ‡	5.1, 28.1	44.7, 136.2
Count	~	~	~	8	15
Michigan Rate	‡	4.3	7.7	14.2	50.6
95% CI	‡, ‡	2.4, 6.3	5.8, 9.6	12.0, 16.3	43.3, 57.9
Count	~	19	63	168	187
HP 2010 Target	1.0	1.0	2.0	9.0	60.0

‡ Insufficient data to compute a stable rate (number of events <5 or population <5000).

~ Due to a low number of events (<5), results are suppressed to protect the identity of the deceased.

Data Source: Michigan Resident Death Files, Bureau of Epidemiology, MDCH.

- ✧ The rate of asthma mortality in the State of Michigan is significantly higher than the *Healthy People 2010* Target Rate for the 5 to 14, 15 to 34, and 35 to 64 year age groups, 2001-2003.
- ✧ The rate of asthma mortality in the State of Michigan is significantly lower than the *Healthy People 2010* Target Rate for the 65 years and older age group, 2001-2003.

Section 5: Appendix

This appendix includes a compilation of supporting data tables presenting annual hospitalization and mortality rates for Bay, Midland, and Saginaw Counties, East-Central Michigan, and the State of Michigan. It also includes a summary for each East-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 Bay, Midland, and Saginaw Counties, East-Central Michigan [5], and the State of Michigan, 1990-2002.

Year	Bay		Midland		Saginaw		East-Central MI		Michigan	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	26.2	296	13.5	101	23.4	508	22.3	905	19.1	17,790
1991	17.9	201	11.5	89	22.5	491	19.1	781	18.1	16,995
1992	20.3	231	7.9	60	23.7	520	19.7	811	18.4	17,597
1993	21.6	241	10.9	85	26.3	569	22.0	895	19.8	18,975
1994	17.0	191	8.8	69	24.3	521	19.3	781	18.4	17,609
1995	16.7	187	7.9	62	27.7	599	20.8	848	19.5	18,945
1996	18.3	204	7.9	64	24.4	520	19.5	788	18.5	18,058
1997	17.6	190	9.9	81	26.3	562	20.6	833	17.7	17,320
1998	13.4	146	9.6	78	23.6	500	17.9	724	15.6	15,289
1999	15.6	168	11.1	89	25.1	531	19.6	788	15.6	15,385
2000	12.9	139	11.2	91	26.0	549	19.4	779	16.0	15,886
2001	13.7	146	10.6	87	24.5	519	18.7	752	15.5	15,363
2002	17.4	186	11.5	96	22.0	469	18.5	751	14.7	14,696

Spearman's ρ	-0.74**	0.05	0.14	-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 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

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

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

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 Bay, Midland, and Saginaw Counties, East-Central Michigan [5],
and the State of Michigan, 1990-2002.**

Year	Bay		Midland		Saginaw		East-Central MI		Michigan	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	22.9	126	14.4	56	21.4	233	20.5	415	17.1	7,951
1991	17.4	96	10.4	43	20.7	230	17.8	369	15.7	7,345
1992	18.7	105	6.5	25	23.1	256	18.7	386	16.1	7,666
1993	18.4	102	9.2	36	22.5	243	18.7	381	16.6	7,929
1994	12.9	70	8.2	32	19.9	214	15.7	316	15.4	7,339
1995	14.8	80	6.3	26	25.4	275	18.8	381	17.1	8,275
1996	17.2	91	7.6	30	20.4	216	16.9	337	15.9	7,725
1997	15.6	83	9.6	39	23.7	253	18.6	375	15.4	7,546
1998	12.2	65	9.9	39	20.3	214	15.9	318	12.7	6,199
1999	11.7	60	10.7	41	20.6	213	16.0	314	12.7	6,229
2000	10.7	56	11.2	45	24.3	252	17.9	353	13.7	6,745
2001	10.6	54	10.6	42	22.5	232	16.8	328	12.8	6,271
2002	12.9	66	10.3	42	14.9	152	13.4	260	12.2	5,971

Spearman's ρ	-0.86**	0.24	-0.14	-0.62*	-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 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

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

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

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 Bay, Midland, and Saginaw Counties, East-Central Michigan [5], and the State of Michigan, 1990-2002.

Year	Bay		Midland		Saginaw		East-Central MI		Michigan	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	29.0	170	12.3	45	25.1	275	23.9	490	20.6	9,834
1991	17.9	105	12.2	46	23.6	261	19.9	412	20.0	9,648
1992	21.2	126	9.1	35	23.8	264	20.4	425	20.3	9,927
1993	24.3	139	12.4	49	29.2	326	24.6	514	22.6	11,043
1994	20.7	121	9.2	37	28.0	307	22.4	465	20.9	10,269
1995	18.3	107	9.1	36	29.6	324	22.5	467	21.6	10,668
1996	19.1	113	8.2	34	27.9	304	21.7	451	20.8	10,333
1997	19.5	107	10.2	42	28.4	309	22.3	458	19.6	9,774
1998	14.3	81	9.4	39	26.0	286	19.5	406	18.1	9,089
1999	18.8	108	11.2	48	28.8	318	22.6	474	18.1	9,155
2000	14.6	83	10.9	46	27.0	297	20.3	426	18.0	9,141
2001	16.1	92	10.6	45	25.7	287	20.0	424	17.8	9,092
2002	21.2	120	12.0	54	28.3	317	22.9	491	16.9	8,725

Spearman's ρ	-0.47	-0.09	0.30	-0.17	-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 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

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

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 WHITES [5], All Ages, for Bay, Midland, and Saginaw Counties, East-Central Michigan [6], and the State of Michigan, 1990-2002.

Year	Bay		Midland		Saginaw		East-Central MI		Michigan	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	25.7	284	13.4	98	17.8	306	19.3	688	15.1	11,791
1991	17.4	190	11.4	85	14.8	257	14.9	532	14.2	11,148
1992	20.5	228	8.1	60	14.1	243	14.8	531	14.1	11,165
1993	21.4	232	11.2	85	16.8	288	17.0	605	14.8	11,757
1994	16.7	183	9.1	69	15.7	265	14.6	517	13.2	10,488
1995	16.1	176	7.9	60	18.2	306	15.3	542	13.2	10,586
1996	17.3	189	7.8	61	15.8	265	14.6	515	12.6	10,140
1997	17.8	185	9.6	76	17.6	292	15.9	553	12.2	9,849
1998	13.4	142	9.9	78	14.0	234	12.9	454	10.5	8,522
1999	15.8	165	11.4	88	16.1	271	14.9	524	10.7	8,716
2000	12.8	132	11.1	87	16.2	272	14.0	491	10.8	8,781
2001	12.2	126	10.9	86	15.7	267	13.5	479	10.5	8,541
2002	16.0	165	11.8	96	13.5	232	13.8	493	9.9	8,133

Spearman's ρ	-0.84**	0.04	-0.27	-0.68*	-0.95**
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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 For records that are missing data for race, race was assigned based on the 1990 census population for Michigan.

6 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

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

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

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among whites in Michigan was 9.9 per 10,000 population.

Sample Trend Interpretation:

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

**Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for
BLACKS [5], All Ages, for Bay, Midland, and Saginaw Counties, East-Central
Michigan [6], and the State of Michigan, 1990-2002.**

Year	Bay		Midland		Saginaw		East-Central MI		Michigan	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	‡	~	‡	~	45.1	196	44.2	202	43.0	5,800
1991	‡	~	‡	~	52.8	226	51.7	233	41.4	5,715
1992	‡	~	‡	~	59.1	264	56.1	264	44.4	6,209
1993	‡	~	‡	~	64.1	269	61.5	273	49.1	6,948
1994	‡	~	‡	~	59.2	249	57.0	254	48.5	6,858
1995	‡	~	‡	~	58.9	273	57.3	281	54.0	8,031
1996	‡	~	‡	~	56.4	244	55.1	254	51.3	7,603
1997	‡	~	‡	~	58.5	265	55.9	270	48.0	7,246
1998	‡	~	‡	~	63.4	266	60.4	269	45.3	6,607
1999	‡	~	‡	~	59.9	252	57.0	255	44.2	6,459
2000	‡	~	‡	~	62.0	272	59.7	280	45.2	6,888
2001	‡	~	‡	~	52.9	226	50.9	234	43.2	6,518
2002	‡	~	‡	~	51.0	209	51.4	224	42.0	6,279

Spearman's ρ	ψ	ψ	0.10	0.04	-0.07
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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 For records that are missing data for race, race was assigned based on the 1990 census population for Michigan.

6 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw 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 blacks in Michigan was 42.0 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, a significant overall trend in asthma hospitalization rates has not been observed for blacks in Michigan.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for WHITE MALES [5], All Ages, for Bay, Midland, and Saginaw Counties, East-Central Michigan [6], and the State of Michigan, 1990-2002.

Year	Bay		Midland		Saginaw		East-Central MI		Michigan	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	22.1	118	14.1	54	15.8	133	17.4	305	13.4	5,142
1991	17.0	91	9.8	39	11.8	100	13.0	230	12.0	4,632
1992	18.9	103	6.7	25	13.4	113	13.6	241	12.1	4,715
1993	17.8	96	9.4	36	14.6	119	14.4	251	11.9	4,633
1994	12.7	67	8.5	32	12.6	103	11.8	202	10.4	4,033
1995	14.7	77	6.3	25	15.7	127	13.4	229	10.9	4,285
1996	15.8	81	7.2	27	11.6	93	11.9	201	10.2	4,012
1997	15.9	81	9.7	38	13.9	111	13.5	230	10.1	3,993
1998	12.5	64	10.2	39	10.3	82	10.9	185	8.1	3,198
1999	12.2	60	10.9	40	11.5	92	11.6	192	8.5	3,338
2000	10.9	54	10.6	41	13.0	102	11.8	197	8.9	3,499
2001	9.7	47	10.7	41	12.5	100	11.2	188	8.4	3,284
2002	12.7	62	10.7	42	8.7	69	10.4	173	8.0	3,133

Spearman's ρ	-0.85**	0.36	-0.59*	-0.82**	-0.95**
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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 For records that are missing data for race, race was assigned based on the 1990 census population for Michigan.

6 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

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

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

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among white males in Michigan was 8.0 per 10,000 population.

Sample Trend Interpretation:

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

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for WHITE FEMALES [5], All Ages, for Bay, Midland, and Saginaw Counties, East-Central Michigan [6], and the State of Michigan, 1990-2002.

Year	Bay		Midland		Saginaw		East-Central MI		Michigan	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	28.8	166	12.3	44	19.7	173	21.0	383	16.5	6,647
1991	17.3	99	12.5	46	17.4	157	16.4	302	16.0	6,514
1992	21.5	125	9.3	35	14.7	130	15.7	290	15.7	6,446
1993	24.3	136	12.8	49	18.5	169	19.1	354	17.3	7,122
1994	20.2	116	9.4	37	18.3	162	17.0	315	15.6	6,455
1995	17.2	99	9.1	35	20.7	179	17.2	313	15.2	6,301
1996	18.6	108	8.5	34	19.8	172	17.0	314	14.8	6,128
1997	19.5	104	9.6	38	21.1	181	18.0	323	14.1	5,856
1998	14.1	78	9.6	39	17.3	152	14.6	269	12.7	5,324
1999	18.8	105	11.6	48	20.2	179	17.8	332	12.7	5,378
2000	14.2	78	11.3	46	19.0	170	15.8	294	12.5	5,282
2001	14.1	79	11.0	45	18.4	167	15.4	291	12.4	5,257
2002	18.5	103	12.3	54	18.0	163	16.7	320	11.6	5,000

Spearman's ρ	-0.64*	-0.06	0.11	-0.39	-0.97**
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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 For records that are missing data for race, race was assigned based on the 1990 census population for Michigan.
- 6 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

* Correlation is statistically significant; p-value < 0.05.
 ** Correlation is statistically significant; p-value < 0.01.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among white females in Michigan was 11.6 per 10,000 population.

Sample Trend Interpretation:

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

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for BLACK MALES [5], All Ages, for Bay, Midland, and Saginaw Counties, East-Central Michigan [6], and the State of Michigan, 1990-2002.

Year	Bay		Midland		Saginaw		East-Central MI		Michigan	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	‡	~	‡	~	43.9	98	43.6	102	39.2	2,721
1991	‡	~	‡	~	52.8	126	51.6	131	36.6	2,660
1992	‡	~	‡	~	58.5	138	55.1	138	39.0	2,864
1993	‡	~	‡	~	50.4	116	48.1	119	42.8	3,169
1994	‡	~	‡	~	49.3	110	47.1	112	43.1	3,176
1995	‡	~	‡	~	52.8	138	50.3	140	48.6	3,838
1996	‡	~	‡	~	51.1	118	50.4	126	45.8	3,569
1997	‡	~	‡	~	56.2	138	53.1	140	43.7	3,452
1998	‡	~	‡	~	58.5	132	55.0	133	38.3	2,927
1999	‡	~	‡	~	54.4	115	51.0	116	37.0	2,796
2000	‡	~	‡	~	65.7	147	63.1	152	39.4	3,147
2001	‡	~	‡	~	56.4	124	54.6	131	36.6	2,856
2002	‡	~	‡	~	35.9	77	34.8	80	35.0	2,699

Spearman's ρ	ψ	ψ	0.27	0.20	-0.30
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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 For records that are missing data for race, race was assigned based on the 1990 census population for Michigan.
- 6 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw 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 black males in Michigan was 35.0 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, a significant overall trend in asthma hospitalization rates has not been observed for black males in Michigan.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for BLACK FEMALES [5], All Ages, for Bay, Midland, and Saginaw Counties, East-Central Michigan [6], and the State of Michigan, 1990-2002.

Year	Bay		Midland		Saginaw		East-Central MI		Michigan	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	‡	~	‡	~	45.4	98	44.1	100	45.3	3,079
1991	‡	~	‡	~	50.9	100	50.0	102	44.3	3,055
1992	‡	~	‡	~	58.8	126	56.2	126	47.8	3,345
1993	‡	~	‡	~	73.2	153	70.6	154	53.4	3,779
1994	‡	~	‡	~	66.2	139	64.3	142	51.9	3,682
1995	‡	~	‡	~	61.8	135	61.3	141	57.1	4,193
1996	‡	~	‡	~	59.4	126	57.6	128	54.7	4,034
1997	‡	~	‡	~	59.1	127	57.1	130	50.6	3,794
1998	‡	~	‡	~	65.4	134	63.1	136	50.0	3,680
1999	‡	~	‡	~	63.9	137	61.4	139	49.4	3,663
2000	‡	~	‡	~	57.7	125	55.8	128	49.0	3,741
2001	‡	~	‡	~	48.5	102	46.3	103	48.0	3,662
2002	‡	~	‡	~	62.5	132	64.4	144	47.0	3,580

Spearman's ρ	ψ	ψ	0.14	0.23	0.08
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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 For records that are missing data for race, race was assigned based on the 1990 census population for Michigan.
- 6 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw 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 black females in Michigan was 47.0 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, a significant overall trend in asthma hospitalization rates has not been observed for black 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 Bay, Midland, and Saginaw Counties, East-Central Michigan [5], and the State of Michigan, 1990-2002.

Year	Bay		Midland		Saginaw		East-Central MI		Michigan	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	93.5	75	46.8	27	74.6	124	74.3	226	66.1	4,712
1991	69.4	55	36.4	21	65.4	109	60.9	185	57.1	4,106
1992	80.3	63	‡	15	86.0	143	73.1	221	64.4	4,638
1993	71.0	55	‡	20	73.9	122	65.7	197	59.6	4,291
1994	49.0	37	39.0	22	70.2	113	58.7	172	53.2	3,783
1995	54.7	40	45.3	25	97.3	152	76.2	217	63.9	4,457
1996	60.5	43	‡	16	59.3	90	53.7	149	59.6	4,092
1997	80.2	56	38.7	21	80.3	119	72.0	196	59.2	4,019
1998	43.7	30	‡	19	56.9	83	49.2	132	40.5	2,734
1999	82.7	56	‡	18	55.1	79	57.8	153	40.6	2,725
2000	55.2	37	‡	19	60.5	85	54.2	141	48.8	3,257
2001	67.4	44	‡	16	54.7	76	53.0	136	50.5	3,341
2002	81.6	53	‡	17	48.1	67	53.3	137	45.8	3,039

Spearman's ρ	-0.14	ψ	-0.72**	-0.73**	-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 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

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

** 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 Bay, Midland, and Saginaw Counties, East-Central Michigan [5], and the State of Michigan, 1990-2002.

Year	Bay		Midland		Saginaw		East-Central MI		Michigan	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	32.4	53	‡	19	34.3	112	30.3	184	20.9	2,826
1991	19.5	32	‡	15	29.9	98	23.7	145	19.4	2,666
1992	23.2	38	‡	9	31.2	102	24.3	149	18.5	2,571
1993	19.5	32	‡	14	29.0	95	22.9	141	21.1	2,972
1994	16.0	26	‡	5	21.8	71	16.7	102	17.1	2,418
1995	16.7	27	‡	7	39.5	129	26.5	163	21.9	3,152
1996	20.7	33	‡	9	29.7	97	22.7	139	21.4	3,113
1997	25.8	41	‡	12	39.5	129	29.6	182	22.1	3,244
1998	14.6	23	‡	11	30.4	99	21.7	133	16.8	2,491
1999	‡	12	‡	11	31.4	102	20.5	125	16.8	2,497
2000	13.8	21	‡	13	39.2	125	26.5	159	20.4	3,010
2001	‡	10	‡	9	30.3	96	19.3	115	16.0	2,363
2002	‡	17	‡	8	19.5	61	14.6	86	13.7	2,002

Spearman's ρ	ψ	ψ	-0.05	-0.51	-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 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

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

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 Bay, Midland, and Saginaw Counties, East-Central Michigan [5], and the State of Michigan, 1990-2002.

Year	Bay		Midland		Saginaw		East-Central MI		Michigan	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	8.7	29	‡	10	13.2	85	10.2	124	9.1	2,709
1991	6.4	21	‡	15	15.3	96	11.1	132	8.9	2,628
1992	11.9	38	‡	7	18.2	112	13.4	157	9.8	2,839
1993	14.3	45	‡	15	18.9	114	15.2	174	11.7	3,352
1994	7.5	23	‡	12	17.5	105	12.4	140	10.9	3,081
1995	9.6	29	‡	12	16.4	97	12.4	138	11.8	3,341
1996	9.8	29	‡	8	19.9	116	13.9	153	11.5	3,220
1997	12.8	37	‡	18	20.1	115	15.7	170	10.6	2,959
1998	9.2	26	‡	13	15.5	87	11.8	126	10.0	2,755
1999	‡	20	9.8	21	16.4	91	12.6	132	9.2	2,526
2000	‡	15	‡	16	14.4	79	10.6	110	9.2	2,502
2001	‡	18	‡	17	15.7	86	11.7	121	8.2	2,253
2002	9.6	26	‡	11	11.3	62	9.6	99	7.7	2,104

Spearman's ρ	ψ	ψ	-0.20	-0.20	-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 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

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

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 Bay, Midland, and Saginaw Counties, East-Central Michigan [5], and the State of Michigan, 1990-2002.

Year	Bay		Midland		Saginaw		East-Central MI		Michigan	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	21.8	85	12.2	33	18.5	135	18.2	253	14.8	4,694
1991	15.6	62	10.1	28	19.2	142	16.4	232	15.0	4,838
1992	10.9	44	‡	17	15.6	117	12.4	178	14.5	4,795
1993	18.5	76	7.2	21	22.7	172	18.4	269	15.9	5,369
1994	14.9	62	‡	19	23.4	179	17.6	260	16.0	5,509
1995	12.6	53	‡	11	21.0	163	15.1	227	15.6	5,493
1996	11.0	47	8.4	26	20.7	162	15.4	235	15.0	5,401
1997	9.3	40	7.3	23	17.6	139	13.1	202	13.8	5,065
1998	11.2	49	8.1	26	21.3	170	15.8	245	14.2	5,275
1999	11.8	52	7.3	24	23.0	184	16.6	260	14.7	5,547
2000	10.8	48	9.3	31	24.0	194	17.2	273	13.6	5,264
2001	12.5	56	8.3	28	21.3	173	16.1	257	13.8	5,383
2002	14.0	63	8.8	30	21.7	177	16.8	270	13.5	5,317

Spearman's ρ	-0.46	ψ	0.50	-0.08	-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 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

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

** 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 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 Bay, Midland, and Saginaw Counties, East-Central Michigan [5], and the State of Michigan, 1990-2002.

Year	Bay		Midland		Saginaw		East-Central MI		Michigan	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	35.9	54	‡	12	20.3	52	24.4	118	25.7	2,849
1991	20.3	31	‡	10	17.6	46	17.7	87	24.4	2,757
1992	31.0	48	‡	12	17.4	46	21.1	106	23.9	2,754
1993	21.1	33	‡	15	24.7	66	22.4	114	25.6	2,991
1994	27.3	43	‡	11	19.6	53	20.7	107	23.8	2,818
1995	23.9	38	‡	7	21.3	58	19.7	103	20.9	2,502
1996	32.4	52	‡	5	20.0	55	21.2	112	18.5	2,232
1997	‡	16	‡	7	21.6	60	15.5	83	16.8	2,033
1998	‡	18	‡	9	21.9	61	16.4	88	16.8	2,034
1999	17.4	28	‡	15	26.7	75	21.8	118	17.2	2,090
2000	‡	18	‡	12	23.3	66	17.6	96	15.2	1,853
2001	‡	18	‡	17	30.8	88	22.4	123	16.5	2,023
2002	16.6	27	28.9	30	35.6	102	28.7	159	18.1	2,234

Spearman's ρ	ψ	ψ	0.79**	0.03	-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 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

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

** 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 Bay, Midland, and Saginaw Counties, East-Central Michigan [5], and the State of Michigan, 1990-2002.

Year	Bay		Midland		Saginaw		East-Central MI		Michigan	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	46.8	138	24.2	51	43.4	260	40.6	449	31.7	8,063
1991	32.1	94	17.9	38	39.1	234	33.1	366	28.3	7,254
1992	37.8	110	12.2	26	47.1	282	37.9	418	29.9	7,735
1993	34.2	99	17.8	38	40.2	241	34.2	378	30.5	7,875
1994	23.1	66	13.6	29	34.9	206	27.6	301	26.2	6,757
1995	25.4	71	15.8	33	52.2	305	38.0	409	31.9	8,221
1996	30.6	83	12.3	26	36.6	211	30.1	320	30.2	7,769
1997	38.5	104	16.5	35	47.6	272	38.9	411	30.1	7,742
1998	21.3	57	14.4	30	34.7	195	27.0	282	21.8	5,594
1999	27.3	70	13.8	29	34.7	194	28.4	293	21.6	5,546
2000	24.0	62	15.4	32	40.1	220	30.8	314	26.3	6,693
2001	22.2	55	13.0	27	35.4	192	27.3	274	24.1	6,089
2002	28.7	71	12.9	27	24.8	133	23.3	231	21.3	5,359

Spearman's ρ	-0.59*	-0.45	-0.55	-0.68*	-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 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

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

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 Bay, Midland, and Saginaw Counties, East-Central Michigan [5], and the State of Michigan, 1990-2002.

Year	Bay		Midland		Saginaw		East-Central MI		Michigan	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	19.1	158	9.8	50	16.4	248	16.0	456	14.7	9,727
1991	13.0	107	9.3	51	16.7	257	14.3	415	14.5	9,741
1992	14.2	121	6.4	34	15.5	238	13.4	393	14.5	9,862
1993	17.2	142	8.6	47	21.4	328	17.7	517	16.1	11,100
1994	14.9	125	7.2	40	20.6	315	16.4	480	15.7	10,852
1995	13.7	116	5.2	29	19.1	294	14.9	439	15.2	10,724
1996	14.0	121	6.4	38	20.2	309	15.8	468	14.5	10,289
1997	10.4	86	7.7	46	18.9	290	14.3	422	13.3	9,578
1998	10.6	89	8.0	48	19.7	305	14.8	442	13.4	9,695
1999	11.5	98	10.2	60	21.7	337	16.5	495	13.5	9,839
2000	9.0	77	9.8	59	21.1	329	15.4	465	12.5	9,193
2001	10.7	91	9.8	60	20.7	327	15.7	478	12.5	9,274
2002	13.6	115	10.9	69	21.1	336	16.8	520	12.5	9,337

Spearman's ρ	-0.69*	0.45	0.64*	0.22	-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 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

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

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

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.

Bay County

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

		Count	Rate	95% Confidence Interval	
				Lower Limit	Upper Limit
Total Population		471	14.7	13.4	16.0
Sex	Male	176	11.5	9.8	13.2
	Female	295	17.3	15.3	19.3
Race ⁵	White	423	13.7	12.4	15.0
	Black	28	49.7	28.8	70.6
Sex and Race ⁵	White Male	163	11.1	9.4	12.9
	White Female	260	15.7	13.7	17.6
	Black Male	12	‡	‡	‡
	Black Female	16	‡	‡	‡
Age (unadjusted)	0-4 Years	134	68.4	56.8	79.9
	5-14 Years	48	10.6	7.6	13.6
	15-34 Years	59	7.3	5.4	9.1
	35-64 Years	167	12.4	10.5	14.3
	65+ Years	63	13.0	9.8	16.2
Age	<18 Years	188	25.1	21.5	28.7
	18+ Years	283	11.1	9.8	12.4

For comparison, State of Michigan and East-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 Bay County, 2000-2002, Comparable to the Healthy People 2010 Targets.

		Count	Rate	95% Confidence Interval	
				Lower Limit	Upper Limit
Age	0-4 Years ⁶	134	68.4	56.8	79.9
	5-64 Years	274	10.4	9.2	11.6
	65+ Years	63	12.7	9.5	15.8
	<18 Years ⁶	188	23.8	20.4	27.2

For comparison, State of Michigan and East-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).

Midland County

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

		Count	Rate	95% Confidence Interval	
				Lower Limit	Upper Limit
Total Population		274	11.1	9.8	12.5
Sex	Male	129	10.8	8.9	12.6
	Female	145	11.2	9.4	13.0
Race ⁵	White	269	11.3	10.0	12.7
	Black	~	‡	‡	‡
Sex and Race ⁵	White Male	124	10.7	8.8	12.7
	White Female	145	11.5	9.6	13.4
	Black Male	~	‡	‡	‡
	Black Female	~	‡	‡	‡
Age (unadjusted)	0-4 Years	52	33.0	24.0	41.9
	5-14 Years	30	7.8	5.0	10.6
	15-34 Years	44	6.8	4.8	8.8
	35-64 Years	89	8.7	6.9	10.6
	65+ Years	59	19.3	14.4	24.2
Age	<18 Years	86	13.9	10.9	16.8
	18+ Years	188	10.2	8.7	11.7

For comparison, State of Michigan and East-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 Midland County, 2000-2002, Comparable to the Healthy People 2010 Targets.

		Count	Rate	95% Confidence Interval	
				Lower Limit	Upper Limit
Age	0-4 Years ⁶	52	33.0	24.0	41.9
	5-64 Years	163	8.0	6.7	9.2
	65+ Years	59	19.5	14.5	24.4
	<18 Years ⁶	86	13.1	10.3	15.9

For comparison, State of Michigan and East-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.

Saginaw County

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

		Count	Rate	95% Confidence Interval	
				Lower Limit	Upper Limit
Total Population		1537	24.2	23.0	25.4
Sex	Male	636	20.7	19.1	22.3
	Female	901	27.0	25.3	28.8
Race ⁵	White	771	15.2	14.1	16.3
	Black	707	55.5	51.2	59.7
Sex and Race ⁵	White Male	271	11.5	10.1	12.8
	White Female	500	18.5	16.8	20.1
	Black Male	348	52.8	46.9	58.7
	Black Female	359	56.5	50.5	62.5
Age (unadjusted)	0-4 Years	228	54.7	47.6	61.8
	5-14 Years	282	29.7	26.2	33.1
	15-34 Years	227	13.8	12.0	15.6
	35-64 Years	544	22.3	20.5	24.2
	65+ Years	256	29.9	26.2	33.5
Age	<18 Years	545	33.6	30.8	36.4
	18+ Years	992	20.9	19.6	22.2

For comparison, State of Michigan and East-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 Saginaw County, 2000-2002, Comparable to the Healthy People 2010 Targets.

		Count	Rate	95% Confidence Interval	
				Lower Limit	Upper Limit
Age	0-4 Years ⁶	228	54.7	47.6	61.8
	5-64 Years	1053	20.7	19.4	21.9
	65+ Years	256	30.0	26.3	33.7
	<18 Years ⁶	545	33.1	30.3	35.8

For comparison, State of Michigan and East-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.

Counts and Rates (per 1,000,000) [1,2] of Mortality [3] due to Asthma [4] by Year, All Ages, for Bay, Midland, and Saginaw Counties, East-Central Michigan [5], and the State of Michigan, 1990-2002 [6].

Year	Bay		Midland		Saginaw		East-Central MI		Michigan	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	46.9	5	‡	~	‡	~	15.9	6	18.4	159
1991	‡	~	‡	~	‡	~	15.4	6	20.5	179
1992	‡	~	‡	~	25.4	5	13.5	5	18.8	165
1993	‡	~	‡	~	24.5	5	27.5	11	22.0	196
1994	‡	~	‡	~	23.0	5	17.4	7	21.1	193
1995	‡	~	‡	~	25.1	5	13.3	5	23.1	216
1996	‡	~	‡	~	‡	~	‡	~	20.4	190
1997	‡	~	‡	~	‡	~	12.3	5	18.2	171
1998	‡	~	‡	~	40.4	9	28.4	12	22.7	217
1999	‡	~	‡	~	22.2	5	14.1	6	16.6	162
2000	‡	~	‡	~	‡	~	19.5	8	16.7	164
2001	‡	~	‡	~	31.9	7	20.7	9	15.4	153
2002	‡	~	‡	~	46.6	10	30.6	13	15.1	152

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.

3 Asthma death is defined as a primary cause of death as asthma, ICD-9=493.XX and ICD-10=J45 or J46.

4 Data Source: Michigan Resident Death Files, Bureau of Epidemiology, MDCH.

5 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

6 Due to a change in coding for asthma deaths beginning in 1999, rates calculated for 1999-2002 are not comparable to rates calculated for 1990-1998.

‡ Insufficient data to compute a stable rate (number of events <5 or population <5000).

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

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma mortality in Michigan was 15.1 per 1,000,000 population.

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

Year	HP 2010 Objective	Bay		Midland		Saginaw		East-Central MI		Michigan	
		Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	17.3	47.1	138	24.6	51	43.7	260	41.0	449	32.8	8,063
1991	17.3	32.2	94	18.1	38	39.5	234	33.5	366	29.2	7,254
1992	17.3	37.9	110	12.2	26	47.8	282	38.3	418	30.9	7,735
1993	17.3	34.1	99	17.7	38	40.8	241	34.5	378	31.2	7,875
1994	17.3	23.0	66	13.4	29	35.2	206	27.6	301	26.6	6,757
1995	17.3	25.1	71	15.2	33	52.1	305	37.7	409	32.1	8,221
1996	17.3	29.7	83	11.8	26	36.3	211	29.6	320	30.1	7,769
1997	17.3	37.4	104	15.8	35	47.2	272	38.2	411	30.0	7,742
1998	17.3	20.8	57	13.5	30	34.2	195	26.4	282	21.7	5,594
1999	17.3	25.8	70	13.0	29	34.5	194	27.7	293	21.4	5,546
2000	17.3	23.2	62	14.5	32	39.8	220	30.2	314	26.0	6,693
2001	17.3	20.9	55	12.3	27	34.9	192	26.6	274	23.7	6,089
2002	17.3	27.2	71	12.4	27	24.3	133	22.5	231	20.8	5,359

Spearman's ρ	-0.62*	-0.50	-0.61*	-0.73**	-0.79**
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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 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

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

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

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 Bay, Midland, and Saginaw Counties, East-Central Michigan [5], and the State of Michigan, 1990-2002, Compared to the Healthy People 2010 Target (Objective 24-2).

Year	HP 2010 Objective	Bay		Midland		Saginaw		East-Central MI		Michigan	
		Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	25.0	93.5	75	46.8	27	74.6	124	74.3	226	66.1	4,712
1991	25.0	69.4	55	36.4	21	65.4	109	60.9	185	57.1	4,106
1992	25.0	80.3	63	‡	15	86.0	143	73.1	221	64.4	4,638
1993	25.0	71.0	55	‡	20	73.9	122	65.7	197	59.6	4,291
1994	25.0	49.0	37	39.0	22	70.2	113	58.7	172	53.2	3,783
1995	25.0	54.7	40	45.3	25	97.3	152	76.2	217	63.9	4,457
1996	25.0	60.5	43	‡	16	59.3	90	53.7	149	59.6	4,092
1997	25.0	80.2	56	38.7	21	80.3	119	72.0	196	59.2	4,019
1998	25.0	43.7	30	‡	19	56.9	83	49.2	132	40.5	2,734
1999	25.0	82.7	56	‡	18	55.1	79	57.8	153	40.6	2,725
2000	25.0	55.2	37	‡	19	60.5	85	54.2	141	48.8	3,257
2001	25.0	67.4	44	‡	16	54.7	76	53.0	136	50.5	3,341
2002	25.0	81.6	53	‡	17	48.1	67	53.3	137	45.8	3,039

Spearman's ρ	-0.14	ψ	-0.72**	-0.73**	-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 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

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

** 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 Bay, Midland, and Saginaw Counties, East-Central Michigan [5], and the State of Michigan, 1990-2002, Compared to the Healthy People 2010 Target (Objective 24-2).

Year	HP 2010 Objective	Bay		Midland		Saginaw		East-Central MI		Michigan	
		Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	7.7	18.7	167	10.3	62	19.5	332	17.5	561	14.0	10,229
1991	7.7	13.2	115	9.4	58	19.6	336	15.9	509	13.7	10,132
1992	7.7	13.5	120	5.3	33	19.4	331	15.0	484	13.6	10,205
1993	7.7	17.3	153	7.8	50	22.5	381	18.1	584	15.5	11,693
1994	7.7	12.6	111	5.7	36	21.1	355	15.7	502	14.5	11,008
1995	7.7	12.3	109	4.6	30	22.8	389	16.3	528	15.5	11,986
1996	7.7	12.4	109	6.4	43	22.1	375	16.3	527	15.0	11,734
1997	7.7	13.5	118	7.9	53	22.4	383	17.0	554	14.2	11,268
1998	7.7	11.1	98	7.4	50	21.0	356	15.5	504	13.2	10,521
1999	7.7	9.5	84	8.4	56	22.2	377	15.9	517	13.2	10,570
2000	7.7	9.6	84	8.9	60	23.4	398	16.7	542	13.3	10,776
2001	7.7	9.5	84	7.9	54	20.9	355	15.2	493	12.3	9,999
2002	7.7	12.1	106	7.0	49	17.6	300	13.9	455	11.5	9,423

Spearman's ρ	-0.83**	-0.04	0.15	-0.39	-0.63*
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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 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

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

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

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 Bay, Midland, and Saginaw Counties, East-Central Michigan [5], and the State of Michigan, 1990-2002, Compared to the Healthy People 2010 Target (Objective 24-2).

Year	HP 2010 Objective	Bay		Midland		Saginaw		East-Central MI		Michigan	
		Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	11.0	37.3	54	‡	12	19.5	52	24.4	118	25.8	2,849
1991	11.0	19.9	31	‡	10	17.3	46	17.3	87	24.3	2,757
1992	11.0	30.8	48	‡	12	17.1	46	20.8	106	23.9	2,754
1993	11.0	22.2	33	‡	15	24.8	66	22.9	114	25.5	2,991
1994	11.0	27.8	43	‡	11	19.5	53	20.8	107	23.9	2,818
1995	11.0	23.8	38	‡	7	21.1	58	19.6	103	20.9	2,502
1996	11.0	32.2	52	‡	5	20.1	55	21.1	112	18.6	2,232
1997	11.0	‡	16	‡	7	21.6	60	15.5	83	16.8	2,033
1998	11.0	‡	18	‡	9	21.9	61	16.4	88	16.8	2,034
1999	11.0	17.1	28	‡	15	26.8	75	21.7	118	17.2	2,090
2000	11.0	‡	18	‡	12	23.4	66	17.6	96	15.2	1,853
2001	11.0	‡	18	‡	17	30.9	88	22.3	123	16.5	2,023
2002	11.0	16.3	27	28.8	30	35.7	102	28.6	159	18.1	2,234

Spearman's ρ	ψ	ψ	0.84**	0.07	-0.87**
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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 East-Central Michigan is defined by the Tri-County Asthma Coalition coverage area (Bay, Midland, Saginaw Counties).

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

** 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 6: 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?Id=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 7: 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.

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

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.

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

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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