

Epidemiology of Asthma

In Jackson County, Michigan

Elizabeth Wasilevich, MPH
Asthma Epidemiologist
Bureau of Epidemiology
Michigan Department of Community Health
517.335.8164

Publication Date:
November 2005

Development and publication of this report was supported by Cooperative Agreement number U59-CCU517742 from the Centers for Disease Control and Prevention (CDC). Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the CDC.

Table of Contents	page
Section 1: Asthma Prevalence	4
Section 2: Hospitalization for Asthma	6
Total Population, 3-Year Rates	8
Total Population, Annual Rates	9
Sex Stratified, 3-Year Rates	10
Sex Stratified, Annual Rates	11
Race Stratified, 3-Year Rates	12
Race Stratified, Annual Rates	13
Sex and Race Stratified, 3-Year Rates	14
Sex and Race Stratified, Annual Rates	15
Income Stratified, 3-Year Rates	16
Age Stratified (0-4, 5-14, 15-34, 35-64, and ≥65), 3-Year Rates	17
Age Stratified (0-4, 5-14, 15-34, 35-64, and ≥65), Annual Rates	18
Age Stratified (<18 and ≥18), 3-Year Rates	19
Age Stratified (<18 and ≥18), Annual Rates	20
Total Population by Zip Code, 3-Year Rates	21
Section 3: Asthma Mortality	22
Total Population, 3-Year Rates	23
Section 4: <i>Healthy People 2010</i> Objectives for Asthma	24
<u>Hospitalization:</u>	
Children Aged <18 Years, 3-Year Rates	25
Children Aged <18 Years, Annual Rates	26
Age Stratified (0-4, 5-64, and ≥65), 3-Year Rates	27
Age Stratified (0-4, 5-64, and ≥65), Annual Rates	28
Section 5: Appendix	29
<u>Hospitalization:</u>	
Total Population, Annual Rates for County and State	30
Males, Annual Rates for County and State	31
Females, Annual Rates for County and State	32
Whites, Annual Rates for County and State	33
Blacks, Annual Rates for County and State	34
White Males, Annual Rates for County and State	35
White Females, Annual Rates for County and State	36
Black Males, Annual Rates for County and State	37
Black Females, Annual Rates for County and State	38

<i>Table of Contents (continued)</i>	page
Children Aged 0-4 Years, Annual Rates for County and State	39
Children Aged 5-14 Years, Annual Rates for County and State	40
Children/Adults Aged 15-34 Years, Annual Rates for County and State	41
Adults Aged 35-64 Years, Annual Rates for County and State	42
Adults Aged ≥65 Years, Annual Rates for County and State	43
Children Aged <18 Years, Annual Rates for County and State	44
Adults Aged ≥18 Years, Annual Rates for County and State	45
Jackson County, 3-Year Rates	46
<u>HP 2010 Hospitalization:</u>	
Children Aged <18 Years, Annual Rates for County and State	47
Children Aged 0-4 Years, Annual Rates for County and State	48
Children/Adults Aged 5-64 Years, Annual Rates for County and State	49
Adults Aged ≥65 Years, Annual Rates for County and State	50
Section 6: Data Sources	51
Section 7: Methods	53

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 Jackson County and the State of Michigan.

	Children (<18 Years)	Adults (≥18 Years)
	2002	2003
Jackson County	3,677	11,366
Michigan	233,894	701,319

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

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

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.

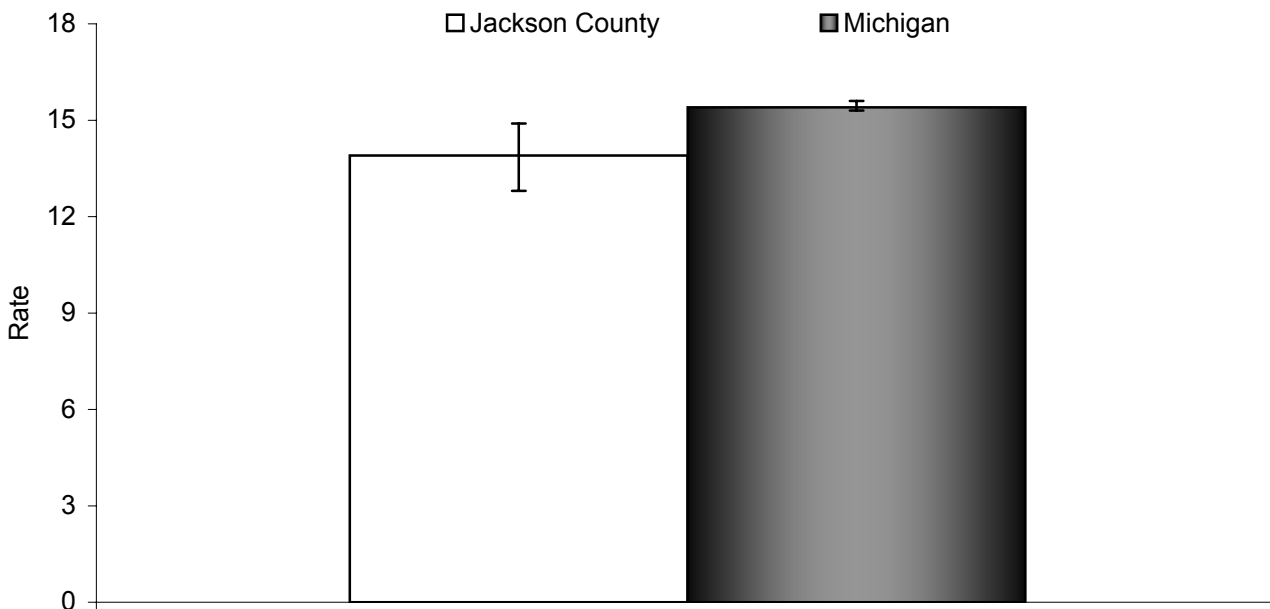
These data are the number of inpatient hospitalizations for asthma. This is not the same as the number of individual people hospitalized for asthma. An individual can be hospitalized more than once for the same condition during the study period and multiple hospitalizations cannot be distinguished from 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 Jackson County and the State of Michigan, All Ages, 2000-2002.



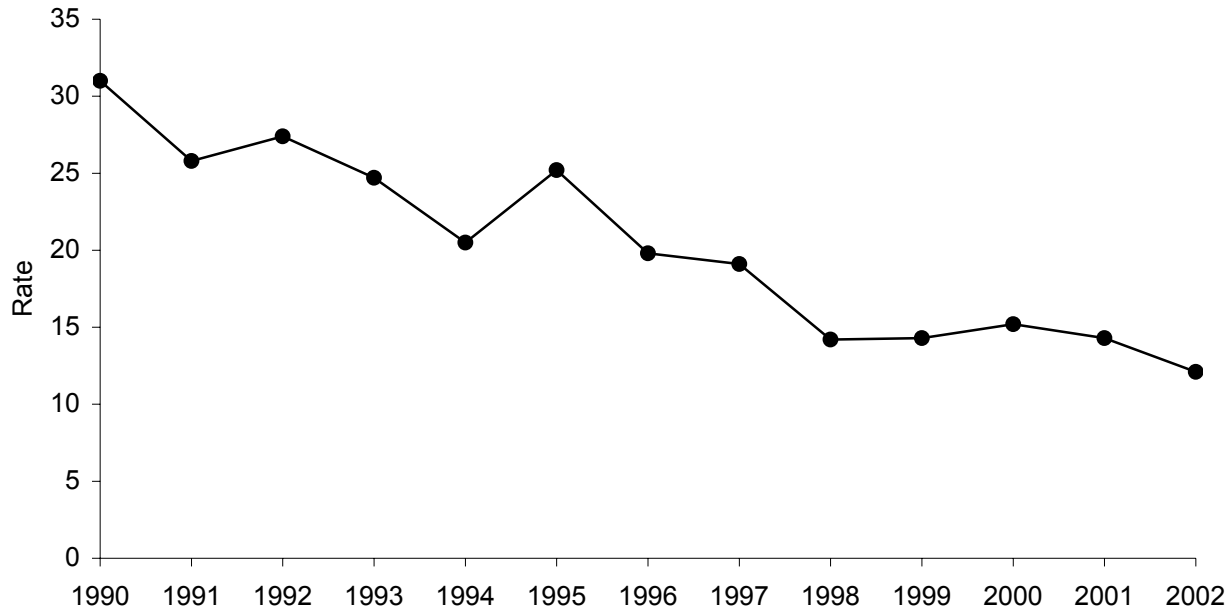
- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 2 Population estimates are taken from the Michigan population estimates for 2001.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

	Total Population
Jackson County Rate	13.9
95% CI	12.8 , 14.9
Count	655
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 Jackson County, 2000-2002, is 218.
- ✧ Jackson County has significantly lower asthma hospitalization rates than the State of Michigan as a whole, 2000-2002.

Figure 2. Annual Rates (per 10,000) [1,2] of Asthma [3] Hospitalization, All Ages, for Jackson County, 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.

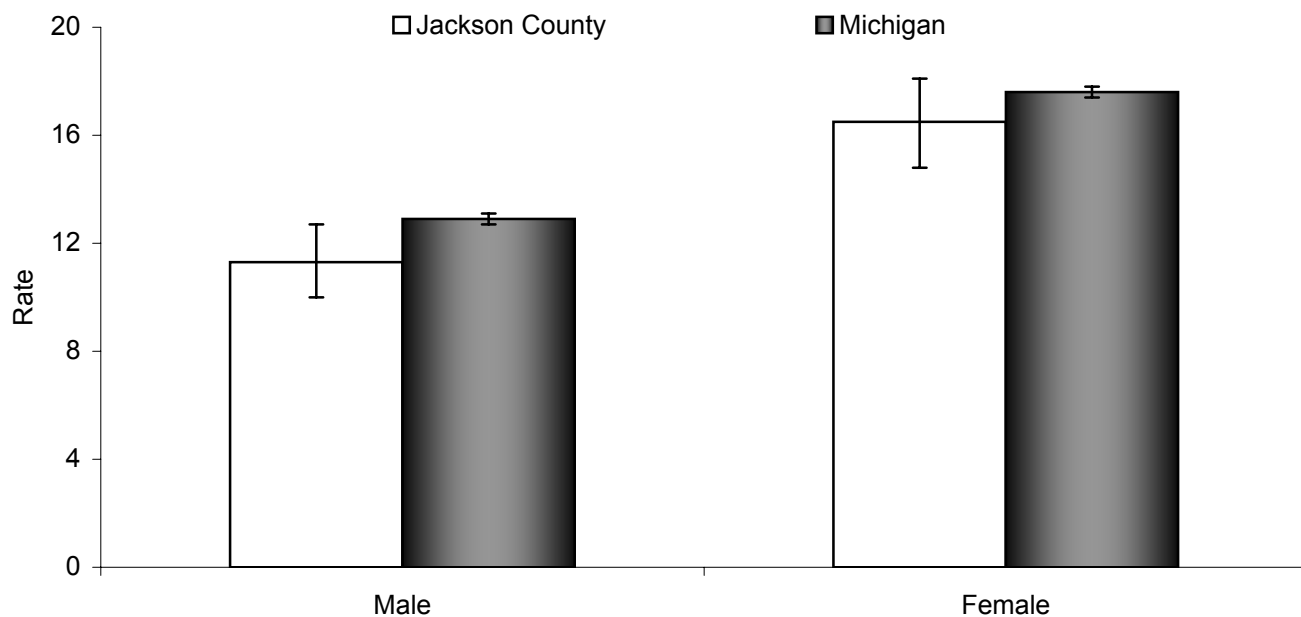
Year	Total Population	
	Rate	Count
1990	31.0	477
1991	25.8	393
1992	27.4	416
1993	24.7	379
1994	20.5	312
1995	25.2	385
1996	19.8	302
1997	19.1	293
1998	14.2	220
1999	14.3	224
2000	15.2	240
2001	14.3	225
2002	12.1	190

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 Jackson County ($\rho = -0.94$, $p < 0.01$).

See appendix page 30 for supporting data.

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



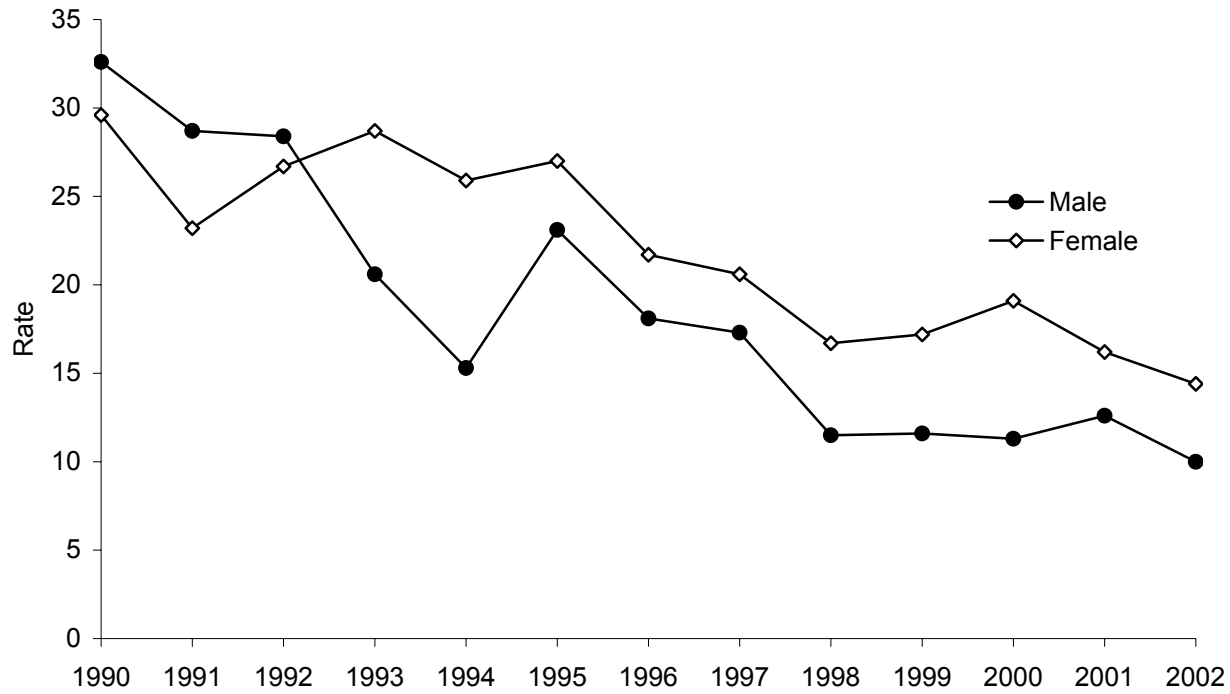
- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 2 Population estimates are taken from the Michigan population estimates for 2001.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

	Male	Female
Jackson County Rate	11.3	16.5
95% CI	10.0 , 12.7	14.8 , 18.1
Count	268	387
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.

✧ In Jackson County and the State of Michigan, females have significantly higher asthma hospitalization rates than males, 2000-2002.

Figure 4. Annual Rates (per 10,000) [1,2] of Asthma [3] Hospitalization by Sex, All Ages, for Jackson County, 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.

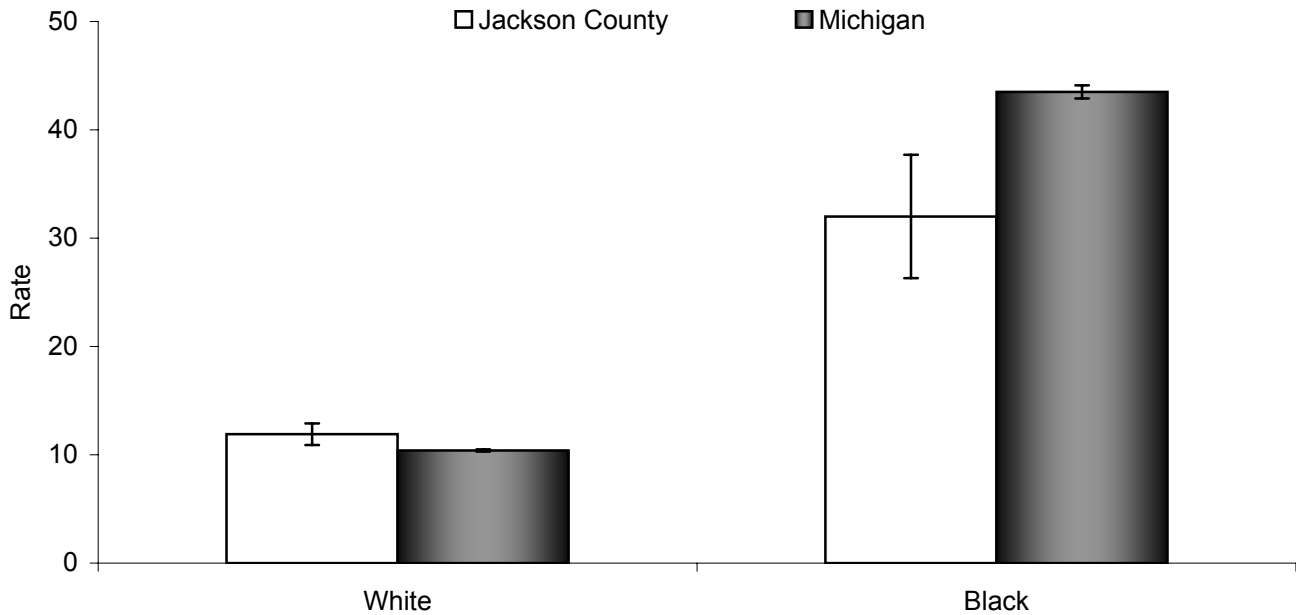
Year	Male		Female	
	Rate	Count	Rate	Count
1990	32.6	253	29.6	224
1991	28.7	218	23.2	175
1992	28.4	213	26.7	203
1993	20.6	162	28.7	217
1994	15.3	115	25.9	197
1995	23.1	181	27.0	204
1996	18.1	141	21.7	161
1997	17.3	136	20.6	157
1998	11.5	89	16.7	131
1999	11.6	90	17.2	134
2000	11.3	90	19.1	150
2001	12.6	99	16.2	126
2002	10.0	79	14.4	111

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 both the male and the female populations in Jackson County (male, $\rho = -0.92$, $p < 0.01$; female, $\rho = -0.90$, $p < 0.01$).

See appendix pages 31 and 32 for supporting data.

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



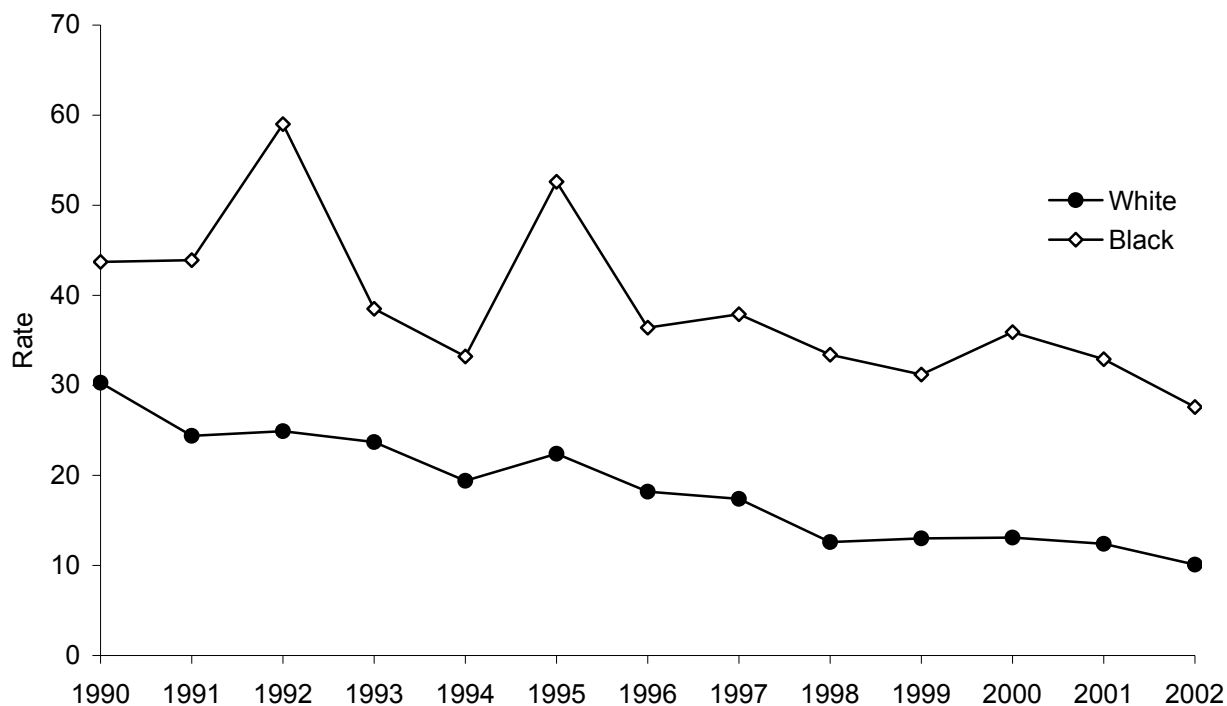
- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 2 Population estimates are taken from the Michigan population estimates for 2001.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis 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.

	White	Black
Jackson County Rate	11.9	32.0
95% CI	10.9 , 12.9	26.3 , 37.7
Count	508	136
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.

- ✧ The asthma hospitalization rate for white persons in Jackson County is significantly higher than the rate among white persons in the State of Michigan as a whole, 2000-2002.
- ✧ The asthma hospitalization rate for black persons in Jackson County is significantly lower than the rate among black persons in the State of Michigan as a whole, 2000-2002.
- ✧ The asthma hospitalization rates for white persons in Jackson County and the State of Michigan are significantly lower than the respective rates for black persons, 2000-2002.
- ✧ While black persons in Jackson County and the State of Michigan have higher asthma hospitalization rates, 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 Jackson County, 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.

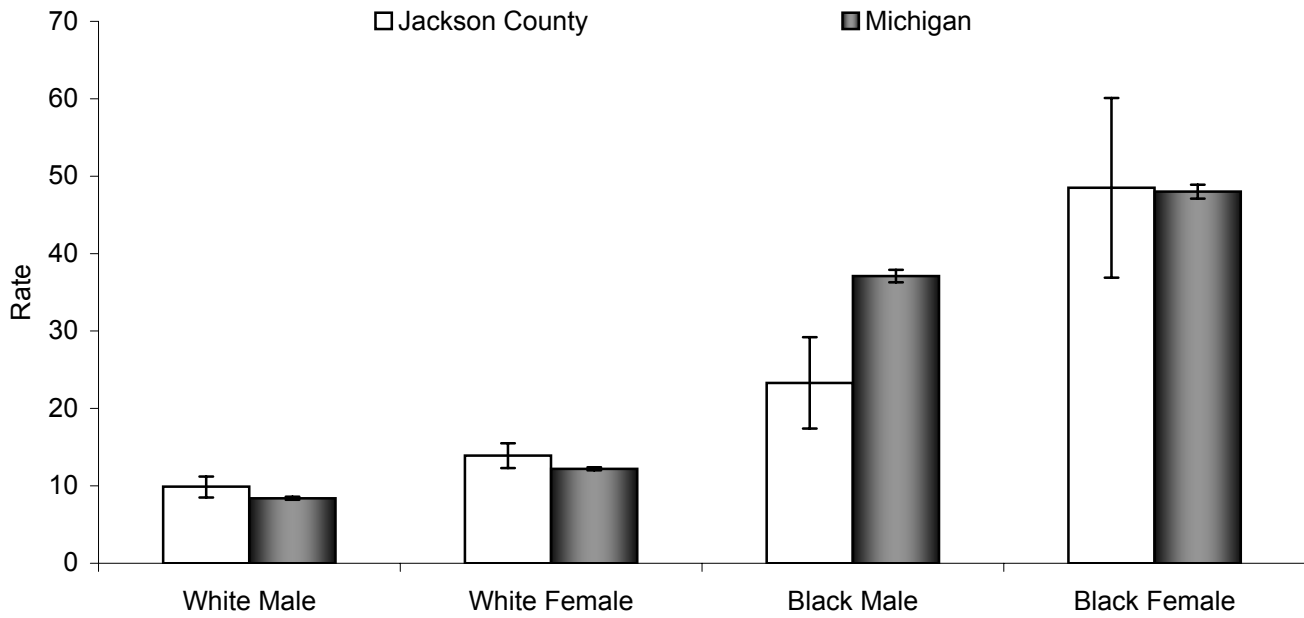
Year	White		Black	
	Rate	Count	Rate	Count
1990	30.3	424	43.7	53
1991	24.4	340	43.9	52
1992	24.9	343	59.0	71
1993	23.7	329	38.5	49
1994	19.4	268	33.2	41
1995	22.4	308	52.6	75
1996	18.2	251	36.4	46
1997	17.4	240	37.9	53
1998	12.6	177	33.4	42
1999	13.0	183	31.2	39
2000	13.1	187	35.9	51
2001	12.4	176	32.9	44
2002	10.1	145	27.6	41

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 both white persons and black persons in Jackson County (white, $\rho = -0.97$, $p < 0.01$; black, $\rho = -0.80$, $p < 0.01$).

See appendix pages 33 and 34 for supporting data.

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



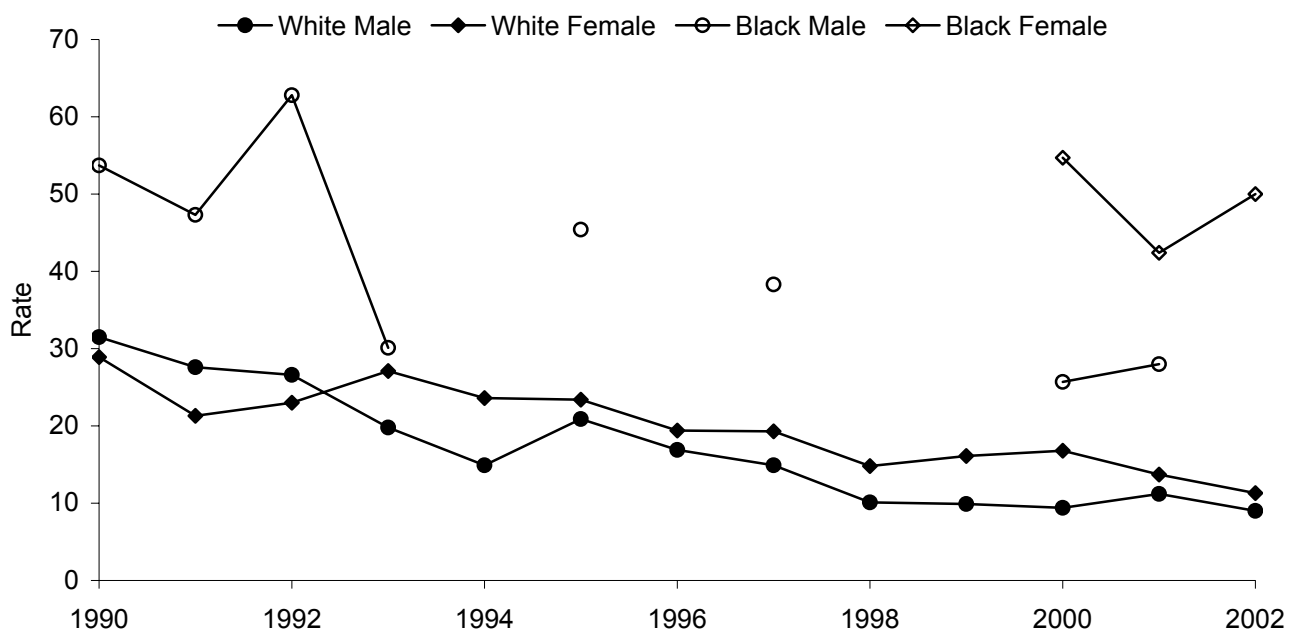
- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 2 Population estimates are taken from the Michigan population estimates for 2001.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis 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.

	White Male	White Female	Black Male	Black Female
Jackson County Rate	9.9	13.9	23.3	48.5
95% CI	8.5 , 11.2	12.3 , 15.5	17.4 , 29.2	36.9 , 60.1
Count	205	303	62	74
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.

- ✧ The asthma hospitalization rate for black females in Jackson County is significantly higher than the rates among white males, white females, or black males in Jackson County, 2000-2002.
- ✧ The asthma hospitalization rate for black persons in Jackson County is significantly higher than the rate among white persons in Jackson County, 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 Jackson County, 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.

Year	White Male		White Female		Black Male		Black Female	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	31.5	222	28.9	202	53.7	31	‡	22
1991	27.6	190	21.3	150	47.3	28	‡	24
1992	26.6	181	23.0	162	62.8	32	‡	39
1993	19.8	139	27.1	190	30.1	22	‡	27
1994	14.9	101	23.6	167	‡	12	‡	29
1995	20.9	144	23.4	164	45.4	37	‡	38
1996	16.9	117	19.4	134	‡	20	‡	26
1997	14.9	103	19.3	137	38.3	33	‡	20
1998	10.1	69	14.8	108	‡	20	‡	22
1999	9.9	68	16.1	115	‡	20	‡	19
2000	9.4	65	16.8	122	25.7	25	54.7	26
2001	11.2	77	13.7	99	28.0	22	42.4	22
2002	9.0	63	11.3	82	‡	15	50.0	26

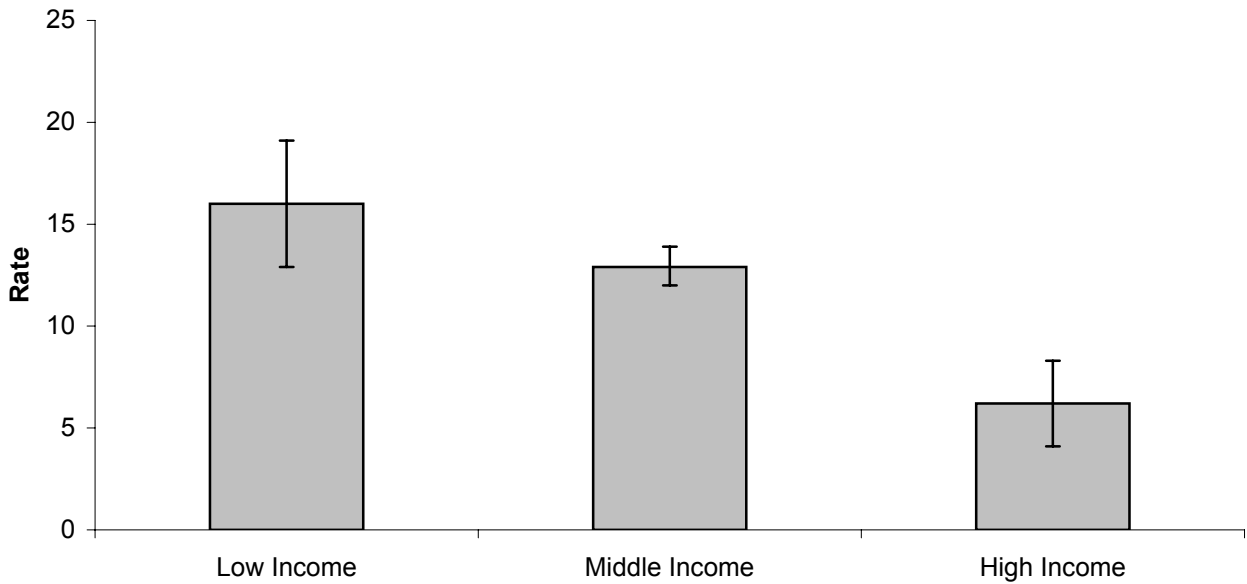
‡ Insufficient data to compute a stable rate (number of events ≤20 or population <5000).

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

✧ Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates among both the white male and white female populations in Jackson County (white male, $\rho = -0.93$, $p < 0.01$; white female, $\rho = -0.89$, $p < 0.01$).

See appendix pages 35 through 38 for supporting data.

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



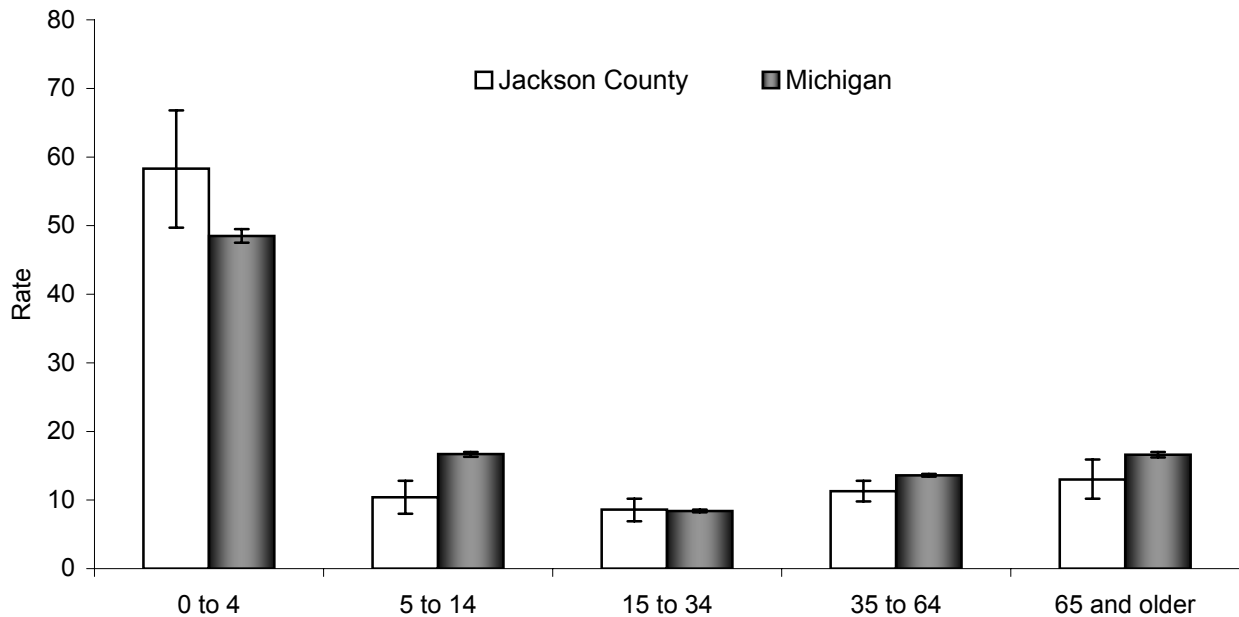
- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 2 Populations are taken from the 2000 US Census.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
- 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

	Low Income	Medium Income	High Income
Jackson County Rate	16.0	12.9	6.2
95% CI	12.9 , 19.1	12 , 13.9	4.1 , 8.3
Count	105	689	35

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

✧ The asthma hospitalization rate for high income areas in Jackson County is significantly lower than the rate for low or middle income areas in Jackson County, 2000-2002.

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



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

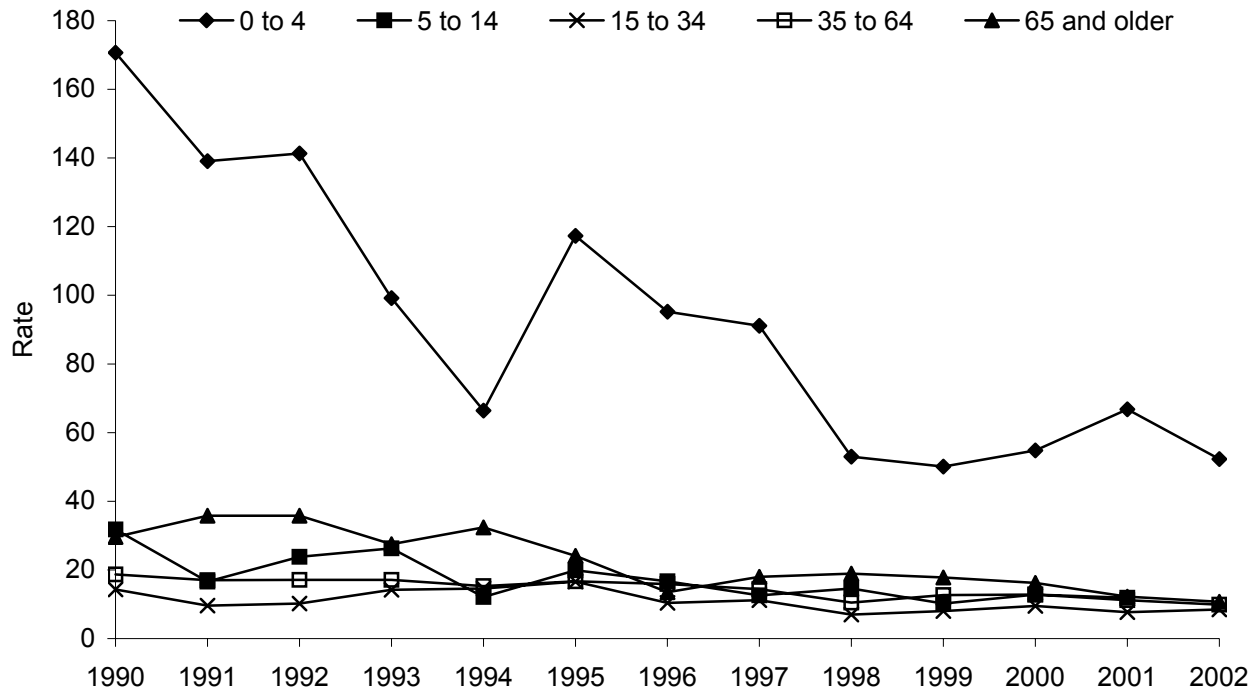
2 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

	0 to 4	5 to 14	15 to 34	35 to 64	65 and older
Jackson County Rate	58.3	10.4	8.6	11.3	13.0
95% CI	49.7 , 66.8	8.0 , 12.8	6.9 , 10.2	9.8 , 12.8	10.2 , 15.9
Count	178	73	107	217	80
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 Jackson County and the State of Michigan, children aged 0 to 4 years have significantly higher rates of asthma hospitalization than all other age groups, 2000-2002.
- ✧ The asthma hospitalization rate for children aged 0 to 4 years in Jackson County is significantly higher than the respective rate for the State of Michigan as a whole, 2000-2002.
- ✧ The asthma hospitalization rates for individuals aged 5 to 14, 35 to 64, and 65 years and older in Jackson County are significantly lower than the respective rates for the State of Michigan as a whole, 2000-2002.

Figure 11. Annual Rates (per 10,000) [1] of Asthma [2] Hospitalization by Age Group for Jackson County, 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.

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	170.7	189	31.8	68	14.3	67	18.7	98	29.6	55
1991	139.1	154	16.6	36	9.6	44	17.0	91	35.8	68
1992	141.3	156	23.8	52	10.2	46	17.1	93	35.8	69
1993	99.2	109	26.3	58	14.2	63	17.1	95	27.5	54
1994	66.4	72	12.1	27	14.6	63	15.3	86	32.4	64
1995	117.3	125	19.9	45	16.6	71	16.7	96	24.1	48
1996	95.2	100	16.7	38	10.4	44	15.9	93	13.5	27
1997	91.1	95	12.6	29	11.2	47	14.4	86	18.0	36
1998	53.0	55	14.6	34	7.0	29	10.5	64	18.9	38
1999	50.1	52	10.2	24	8.0	33	12.7	79	17.8	36
2000	54.8	57	12.8	30	9.5	39	12.8	81	16.2	33
2001	66.8	68	11.9	28	7.7	32	11.2	72	12.2	25
2002	52.3	53	‡	15	8.5	36	9.9	64	10.7	22

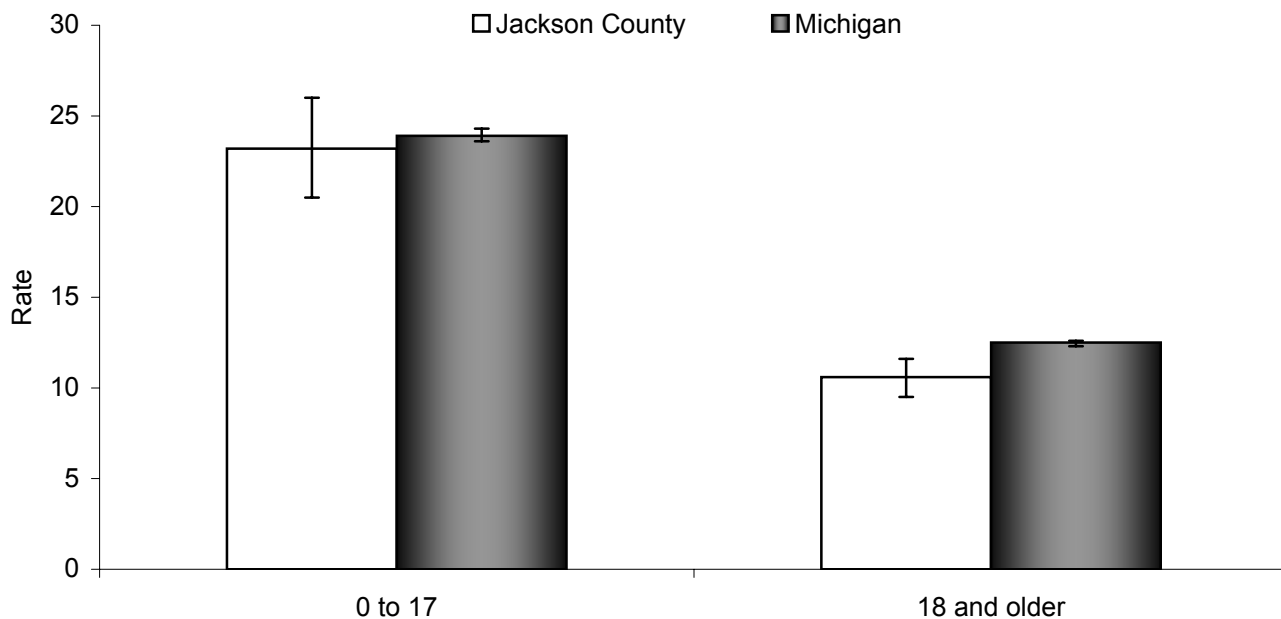
‡ Insufficient data to compute a stable rate (number of events ≤20 or population <5000).

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

✧ Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates among individuals aged 0 to 4, 15 to 34, 35 to 64, and 65 years and older in Jackson County (0 to 4, $\rho = -0.85$, $p < 0.01$; 15 to 34, $\rho = -0.64$, $p < 0.05$; 35 to 64, $\rho = -0.93$, $p < 0.01$; 65 and older, $\rho = -0.89$, $p < 0.01$).

See appendix pages 39 through 43 for supporting data.

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



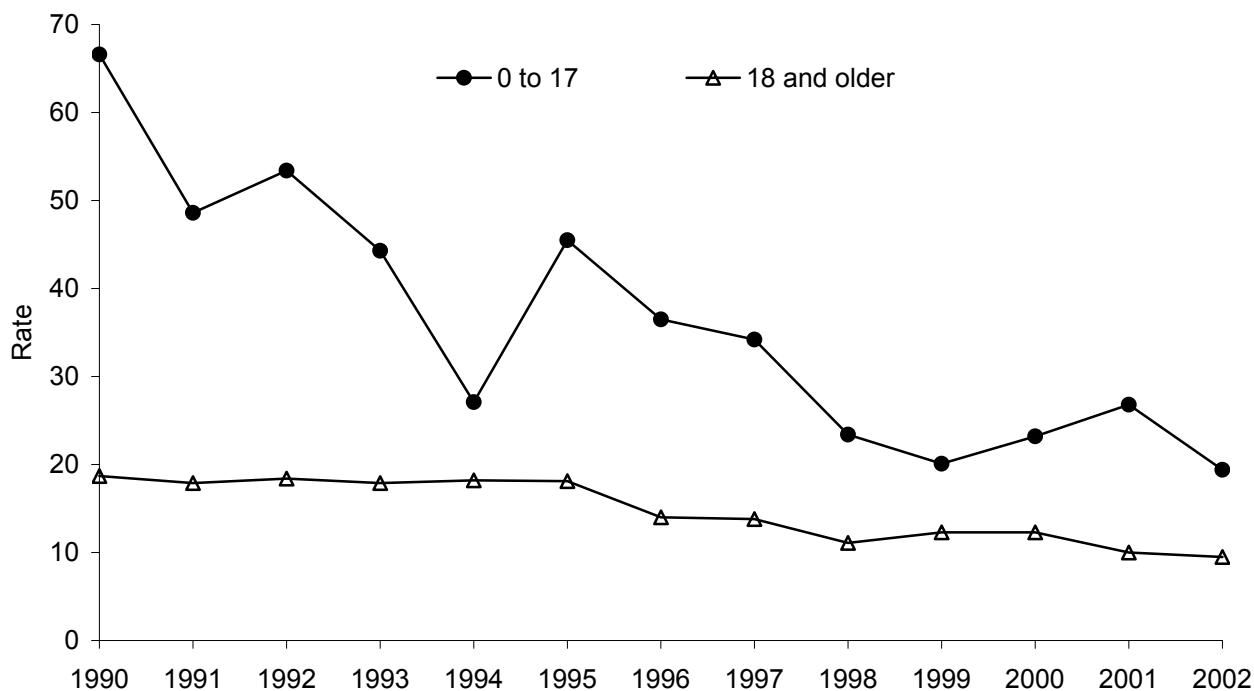
- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 2 Population estimates are taken from the Michigan population estimates for 2001.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

	0 to 17	18 and Older
Jackson County Rate	23.2	10.6
95% CI	20.5 , 26.0	9.5 , 11.6
Count	271	384
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 Jackson County and the State of Michigan, the rates of asthma hospitalization for children less than 18 years of age are significantly higher than the respective rates for adults aged 18 years and older, 2000-2002.
- ✧ The rate of asthma hospitalization for adults aged 18 years and older in Jackson County is significantly lower than the respective rate 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 Jackson County, 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.

Year	0 to 17		18 and Older	
	Rate	Count	Rate	Count
1990	66.6	269	18.7	208
1991	48.6	197	17.9	196
1992	53.4	215	18.4	201
1993	44.3	177	17.9	202
1994	27.1	107	18.2	205
1995	45.5	179	18.1	206
1996	36.5	143	14.0	159
1997	34.2	134	13.8	159
1998	23.4	92	11.1	128
1999	20.1	79	12.3	145
2000	23.2	92	12.3	148
2001	26.8	104	10.0	121
2002	19.4	75	9.5	115

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 and persons aged 18 years and older in Jackson County (less than 18, $\rho = -0.91$, $p < 0.01$; 18 and older, $\rho = -0.92$, $p < 0.01$).

See appendix pages 44 and 45 for supporting data.

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

Zip Code	Count	Rate	95% Confidence Interval	
			Lower Limit	Upper Limit
48158	8	‡	‡	‡
48827	43	10.2	7.1	13.4
49201	189	14.5	12.4	16.6
49202	105	16.0	12.9	19.1
49203	196	16.5	14.2	18.8
49224	58	14.1	10.5	17.8
49230	27	10.4	6.4	14.4
49233	10	‡	‡	‡
49234	5	‡	‡	‡
49237	13	‡	‡	‡
49240	14	‡	‡	‡
49241	9	‡	‡	‡
49246	8	‡	‡	‡
49249	6	‡	‡	‡
49250	15	‡	‡	‡
49251	19	‡	‡	‡
49252	8	‡	‡	‡
49254	16	‡	‡	‡
49259	~	‡	‡	‡
49263	~	‡	‡	‡
49264	5	‡	‡	‡
49269	22	11.5	6.6	16.3
49272	5	‡	‡	‡
49277	10	‡	‡	‡
49283	11	‡	‡	‡
49284	10	‡	‡	‡
49285	12	‡	‡	‡
Jackson County	655	13.9	12.8	14.9

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.

‡ 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.

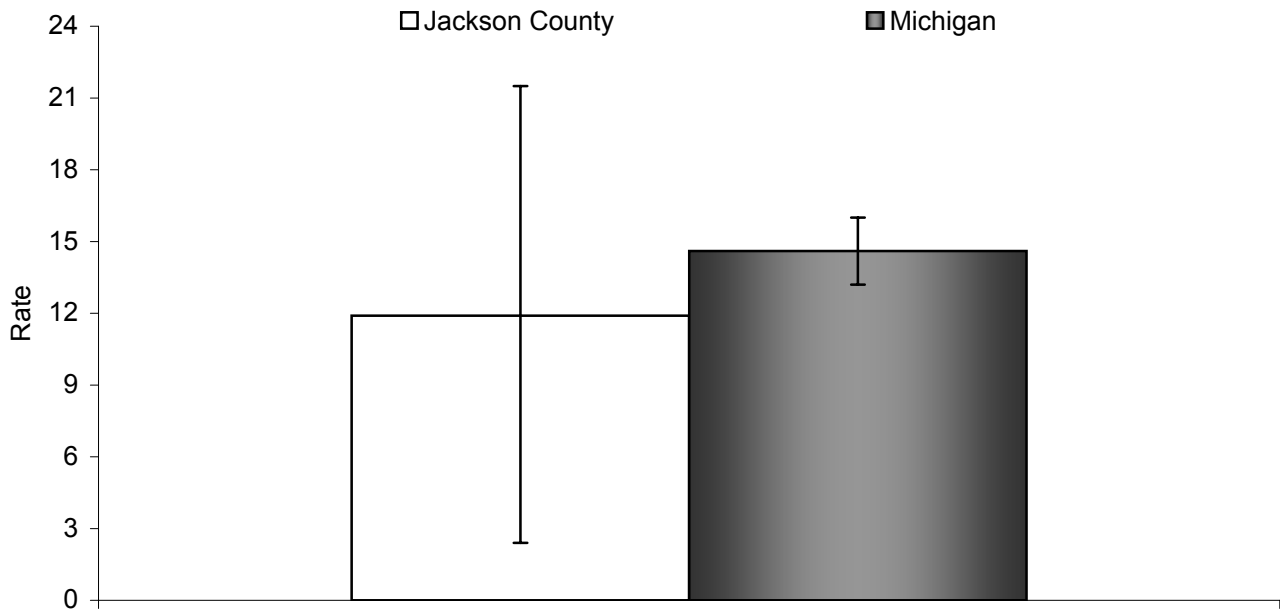
While a comparability ratio between ICD-9 and ICD-10 exists for asthma (0.8938; that is, for every 100 asthma deaths coded with ICD-9, only 89.38 would be coded as asthma using ICD-10), the analysis presented here does not attempt to compare pre-1999 data with asthma death occurring since 1999. (Anderson 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 was not conducted.

Figure 14. Rates (per 1,000,000) [1,2] of Mortality due to Asthma [3] for Jackson County 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.

	Total Population
Jackson County Rate	11.9
95% CI	2.4 , 21.5
Count	6
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 Jackson County is not significantly different than the rate for the State of Michigan as a whole, 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 figures provide information for Jackson County 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 Jackson County Data are Available for Comparison.

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

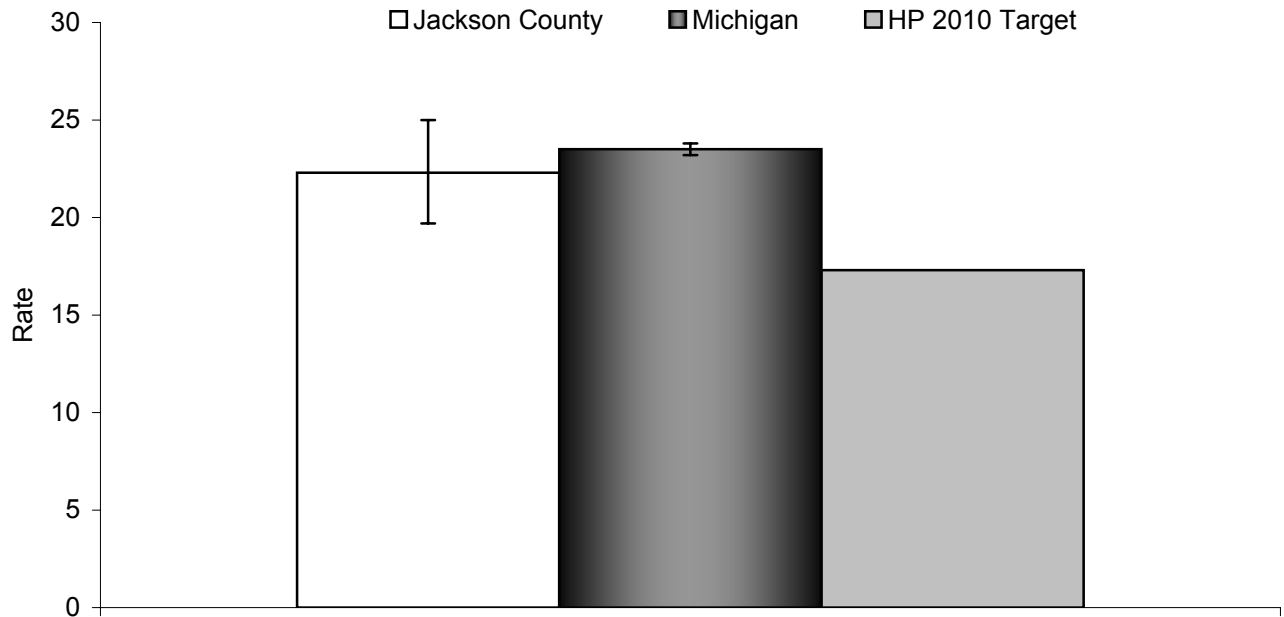
Target: 17.3 per 10,000 (age 0-17 years)

Objective 24-2: Reduce hospitalizations for asthma.

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

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

Figure 19. Rates (per 10,000) [1,2] of Hospitalization due to Asthma [3] for Children (aged less than 18 years) in Jackson County 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.

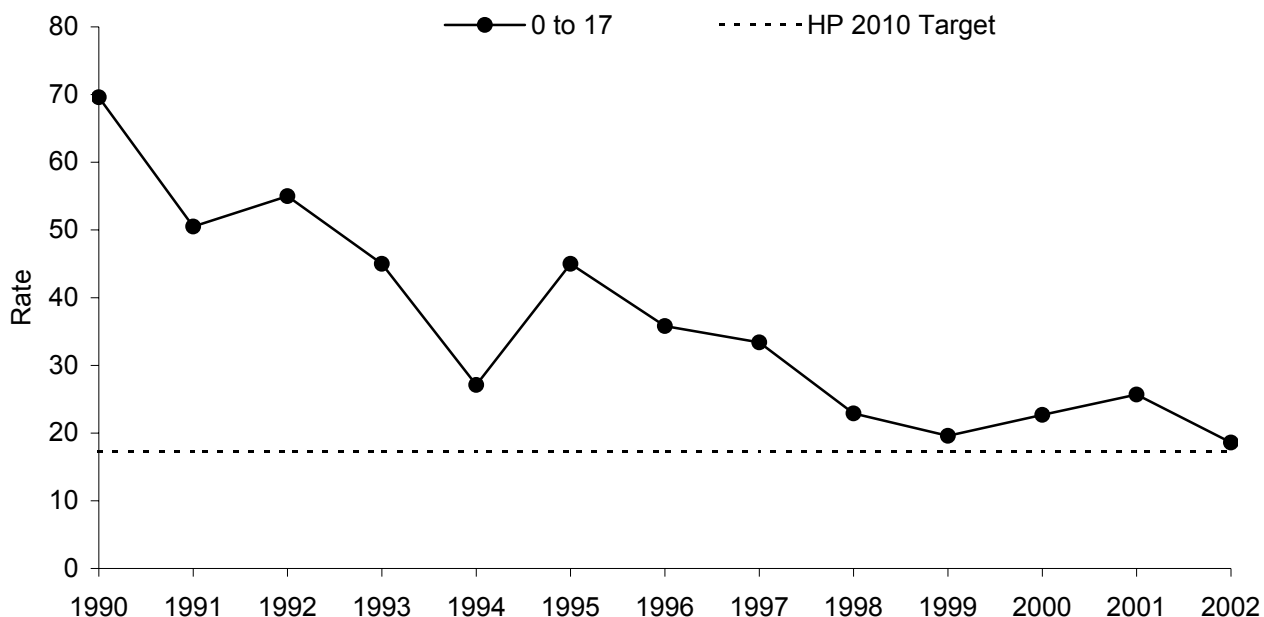
3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

	Total Population
Jackson County Rate	22.3
95% CI	19.7 , 25.0
Count	271
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 Jackson County, 2000-2002, is 90.
- ✧ The rate of asthma hospitalization for children aged less than 18 years in Jackson County, 2000-2002, is significantly higher than the *Healthy People 2010* target.

Figure 20. Annual Rates (per 10,000) [1,2] of Asthma [3] Hospitalization for Children (aged less than 18 years) in Jackson County, 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.

Year	0 to 17	
	Rate	Count
1990	69.6	269
1991	50.5	197
1992	55.0	215
1993	45.0	177
1994	27.1	107
1995	45.0	179
1996	35.8	143
1997	33.4	134
1998	22.9	92
1999	19.6	79
2000	22.7	92
2001	25.7	104
2002	18.6	75

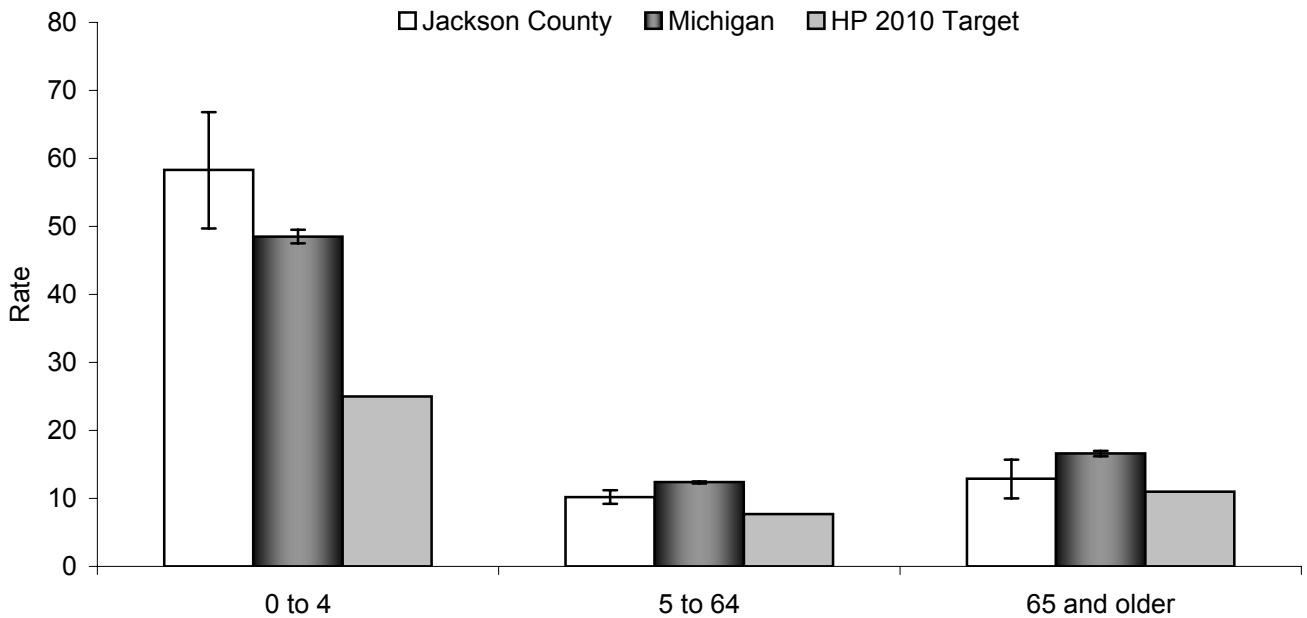
HP 2010 Target	17.3
-----------------------	-------------

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 Jackson County ($\rho = -0.92$, $p < 0.01$).

See appendix page 47 for supporting data.

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



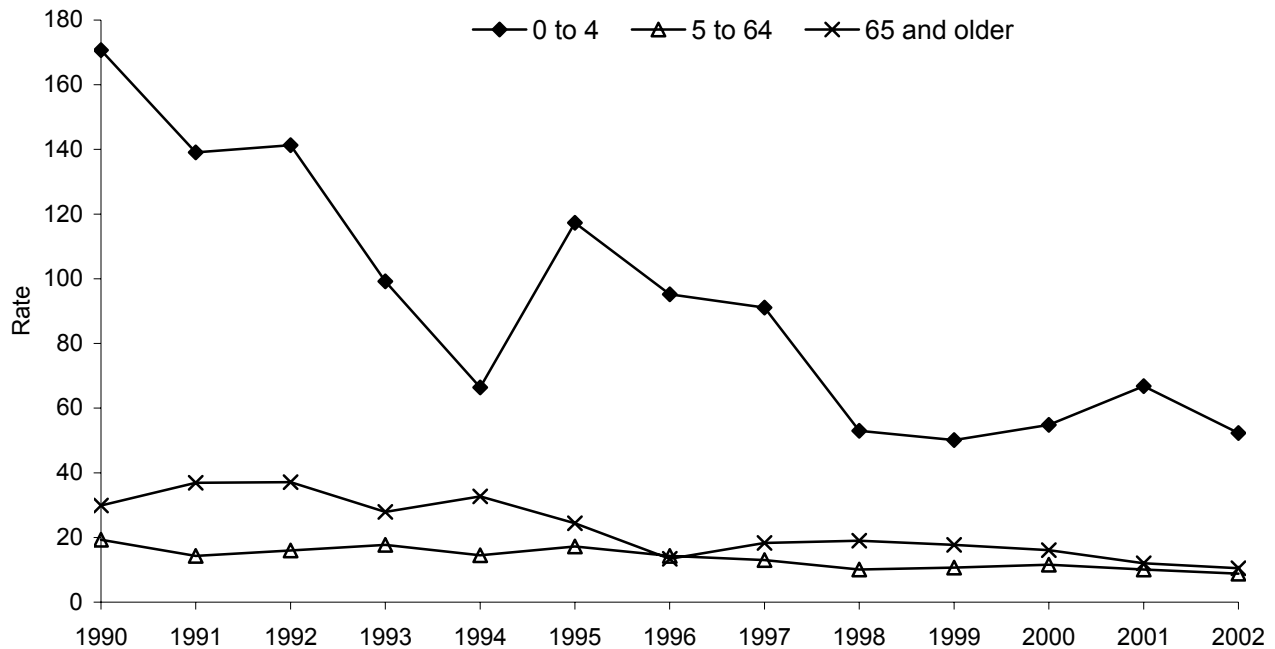
1 For age group 5-64 years and age group 65 and older, rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
 2 Population estimates are taken from the Michigan population estimates for 2001.
 3 Asthma hospitalization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

	0 to 4	5 to 64	65 and Older
Jackson County Rate	58.3	10.2	12.9
95% CI	49.7 , 66.8	9.2 , 11.2	10 , 15.7
Count	178	397	80
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.

- ✧ For the 0 to 4 and 5 to 64 year age groups, the rates of asthma hospitalization in Jackson County are significantly higher than the respective *Healthy People 2010* target rates, 2000-2002.
- ✧ The rate of asthma hospitalization in Jackson County is significantly higher than the rate for Michigan as a whole for the 0 to 4 year age group, 2000-2002.
- ✧ The rates of asthma hospitalization in Jackson County are significantly lower than the rates for Michigan as a whole for the 5 to 64 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 Jackson County, 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.

Year	0 to 4		5 to 64		65 and Older	
	Rate	Count	Rate	Count	Rate	Count
1990	170.7	189	19.3	233	29.9	55
1991	139.1	154	14.3	171	36.9	68
1992	141.3	156	16.0	191	37.1	69
1993	99.2	109	17.7	216	27.9	54
1994	66.4	72	14.5	176	32.7	64
1995	117.3	125	17.2	212	24.4	48
1996	95.2	100	14.3	175	13.4	27
1997	91.1	95	13.0	162	18.3	36
1998	53.0	55	10.1	127	19.0	38
1999	50.1	52	10.7	136	17.7	36
2000	54.8	57	11.6	150	16.1	33
2001	66.8	68	10.1	132	12.0	25
2002	52.3	53	8.8	115	10.5	22
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 for persons aged 0 to 4, 5 to 64, and 65 years and older in Jackson County (0 to 4, $\rho = -0.85$, $p < 0.01$; 5 to 64, $\rho = -0.88$, $p < 0.01$; 65 and older, $\rho = -0.89$, $p < 0.01$).

See appendix pages 48 through 50 for supporting data.

Section 5: Appendix

This appendix includes a compilation of supporting data tables presenting annual hospitalization rates for Jackson County and the State of Michigan. It also includes a summary for Jackson 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 Jackson County and the State of Michigan, 1990-2002.

Year	Jackson County		Michigan	
	Rate	Count	Rate	Count
1990	31.0	477	19.1	17,790
1991	25.8	393	18.1	16,995
1992	27.4	416	18.4	17,597
1993	24.7	379	19.8	18,975
1994	20.5	312	18.4	17,609
1995	25.2	385	19.5	18,945
1996	19.8	302	18.5	18,058
1997	19.1	293	17.7	17,320
1998	14.2	220	15.6	15,289
1999	14.3	224	15.6	15,385
2000	15.2	240	16.0	15,886
2001	14.3	225	15.5	15,363
2002	12.1	190	14.7	14,696

Spearman's ρ	-0.94**	-0.79**
-------------------	---------	---------

- 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.

** 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 Jackson County and the State of Michigan, 1990-2002.

Year	Jackson County		Michigan	
	Rate	Count	Rate	Count
1990	32.6	253	17.1	7,951
1991	28.7	218	15.7	7,345
1992	28.4	213	16.1	7,666
1993	20.6	162	16.6	7,929
1994	15.3	115	15.4	7,339
1995	23.1	181	17.1	8,275
1996	18.1	141	15.9	7,725
1997	17.3	136	15.4	7,546
1998	11.5	89	12.7	6,199
1999	11.6	90	12.7	6,229
2000	11.3	90	13.7	6,745
2001	12.6	99	12.8	6,271
2002	10.0	79	12.2	5,971

Spearman's ρ	-0.92**	-0.82**
-------------------	---------	---------

- 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.

** 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 Jackson County and the State of Michigan, 1990-2002.

Year	Jackson County		Michigan	
	Rate	Count	Rate	Count
1990	29.6	224	20.6	9,834
1991	23.2	175	20.0	9,648
1992	26.7	203	20.3	9,927
1993	28.7	217	22.6	11,043
1994	25.9	197	20.9	10,269
1995	27.0	204	21.6	10,668
1996	21.7	161	20.8	10,333
1997	20.6	157	19.6	9,774
1998	16.7	131	18.1	9,089
1999	17.2	134	18.1	9,155
2000	19.1	150	18.0	9,141
2001	16.2	126	17.8	9,092
2002	14.4	111	16.9	8,725

Spearman's ρ	-0.90**	-0.76**
-------------------	---------	---------

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.

** 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 Jackson County and the State of Michigan, 1990-2002.

Year	Jackson County		Michigan	
	Rate	Count	Rate	Count
1990	30.3	424	15.1	11,791
1991	24.4	340	14.2	11,148
1992	24.9	343	14.1	11,165
1993	23.7	329	14.8	11,757
1994	19.4	268	13.2	10,488
1995	22.4	308	13.2	10,586
1996	18.2	251	12.6	10,140
1997	17.4	240	12.2	9,849
1998	12.6	177	10.5	8,522
1999	13.0	183	10.7	8,716
2000	13.1	187	10.8	8,781
2001	12.4	176	10.5	8,541
2002	10.1	145	9.9	8,133

Spearman's ρ	-0.97**	-0.95**
-------------------	---------	---------

- 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.

** 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 Jackson County and the State of Michigan, 1990-2002.

Year	Jackson County		Michigan	
	Rate	Count	Rate	Count
1990	43.7	53	43.0	5,800
1991	43.9	52	41.4	5,715
1992	59.0	71	44.4	6,209
1993	38.5	49	49.1	6,948
1994	33.2	41	48.5	6,858
1995	52.6	75	54.0	8,031
1996	36.4	46	51.3	7,603
1997	37.9	53	48.0	7,246
1998	33.4	42	45.3	6,607
1999	31.2	39	44.2	6,459
2000	35.9	51	45.2	6,888
2001	32.9	44	43.2	6,518
2002	27.6	41	42.0	6,279

Spearman's ρ	-0.80**	-0.07
-------------------	---------	-------

- 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.

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

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 Jackson County and the State of Michigan, 1990-2002.

Year	Jackson County		Michigan	
	Rate	Count	Rate	Count
1990	31.5	222	13.4	5,142
1991	27.6	190	12.0	4,632
1992	26.6	181	12.1	4,715
1993	19.8	139	11.9	4,633
1994	14.9	101	10.4	4,033
1995	20.9	144	10.9	4,285
1996	16.9	117	10.2	4,012
1997	14.9	103	10.1	3,993
1998	10.1	69	8.1	3,198
1999	9.9	68	8.5	3,338
2000	9.4	65	8.9	3,499
2001	11.2	77	8.4	3,284
2002	9.0	63	8.0	3,133

Spearman's ρ	-0.93**	-0.95**
-------------------	---------	---------

- 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.

** 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 Jackson County and the State of Michigan, 1990-2002.

Year	Jackson County		Michigan	
	Rate	Count	Rate	Count
1990	28.9	202	16.5	6,647
1991	21.3	150	16.0	6,514
1992	23.0	162	15.7	6,446
1993	27.1	190	17.3	7,122
1994	23.6	167	15.6	6,455
1995	23.4	164	15.2	6,301
1996	19.4	134	14.8	6,128
1997	19.3	137	14.1	5,856
1998	14.8	108	12.7	5,324
1999	16.1	115	12.7	5,378
2000	16.8	122	12.5	5,282
2001	13.7	99	12.4	5,257
2002	11.3	82	11.6	5,000

Spearman's ρ	-0.89**	-0.97**
-------------------	---------	---------

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.

** 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 Jackson County and the State of Michigan, 1990-2002.

Year	Jackson County		Michigan	
	Rate	Count	Rate	Count
1990	53.7	31	39.2	2,721
1991	47.3	28	36.6	2,660
1992	62.8	32	39.0	2,864
1993	30.1	22	42.8	3,169
1994	‡	12	43.1	3,176
1995	45.4	37	48.6	3,838
1996	‡	20	45.8	3,569
1997	38.3	33	43.7	3,452
1998	‡	20	38.3	2,927
1999	‡	20	37.0	2,796
2000	25.7	25	39.4	3,147
2001	28.0	22	36.6	2,856
2002	‡	15	35.0	2,699

Spearman's ρ	ψ	-0.30
-------------------	--------	-------

- 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.
- ‡ 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 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 Jackson County and the State of Michigan, 1990-2002.

Year	Jackson County		Michigan	
	Rate	Count	Rate	Count
1990	‡	22	45.3	3,079
1991	‡	24	44.3	3,055
1992	‡	39	47.8	3,345
1993	‡	27	53.4	3,779
1994	‡	29	51.9	3,682
1995	‡	38	57.1	4,193
1996	‡	26	54.7	4,034
1997	‡	20	50.6	3,794
1998	‡	22	50.0	3,680
1999	‡	19	49.4	3,663
2000	54.7	26	49.0	3,741
2001	42.4	22	48.0	3,662
2002	50.0	26	47.0	3,580

Spearman's ρ	ψ	0.08
-------------------	--------	------

- 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.
- ‡ 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 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 Jackson County and the State of Michigan, 1990-2002.

Year	Jackson County		Michigan	
	Rate	Count	Rate	Count
1990	170.7	189	66.1	4,712
1991	139.1	154	57.1	4,106
1992	141.3	156	64.4	4,638
1993	99.2	109	59.6	4,291
1994	66.4	72	53.2	3,783
1995	117.3	125	63.9	4,457
1996	95.2	100	59.6	4,092
1997	91.1	95	59.2	4,019
1998	53.0	55	40.5	2,734
1999	50.1	52	40.6	2,725
2000	54.8	57	48.8	3,257
2001	66.8	68	50.5	3,341
2002	52.3	53	45.8	3,039

Spearman's ρ	-0.85**	-0.76**
-------------------	---------	---------

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

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

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

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

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

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 Jackson County and the State of Michigan, 1990-2002.

Year	Jackson County		Michigan	
	Rate	Count	Rate	Count
1990	31.8	68	20.9	2,826
1991	16.6	36	19.4	2,666
1992	23.8	52	18.5	2,571
1993	26.3	58	21.1	2,972
1994	12.1	27	17.1	2,418
1995	19.9	45	21.9	3,152
1996	16.7	38	21.4	3,113
1997	12.6	29	22.1	3,244
1998	14.6	34	16.8	2,491
1999	10.2	24	16.8	2,497
2000	12.8	30	20.4	3,010
2001	11.9	28	16.0	2,363
2002	‡	15	13.7	2,002

Spearman's ρ	ψ	-0.48
-------------------	--------	-------

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.

‡ 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 Jackson County and the State of Michigan, 1990-2002.

Year	Jackson County		Michigan	
	Rate	Count	Rate	Count
1990	14.3	67	9.1	2,709
1991	9.6	44	8.9	2,628
1992	10.2	46	9.8	2,839
1993	14.2	63	11.7	3,352
1994	14.6	63	10.9	3,081
1995	16.6	71	11.8	3,341
1996	10.4	44	11.5	3,220
1997	11.2	47	10.6	2,959
1998	7.0	29	10.0	2,755
1999	8.0	33	9.2	2,526
2000	9.5	39	9.2	2,502
2001	7.7	32	8.2	2,253
2002	8.5	36	7.7	2,104

Spearman's ρ	-0.64*	-0.31
-------------------	--------	-------

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.

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

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 Jackson County and the State of Michigan, 1990-2002.

Year	Jackson County		Michigan	
	Rate	Count	Rate	Count
1990	18.7	98	14.8	4,694
1991	17.0	91	15.0	4,838
1992	17.1	93	14.5	4,795
1993	17.1	95	15.9	5,369
1994	15.3	86	16.0	5,509
1995	16.7	96	15.6	5,493
1996	15.9	93	15.0	5,401
1997	14.4	86	13.8	5,065
1998	10.5	64	14.2	5,275
1999	12.7	79	14.7	5,547
2000	12.8	81	13.6	5,264
2001	11.2	72	13.8	5,383
2002	9.9	64	13.5	5,317

Spearman's ρ	-0.93**	-0.70**
-------------------	---------	---------

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.

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

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 Jackson County and the State of Michigan, 1990-2002.

Year	Jackson County		Michigan	
	Rate	Count	Rate	Count
1990	29.6	55	25.7	2,849
1991	35.8	68	24.4	2,757
1992	35.8	69	23.9	2,754
1993	27.5	54	25.6	2,991
1994	32.4	64	23.8	2,818
1995	24.1	48	20.9	2,502
1996	13.5	27	18.5	2,232
1997	18.0	36	16.8	2,033
1998	18.9	38	16.8	2,034
1999	17.8	36	17.2	2,090
2000	16.2	33	15.2	1,853
2001	12.2	25	16.5	2,023
2002	10.7	22	18.1	2,234

Spearman's ρ	-0.89**	-0.88**
-------------------	---------	---------

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.

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

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 Jackson County and the State of Michigan, 1990-2002.

Year	Jackson County		Michigan	
	Rate	Count	Rate	Count
1990	66.6	269	31.7	8,063
1991	48.6	197	28.3	7,254
1992	53.4	215	29.9	7,735
1993	44.3	177	30.5	7,875
1994	27.1	107	26.2	6,757
1995	45.5	179	31.9	8,221
1996	36.5	143	30.2	7,769
1997	34.2	134	30.1	7,742
1998	23.4	92	21.8	5,594
1999	20.1	79	21.6	5,546
2000	23.2	92	26.3	6,693
2001	26.8	104	24.1	6,089
2002	19.4	75	21.3	5,359

Spearman's ρ	-0.91**	-0.68*
-------------------	---------	--------

- 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.

* 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 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 Jackson County and the State of Michigan, 1990-2002.

Year	Jackson County		Michigan	
	Rate	Count	Rate	Count
1990	18.7	208	14.7	9,727
1991	17.9	196	14.5	9,741
1992	18.4	201	14.5	9,862
1993	17.9	202	16.1	11,100
1994	18.2	205	15.7	10,852
1995	18.1	206	15.2	10,724
1996	14.0	159	14.5	10,289
1997	13.8	159	13.3	9,578
1998	11.1	128	13.4	9,695
1999	12.3	145	13.5	9,839
2000	12.3	148	12.5	9,193
2001	10.0	121	12.5	9,274
2002	9.5	115	12.5	9,337

Spearman's ρ	-0.92**	-0.80**
-------------------	---------	---------

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.

** 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.

Jackson County

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

		Count	Rate	95% Confidence Interval	
				Lower Limit	Upper Limit
Total Population		655	13.9	12.8	14.9
Sex	Male	268	11.3	10.0	12.7
	Female	387	16.5	14.8	18.1
Race ⁵	White	508	11.9	10.9	12.9
	Black	136	32.0	26.3	37.7
Sex and Race ⁵	White Male	205	9.9	8.5	11.2
	White Female	303	13.9	12.3	15.5
	Black Male	62	23.3	17.4	29.2
	Black Female	74	48.5	36.9	60.1
Age (unadjusted)	0-4 Years	178	58.3	49.7	66.8
	5-14 Years	73	10.4	8.0	12.8
	15-34 Years	107	8.6	6.9	10.2
	35-64 Years	217	11.3	9.8	12.8
	65+ Years	80	13.0	10.2	15.9
Age	<18 Years	271	23.2	20.5	26.0
	18+ Years	384	10.6	9.5	11.6

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

		Count	Rate	95% Confidence Interval	
				Lower Limit	Upper Limit
Age	0-4 Years ⁶	178	58.3	49.7	66.8
	5-64 Years	397	10.2	9.2	11.2
	65+ Years	80	12.9	10.0	15.7
	<18 Years ⁶	271	22.3	19.7	25.0

For comparison, State of Michigan and Jackson County 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 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for CHILDREN Aged Less Than 18 Years, for Jackson County and the State of Michigan, 1990-2002, Compared to the Healthy People 2010 Target (Objective 1-9a).

Year	HP 2010 Target	Jackson County		Michigan	
		Rate	Count	Rate	Count
1990	17.3	69.6	269	32.8	8,063
1991	17.3	50.5	197	29.2	7,254
1992	17.3	55.0	215	30.9	7,735
1993	17.3	45.0	177	31.2	7,875
1994	17.3	27.1	107	26.6	6,757
1995	17.3	45.0	179	32.1	8,221
1996	17.3	35.8	143	30.1	7,769
1997	17.3	33.4	134	30.0	7,742
1998	17.3	22.9	92	21.7	5,594
1999	17.3	19.6	79	21.4	5,546
2000	17.3	22.7	92	26.0	6,693
2001	17.3	25.7	104	23.7	6,089
2002	17.3	18.6	75	20.8	5,359

Spearman's ρ	-0.92**	-0.79**
-------------------	---------	---------

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

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

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

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

** 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 Jackson County and the State of Michigan, 1990-2002, Compared to the Healthy People 2010 Target (Objective 24-2).

Year	HP 2010 Target	Jackson County		Michigan	
		Rate	Count	Rate	Count
1990	25.0	170.7	189	66.1	4,712
1991	25.0	139.1	154	57.1	4,106
1992	25.0	141.3	156	64.4	4,638
1993	25.0	99.2	109	59.6	4,291
1994	25.0	66.4	72	53.2	3,783
1995	25.0	117.3	125	63.9	4,457
1996	25.0	95.2	100	59.6	4,092
1997	25.0	91.1	95	59.2	4,019
1998	25.0	53.0	55	40.5	2,734
1999	25.0	50.1	52	40.6	2,725
2000	25.0	54.8	57	48.8	3,257
2001	25.0	66.8	68	50.5	3,341
2002	25.0	52.3	53	45.8	3,039

Spearman's ρ	-0.85**	-0.76**
-------------------	---------	---------

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

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

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

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

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

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 Jackson County and the State of Michigan, 1990-2002, Compared to the Healthy People 2010 Target (Objective 24-2).

Year	HP 2010 Target	Jackson County		Michigan	
		Rate	Count	Rate	Count
1990	7.7	19.3	233	14.0	10,229
1991	7.7	14.3	171	13.7	10,132
1992	7.7	16.0	191	13.6	10,205
1993	7.7	17.7	216	15.5	11,693
1994	7.7	14.5	176	14.5	11,008
1995	7.7	17.2	212	15.5	11,986
1996	7.7	14.3	175	15.0	11,734
1997	7.7	13.0	162	14.2	11,268
1998	7.7	10.1	127	13.2	10,521
1999	7.7	10.7	136	13.2	10,570
2000	7.7	11.6	150	13.3	10,776
2001	7.7	10.1	132	12.3	9,999
2002	7.7	8.8	115	11.5	9,423

Spearman's ρ	-0.88**	-0.63*
-------------------	---------	--------

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

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

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

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

* 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 Jackson County and the State of Michigan, 1990-2002, Compared to the Healthy People 2010 Target (Objective 24-2).

Year	HP 2010 Target	Jackson County		Michigan	
		Rate	Count	Rate	Count
1990	11.0	29.9	55	25.8	2,849
1991	11.0	36.9	68	24.3	2,757
1992	11.0	37.1	69	23.9	2,754
1993	11.0	27.9	54	25.5	2,991
1994	11.0	32.7	64	23.9	2,818
1995	11.0	24.4	48	20.9	2,502
1996	11.0	13.4	27	18.6	2,232
1997	11.0	18.3	36	16.8	2,033
1998	11.0	19.0	38	16.8	2,034
1999	11.0	17.7	36	17.2	2,090
2000	11.0	16.1	33	15.2	1,853
2001	11.0	12.0	25	16.5	2,023
2002	11.0	10.5	22	18.1	2,234

Spearman's ρ	-0.89**	-0.87**
-------------------	---------	---------

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

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

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

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

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

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.

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

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

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

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

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

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

Topic 5: Data Suppression

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

Topic 6: Trend Analysis

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

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

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

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

From this, it follows that:

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

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

References

Hennekens CH. And Buring JE. Ed. Mayrent SL. *Epidemiology in Medicine*. Boston, MA: Little, Brown, and Company, 1987.

Hollander M and Wolfe DA. *Nonparametric Statistical Methods, Second Edition*. New York: John Wiley & Sons, Inc., 1999

Klein RJ and Schoenborn CA. Healthy People 2010: *Age Adjustment Using the 2000 Projected U.S. Population*. Statistical Notes (20). Department of Health and Human Services. Centers for Disease Control and Prevention, National Center for Health Statistics. January 2001, (<http://www.cdc.gov/nchs/data/statnt/statnt20.pdf>).

Rothman KJ and Greenland S. *Modern Epidemiology, Second Edition*. Philadelphia: Lippincott-Raven Publishers, 1998.

Szklo M and Nieto FJ. *Epidemiology Beyond the Basics*. Gaithersburg, MD: Aspen Publishers, Inc., 2000.