

DIABETES SURVEILLANCE INDICATOR REPORT

HEALTH CARE UTILIZATION BY MICHIGAN MEDICAID BENEFICIARIES

2007-2012

Sarah Lyon-Callo, MS, MA
Bureau Director
Bureau of Epidemiology and Population Health
Michigan Department of Health and Human Services

Patricia McKane, DVM, MPH
Division Director, Lifecourse Epidemiology and Genomics Division
Bureau of Epidemiology and Population Health
Michigan Department of Health and Human Services

Robert L. Wahl, DVM, MS
Section Manager, Chronic Disease Epidemiology Section
Lifecourse Epidemiology and Genomics Division
Bureau of Epidemiology and Population Health
Michigan Department of Health and Human Services

Richard Wimberley, MPA
Section Manager, Diabetes and Other Chronic Diseases Section
Division of Chronic Disease and Injury Control
Bureau of Health and Wellness
Michigan Department of Health and Human Services

Erika Garcia, MS**
Health Analyst
Lifecourse Epidemiology and Genomics Division
Bureau of Epidemiology and Population Health
Michigan Department of Health and Human Services

H.C. Michelle Byrd, PhD, MPH
Diabetes and Obesity Epidemiologist
Lifecourse Epidemiology and Genomics Division
Bureau of Epidemiology and Population Health
Michigan Department of Health and Human Services

**Currently at Optum Government Solutions, Inc.

Suggested Citation: Byrd HCM, Garcia E, Lyon-Callo S, Wahl R, and Wimberley R. Diabetes Surveillance Indicator Report Health Care Utilization by Michigan Medicaid Beneficiaries 2007-2012. Lansing, Michigan: Michigan Department of Health and Human Services, Lifecourse Epidemiology and Genomics Division, Chronic Disease Epidemiology Section and Chronic Disease Epidemiology Section and Division of Chronic Disease and Injury Control, Diabetes and Other Chronic Diseases Section.

This publication was supported by the Grant Number 6 NU58DP004814-03-01 funded by the Centers for Disease Control and Prevention. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the Centers for Disease Control and Prevention or the Department of Health and Human Services.

Table of Contents

Acronyms.....	vi
Background.....	vii
Executive Summary.....	viii
Diabetes Prevalence.....	1
Diabetes Self-Management Education.....	2
Office Visits.....	3
Inpatient Hospitalization and Emergency Department Visits.....	4
Local Health Department.....	9
Future Steps.....	10
Methods.....	11
Appendices.....	12
References.....	25

Acronyms

Acronym	Description
ADA	American Diabetes Association
AI/AN	American Indian/Alaska Native
Asian/PI or As/PI	Asian/Pacific Islander
CPT	Current Procedural Terminology
DPCP	Diabetes Prevention and Control Program
DSME/T	Diabetes Self-Management Education and Training
ED	Emergency Department
HEDIS®	Healthcare Effectiveness Data and Information Set
Hisp	Hispanic
IP	Inpatient Hospitalization
LHD	Local Health Department
LMAS	Luce-Mackinac-Antrium-Schoolcraft
MDHHS	Michigan Department of Health and Human Services
PWD	Person(s) with Diabetes or Medicaid Beneficiaries with Diabetes
Race, NH	non-Hispanic Race (e.g., Black, NH represents non-Hispanic Black)
UP	Upper Peninsula

Background

Diabetes mellitus refers to a group of diseases in which blood glucose levels are above normal.¹ The number of adults with diagnosed diabetes in the United States nearly quadrupled from 5.5 million in 1980 to 21.3 million in 2012.² Among adults, about 1.7 million new cases of diabetes are diagnosed each year in the United States.² In Michigan, diabetes was the seventh leading cause of death in 2014.³

Diabetes is a complex, chronic disease that requires continuous medical care with multi-faceted risk-reduction strategies.¹ Two landmark longitudinal clinical studies on complications associated with type I and type II diabetes reported the importance of daily monitoring and maintaining blood glucose levels as close as possible to normal levels to avoid complications.⁴⁻⁷ In 2009, the National Center for Chronic Disease Prevention and Health Promotion released a report on the power of prevention in addressing chronic disease in the 21st Century.⁸

The American Diabetes Association (ADA) commissioned a study on total health costs of diabetes in the United States to examine the financial burden, health resources, and lost productivity associated with diabetes.⁹ The total estimated cost of diagnosed diabetes in 2012 was \$245 billion — an increase from \$174 billion in 2007.⁹ The largest component of expenditures was on hospital inpatient care.⁹ The study further reported that 62.4% of diabetes care costs were covered by government insurance (Military, Medicare, and Medicaid).⁹

Michigan Medicaid programs provide coverage for health care services to residents in need of financial assistance. With Medicaid Expansion legislation passing in Michigan, a new population of adults are eligible to enroll in Medicaid (Healthy Michigan Plan).¹⁰ A recent study found that a large portion of low-income, uninsured adults who might be eligible to enroll into a Medicaid program were likely to be healthier than currently-enrolled Medicaid beneficiaries (prior to Medicaid Expansion); however, the small proportion with chronic conditions were likely to be more ill than those currently on Medicaid.¹¹ This group of new adult Medicaid beneficiaries with chronic conditions may require more complex levels of care.

The Michigan Department of Health and Human Services (MDHHS) has the opportunity to monitor trends over time of diabetes-related health care utilization of Medicaid beneficiaries with diabetes using the Michigan Medicaid Data Warehouse, which houses paid claims, encounters, and filled prescriptions. These data were used to determine diabetes-related indicators based on technical specifications from Healthcare Effectiveness Data and Information Set (HEDIS®).

This report is a product of the MDHHS Diabetes Prevention and Control Program (DPCP) and the Chronic Disease Epidemiology Section. It presents key findings about select diabetes-related health care utilization indicators of adult Medicaid beneficiaries with diabetes 18-64 years of age in the state of Michigan 2007-2012. Indicators tracked over time include diabetes-related preventive care and acute care services as well as the certified diabetes education program Diabetes Self-Management Education and Training (DSME/T). Health care utilization statistics were also determined by demographic group and geographic setting. These results may be applicable in identifying possible over- or underutilization of services by specific subgroups. Ninety five percent (95%) confidence intervals were determined for all statistics. Disparity in outcomes was the relative difference of statistics between subgroups or years.

The indicators presented are statistics based on utilization and only reflect services that were paid by Michigan Medicaid programs. For the purposes of this report, the diabetes utilization prevalence is the percentage of **Medicaid beneficiaries** with diabetes, as determined by paid claims, encounters, and/or filled prescriptions (See Methods). The word ‘utilization’ will be assumed. For example, ‘diabetes utilization prevalence’ will be written as ‘diabetes prevalence.’ Persons not meeting the diabetes criteria in the Methods section were excluded resulting in a possible underestimation in the number of persons with diabetes in Medicaid. The reported statistics cannot be generalized to all adults in a Michigan Medicaid program or the Michigan adult population.

Executive Summary

- ❖ In 2012, diabetes affected about one in ten, or 38,549, adult Medicaid beneficiaries age 18-64 years in Michigan.
- ❖ About 1 in 20 adult persons with diabetes (PWD) had at least one DSME/T session in 2012.
- ❖ Over half the adult PWD had at least two diabetes-related office visits in 2012.
- ❖ The rate of inpatient hospitalization (IP) with any mention of diabetes was 337.7 per 1,000 adult PWD in 2007, peaked at 418.2 in 2009, then decreased to near baseline 349.9 by 2012.
- ❖ The rate of Emergency department (ED) visits with any mention of diabetes increased from 81.7 per 100 adult PWD in 2007 to 124.4 in 2010, then decreased slightly to 117.2 in 2012.
- ❖ About 54% of adult beneficiaries with diabetes had no diabetes-related ED admissions in 2012. However, the percent of PWD with five or more ED visits during the calendar year increased from 3.6% in 2007 to 5.7% in 2012.
- ❖ In 2012, diabetes prevalence was higher among non-Hispanic Black Medicaid beneficiaries 18-64 years than non-Hispanic White beneficiaries 18-64 years (9.8% versus 9.0%). Among those with diabetes, non-Hispanic Black adults (3.5%) had approximately 40% lower DSME/T enrollment than non-Hispanic White adults with diabetes (5.7%). The rate of diabetes-related inpatient hospitalization was approximately 40% higher among non-Hispanic Black adults with diabetes compared to non-Hispanic White adults with diabetes (428.3 versus 300.6 per 1,000 PWD). If non-Hispanic Black and White adult PWD have had similar ED utilization characteristics, about 940 more non-Hispanic Black PWD would not have had any diabetes-related ED encounters in 2012.
- ❖ In 2012, diabetes affected a slightly higher percentage of adult male than female beneficiaries 18-64 years (9.9% versus 9.4%). Adult males with diabetes had lower DSME/T enrollment (3.4%) compared to females (5.5%). Among adult PWD, females and males 18-44 years had comparable rates of diabetes-related inpatient hospitalization (about 320 per 1,000 PWD), but female PWD 18-44 years had about 17% higher rates of diabetes-related ED visits than male PWD of the same age group (137.9 versus 118.2 per 100 PWD).
- ❖ In 2012, nearly 1 in 20 beneficiaries 18-44 years (4.7%) were affected by diabetes compared to one in five beneficiaries 45-64 years (21.9%). The percentage of PWD 18-44 years who attended at least one DSME/T session was 2.4 times the percentage of PWD 45-64 years (7.6% versus 3.2%). There was no improvement in the percent of younger adult PWD who had at least two diabetes-related office visits between 2007 and 2012 (45.0% and 44.8%, respectively). The rate of diabetes-related ED visits was approximately 20% higher among younger adult beneficiaries with diabetes than that of older beneficiaries with diabetes (131.7 versus 109.3 per 100 adult PWD). If the diabetes-related ED experience was the same regardless of age, 140 more 18-44 year old persons with diabetes would have had less than five visits in 2012.
- ❖ In 2012, diabetes prevalence was slightly higher for adult Medicaid beneficiaries residing in an urban setting compared to a rural setting in Michigan (9.7% and 9.3%, respectively). The percentage of adults with diabetes and who had at least one DSME/T session was higher in rural areas (8.9%) than in urban areas (4.0%). Among adult beneficiaries with diabetes, rates of diabetes-related inpatient hospitalization and ED visits were consistently higher among those living in urban areas than rural areas. In 2012, the rate of diabetes-related inpatient hospitalization was 362.0 per 1,000 adult PWD living in urban areas versus 283.3 per 1,000 adult PWD in rural areas, and the rate of diabetes-related ED visits were 119.9 per 100 adult PWD living in urban areas versus 103.1 per 100 adult PWD living in rural areas.

Diabetes-Related Indicators among Adult Michigan Medicaid Beneficiaries (18-64 yrs), 2007—2012

Indicators for Michigan Medicaid Beneficiaries (18-64 years)	2007	2008	2009	2010	2011	2012	Absolute Difference 2007 and 2012	Linear Trend*
<i>Adult Population</i>								
Diabetes Prevalence	9.1%	9.0%	9.2%	9.0%	9.2%	9.6%	0.5%	Yes
<i>Adult Diabetes Population</i>								
At Least One Diabetes Self-Management Education Session	5.1%	4.8%	5.1%	5.1%	5.1%	4.7%	-0.3%	No
At Least Two Diabetes-Related Office Visits	56.7%	55.1%	53.2%	52.0%	51.2%	53.1%	-3.6%	Yes
Inpatient Hospitalization Rate, Diabetes Listed as Any Diagnosis (per 1,000)	337.7	351.3	418.2	401.0	368.8	349.9	12.2	No
Emergency Department Visit Rate, Diabetes Listed as Any Diagnosis (per 100)	81.7	93.5	116.4	124.4	120.1	117.2	35.6	No
Five or More ED Visits (i.e., Super Utilizer), Diabetes Listed as Any Diagnosis	3.6%	4.2%	5.6%	6.1%	5.9%	5.7%	2.1%	Yes

*Cochran-Armitage statistical test was used to determine evidence of a linear trend with time (year). Absolute difference subject to rounding

1) What was diabetes prevalence among the adult Medicaid population?

Diabetes prevalence shows the burden of diabetes within the Medicaid population. Trends over time can be used as a starting point to understand primary intervention needs, as well as changes in diabetes management, and health care access.

- Diabetes prevalence was 9.1% in 2007 and 9.6% in 2012 (Fig. 1).
- Diabetes prevalence was approximately 29% higher for non-Hispanic American Indian/Alaska Natives and about 56% higher for non-Hispanic Asian/Pacific Islander adult beneficiaries compared with non-Hispanic White adult beneficiaries (Table 1 and Fig. 2).
- One in five beneficiaries age 45-64 years were affected by diabetes compared to approximately 1 in 20 beneficiaries 18-44 years (Table 1 and Fig. 2).
- Diabetes prevalence was slightly higher among males compared to females (9.9% and 9.4%).
- The same was true for urban versus rural settings (9.7% versus 9.3%).

Table 1. Diabetes Prevalence by Characteristic, Adults (18-64 yrs), Michigan, Medicaid, 2012

Characteristic	2012	
	Diabetes Prevalence	Adult PWD
Overall	9.6%	38,549
<i>Gender</i>		
Female	9.4%*	24,088
Male (ref.)	9.9%	14,461
<i>Race/Ethnicity</i>		
White, NH (ref.)	9.0%	19,530
Black, NH	9.8%*	14,864
Hispanic	9.7%*	1,223
AI/AN, NH	11.6%*	274
Asian/PI, NH	14.0%*	786
<i>Age (years)</i>		
18-44	4.7%*	13,545
45-64 (ref.)	21.9%	25,004
<i>Geography</i>		
Urban (ref.)	9.7%	32,419
Rural	9.3%*	6,021

PWD—Persons with Diabetes; NH – non-Hispanic; AI/AN – American Indian/Alaska Native; Asian/PI – Asian/Pacific Islander
 *Statistically significant difference in prevalence compared to reference group (ref.), $\alpha=0.05$

Figure 1. Diabetes Prevalence, Adults (18-64 yrs), Michigan, Medicaid, 2007-2012

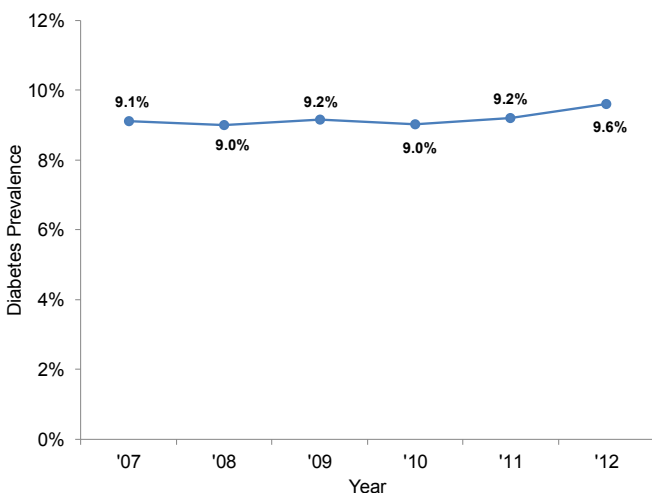
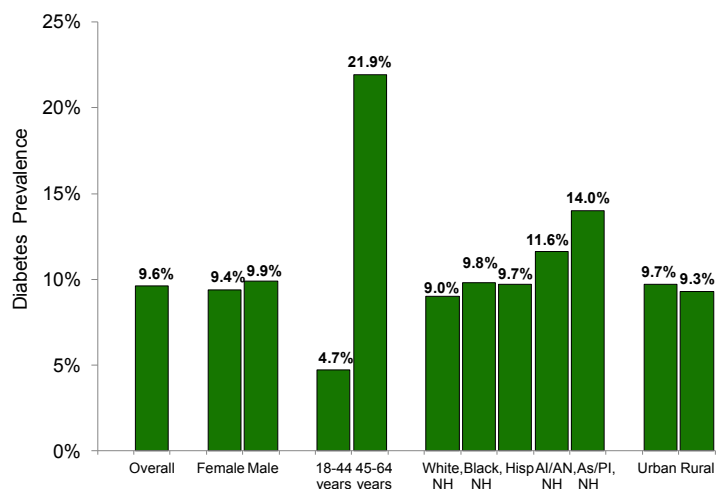


Figure 2. Diabetes Prevalence by Characteristic, Adults (18-64 yrs), Michigan, Medicaid, 2012*



NH – non-Hispanic; Hisp – Hispanic; AI/AN – American Indian/Alaska Native; As/PI – Asian/Pacific Islander

*Statistically significant difference in prevalence for gender, age, geographic setting, and White, NH compared to other racial/ethnic groups, $\alpha=0.05$

2) What percentage of adult Medicaid beneficiaries with diabetes utilized DSME/T programs?

DSME/T programs increase knowledge and promote positive behavior changes in PWD. The ADA stresses the importance of PWD attending DSME/T programs that follow the national standards.¹ In Michigan, Medicaid beneficiaries with diabetes are eligible for 20 half-hour paid state-certified DSME/T sessions, if newly diagnosed, and four half-hour sessions annually, if previously diagnosed.

- Nearly 2,000 adult beneficiaries with diabetes (4.7%) attended at least one DSME/T session in 2012 (Table 2). The prevalence was constant between 2007-2012 (Fig. 3).
- Disparities in enrollment were observed among adult beneficiaries with diabetes by all characteristics in 2012 (Table 2).
- The prevalence of male PWD attending at least one DSME session was 38% lower than the prevalence of female PWD (Table 2).
- Compared to non-Hispanic White PWD, attendance of at least one DSME/T session was lower for non-Hispanic Black (39%) and Asian/Pacific Islander (58%) PWD from 2007 to 2012 (Table 2 and Fig. 3).
- The percentage of beneficiaries 18-24 years (11.3%) with diabetes who attended at least one DSME/T session was four times that of beneficiaries 55-64 years (2.8%) with diabetes (Fig. 4).

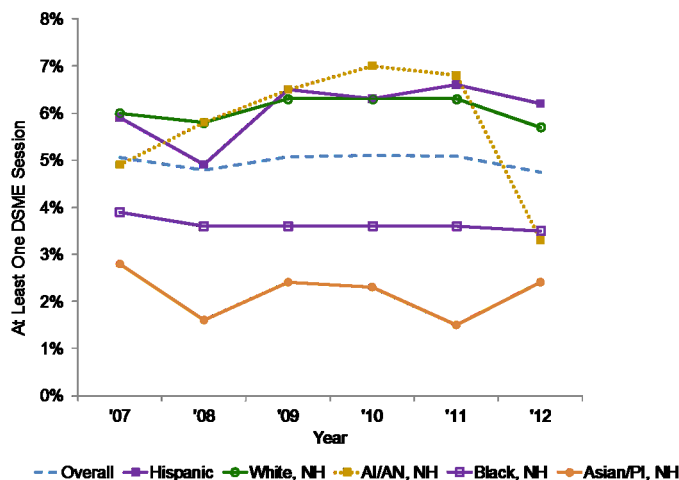
Table 2. Attended at Least One 30-minute DSME/T Session by Characteristic, PWD (18-64 yrs), Michigan, Medicaid, 2012

Characteristic	2012	
	Prevalence	Adult PWD
Overall	4.7%	1,826
<i>Gender</i>		
Female	5.5%*	1,329
Male (ref.)	3.4%	497
<i>Race/Ethnicity</i>		
White, NH (ref.)	5.7%	1,117
Black, NH	3.5%*	525
Hispanic	6.2%	76
AI/AN, NH	3.3%	9
Asian/PI, NH	2.4%*	19
<i>Age (years)</i>		
18-44	7.6%*	1,024
45-64 (ref.)	3.2%	802
<i>Geography</i>		
Urban (ref.)	4.0%	1,287
Rural	8.9%*	535

DSME/T—Diabetes Self-Management Education and Training; PWD—Persons with diabetes who attended at least one 30-minute DSME/T session; NH – non-Hispanic; AI/AN – American Indian/Alaska Native; Asian/PI – Asian/Pacific Islander

*Statistically significant difference in prevalence compared to reference group (ref.), $\alpha=0.05$

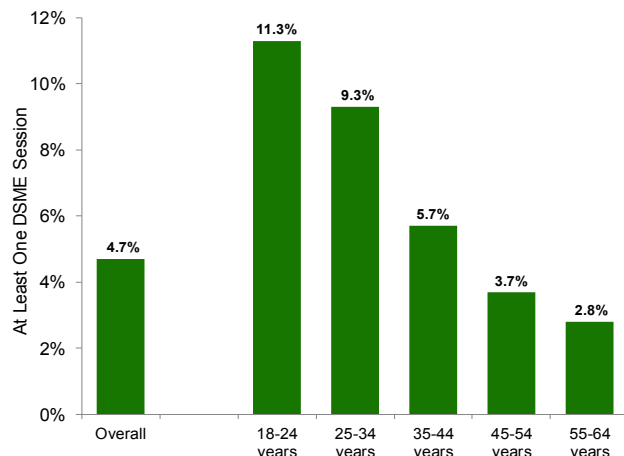
Figure 3. Attended at Least One DSME/T Session by Race/Ethnicity, PWD (18-64 yrs), Michigan, Medicaid, 2007-2012*



DSME/T—Diabetes Self-Management Education and Training; PWD—Persons with Diabetes; NH – non-Hispanic; AI/AN – American Indian/Alaska Native; Asian/PI – Asian/Pacific Islander

*Statistically significant difference in prevalence for White, NH compared to Black, NH and Asian/PI, NH, $\alpha=0.05$

Figure 4. Attended at Least One 30-minute DSME/T Session by Age Group, PWD (18-64 yrs), Michigan, Medicaid, 2012*



DSME/T—Diabetes Self-Management Education and Training; PWD—Persons with Diabetes

*Statistically significant difference in prevalence for age group 55-64 years compared to other age groups, $\alpha=0.05$

3) What percentage of adult Medicaid beneficiaries had at least two diabetes-related visits with a health provider in a given year?

Visiting a health professional routinely for diabetes-related clinical care is important in managing diabetes and minimizing diabetes-related complications.¹

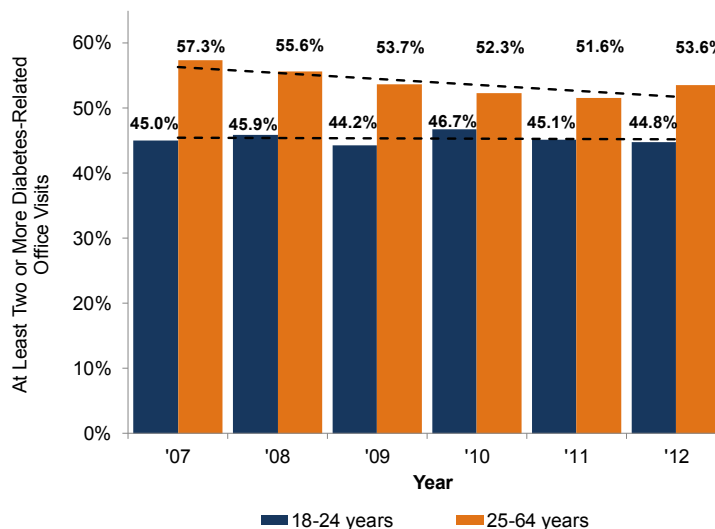
- Approximately 50% of adult beneficiaries with diabetes had at least two diabetes-related office visits in 2012 (Table 3).
- In 2012, utilization was statistically significantly lower among
 - adult female PWD compared to adult male PWD;
 - adult non-Hispanic Black PWD compared to adult non-Hispanic White PWD;
 - PWD 18-44 years compared to 45-64 years;
 - adult PWD residing in urban areas compared to those residing in rural areas.
- Further analysis of five age group breakdown showed that utilization among young adults 18-24 years of age was disproportionately lower than adults 25 years and older (Fig. 5). The disparity between the age groups was 27.3% in 2007 and 19.6% in 2012 (Fig.5). The disparity decreased because utilization remained the same among PWD 18-24 years of age and declined among PWD 25 to 64 years of age over the six years.

Table 3. Had at Least Two Diabetes-Related Office Visits by Characteristic, PWD (18-64 yrs), Michigan, Medicaid, 2012

Characteristic	2012	
	Prevalence	Adult PWD
Overall	53.1%	20,486
<i>Gender</i>		
Female	51.8%*	12,488
Male (ref.)	55.3%	7,998
<i>Race/Ethnicity</i>		
White, NH (ref.)	55.0%	10,749
Black, NH	49.8%*	7,396
Hispanic	61.8%	756
AI/AN, NH	52.9%	145
Asian/PI, NH	58.8%	462
<i>Age (years)</i>		
18-44	49.5%*	6,703
45-64 (ref.)	55.1%	13,783
<i>Geography</i>		
Urban (ref.)	52.7%	17,079
Rural	56.0%*	3,373

PWD—Persons with Diabetes who had at least two diabetes-related office visits; NH – non-Hispanic; AI/AN – American Indian/Alaska Native; Asian/PI – Asian/Pacific Islander
 *Statistically significant difference compared to reference group (ref.), $\alpha=0.05$

Figure 5. Had At Least Two Diabetes-Related Office Visits by Age Group, PWD (18-64 yrs), Michigan, Medicaid, 2007-2012*



PWD—Persons with Diabetes

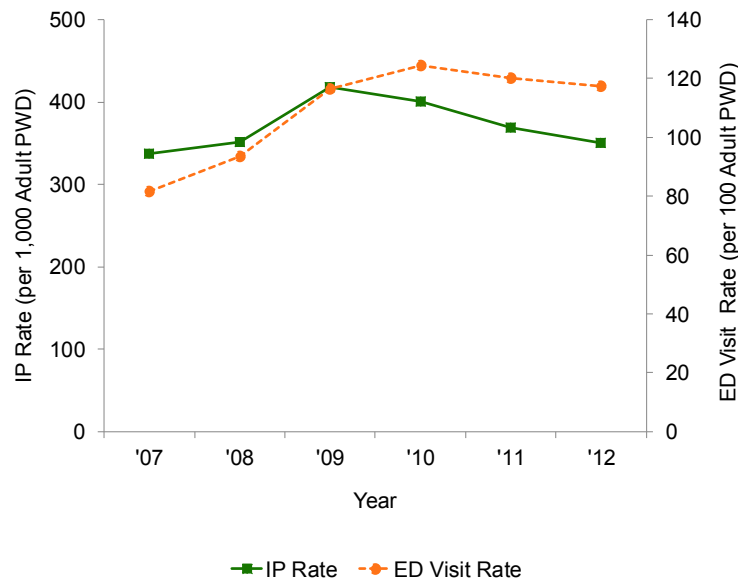
*Statistically significant difference in prevalence between two age groups for all years, $\alpha=0.05$

4) What was the frequency of diabetes-related inpatient hospitalizations and emergency department visits among adult Medicaid beneficiaries with diabetes annually?

A significant portion of total diabetes costs goes towards inpatient hospitalization.⁹ Changes in the frequency of diabetes-related IP and ED admissions can provide information about the health of the diabetes population and identify disproportionate IP and ED visit rates within subpopulations.

- The rate of IP where diabetes was listed as any diagnosis was 337.7 per 1,000 adult PWD in 2007, peaked to 418.2 in 2009, and decreased to 349.9 by 2012 (Fig. 6).
- The ED visit rate where diabetes was listed as any diagnosis climbed from 81.6 per 100 PWD in 2007 to 124.4 in 2010 and remained high at 117.2 in 2012 (Fig. 6).

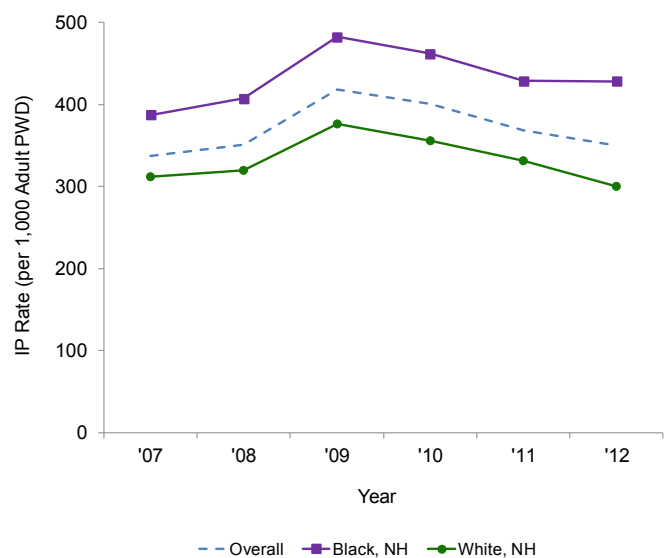
Figure 6. Diabetes-Related Inpatient Hospitalization (IP) and Emergency Department (ED) Visit Rates, PWD (18-64 yrs), Michigan, Medicaid, 2007-2012



PWD—Persons with Diabetes

- The frequency of diabetes-related hospitalization was higher among non-Hispanic Black adults with diabetes compared to non-Hispanic White adults with diabetes from 2007 to 2012 (Fig. 7).
- The relative difference in IP rate between non-Hispanic Black and White PWD increased from approximately 24% in 2007 to 42% in 2012 (Fig. 7).

Figure 7. Diabetes-Related Inpatient Hospitalization (IP) Rate by Race, PWD (18-64 yrs), Michigan, Medicaid, 2007-2012*

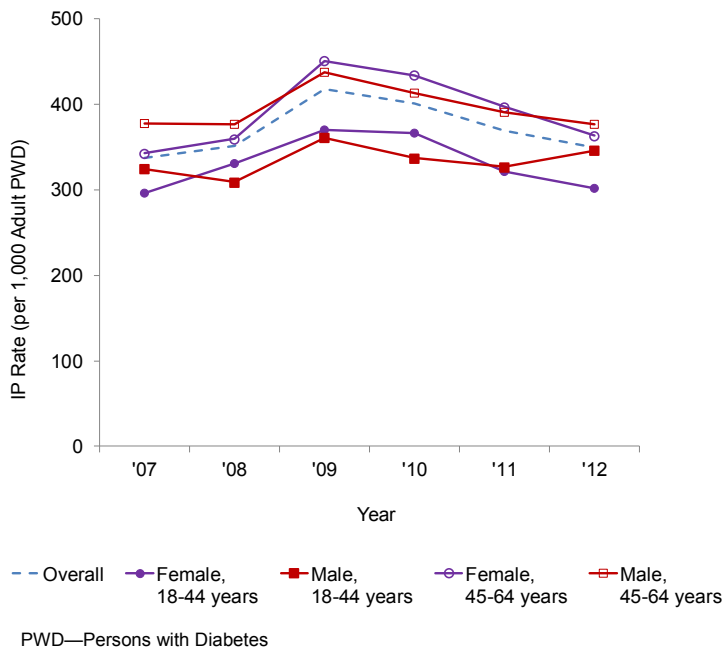


PWD—Persons with Diabetes; NH—non-Hispanic

*Statistically significant difference in rate for White, NH compared to Black, NH, $\alpha=0.05$

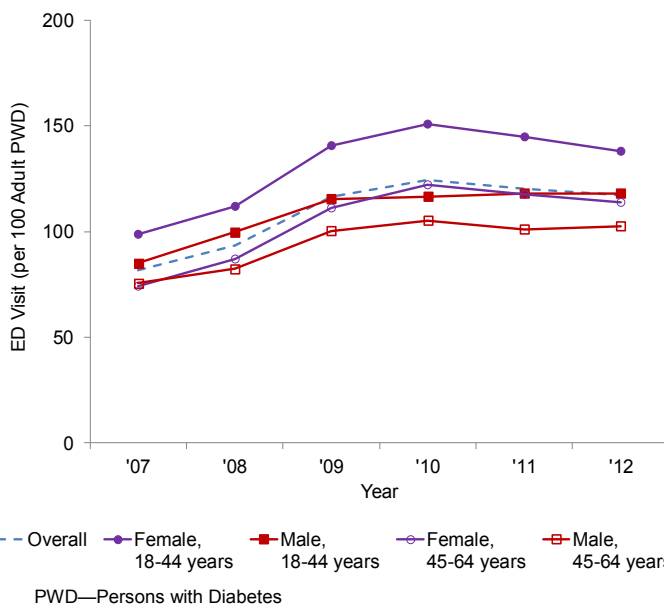
- In 2012, the rate of diabetes-related IP was higher among PWD 45-64 years compared to PWD 18-44 years (368.6 per 1,000 PWD versus 315.3 per 1,000 PWD).
- However, the ED visit rate in 2012 was higher among the younger age group than the older age group (131.7 per 100 PWD 109.3 versus per 100 PWD).
- Diabetes-related IP rates were comparable among female and male beneficiaries with diabetes 18-64 years for 2008-2011 (See Appendix D). The rate in 2012 was slightly higher for male PWD compared to the rate among female PWD (367.5 per 1,000 male PWD versus 339.3 per 1,000 female PWD).
- Different age groups were examined by gender. IP was higher among the older age group PWD 45-64 years than younger age group PWD 18-44 years, but predominately comparable between males and females in the same age group (Fig. 8).

Figure 8. Diabetes-Related Inpatient Hospitalization (IP) Rate by Gender and Age, PWD (18-64 yrs), Michigan, Medicaid, 2007-2012



- However, the rate of female beneficiaries with diabetes 18-64 years visiting the ED was higher for diabetes-related events than male beneficiaries 18-64 years (123.2 per 100 adult PWD versus 107.2 per 100 adult PWD in 2012).
- This was especially the case for women of reproductive age (18-44 years), who visited the ED at a rate of 137.9 per 100 adult PWD in 2012, which was about 17% higher than males 18-44 years and about 21% higher than older females 45-64 years (Fig. 9).

Figure 9. Diabetes-Related Emergency Department (ED) Visit Rate by Gender and Age, PWD (18-64 yrs), Michigan, Medicaid, 2007-2012



- Adult beneficiaries with diabetes residing in urban areas consistently had higher rates of diabetes-related IP and ED visits compared to those residing in rural areas (Appendices D and E). For example, the diabetes-related IP rate in 2012 was 362.0 per 1,000 PWD for urban and 283.3 per 1,000 PWD for rural. The rate of ED visits in 2012 was 119.9 per 100 PWD for those living in an urban area compared to 103.1 for those living in a rural area.

5) What was the number of annual diabetes-related ED visits by adult Medicaid beneficiaries with diabetes? Does it vary by characteristic?

Underutilization of preventive care services, poor adherence to diabetes management, and severity of the disease may influence the number of diabetes-related ED visits by adult beneficiaries with diabetes annually.¹²

Table 4. Diabetes-Related Emergency Department (ED) Visits by Characteristic, PWD (18-64 yrs), Michigan, Medicaid, 2012

Characteristic	2012							
	0 Visits		1 Visit		2-4 Visits		5+ Visits	
	Prevalence	Adult PWD	Prevalence	Adult PWD	Prevalence	Adult PWD	Prevalence	Adult PWD
<i>Overall</i>	53.8%	20,746	24.0%	9,234	16.6%	6,384	5.7%	2,185
<i>Gender</i>								
Female	51.8%*	12,483	24.4%*	5,889	17.6%*	4,246	6.1%*	1,470
Male (ref.)	57.1%	8,263	23.1%	3,345	14.8%	2,138	4.9%	715
<i>Race/Ethnicity</i>								
White, NH (ref.)	58.1%	11,343	22.2%	4,332	14.8%	2,882	5.0%	973
Black, NH	47.5%*	7,057	26.5%*	3,939	19.2%*	2,847	6.9%*	1,021
Hispanic	53.9%*	884	24.1%	962	17.2%	996	4.8%	1,135
AI/AN, NH	50.7%*	139	27.7%	76	15.7%	43	5.8%	16
Asian/PI, NH	72.4%*	569	18.8%*	148	7.3%*	57	1.5%*	12
<i>Age Group (years)</i>								
18-24	48.7%*	891	26.3%*	482	18.5%*	339	6.4%*	118
25-34	49.2%*	2,024	26.3%*	1,083	17.5%	720	6.9%*	284
35-44	51.9%*	3,948	24.9%*	1,893	16.6%	1,259	6.6%*	504
45-54	53.5%*	6,287	23.9%*	2,808	16.8%	1,969	5.8%*	677
55-64 (ref.)	57.3%	7,596	22.4%	2,968	15.8%	2,097	4.5%	602
<i>Geography</i>								
Urban (ref.)	53.3%	17,277	24.1%	7,820	16.8%	5,448	5.8%	1,874
Rural	56.6%*	3,405	23.1%	1,392	15.3%*	922	5.0%	302

PWD—Persons with Diabetes who had the specified number of diabetes-related ED visits; NH – non-Hispanic; AI/AN – American Indian/Alaska Native; As/PI – Asian/Pacific Islander

*Statistically significant difference in prevalence compared to reference group (ref.), $\alpha=0.05$

From Table 4:

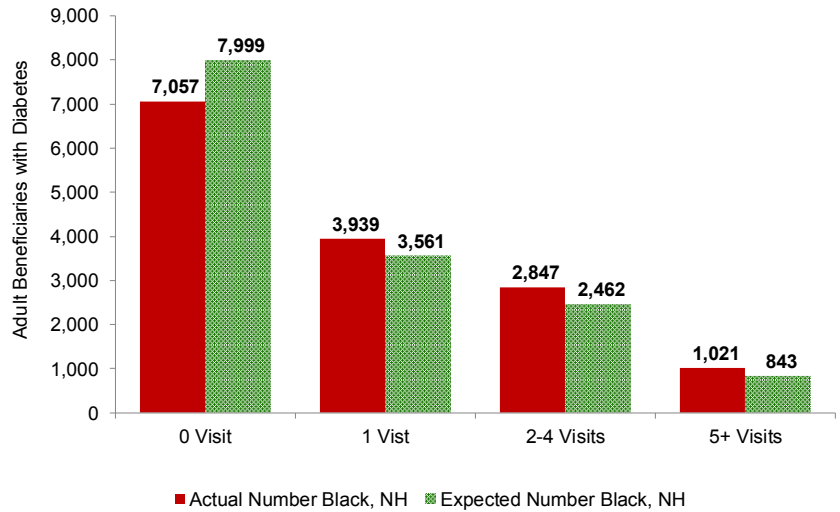
- Over 50% of adult Medicaid beneficiaries with diabetes did not visit the ED for their diabetes in 2012.
- 2,185 PWD had five or more diabetes-related ED visits in 2012.
- A higher percentage of adult females with diabetes had at least one diabetes-related ED discharge during 2012 compared to adult males with diabetes.
- The percentage of non-Hispanic white adult PWD with no diabetes-related ED admissions during the year was 22% higher than the percentage of non-Hispanic Black adult PWD.
- Non-Hispanic Asian/Pacific Islanders with diabetes had the highest prevalence of no diabetes-related ED discharges (72.4%). The prevalences of those with two or more ED visits were significantly lower than non-Hispanic White adults with diabetes.
- A significantly higher percentage of 54-64 year olds with diabetes had no ED visits for their diabetes during 2012 compared to that of 18-24 year olds with diabetes (57.3% versus 48.7%). The percentage of PWD 18-24 year olds with five or more ED visits was 42% higher than the percentage of PWD 54-64 year olds (6.4% versus 4.5%).

6) Was there a difference between the observed and expected number of adult Medicaid beneficiaries who visited the ED for their diabetes?

Comparing the expected number and actual number of adult beneficiaries with diabetes that utilized specific health care services can assist in identifying disparities.

- If ED utilization was the same between non-Hispanic Black and White adult beneficiaries with diabetes, 942 more Black adult PWD would not have visited the ED for their diabetes in 2012 (Fig. 10).
- If ED utilization for diabetes-related events was the same for non-Hispanic Black and White adult beneficiaries with diabetes, 178 fewer Black adult PWD would have had five or more diabetes-related ED visits in 2012 (Fig. 10).

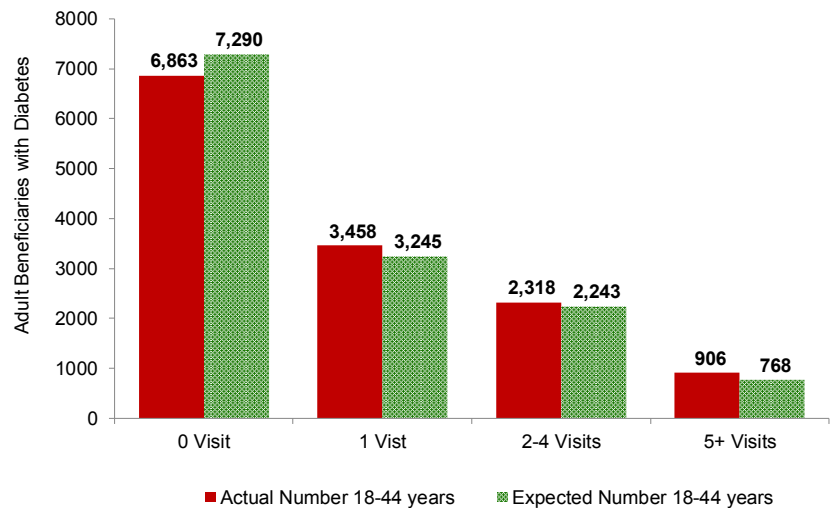
Figure 10. Diabetes-Related Emergency Department (ED) Visits, Black, NH Adult PWD (18-64 yrs), Michigan, Medicaid, 2012



PWD—Persons with Diabetes; NH – non-Hispanic

- If the diabetes-related ED experience was the same regardless of age, 138 more adult beneficiaries with diabetes 18-44 years of age would have had less than five diabetes-related ED visits in 2012 (Fig. 11).

Figure 11. Diabetes-Related Emergency Department (ED) Visits, Adult PWD 18-44 yrs, Michigan, Medicaid, 2012



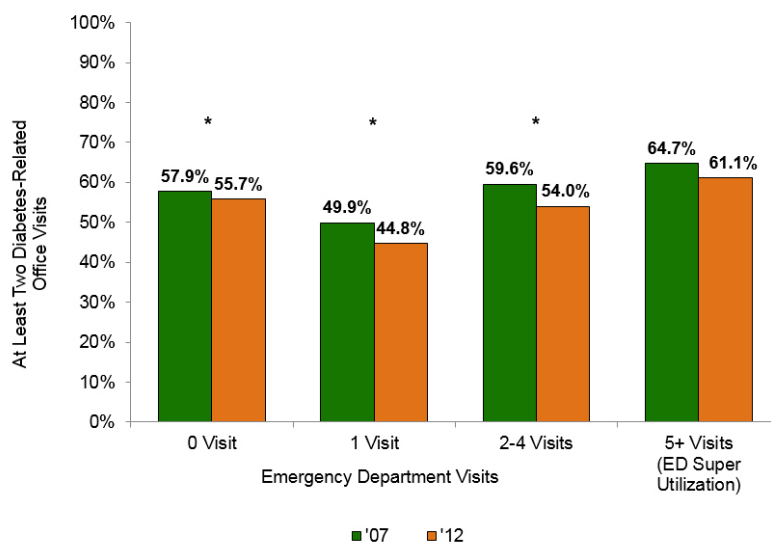
PWD—Persons with Diabetes

7) Does preventive care utilization differ among adult beneficiaries who were ED super utilizers for their diabetes compared to beneficiaries with fewer diabetes-related ED visits?

Frequent users of the ED (ED super utilizers) account for a high number of ED visits with a disproportionate high health care cost.¹³ Understanding health care utilization of super utilizers (defined here as five or more diabetes-related ED admissions) compared to those with fewer than five admissions may provide information for developing customized strategies for prevention. Some reasons for frequent diabetes-related ED visits include complications due to disease progression, not being diagnosed, and ED visits being substituted for outpatient care.^{12,13}

- When comparing 2007 and 2012, there was no improvement in the percentage of adult beneficiaries who had at least two diabetes-related office visits regardless of the number of diabetes-related ED visits.
- ED super utilizers with diabetes had the highest prevalence of visiting the doctor for their diabetes in both 2007 and 2012 (64.7% and 61.1%, respectively) (Fig. 12).
- For those with less than five or no ED visits, the percentage within an ED group who had at least two office visits was higher in 2007 than those within the same category in 2012.

Figure 12. Had Two or More Diabetes-Related Office Visits by Number of Diabetes-Related Emergency Department (ED) Visits, PWD (18-64 yrs), Michigan, Medicaid, 2007 and 2012*

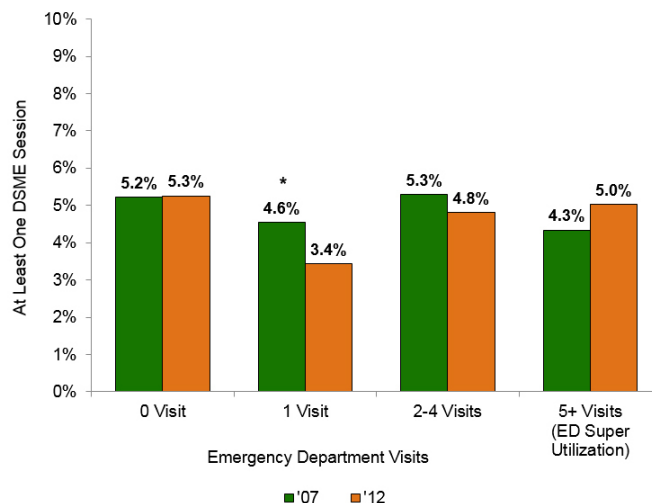


PWD—Persons with Diabetes

*Statistically significant difference in prevalence between two years for that category, $\alpha=0.05$

- Between 2007 and 2012, there was no improvement in the percentage of adult PWD who attended at least one half-hour DSME/T session regardless of number of ED visits (Fig. 13).
- Comparing 2007 and 2012, the percentage of adult PWD who had one ED admission and attended at least one half-hour DSME/T session decrease 26% (4.6% and 3.4%, respectively) (Fig. 13).

Figure 13. Attended at Least One 30-Minute DSME/T Session by Number of Diabetes-Related Emergency Department (ED) Visits, PWD (18-64 yrs), Michigan, Medicaid, 2007 and 2012*



DSME/T—Diabetes Self-Management Education and Training; PWD—Persons with Diabetes

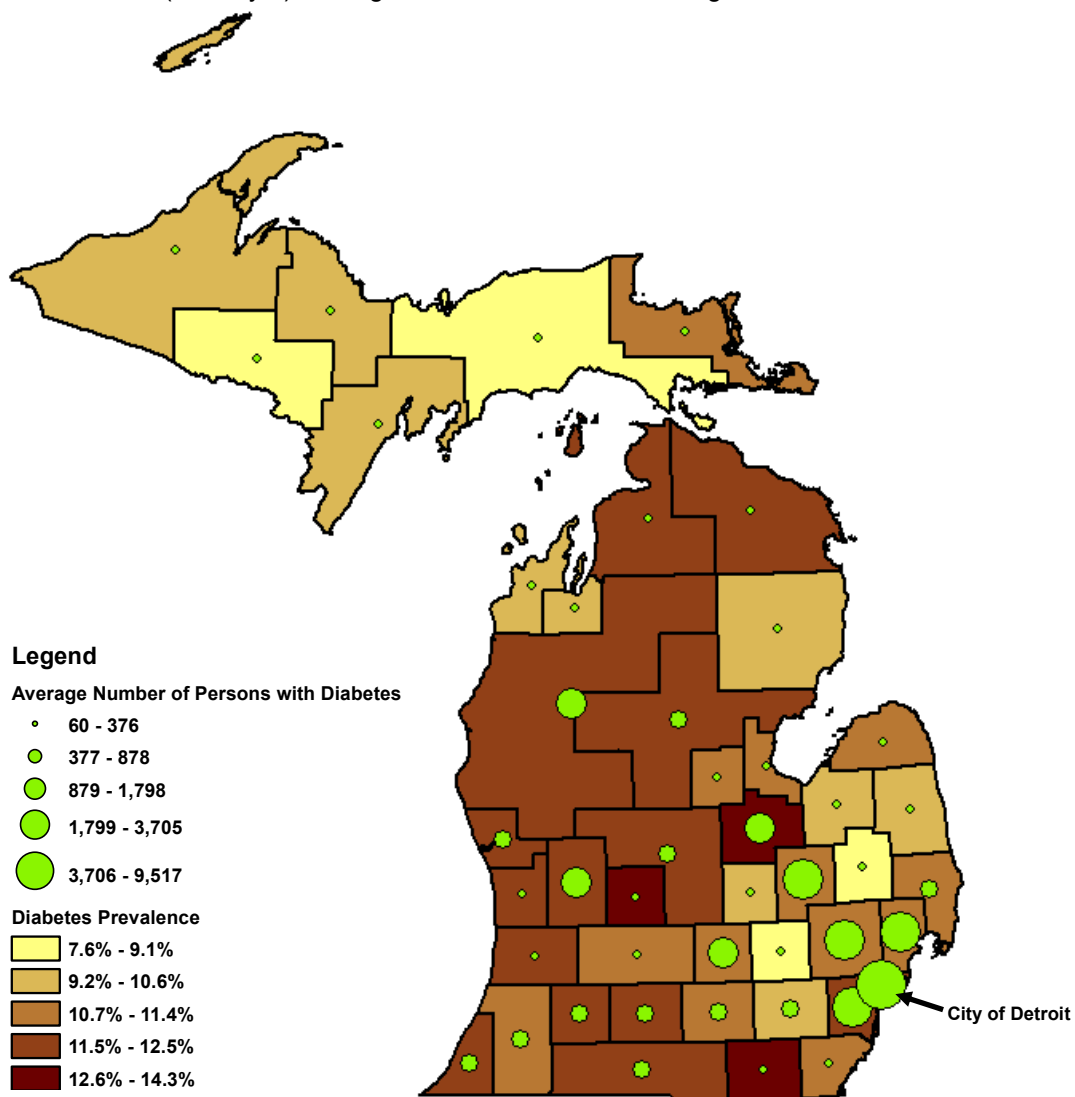
*Statistically significant difference in prevalence between two years for that category, $\alpha=0.05$

8) Does diabetes prevalence differ by local health department (LHD)?

LHDs plan and implement local interventions to improve the health of the communities that they serve. Health care utilization among Michigan Medicaid beneficiaries with diabetes may provide LHDs data to assist in monitoring utilization of health care services.

- Some of the LHD jurisdictions had sparse populations especially those in the Upper Peninsula (UP) causing the one-year diabetes prevalence to be less stable compared to more populated LHD jurisdictions. Three calendar years of data (2010-2012) were averaged to improve stability.
- The diabetes prevalences were also age-adjusted to account for the percentages of older adults being higher in the Northern region than the Southern region of Michigan.
- The age-adjusted diabetes prevalence among Michigan Medicaid beneficiaries was 11.5%.
- LHDs for Lenawee, Saginaw, and Ionia had the diabetes prevalences between 12.6% and 14.3%. LHDs for Livingston, Iron-Dickinson, LMAS, and Lapeer had prevalences between 7.6% and 9.1% (Fig. 14, see Appendix L).
- Eight LHD jurisdictions, which were mostly clustered in the Southeast, had on average more than 1,000 adult beneficiaries with diabetes, and three LHD jurisdictions (two in the UP) had less than 100 (Fig. 14, see Appendix L).

Figure 14. Age-Adjusted Diabetes Prevalence by Local Health Department, Adults (18-64 yrs), Michigan, Medicaid, 3-Year Average, 2010-2012 Combined



Natural breaks method was used to set ranges for number of adults with diabetes and diabetes prevalence. Average number of persons with diabetes was average number of adult persons with diabetes annually.

Future Steps

MDHHS DPCP and the Chronic Disease Epidemiology Section plan to expand indicators about preventive care practices, IP, and ED visit utilization for adult Medicaid beneficiaries. These additional indicators include dental office visits, visits to the podiatrist, HbA1C testing, ED reliance, hospital readmission, and medication use and adherence. Surveillance of these additional indicators will help in evaluating diabetes-related interventions and assist in future state and local program planning.

To learn more about Michigan adults with diabetes insured by Medicaid, visit www.michigan.gov/diabetes.

Methods

Medicaid adult beneficiary, diabetes case, and other diabetes-related surveillance indicators (excluding DSME/T) were defined based on adaptations of the 2012 HEDIS® criteria for each calendar year (2007-2012).¹⁴

Medicaid beneficiaries were 18-64 years, had full medical and prescription coverage, no other insurance, and enrolled continuously for at least 11 months during the calendar year. A diabetes case was based on the definition in the Comprehensive Diabetes Care section of 2012 HEDIS® where there was evidence of 1) paid claims/encounters for IP, ED, outpatient, or non-acute services with an ICD-9-CM diagnosis code for diabetes (250.xx, 357.2, 362.0, 366.41, and 648.0) and the appropriate Current Procedural Terminology (CPT) and Revenue codes or 2) paid pharmacy claim for antidiabetic medications listed in 2012 HEDIS®. Because of these restrictions, services provided but not billed or paid by Medicaid are not represented by these data, and these results cannot be generalized to adults with other insurance, discontinuously enrolled, or without insurance.

Office visits, IP, and ED indicators were based on paid utilization for diabetes-related service for the calendar year. ICD-9-CM diagnosis codes for diabetes (250.xx, 357.2, 362.0, 366.41, and 648.0) had to be listed with claim or encounter as well as the appropriate CPT and Revenue codes. The DSME/T indicator was based on anyone in the defined Medicaid population who had a claim with the billing codes G0108 or G0109 and a diagnosis of diabetes for the calendar year.

Cochran-Armitage statistical test was used to determine evidence of a linear trend with time (year) for the following indicators: diabetes prevalence, had least one DSME/T session annually, had two or more diabetes-related office visits annually, and had at least five or more diabetes-related ED visits annually.¹⁵

Disparity in diabetes prevalence and diabetes-related indicators were based relative difference between the two estimates. The binomial assumption was used to determine standard error about the mean and 95% confidence interval ($\alpha=0.05$) for prevalence and Poisson for diabetes-related IP and ED visit rates.¹⁵ If the confidence intervals did not overlap between two statistics, then the two statistics were significantly different.

Racial/ethnic groups were defined by five race categories and Hispanic. Urban and rural designation was based on whether a zip code was located inside or outside a Michigan Metropolitan Statistical Area (MSA). If the zip code was located in a MSA, the beneficiary resided in an urban area. If the zip code was outside MSA, the beneficiary resided in a rural area (<https://www.census.gov/population/metro/data/other.html>).

Expected counts for diabetes-related ED visits were estimated using the indirect standardization method.¹⁶ Using the indirect method, the expected number of non-Hispanic Black adult PWD who had ED visits for their diabetes was calculated by multiplying the number of non-Hispanic Black adult PWD in Medicaid times the prevalence of diabetes-related ED utilization among the overall adult diabetes population in Medicaid. Using the indirect method, the expected number of adult beneficiaries 18-44 years of age who had ED visits for their diabetes was calculated by multiplying the number of PWD 18-44 years in Medicaid times the prevalence of diabetes-related ED utilization among the overall adult diabetes population in Medicaid.

Diabetes prevalences for LHDs were 3-year averages of 2007-2009 and 2010-2012 data. The prevalences were adjusted to the 2000 U.S. Standard Population using four age groups (18-24, 25-34, 35-44, and 45-64 years).¹⁷ The average number of adult PWD in a LHD jurisdiction was the average for the three years.

Natural breaks method was used to set ranges for average number of persons with diabetes and diabetes prevalence for LHD map.

Appendices

Appendix A. Diabetes Prevalence by Characteristic, Adults (18-64 yrs), Michigan, Medicaid, 2007-2012

Characteristic	2007		2008		2009		2010		2011		2012	
	Prevalence	Adult PWD	Prevalence	Adult PWD	Prevalence	Adult PWD	Prevalence	Adult PWD	Prevalence	Adult PWD	Prevalence	Adult PWD
Overall	9.1%	29,386	9.0%	31,708	9.2%	32,218	9.0%	35,816	9.2%	38,944	9.6%	38,549
Gender												
Female	9.1%	19,498	9.1%	20,599	9.2%	21,075	9.1%	22,844	9.2%	24,345	9.4%*	24,088
Male (ref.)	9.1%	9,888	8.9%	11,109	9.2%	11,143	9.0%	12,972	9.2%	14,599	9.9%	14,461
Race/Ethnicity												
White, NH (ref.)	9.2%	15,640	9.0%	16,805	9.0%	16,781	8.7%	18,415	8.8%	19,898	9.0%	19,530
Black, NH	8.7%*	11,512	8.6%*	12,448	9.1%	12,849	9.1%*	14,133	9.3%*	15,127	9.8%*	14,864
Hispanic	9.9%	884	9.7%	962	9.5%	996	9.4%*	1,135	9.7%*	1,236	9.7%*	1,223
AI/AN, NH	12.1%*	224	11.9%*	243	13.1%*	276	12.7%*	301	12.2%*	310	11.6%*	274
Asian/PI, NH	14.5%*	565	14.2%*	568	13.7%*	550	13.7%*	684	14.0%*	786	14.0%*	786
Age Group (years)												
18-24	1.6%*	1,426	1.7%*	1,588	1.6%*	1,677	1.5%*	1,853	1.6%*	1,879	1.7%*	1,830
25-34	3.9%*	3,009	3.9%*	3,347	4.1%*	3,478	4.1%*	4,018	4.1%*	4,290	4.0%*	4,111
35-44	9.1%*	5,749	9.0%*	6,205	9.7%*	6,252	9.8%*	7,134	9.8%*	7,792	9.9%*	7,604
45-54	16.4%*	9,465	16.0%*	10,283	17.5%*	10,160	17.3%*	11,152	17.0%*	12,119	17.9%*	11,741
55-64 (ref.)	27.2%	9,737	26.6%	10,285	28.3%	10,651	27.6%	11,659	26.8%	12,864	27.4%	13,263
Age Group (years)												
18-44	4.5%*	10,184	4.5%*	11,140	4.5%*	11,407	4.5%*	13,005	4.6%*	13,961	4.7%*	13,545
45-64 (ref.)	20.5%	19,202	20.0%	20,568	21.7%	20,811	21.4%	22,811	20.9%	24,983	21.9%	25,004
Geography												
Urban (ref.)	9.2%	24,372	9.1%	26,434	9.2%	26,911	9.1%	29,990	9.3%	32,741	9.7%	32,419
Rural	9.1%	4,794	8.8%	5,104	8.8%	5,184	8.9%	5,707	9.0%	6,093	9.3%*	6,021

PWD—Persons with Diabetes; NH – non-Hispanic; AI/AN – American Indian/Alaska Native; Asian/PI – Asian/Pacific Islander

*Statistically significant difference in prevalence compared to reference group (ref.), $\alpha=0.05$

Appendix B. Attended At Least One 30-minute Diabetes Self-Management Education (DSME/T) Session by Characteristic, PWD (18-64 yrs), Michigan, Medicaid, 2007-2012

Characteristic	2007		2008		2009		2010		2011		2012	
	Prevalence	Adult PWD	Prevalence	Adult PWD	Prevalence	Adult PWD	Prevalence	Adult PWD	Prevalence	Adult PWD	Prevalence	Adult PWD
Overall	5.1%	1,487	4.8%	1,518	5.1%	1,635	5.1%	1,827	5.1%	1,983	4.7%	1,826
Gender												
Female	6.0%*	1,161	5.5%*	1,140	6.0%*	1,275	6.0%*	1,368	6.2%*	1,500	5.5%*	1,329
Male (ref.)	3.3%	326	3.4%	378	3.2%	378	3.5%	360	3.3%	483	3.4%	497
Race/Ethnicity												
White, NH (ref.)	6.0%	937	5.8%	968	6.3%	1,060	6.3%	1,167	6.3%	1,253	5.7%	1,117
Black, NH	3.9%*	451	3.6%*	450	3.6%*	463	3.6%*	504	3.6%*	547	3.5%*	525
Hispanic	5.9%	52	4.9%	47	6.5%	65	6.3%	71	6.6%	82	6.2%	76
AI/AN, NH	4.9%	11	5.8%	14	6.5%	18	7.0%	21	6.8%	21	3.3%	9
Asian/PI, NH	2.8%*	16	1.6%*	9	2.4%*	13	2.3%*	16	1.5%*	12	2.4%*	19
Age Group (years)												
18-24	11.9%*	169	10.1%*	160	12.7%*	213	11.0%*	204	10.3%*	194	11.3%*	207
25-34	11.1%*	335	10.2%*	343	11.4%*	395	9.7%*	390	10.7%*	460	9.3%*	383
35-44	5.3%*	307	5.8%*	361	5.9%*	367	6.0%*	427	5.5%*	427	5.7%*	434
45-54	3.8%	356	3.5%	358	3.4%	348	4.0%*	450	4.2%*	513	3.7%*	434
55-64 (ref.)	3.3%	320	2.9%	296	2.9%	312	3.1%	356	3.0%	389	2.8%	368
Age Group (years)												
18-44	8.0%*	811	7.8%*	864	8.5%*	975	7.9%*	1,021	7.7%*	1,081	7.6%*	1,024
45-64 (ref.)	3.5%	676	3.2%	654	3.2%	660	3.5%	806	3.6%	902	3.2%	802
Geography												
Urban (ref.)	4.6%	1,123	4.0%	1,058	4.3%	1,159	4.3%	1,285	4.3%	1,417	4.0%	1,287
Rural	7.3%*	348	8.8%*	449	9.1%*	471	9.5%*	540	9.2%*	562	8.9%*	535

PWD—Persons with diabetes who attended at least one DSME/T session; NH – non-Hispanic; AI/AN – American Indian/Alaska Native; Asian/PI – Asian/Pacific Islander
 *Statistically significant difference in prevalence compared to reference group (ref.), $\alpha=0.05$

Appendix C. Had At Least Two Diabetes-Related Office Visits by Characteristic, PWD (18-64 yrs), Michigan, Medicaid, 2007-2012

Characteristic	2007		2008		2009		2010		2011		2012	
	Prevalence	Adult PWD	Prevalence	Adult PWD	Prevalence	Adult PWD	Prevalence	Adult PWD	Prevalence	Adult PWD	Prevalence	Adult PWD
Overall	56.7%	16,662	55.1%	17,480	53.2%	17,145	52.0%	18,628	51.2%	19,956	53.1%	20,486
Gender												
Female	56.4%	11,000	54.6%*	11,240	52.6%*	11,084	51.0%*	11,640	50.4%*	12,265	51.8%*	12,488
Male (ref.)	57.3%	5,662	56.2%	6,240	54.4%	6,240	53.9%	6,061	52.7%	7,691	55.3%	7,998
Race/Ethnicity												
White, NH (ref.)	59.1%	9,238	57.5%	9,663	56.0%	9,395	55.2%	10,164	53.5%	10,655	55.0%	10,749
Black, NH	53.2%*	6,119	51.2%*	6,375	48.6%*	6,244	47.2%*	6,669	47.7%*	7,213	49.8%*	7,396
Hispanic	63.2%*	559	61.9%*	595	62.8%*	625	58.7%	666	55.7%	688	61.8%*	756
AI/AN, NH	58.5%	131	56.8%	138	54.3%	150	54.2%	163	53.9%	167	52.9%	145
Asian/PI, NH	58.8%	332	55.6%	316	58.2%	320	54.1%	370	52.9%	416	58.8%	462
Age Group (years)												
18-24	45.0%*	642	45.9%*	729	44.2%*	742	46.7%*	866	45.1%*	847	44.8%*	819
25-34	50.5%*	1,521	49.9%*	1,671	47.0%*	1,636	44.9%*	1,803	44.9%*	1,926	46.2%*	1,901
35-44	56.7%	3,259	55.1%	3,418	53.9%	3,368	52.4%	3,739	50.4%*	3,930	52.4%*	3,983
45-54	58.5%	5,541	57.2%	5,884	55.2%	5,605	53.6%	5,979	52.8%	6,397	55.7%	6,541
55-64 (ref.)	58.5%	5,699	56.2%	5,778	54.4%	5,794	53.5%	6,241	53.3%	6,856	54.6%	7,242
Age Group (years)												
18-44	53.2%*	5,422	52.2%*	5,818	50.4%*	5,746	49.3%	6,408	48.0%*	6,703	49.5%*	6,703
45-64 (ref.)	58.5%	11,240	56.7%	11,662	54.8%	11,399	53.6%	12,220	53.0%	13,253	55.1%	13,783
Geography												
Urban (ref.)	56.1%	13,672	54.5%	14,416	52.4%	14,100	50.6%	15,172	50.3%	16,466	52.7%	17,079
Rural	59.9%*	2,873	58.4%*	2,980	58.0%*	3,006	59.7%*	3,406	56.6%*	3,448	56.0%*	3,373

PWD—Persons with diabetes who had at least two diabetes-related office visits; NH – non-Hispanic; AI/AN – American Indian/Alaska Native; Asian/PI – Asian/Pacific Islander

*Statistically significant difference in prevalence compared to reference group (ref.), $\alpha=0.05$

Appendix D. Diabetes-Related Inpatient Hospitalization (IP) Rate by Characteristic, PWD (18-64 yrs), Michigan, Medicaid, 2007-2012*

Characteristic	2007	2008	2009	2010	2011	2012
Overall	337.7	351.3	418.2	401.0	368.8	349.9
Gender						
Female	325.5*	348.8	420.2	407.5	367.3	339.3*
Male (ref.)	361.8	356.0	414.4	389.5	371.2	367.5
Race/Ethnicity						
White, NH (ref.)	312.3	319.8	376.6	356.0	331.3	300.6
Black, NH	387.3*	407.2*	482.5*	462.3*	429.0*	428.3*
Hispanic	252.3*	262.0*	300.2*	320.7*	318.8	224.0*
AI/AN, NH	290.2	370.4	413.0	458.5	435.5	332.1
Asian/PI, NH	207.1*	214.8*	254.6*	228.1*	174.3*	151.4*
Age Group (years)						
18-24	383.6*	401.8	428.7	435.0	406.1	409.8
25-34	314.4*	325.1*	361.4*	352.4*	300.0*	302.6*
35-44	279.7*	303.5*	354.6*	339.5*	315.6*	299.3*
45-54	349.5	349.2*	424.4*	394.1*	365.7*	335.0*
55-64 (ref.)	360.9	383.0	466.4	456.6	421.4	398.4
Age Group (years)						
18-44	304.5*	324.0*	367.6*	357.1*	323.0*	315.3*
45-64 (ref.)	355.3	366.1	445.9	426.0	394.4	368.6
Geography						
Urban (ref.)	349.8	364.3	437.7	417.8	387.1	362.0
Rural	280.1*	284.3*	317.9*	310.2*	270.3*	283.3*

†per 1,000 Adult PWD

PWD—Persons with Diabetes; NH – non-Hispanic; AI/AN – American Indian/Alaska Native;

Asian/PI – Asian/Pacific Islander

*Statistically significant difference in rate compared to reference group (ref.), $\alpha=0.05$

Appendix E: Diabetes-Related Emergency Department (ED) Visit Rate by Characteristic, PWD (18-64 yrs), Michigan, Medicaid, 2007-2012[†]

Characteristic	2007	2008	2009	2010	2011	2012
<i>Overall</i>	81.7	93.5	116.4	124.4	120.1	117.2
<i>Gender</i>						
Female	83.2*	96.5*	122.5*	133.3*	128.3*	123.2*
Male (ref.)	78.6	87.8	104.9	108.8	106.4	107.2
<i>Race/Ethnicity</i>						
White, NH (ref.)	73.8	82.7	103.4	111.8	107.8	103.7
Black, NH	95.4*	110.1*	137.4*	143.9*	139.8*	138.9*
Hispanic	69.2	87.2	102.9	112.8	124.6*	108.6
AI/AN, NH	81.7	112.8*	108.0	138.5*	121.3	117.5
Asian/PI, NH	39.5*	50.9*	58.4*	58.9*	57.6*	47.2*
<i>Age Group (years)</i>						
18-24	101.7*	111.0*	126.2*	135.6*	132.5*	135.5*
25-34	96.5*	113.7*	135.3*	144.7*	143.9*	136.4*
35-44	91.9*	104.8*	133.9*	138.6*	133.1*	128.3*
45-54	82.0*	93.1*	117.0*	124.6*	119.9*	118.1*
55-64 (ref.)	67.7	77.7	97.8	106.7	102.7	101.6
<i>Age Group (years)</i>						
18-44	94.6*	108.4*	133.2*	140.0*	136.3*	131.7*
45-64 (ref.)	74.8	85.4	107.2	115.5	111.0	109.3
<i>Geography</i>						
Urban (ref.)	84.1	96.3	121.1	127.6	124.2	119.9
Rural	70.1*	79.4*	93.1*	107.6*	98.3*	103.1*

[†]per 100 Adult PWD

PWD—Persons with Diabetes; NH – non-Hispanic; AI/AN – American Indian/Alaska Native;

Asian/PI – Asian/Pacific Islander

*Statistically significant difference in rate compared to reference group (ref.), $\alpha=0.05$

Appendix F. Diabetes-Related Emergency Department (ED) Visits by Characteristic, PWD (18-64 yrs), Michigan, Medicaid, 2007

Characteristic	2007							
	0 Visits		1 Visit		2-4 Visits		5+ Visits	
	Prevalence	Adult PWD	Prevalence	Adult PWD	Prevalence	Adult PWD	Prevalence	Adult PWD
<i>Overall</i>	63.4%	18,634	20.5%	6,021	12.5%	3,671	3.6%	1,060
<i>Gender</i>								
Female	62.4%*	12,163	21.1%*	4,107	13.0%*	2,530	3.6%	698
Male (ref.)	65.4%	6,471	19.4%	1,914	11.5%	1,141	3.7%	362
<i>Race/Ethnicity</i>								
White, NH (ref.)	66.1%	10,334	19.3%	3,021	11.4%	1,777	3.2%	508
Black, NH	58.7%*	6,763	22.4%*	2,580	14.6%*	1,682	4.2%*	487
Hispanic	64.7%	572	21.5%	190	11.1%	98	2.7%	24
AI/AN, NH	61.6%	138	22.3%	50	11.6%	26	4.5%	10
Asian/PI, NH	78.9%*	446	14.0%*	79	5.3%*	30	1.8%*	10
<i>Age Group (years)</i>								
18-24	56.5%*	806	24.7%*	352	14.3%*	204	4.5%*	64
25-34	58.7%*	1,767	22.5%*	677	14.2%*	428	4.6%*	137
35-44	61.4%*	3,532	21.1%*	1,211	13.0%*	746	4.5%*	260
45-54	63.4%*	6,000	20.5%	1,939	12.6%*	1,193	3.5%*	333
55-64 (ref.)	67.1%	6,529	18.9%	1,842	11.3%	1,100	2.7%	266
<i>Age Group (years)</i>								
18-44	59.9%*	6,105	22.0%*	2,240	13.5%*	1,378	4.5%*	461
45-64 (ref.)	65.2%	12,529	19.7%	3,781	11.9%	2,293	3.1%	599
<i>Geography</i>								
Urban (ref.)	62.8%	15,306	20.8%	5,063	12.7%	3,092	3.7%	911
Rural	66.3%*	3,177	19.3%	924	11.5%	550	3.0%*	143

PWD—Persons with Diabetes; NH – non-Hispanic; AI/AN – American Indian/Alaska Native; Asian/PI – Asian/Pacific Islander

*Statistically significant difference in prevalence compared to reference group (ref.), $\alpha=0.05$

Estimates may not sum to 100.0% due to rounding.

Appendix G. Diabetes-Related Emergency Department (ED) Visits by Characteristic, (18-64 yrs), Michigan, Medicaid, 2008

Characteristic	2008							
	0 Visits		1 Visit		2-4 Visits		5+ Visits	
	Prevalence	Adult PWD	Prevalence	Adult PWD	Prevalence	Adult PWD	Prevalence	Adult PWD
<i>Overall</i>	59.7%	18,939	22.0%	6,970	14.1%	4,475	4.2%	1,324
<i>Gender</i>								
Female	58.5%*	12,041	22.7%	4,675	14.7%*	3,026	4.2%	857
Male (ref.)	62.1%	6,898	20.7%	2,295	13.0%	1,449	4.2%	467
<i>Race/Ethnicity</i>								
White, NH (ref.)	63.6%	10,688	20.2%	3,401	12.5%	2,101	3.7%	615
Black, NH	53.5%*	6,656	24.8%*	3,082	16.7%*	2,084	5.0%*	626
Hispanic	60.8%	585	22.2%	214	12.8%	123	4.2%	40
AI/AN, NH	58.8%	143	21.4%	52	13.6%	33	6.2%	15
Asian/PI, NH	76.8%*	436	15.0%*	85	6.3%*	36	1.9%*	11
<i>Age Group (years)</i>								
18-24	54.2%*	861	25.6%*	407	14.9%	236	5.3%*	84
25-34	54.8%*	1,833	24.9%*	835	14.9%	498	5.4%*	181
35-44	57.1%*	3,544	23.3%*	1,447	14.8%	920	4.7%*	294
45-54	59.6%*	6,129	22.0%*	2,260	14.1%	1,445	4.4%*	449
55-64 (ref.)	63.9%	6,572	19.6%	2,021	13.4%	1,376	3.1%	316
<i>Age Group (years)</i>								
18-44	56.0%*	6,238	24.1%*	2,689	14.8%*	1,654	5.0%*	559
45-64 (ref.)	61.8%	12,701	20.8%	4,281	13.7%	2,821	3.7%	765
<i>Geography</i>								
Urban (ref.)	58.8%	15,549	22.4%	5,920	14.4%	3,817	4.3%	1,148
Rural	64.2%*	3,279	19.9%*	1,016	12.5%*	638	3.4%*	171

PWD—Persons with Diabetes; NH – non-Hispanic; AI/AN – American Indian/Alaska Native; Asian/PI – Asian/Pacific Islander

*Statistically significant difference in prevalence compared to reference group (ref.), $\alpha=0.05$

Estimates may not sum to 100.0% due to rounding.

Appendix H. Diabetes-Related Emergency Department (ED) Visits by Characteristic, PWD (18-64 yrs), Michigan, Medicaid, 2009

Characteristic	2009							
	0 Visits		1 Visit		2-4 Visits		5+ Visits	
	Prevalence	Adult PWD	Prevalence	Adult PWD	Prevalence	Adult PWD	Prevalence	Adult PWD
<i>Overall</i>	53.6%	17,280	23.9%	7,690	16.9%	5,439	5.6%	1,809
<i>Gender</i>								
Female	52.0%*	10,954	24.3%	5,118	17.8%*	3,758	5.9%*	1,245
Male (ref.)	56.8%	6,326	23.1%	2,572	15.1%	1,681	5.1%	564
<i>Race/Ethnicity</i>								
White, NH (ref.)	58.2%	9,761	21.8%	3,651	15.2%	2,547	4.9%	822
Black, NH	47.0%	6,033	26.8%	3,439	19.4%	2,498	6.8%	879
Hispanic	52.3%	521	27.2%	271	16.2%	161	4.3%	43
AI/AN, NH	51.1%	141	24.3%	67	19.6%	54	5.1%	14
Asian/PI, NH	72.5%	399	17.1%	94	8.2%	45	2.2%	12
<i>Age Group (years)</i>								
18-24	50.0%*	838	27.0%*	453	16.3%	274	6.7%*	112
25-34	48.8%*	1,699	26.4%*	917	17.6%	612	7.2%*	250
35-44	51.3%*	3,205	25.0%*	1,564	17.2%	1,073	6.6%*	410
45-54	53.9%*	5,479	23.3%	2,367	17.1%	1,734	5.7%*	580
55-64 (ref.)	56.9%	6,059	22.4%	2,389	16.4%	1,746	4.3%	457
<i>Age Group (years)</i>								
18-44	50.3%*	5,742	25.7%*	2,934	17.2%	1,959	6.8%*	772
45-64 (ref.)	55.4%	11,538	22.9%	4,756	16.7%	3,480	5.0%	1,037
<i>Geography</i>								
Urban (ref.)	52.5%	14,132	24.3%	6,534	17.3%	4,656	5.9%	1,589
Rural	59.3%*	3,075	21.8%*	1,129	14.7%*	762	4.2%*	218

PWD—Persons with Diabetes; NH – non-Hispanic; AI/AN – American Indian/Alaska Native; Asian/PI – Asian/Pacific Islander

*Statistically significant difference in prevalence compared to reference group (ref.), $\alpha=0.05$

Estimates may not sum to 100.0% due to rounding.

Appendix I. Diabetes-Related Emergency Department (ED) Visits by Characteristic, PWD (18-64 yrs), Michigan, Medicaid, 2010

Characteristic	2010							
	0 Visits		1 Visit		2-4 Visits		5+ Visits	
	Prevalence	Adult PWD	Prevalence	Adult PWD	Prevalence	Adult PWD	Prevalence	Adult PWD
<i>Overall</i>	52.3%	18,739	24.2%	8,677	17.3%	6,208	6.1%	2,192
<i>Gender</i>								
Female	50.3%*	11,499	24.7%*	5,652	18.3%*	4,189	6.6%*	1,504
Male (ref.)	55.8%	7,240	23.3%	3,025	15.6%	2,019	5.3%	688
<i>Race/Ethnicity</i>								
White, NH (ref.)	56.3%	10,373	22.8%	4,193	15.3%	2,823	5.6%	1,026
Black, NH	46.2%*	6,533	26.4%*	3,730	20.3%*	2,869	7.1%*	1,001
Hispanic	52.2%*	592	25.0%	284	18.1%	205	4.8%	54
AI/AN, NH	51.5%	155	22.6%	68	18.9%	57	7.0%	21
Asian/PI, NH	69.0%*	472	20.5%	140	8.6%*	59	1.9%*	13
<i>Age Group (years)</i>								
18-24	48.8%*	905	27.4%*	508	16.6%	307	7.2%*	133
25-34	47.4%*	1,903	26.4%*	1,060	19.4%*	780	6.8%*	275
35-44	50.0%*	3,570	24.9%*	1,775	18.2%*	1,299	6.9%*	490
45-54	52.4%*	5,842	24.2%*	2,700	17.2%	1,916	6.2%*	694
55-64 (ref.)	55.9%	6,519	22.6%	2,634	16.3%	1,906	5.1%	600
<i>Age Group (years)</i>								
18-44	49.0%*	6,378	25.7%*	3,343	18.3%*	2,386	6.9%*	898
45-64 (ref.)	54.2%	12,361	23.4%	5,334	16.8%	3,822	5.7%	1,294
<i>Geography</i>								
Urban (ref.)	51.4%	15,407	24.7%	7,412	17.7%	5,303	6.2%	1,868
Rural	57.2%*	3,265	21.7%*	1,241	15.5%*	884	5.6%	317

PWD—Persons with Diabetes; NH – non-Hispanic; AI/AN – American Indian/Alaska Native; Asian/PI – Asian/Pacific Islander

*Statistically significant difference in prevalence compared to reference group (ref.), $\alpha=0.05$

Estimates may not sum to 100.0% due to rounding.

Appendix J. Diabetes-Related Emergency Department (ED) Visits by Characteristic, PWD (18-64 yrs), Michigan, Medicaid, 2011

Characteristic	2011							
	0 Visits		1 Visit		2-4 Visits		5+ Visits	
	Prevalence	Adult PWD	Prevalence	Adult PWD	Prevalence	Adult PWD	Prevalence	Adult PWD
<i>Overall</i>	52.9%	20,583	24.1%	9,400	17.1%	6,665	5.9%	2,296
<i>Gender</i>								
Female	51.2%*	12,453	24.3%	5,922	18.2%*	4,425	6.3%*	1,545
Male (ref.)	55.7%	8,130	23.8%	3,478	15.3%	2,240	5.1%	751
<i>Race/Ethnicity</i>								
White, NH (ref.)	57.1%	11,360	22.3%	4,445	15.3%	3,044	5.3%	1,049
Black, NH	46.3%*	7,004	26.9%*	4,063	19.9%*	3,013	6.9%*	1,047
Hispanic	52.9%*	654	21.5%	266	19.8%*	245	5.7%	71
AI/AN, NH	53.9%	167	26.1%	81	13.5%	42	6.5%	20
Asian/PI, NH	69.2%*	544	21.0%	165	7.5%*	59	2.3%	18
<i>Age Group (years)</i>								
18-24	49.3%*	926	26.2%*	492	17.0%	320	7.5%*	141
25-34	48.4%*	2,076	25.1%	1,077	19.2%*	823	7.3%*	314
35-44	50.7%*	3,948	24.8%	1,932	18.1%*	1,411	6.4%*	501
45-54	53.2%*	6,442	23.9%	2,900	16.9%	2,044	6.0%*	733
55-64 (ref.)	55.9%	7,191	23.3%	2,999	16.1%	2,067	4.7%	607
<i>Age Group (years)</i>								
18-44	49.8%*	6,950	25.1%*	3,501	18.3%*	2,554	6.8%*	956
45-64 (ref.)	54.6%	13,633	23.6%	5,899	16.5%	4,111	5.4%	1,340
<i>Geography</i>								
Urban (ref.)	51.8%	16,949	24.6%	8,068	17.4%	5,706	6.2%	2,018
Rural	58.7%*	3,574	21.4%*	1,305	15.5%*	942	4.5%*	272

PWD—Persons with Diabetes; NH – non-Hispanic; AI/AN – American Indian/Alaska Native; Asian/PI – Asian/Pacific Islander

*Statistically significant difference in prevalence compared to reference group (ref.), $\alpha=0.05$

Estimates may not sum to 100.0% due to rounding.

Appendix K. Diabetes-Related Emergency Department (ED) Visits by Characteristic, PWD (18-64 yrs), Michigan, Medicaid, 2012

Characteristic	2012							
	0 Visits		1 Visit		2-4 Visits		5+ Visits	
	Prevalence	Adult PWD	Prevalence	Adult PWD	Prevalence	Adult PWD	Prevalence	Adult PWD
<i>Overall</i>	53.8%	20,746	24.0%	9,234	16.6%	6,384	5.7%	2,185
<i>Gender</i>								
Female	51.8%*	12,483	24.4%*	5,889	17.6%*	4,246	6.1%*	1,470
Male (ref.)	57.1%	8,263	23.1%	3,345	14.8%	2,138	4.9%	715
<i>Race/Ethnicity</i>								
White, NH (ref.)	58.1%	11,343	22.2%	4,332	14.8%	2,882	5.0%	973
Black, NH	47.5%*	7,057	26.5%*	3,939	19.2%*	2,847	6.9%*	1,021
Hispanic	53.9%*	884	24.1%	962	17.2%	996	4.8%	1,135
AI/AN, NH	50.7%*	139	27.7%	76	15.7%	43	5.8%	16
Asian/PI, NH	72.4%*	569	18.8%*	148	7.3%*	57	1.5%*	12
<i>Age Group (years)</i>								
18-24	48.7%*	891	26.3%*	482	18.5%*	339	6.4%*	118
25-34	49.2%*	2,024	26.3%*	1,083	17.5%	720	6.9%*	284
35-44	51.9%*	3,948	24.9%*	1,893	16.6%	1,259	6.6%*	504
45-54	53.5%*	6,287	23.9%*	2,808	16.8%	1,969	5.8%*	677
55-64 (ref.)	57.3%	7,596	22.4%	2,968	15.8%	2,097	4.5%	602
<i>Age Group (years)</i>								
18-44	50.7%*	6,863	25.5%*	3,458	17.1%*	2,318	6.7%*	906
45-64 (ref.)	55.5%	13,883	23.1%	5,776	16.3%	4,066	5.1%	1,279
<i>Geography</i>								
Urban (ref.)	53.3%	17,277	24.1%	7,820	16.8%	5,448	5.8%	1,874
Rural	56.6%*	3,405	23.1%	1,392	15.3%*	922	5.0%	302

PWD—Persons with Diabetes; NH – non-Hispanic; AI/AN – American Indian/Alaska Native; Asian/PI – Asian/Pacific Islander

*Statistically significant difference in prevalence compared to reference group (ref.), $\alpha=0.05$

Estimates may not sum to 100.0% due to rounding.

Appendix L. Age-Adjusted Diabetes Prevalence by Local Health Department (LHD), Adults (18-64 yrs), Michigan, Medicaid, 3-Year Average, 2007-2009 Combined and 2010-2012 Combined

Health Department	2007-2009		2010-2012	
	Diabetes Prevalence	Adult PWD*	Diabetes Prevalence	Adult PWD*
Michigan	11.0%	31,104	11.5%	37,770
Allegan	11.0%	201	12.1%	239
Barry-Eaton	11.4%	253	11.3%	301
Bay	10.4%	311	10.9%	353
Benzie-Leelanau	9.4%	43	10.5%	60
Berrien	12.1%	560	11.8%	634
Branch-Hillsdale-St. Joseph	12.4%	434	11.6%	513
Calhoun	12.6%	607	12.1%	661
Central Michigan	12.0%	763	12.0%	856
Chippewa	11.8%	94	11.1%	108
City of Detroit	10.4%	8,036	11.8%	9,517
District #10	11.0%	853	11.8%	1,062
District #2	10.8%	281	10.6%	316
District #4	12.0%	277	11.6%	306
Genesee	10.6%	1,907	10.9%	2,353
Grand Traverse	10.3%	140	10.1%	161
Huron	12.1%	97	11.3%	103
Ingham	11.1%	812	11.4%	987
Ionia	13.7%	177	14.3%	225
Iron-Dickinson	8.1%	71	8.1%	76
Jackson	11.1%	435	10.7%	533
Kalamazoo	12.1%	703	12.2%	823
Kent	12.0%	1,532	11.9%	1,798
Luce-Mackinac-Alger-Schoolcraft (LMAS)	8.9%	81	8.9%	94
Lapeer	10.1%	130	9.1%	166
Lenawee	13.0%	234	13.1%	297
Livingston	8.9%	99	7.6%	133
Macomb	11.0%	1,807	11.2%	2,480
Marquette	10.0%	134	10.4%	146
Menominee-Delta	11.0%	153	10.5%	171
Mid-Michigan	11.7%	416	12.5%	512
Midland	11.4%	186	11.0%	200
Monroe	12.1%	290	11.4%	376
Muskegon	11.8%	768	11.7%	878
Northwest Michigan	12.0%	223	12.0%	260
Oakland	10.9%	1,823	10.8%	2,452
Ottawa	11.5%	228	11.8%	294
Saginaw	12.8%	1,059	13.3%	1,207
Sanilac	11.0%	138	10.5%	157
Shiawassee	8.7%	150	9.9%	208
St. Clair	11.0%	484	10.7%	573
Tuscola	10.6%	136	10.2%	170
VanBuren-Cass	11.9%	404	11.2%	468
Western Upper Peninsula	9.8%	161	9.8%	183
Washtenaw	10.2%	429	9.9%	593
Wayne	12.1%	2,895	11.9%	3,705

*PWD—Average number of persons with diabetes in a calendar year

Central Michigan—Arenac, Clare, Gladwin, Isabella, Osceola, and Roscommon Counties

District #10—Crawford, Kalkaska, Lake, Manistee, Mason, Mecosta, Missaukee, Newaygo, Oceana, and Wexford Counties

District #2—Alcona, Iosco, Ogemaw and Oscoda Counties

District #4—Alpena, Cheboygan, Montmorency, and Presque Isle Counties

Mid-Michigan—Clinton, Gratiot, and Montcalm Counties

Northwest Michigan—Antrim, Charlevoix, Emmet, and Otsego Counties

Western Upper Peninsula—Baraga, Gogebic, Houghton, Keweenaw, and Ontonagon Counties

References

- ¹American Diabetes Association: Clinical Practice Recommendations 2016. Standards of medical care in diabetes—2016. *Diabetes Care* January 2016 39 (Supplement 1):S6-S112.
- ²Centers for Disease Control and Prevention. *Diabetes Report Card 2014*. Atlanta, GA: Centers for Disease Control and Prevention, US Department of Health and Human Services; 2015.
- ³2014 Geocoded Michigan Death Certificate Registry. Division for Vital Records and Health Statistics, Michigan Department of Health and Human Services.
- ⁴The Diabetes Control and Complications Trial Research Group. *The New England Journal of Medicine* 1993; 329(14): 977-986.
- ⁵UK Prospective Diabetes Study (UKPDS). VIII Study design, progress and performance. *Diabetologia* 1991; 34: 877-90.
- ⁶Holman RR, Paul SK, Bethel MA, Matthews DR, and Neil HAW. 10-Year follow-up of intensive glucose control in type 2 diabetes. *The New England Journal of Medicine* 2008; 359(15): 1577-1589.
- ⁷DCCT/30th Anniversary Summary Findings. *Diabetes Care* 2014; 37(1):5-49.
- ⁸Centers for Disease Control and Prevention. National Center for Chronic Disease Prevention and Health Promotion. *The Power of Prevention, 2009*. Atlanta, GA: U.S. Department of Health and Human Services, 2009.
- ⁹American Diabetes Association. Economic costs of diabetes in the US in 2012. *Diabetes Care* 2013; 36(4): 1033-1046.
- ¹⁰Healthy Michigan Plan Progress Report as of November 16, 2015.. Michigan Department of Community Health; http://www.michigan.gov/mdhhs/0,5885,7-339-71547_2943_66797---,00.html; accessed November 20, 2015.
- ¹¹Decker SL, Kostova D, Kenney GM, Long SK. Health status, risk factors, and medical conditions among persons enrolled in Medicaid vs uninsured low-income adults potentially eligible for Medicaid under the Affordable Care Act. *The Journal of the American Medical Association* 2013; 309(24):2579-2586.
- ¹²Washington RE (AHRQ), Andrews RM (AHRQ), Mutter RL (AHRQ). *Emergency Department Visits for Adults with Diabetes, 2010*. HCUP Statistical Brief #167. November 2013. Agency for Healthcare Research and Quality, Rockville, MD. <http://www.hcup-us.ahrq.gov/reports/statbriefs/sb167.pdf>.
- ¹³Davis MM. Patterns of High Utilization of Emergency Services: National Patterns and Initiatives Relevant for Michigan. Internal Presentation. Developing Michigan's Capacity to Support High Utilizers. Michigan Department of Community Health, Lansing, MI, November 13, 2013.
- ¹⁴HEDIS® 2012 Technical Specifications for Health Plans. Washington DC: NQCA, 2011. Item # 10184-100-12. Print.
- ¹⁵Gordis L. *Epidemiology*, 4th Edition. Philadelphia: Saunders Elsevier, 2009. Print.
- ¹⁶Pagano M, Gauvreau K. *Principles of Biostatistics*, 2nd Edition Pacific Grove, CA: Duxbury (Thompson Learning). Print.
- ¹⁷Klein RJ, Schoenborn CA. Age adjustment using the 2000 projected U.S. population. *Healthy People Statistical Notes*, no. 20. Hyattsville, Maryland: National Center for Health Statistics. January 2001.

