

Impact of Sudden Cardiac Death of the Young in Michigan: 1999 – 2006 Mortality Data

To better understand the burden of sudden death in Michigan young people, mortality data spanning the time period from 1999-2006 were examined for Michigan residents between 1 and 39 years of age whose underlying cause of death was reported on the death certificate using specific codes based on the International Classification of Diseases-Version 10 (ICD-10) system. All inpatient hospital deaths were excluded. During this timeframe, 2,336 deaths were considered to meet Michigan’s case definition for sudden cardiac death of the young based on death certificates filed with the State Registrar. Although there appears to be ambiguity regarding some of the codes used to report underlying causes of death, the MDCH Division for Vital Records and Health Statistics classifies all reported deaths to Michigan residents in accord with national coding requirements.

For this time period, the statewide age-adjusted mortality rate for children and young adults ages 1-39 was found to be approximately 5.5 per 100,000 residents. However, there were significant differences between counties, as depicted in Figure 1. Thirteen counties had mortality rates higher than the statewide average, with the rate of SCDY appearing to be highest in Clare (7.8), followed by Kalkaska (7.3) and Genesee (7.0) counties. Wayne county had the largest total number of deaths (838), followed by Oakland (187), Macomb (156), Genesee (127), and Kent (110) counties. The rates for all Michigan counties with more than five reported cases are included at the end of this summary.

**Age-Adjusted Mortality Rates for SCD,
Michigan Residents Age 1-39 by County,
1999-2006**

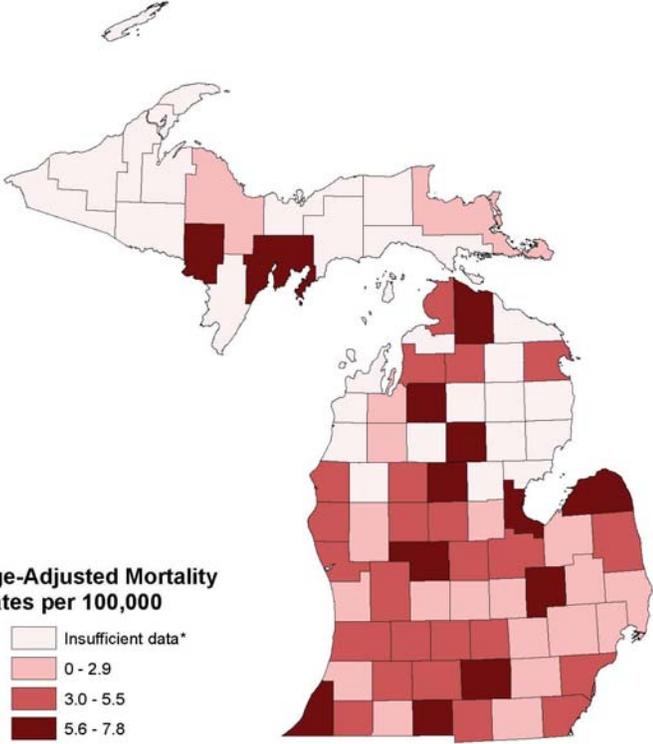


Figure 1

*Counties with fewer than five sudden cardiac deaths from 1999-2006
Michigan's age-adjusted mortality rate is 5.5 per 100,000
Source: MDCH Vital Statistics
Age-adjusted to the 2000 U.S. standard population

Data were also analyzed by sex, race, place of death, autopsy status, and cause of death (Table 1). The majority of individuals (nearly 48%) died in the hospital emergency room/outpatient setting or were dead on arrival, whereas 42% died at home. An autopsy was performed in more than three-quarters of the cases (78%). The mortality rates varied by sex, race, age, and cause of death.

Significant disparities were observed for sex and race, with more than two-thirds of the deaths occurring in males, and one-third in blacks. Only 17.4% of the Michigan population under age 39 is African-American or black, while 78.6% is white. Therefore, SCDY appears to affect blacks disproportionately.

Overall, the rate for males was 7.6 per 100,000 and for females, 3.4 per 100,000. The rate for blacks (11.9 per 100,000) was significantly higher than the rate for whites (4.6 per 100,000). **The single highest age-adjusted mortality rate was for black males at 15.8 per 100,000** which is nearly two-and-a-half times the rate for white males (6.4 per 100,000). The rate for black females was 8.5 per 100,000, more than **triple** the rate for white females (2.5 per 100,000) [Data not shown].

Overall, the number of SCD cases seemed to decrease from ages 5-14 and then exhibited an increasing trend among teens. **The greatest number were reported in adults ages 35-39 years.** The lowest mortality rate was for the 1-9 year old group at 0.5, followed by the 10-19 year old group at 0.9 and the 20-29 year old group at 3.3 per 100,000. There was a dramatic increase between those in their 20s and those in their 30s, with the highest mortality rate for the 30-39 year old age grouping at 13.8 per 100,000.

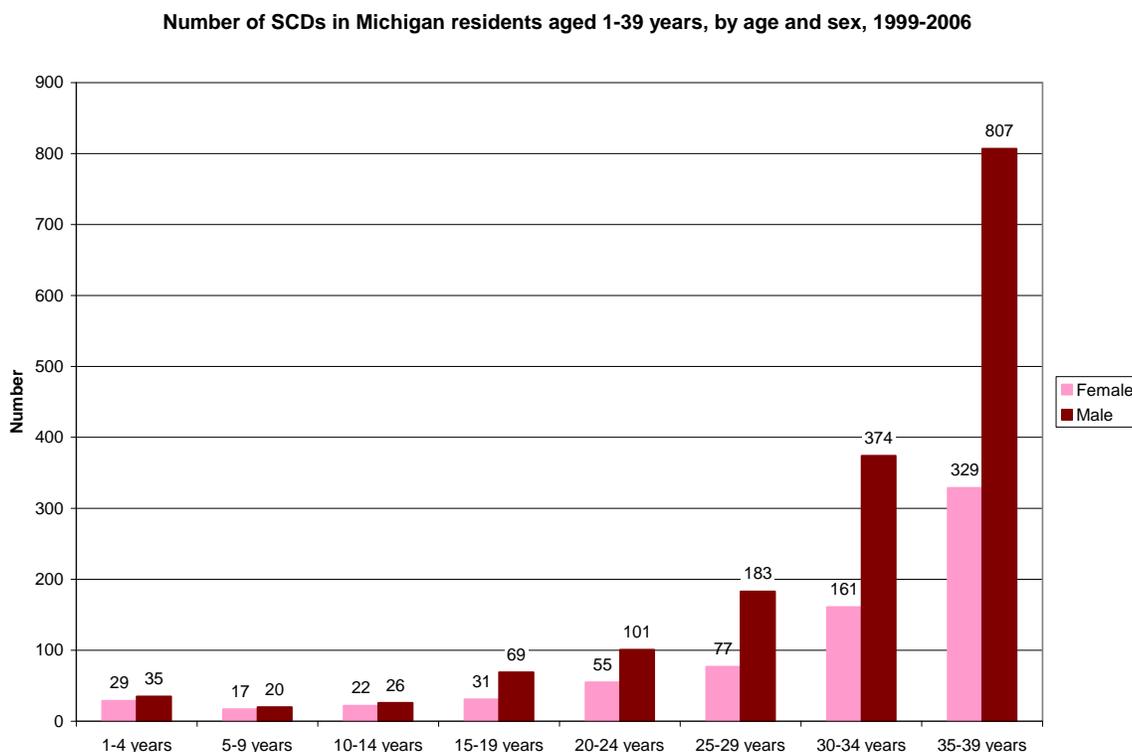
The significantly increased mortality rate in the 30-39 year old group requires further investigation into possible modifiable risk factors associated with these deaths.

Table 1 Sudden cardiac deaths (SCDs)* of Michigan residents aged 1 - 39 years, 1999 - 2006		
	Number	Percent
Total	2,336	
Sex		
Male	1,615	69.1
Female	721	30.9
Race		
White	1,505	64.4
Black	778	33.3
Other	53	2.3
Age		
1-4 years	64	2.7
5-9 years	37	1.6
10-14 years	48	2.1
15-19 years	100	4.2
20-24 years	156	6.7
25-29 years	260	11.1
30-34	535	22.9
35-39	1,136	48.6
Place of death		
Home	983	42.1
Nursing home, extended care	16	6.8
Hospital: emergency room / outpatient	1,112	47.6
Ambulance	33	1.4
Other / unknown	192	8.2
Autopsy		
Yes	1,832	78.4
No	503	21.5
Unknown	1	0.0

* Includes decedents who died out of the hospital, or in an emergency department, or were dead on arrival to an emergency department, and had one of the following ICD-10 codes reported as the underlying cause of death on the death certificate: I00-I51 (cardiac causes), Q20-Q24 (congenital cardiac malformations), R96-R99 (ill-defined causes).

Significant disparities were also observed for age and sex (Figure 2). For all age groups analyzed, males were more commonly affected with SCDY than females. The largest disparity between sexes was observed in the 35-39 year old age group, with males comprising over 70% of cases.

Figure 2



Retrospective Analysis by Specific ICD-10 Codes

For this retrospective review and analysis of Michigan SCDY cases, a methodology was used to examine death certificates similar to that reported by Chugh et al in previously published studies.¹ Cases were assigned to one of three groups according to eligible codes that included **cardiac** (I00-I51), **congenital cardiac malformation** (Q20-Q24) or **ill-defined** (R96-R99) etiologies. [See Appendix B for definitions of specific causes of SCDY]. Although past studies using death certificate data have been used to generate national estimates, this retrospective method has some limitations with respect to accuracy, and has previously been reported to result in an overestimation of true SCD cases. In addition, analysis of death certificate data alone does not allow investigation of potential modifier effects that might provide additional insight or explanation relative to these causes of death—for instance, the impact of environmental or behavioral factors such as smoking, drug or alcohol use, excessive weight or level of physical activity, etc.

Therefore, further assessments of SCD in the general population using *multiple* sources of case ascertainment (i.e., death certificates, emergency medical response systems, medical examiners, hospitals) would enhance the accuracy of the data presented in this report.

Table 2
Ten most frequent underlying causes of death of Michigan SCD* victims,
1999-2006 (n=2,336)

ICD 10 Code	Cause of death	Number	Percent
I25.0	Atherosclerotic cardiovascular disease	341	14.6
I42.0	Dilated cardiomyopathy	321	13.7
I21.9	Acute myocardial infarction	279	11.9
I25.1	Atherosclerotic heart disease	234	10.0
I42.2	Other hypertrophic cardiomyopathy	146	6.3
I11.9	Hypertensive heart disease without heart failure	127	5.4
R99	Other ill-defined and unspecified causes of mortality	113	4.8
I42.9	Cardiomyopathy	93	4.0
I49.9	Cardiac arrhythmia	88	3.8
I26.9	Instantaneous death	65	2.8

* Includes decedents who died out of the hospital, or in an emergency department, or were dead on arrival to an emergency department, and had one of the following ICD-10 codes reported as the underlying cause of death on the death certificate: I00-I51 (cardiac causes), Q20-Q24 (congenital cardiac malformations), R96-R99 (ill-defined causes).

The overall age-adjusted rate for deaths due to cardiac causes was 4.9 per 100,000, significantly higher than rates for ill-defined causes (0.4) and for congenital cardiac malformations (0.3). The single most frequently reported cause of death was atherosclerotic cardiovascular disease (14.6%), followed by dilated cardiomyopathy (13.7%) and acute myocardial infarction (11.9%), as noted in Table 2.

The relative frequency of different SCDY etiologies varies by sex, race and age. For the top ten causes of death, there were notable differences by race, with blacks disproportionately represented among deaths relating to any cause except acute myocardial infarction and atherosclerotic heart disease. The most commonly reported underlying cause in blacks was dilated cardiomyopathy (n=184) while in whites it was acute myocardial infarction (n=233). The largest discrepancies were for dilated cardiomyopathy and hypertensive heart disease, respectively, where blacks represented about 57% and 54% of all deaths due to those etiologies. (Figure 3)



There were also notable differences between males and females, with males more likely than females to die of any cause except instantaneous death. The greatest difference was in the "other hypertrophic cardiomyopathy" category where females comprised just under 12%, while males represented 88% of all deaths. (Figure 4)

Figure 3

Top ten causes of SCD by race, Michigan residents aged 1-39 years, 1999-2006

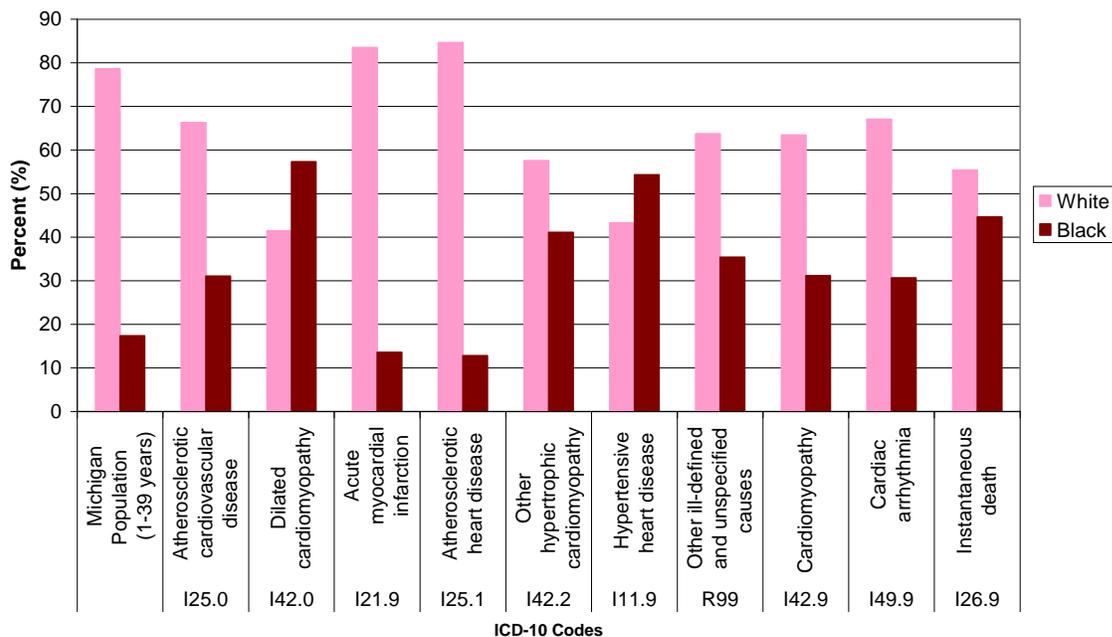
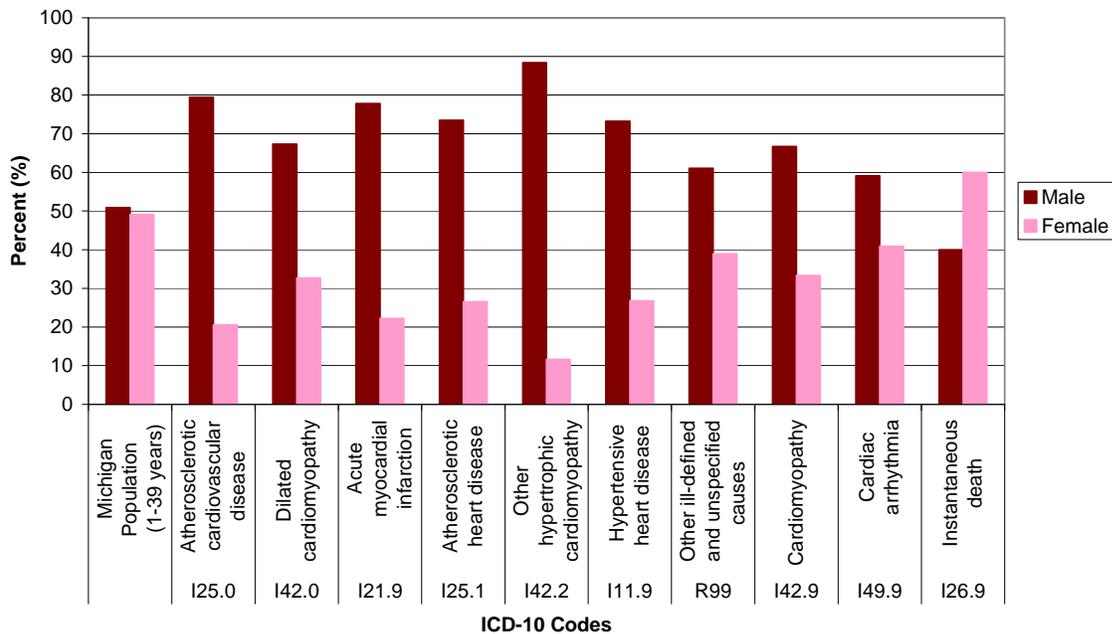


Figure 4

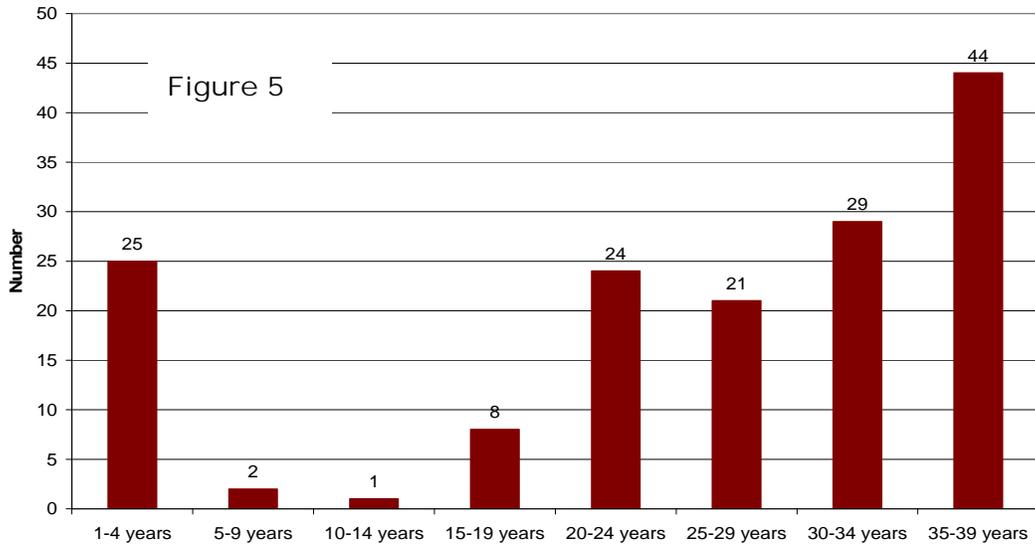
Top ten causes of SCD by sex, Michigan residents aged 1-39 years, 1999-2006



The number of deaths resulting from congenital cardiac malformations remained fairly constant across all age groups with a slight peak (n=26) among 30-34 year olds [Data not shown]. The number of deaths due to ill-defined causes (Figure 5) was highest among 35-39 year olds but extremely low in the 5-14 year age group. Similar to the overall

mortality rates for SCDY shown in Figure 2, cardiac causes were more often reported beginning in the mid-teens with the largest number (n=1,077) in the adult 35-39 age group [Data not shown].

Number of SCDs of Michigan residents aged 1-39 by age group and ill-defined causes of death, 1999-2006



When analyzed by year, there was little fluctuation in the number of SCDY cases due to congenital and ill-defined causes. A slight decrease in cardiac cases was observed in 2004 but the number increased in subsequent years. (Figure 6)

Number of SCDs in Michigan residents aged 1-39 years, by year and underlying cause of death, 1999-2006

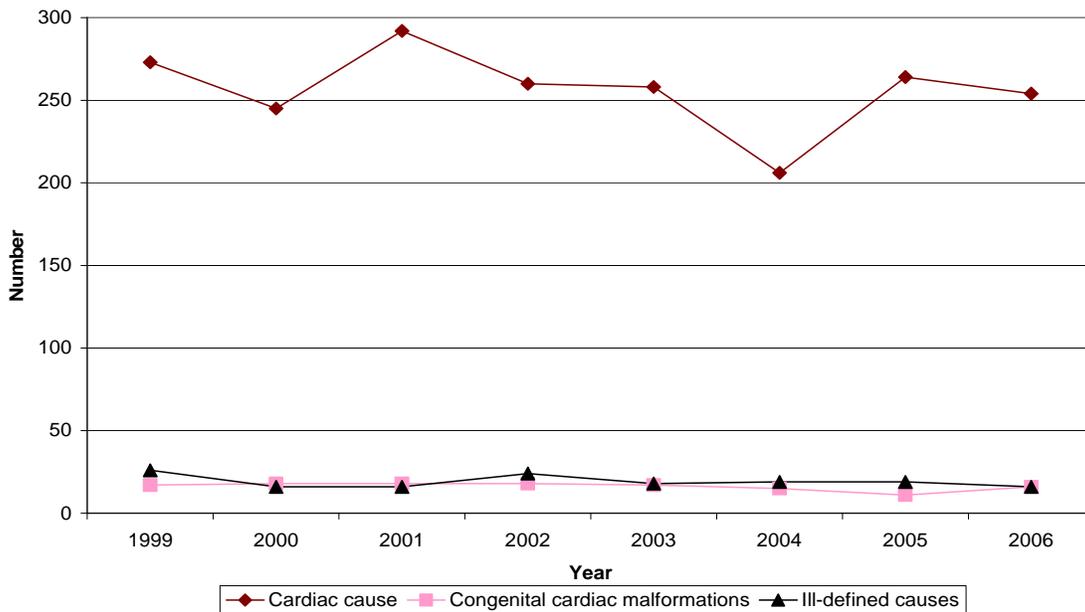


Figure 6

Age Adjusted Mortality Rates by County

Eight year age-adjusted mortality rates per 100,000 by county in Michigan, 1999-2006 for sudden cardiac deaths, ages 1-39 years.

County	Rate	95% Confidence Interval	Number of SCDs
Alcona	-	-	-
Alger	-	-	-
Allegan	3.1	(1.5 - 4.7)	14
Alpena	4.7	(0.5 - 8.8)	7
Antrim	5.4	(0.7 - 10.2)	5
Arenac	-	-	-
Baraga	-	-	-
Barry	3.0	(0.8 - 5.2)	7
Bay	6.2	(3.8 - 8.6)	26
Benzie	-	-	-
Berrien	6.6	(4.6 - 8.7)	41
Branch	5.7	(2.3 - 9.0)	11
Calhoun	5.1	(3.2 - 7.0)	28
Cass	3.6	(0.9 - 6.3)	7
Charlevoix	-	-	-
Cheboygan	5.9	(1.2 - 10.6)	6
Chippewa	2.9	(0.4 - 5.4)	5
Clare	7.8	(2.7 - 13.0)	9
Clinton	2.2	(0.4 - 3.9)	6
Crawford	-	-	-
Delta	5.9	(1.8 - 10.1)	8
Dickinson	6.4	(1.3 - 11.6)	6
Eaton	3.6	(1.8 - 5.4)	15
Emmet	5.1	(1.0 - 9.1)	6
Genesee	7.0	(5.8 - 8.3)	127
Gladwin	-	-	-
Gogebic	-	-	-
Grand Traverse	2.9	(1.1 - 4.8)	10
Gratiot	4.1	(1.1 - 7.2)	7
Hillsdale	5.5	(2.1 - 8.9)	10
Houghton	-	-	-
Huron	5.7	(1.5 - 10.0)	7
Ingham	4.9	(3.6 - 6.2)	58
Ionia	2.2	(0.4 - 3.9)	6
Iosco	-	-	-
Iron	-	-	-
Isabella	4.3	(1.6 - 7.0)	11
Jackson	5.9	(4.1 - 7.7)	40
Kalamazoo	4.3	(3.0 - 5.6)	43
Kalkaska	7.3	(0.9 - 13.7)	5
Kent	4.2	(3.4 - 5.0)	110
Keweenaw	-	-	-

County	Rate	95% Confidence Interval	Number of SCDs
Lake	-	-	-
Lapeer	1.6	(0.7 - 2.6)	11
Leelanau	-	-	-
Lenawee	1.6	(0.7 - 2.6)	12
Livingston	1.7	(1.0 - 2.4)	22
Luce	-	-	-
Mackinac	-	-	-
Macomb	2.4	(2.0 - 2.8)	156
Manistee	-	-	-
Marquette	1.4	(0.3 - 2.6)	6
Mason	4.3	(1.3 - 7.4)	8
Mecosta	3.4	(1.1 - 4.7)	9
Menominee	-	-	-
Midland	1.8	(0.7 - 2.8)	11
Missaukee	-	-	-
Monroe	3.1	(2.1 - 4.2)	35
Montcalm	5.9	(3.7 - 8.1)	28
Montmorency	-	-	-
Muskegon	4.3	(3.1 - 5.4)	53
Newaygo	2.9	(1.1 - 4.7)	10
Oakland	2.0	(1.7 - 2.3)	187
Oceana	3.2	(0.6 - 5.7)	6
Ogemaw	-	-	-
Ontonagon	-	-	-
Osceola	3.3	(0.4 - 6.2)	5
Oscoda	-	-	-
Otsego	5.1	(1.8 - 8.5)	9
Ottawa	1.3	(0.8 - 1.8)	25
Presque Isle	-	-	-
Roscommon	5.8	(1.8 - 9.8)	8
Saginaw	3.2	(2.3 - 4.1)	46
St. Clair	2.3	(1.5 - 3.2)	30
St. Joseph	2.2	(0.8 - 3.6)	10
Sanilac	5.0	(2.5 - 7.6)	15
Schoolcraft	-	-	-
Shiawassee	2.8	(1.4 - 4.2)	15
Tuscola	2.5	(0.9 - 4.1)	10
Van Buren	1.9	(0.7 - 3.0)	10
Washtenaw	1.8	(1.3 - 2.3)	51
Wayne	5.4	(5.0 - 5.7)	838
Wexford	2.3	(0.3 - 4.2)	5

Source: MDCH Vital Statistics
 ICD 10 codes: I00-I51, Q00-Q24 and R96-R99
 -Insufficient data, less than five deaths in the county