Urban Diabetes Care and Outcomes Summary Report, Audit Years 2011-2015

Aggregate Results from Urban Indian Health Organizations

Urban Indian Health Institute
A Division of the Seattle Indian Health Board

September 2016

The mission of the UIHI is to support the health and well-being of urban Indian communities through information, scientific inquiry, and technology.

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INTRODUCTION

Background

In response to the growing diabetes epidemic among American Indian and Alaska Natives (AI/ANs), Congress created the Special Diabetes Program for Indians (SDPI) in 1997. Although an increasing concern for the general United States population, AI/AN people are disproportionately affected by this disease. In 2012, 15.9% of AI/AN adults (aged 20 and older) were diagnosed with diabetes, compared to only 11.7% of all U.S. adults.[1] Futhermore, AI/AN with diabetes are more likely to experience diabetes-related complications such as kindey failure, heart disease, and death, as compared to the general U.S. population.[2]

The Indian Health Service (IHS) Division of Diabetes Treatment and Prevention (DDTP) recommends at least annual medical record review of patients with diabetes to monitor care patterns and changes over time. The IHS Diabetes Care and Outcomes Audit (Diabetes Audit) is a process for assessing diabetes care and health outcomes for AI/AN patients diagnosed with diabetes. Once a year, IHS, Tribal, and Urban (I/T/U) health care facilities submit their audited data to DDTP for centralized processing and analysis. Through a cooperative agreement with IHS, the Urban Indian Health Institute conducts secondary data analysis of Diabetes Audit data and provides technical assistance to support data-driven activities that enhance care and improve outcomes for AI/AN patients at participating Urban Indian Health Organizations (UIHOs). The Diabetes Audit is based on the *IHS Standards of Care and Clinical Practice Recommendations for Type 2 Diabetes* (IHS SOC).

Data Collection

Data for this report were collected between January 1, 2010 and December 31, 2014 at participating UIHOs (Audit Years 2011-2015). All patients included in this report had a diagnosis of diabetes, were AI/AN, and had at least one visit to the UIHO during the Audit period. Patients were excluded if they received the majority of their primary care outside the UIHO. Exclusions also included patients currently on dialysis *and* receiving the majority of their primary care at the dialysis unit, death before the end of the Audit period, pregnant women, pre-diabetics, or patients who moved from the service area.

Analysis

Results were reported as five year aggregates on selected indicators to account for small samples from individual facilities. Prevalence estimates do not include missing/unknown values, unless otherwise indicated, and were weighted to account for differing sampling approaches used in reporting data to IHS (e.g. electronic vs. manual entry of data). Electronic audits include all eligible patients and manual audits follow a standardized chart selection algorithm.

Confidence intervals (CIs) were used to show the differences in outcomes between sub-groups for selected indicators. These are ranges of numbers used to assess the accuracy of a point estimate and measure the variability in the data. A 95% CI is a range of values in which you can be 95% certain that the true estimate of the population is contained in the interval. Sample size is inversely proportional to the precision of these estimates; hence, larger samples produce more precise estimates with smaller CIs, and smaller samples produce less precise estimates with larger CIs. In comparing populations with respect to any item, we used non-overlap of the 95% CI to suggest a significant difference. It should be noted that this is not a formal statistical comparison.

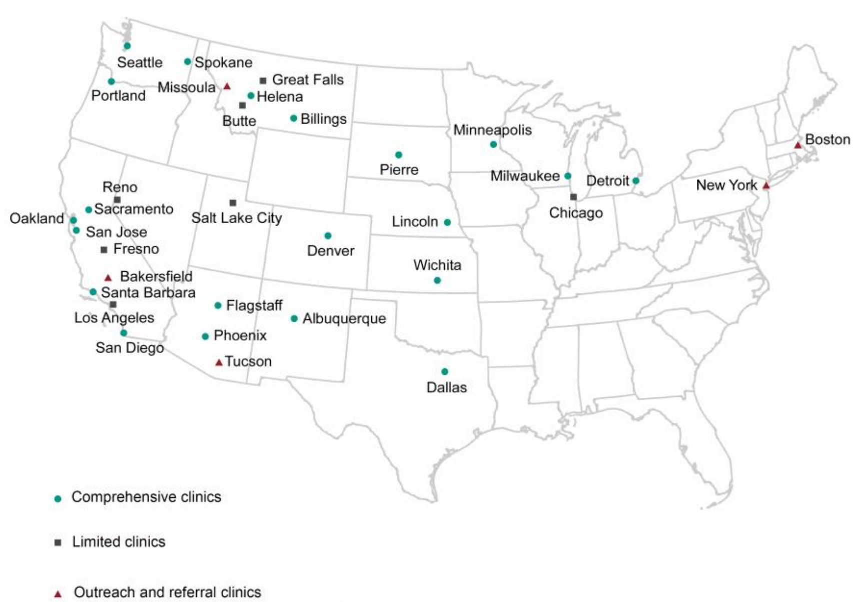
Odds ratios (ORs) were calculated for some indicators as a measure of association between an exposure and an outcome between selected groups. This relationship is defined as the ratio of the odds of an event occurring in one group (referent group) to the odds of it occurring in another comparison group. When OR=1, the outcome is equally likely to occur in both groups. When OR>1, the exposure is associated with higher odds of outcome. An OR<1 indicates the inverse; that the exposure is associated with lower odds of outcome.[3] ORs are reported as unadjusted estimates weighted by facility. Significance was determined at $p<0.05$.

Stata version 13.1 (Stata Corp., College Station, Texas) was used to perform all statistical analyses.

Considerations

This report combines patient data from Audit Years 2011-2015 for each facility (see map below). This is done to increase sample size and ensure confidentiality of patients and facilities; however, aggregating data across UIHOs does present some limitations. For instance, the range of health care services varies from site to site. An aggregate report of UIHO data cannot encompass all the nuances each individual program experiences.

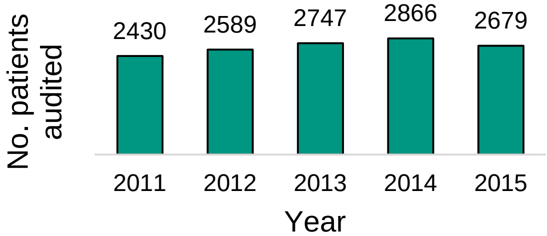
Some measures have a high proportion of missing values which can skew results. Corresponding CIs help account for these uncertainties. Continued reduction in the amount of missing data at each facility will improve the quality of future reports. The proportion of missing data for a given facility may be related to the patients' use of multiple health care providers in different health care systems.



Patient Overview

From Audit Years 2011-2015, the Diabetes Audit collected data on 13,311 urban Indians (aged 18 and older) from 31 UIHOs (Figure 1). There was a steady increase in the total number of patients audited during this period. This is attributable to an increased proportion of patients in the diabetes registry being captured in the Audit. In Audit Year 2015, 72% of patients in the registry were included in the Audit from just 30 UIHOs which provided data.

Figure 1. Number of patients audited (ages ≥18 years), 2011-2015



The sample consisted of a majority of females, with the overall population having an average age of 52 years. Most patients (57%) were in the 45-64 age category (Table 1). In addition, 9% of the sample were within their first year of diagnosis, however, the longest amount of time since diagnosis was 61 years (mean: 8 years duration). While Type 1 diabetes accounts for 5% of all diagnosed cases in the general population, it only represents 2% of this patient sample.[4]

Body Mass Index (BMI) is regularly assessed at diabetes visits as an indicator for future risk of poor health outcomes. Individuals that are categorized as overweight (BMI 25.0-29.9) or obese (BMI≥30.0) may be at greater risk for insulin resistance and higher blood glucose levels, which make diabetes complications worse and make diabetes management more complex. Therefore, IHS SOC recommends patients with BMI>25 be referred to structured weight loss programs. These programs should emphasize goal setting, coaching, and motivational interviewing, education and skills development, physical activity, self-monitoring, problem solving, behavioral change, stress and stimulus control, the importance of social support, and the use of community resources. In this Audit, 92% of patients were overweight or obese.

Lifestyle interventions have been shown to be effective in reducing the incidence of Type 2 diabetes in a diverse population.[1] The National Institute of Health Diabetes Prevention Program's clinical trial achieved a 58% reduction in diabetes incidence in those that received the intervention (compared to placebo). The SDPI Diabetes Prevention Initiative subsequently adapted the lifestyle intervention and implemented this program in AI/AN communities. As of May 2014, 4,549 participants have completed the intervention.

PATIENT OVERVIEW

Tobacco use is an important modifiable risk factor for Type 2 diabetes with a dose-response relationship: the more cigarettes one smokes, the higher the risk for developing Type 2 diabetes. On average, smokers are 30-40% more likely to develop the disease than nonsmokers. Furthermore, smoking also makes diabetes harder to control and increases the risk for diabetes-related complications including heart and kidney disease, poor blood flow, retinopathy, and peripheral neuropathy.[5]

Rates of cigarette smoking among AI/ANs are the highest by race/ethnicity, with 39% of AI/AN adults reporting cigarette smoking in 2012.[5] From 2011-2015, 30% of patients reported current tobacco usage. IHS SOC notes that a brief tobacco intervention can increase quit rates by as much as 80%.[6] Among those that reported current usage, 69% received cessation counseling (data not presented in table).

Table 1. Patient characteristics, 2011-2015

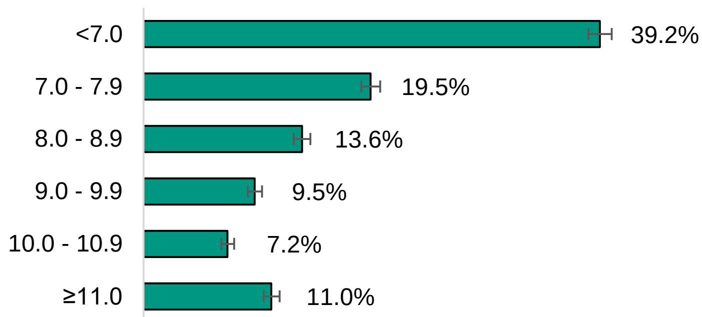
		Mean	Proportion
Age (years)		52.5 (Range: 18-98)	
Age group			
	18-44		25.9%
	45-64		57.1%
	≥65		16.9%
Sex			
	Male		40.0%
	Female		60.0%
Diabetes type			
	Type 1		2.1%
	Type 2		97.9%
Duration (years)		8.3 (Range: 0-61)	
Duration			
	<1 year		9.0%
	1-5 years		35.8%
	6-10 years		25.1%
	11-15 years		14.7%
	≥16 years		15.4%
BMI (kg/m^2)		34.9 (Range: 15-85)	
BMI category (3-levels) *			
	Normal		7.7%
	Overweight		21.2%
	Obese		71.1%
Smoking status			
	Non-smoker		69.7%
	Smoker		30.3%

*Normal, BMI<25.0; Overweight, BMI 25.0-29.9; Obese, BMI≥30.0

Glycemic Control

Diabetes is a disease defined by uncontrolled blood sugar (glycemia) levels, specifically elevated blood sugar (hyperglycemia).[7] There are two ways that blood sugar is commonly tested. Blood glucose meters, which requires a small drop of blood from the finger, can be used to measure acute glycemia levels and be done at home. However, it's normal for glycemic levels to vary throughout the day, therefore, a second test, Hemoglobin A1c (A1c), which is a clinical assessment of average blood sugar over the preceding 120 days, is used as a more robust indicator for disease management.[7] The A1c test is a blood test done in a lab or doctor's office. IHS SOC recommends an A1c test be performed every 3 to 6 months to monitor a patient's disease management progress and facilitate therapeutic decision-making.[8]

Figure 2. Most recent hemoglobin A1c results among patients, 2011-2015



One approach IHS uses when establishing individualized glycemic control targets, is to instead set a target range. Using ranges allows for the flexibility needed for patient safety and controls for limitations of A1c testing accuracy.[8] For many people with diabetes, the A1c goal is below 7.0%.[7] However, a higher goal may be appropriate for patients with a longer duration of disease, shorter life expectancy, or other co-morbidities, since aggressive control may increase complications.[9]

Figure 2 summarizes A1c values for Diabetes Audit patients. 39.2% of Audit patients had A1c<7.0% and an additional 19.5% fell in the A1c 7.0%-7.9% range. 6% of patients did not have an A1c result on-record (data not presented in figure).

GLYCEMIC CONTROL

Table 2 analyzes "good glycemic control" (defined as A1c <8.0%) by selected modifiable (e.g. BMI, smoking status) and non-modifiable (e.g. sex, age) risk factors.

The strongest predictor of A1c outcome were age and duration of disease. Sex, BMI, and smoking status were not significant predictors. As age increased, mean A1c among patients decreased. Patients ages 18-44 had the highest mean A1c at 8.4%, indicating that the majority of these patients did not have good glycemic control. The odds of patients in the ≥65 age category (mean A1c 7.4%) to have good glycemic control were 2.7 times the odds of a patient in the 18-44 age category (OR=2.67, p<0.01). This measure, however, does not consider any other mitigating variables. The mean A1c for patients in the 45-64 age category was 8.0%.

Table 2. Association between glycemic control (A1c <8%) and selected risk factors, 2011-2015

		Mean A1c (%)	OR	p
Sex				
	Male	8.0	referent	
	Female	8.0	1.46	0.14
Age				
	18-44	8.4	referent	
	45-64	8.0	1.46	<0.01
	≥65	7.4	2.67	<0.01
Duration				
	<5 years	7.6	referent	
	5-9 years	8.0	0.68	<0.01
	≥10 years	8.4	0.48	<0.01
BMI category (3-levels) *				
	Normal	8.1	referent	
	Overweight	8.0	1.11	0.23
	Obese	8.0	1.02	0.82
Smoking status				
	Non-smoker	8.0	referent	
	Smoker	7.9	0.98	0.59

*Normal, BMI<25.0, Overweight, BMI 25.0-29.9. Obese, BMI≥30.0

Duration of disease was also a significant predictor of A1c outcome with a direct association where mean A1c increases with duration of disease. Those having been diagnosed with diabetes <5 years had the lowest mean A1c (7.6%). The odds of a person having a diagnosis of diabetes ≥10 years with good glycemic control was 0.5 times the odds of (or, 50% less likely than) a newly diagnosed patient (duration <5 years; OR=0.48, p<0.01). The mean A1c for patients diagnosed with diabetes for 5-9 years and ≥10 years were 8.0% and 8.4%, respectively.

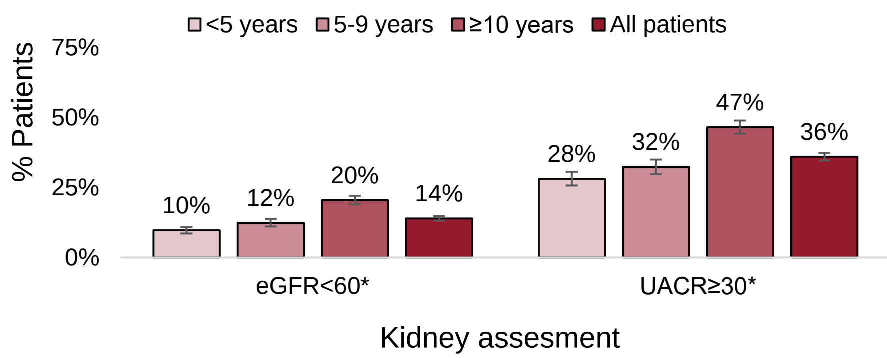
Age and duration of disease had a strong, inverse association which suggests better A1c outcomes for older patients who were newly diagnosed as compared to younger patients who have lived with the disease for a longer period—a conclusion supported by the SDPI 2014 Report to Congress. Being diagnosed with diabetes at an older age means that a person is less likely to experience complications that develop after many years of living with the disease.[1]

Kidney Function

Diabetes significantly increases one's risk of developing chronic kidney disease (CKD) when high levels of blood sugar disrupt the body's filtration system, causing it to filter at a slower rate. Left untreated, this damage results in an accumulation of proteins and other waste products in the blood. Over time, proteins may start to leak through the filters and into the urine, a condition known as albuminuria.[10]

IHS SOC recommends the use of both estimated glomerular filtration rate (eGFR) and urine albumin-to-creatinine ratio (UACR) to screen, diagnose, and monitor the progress of CKD, and to assess the effectiveness of intervention. CKD is indicated as greater than three months duration of either decreased filtration rate (i.e. eGFR <60 mL/min/1.73m^2) or increased albuminuria (i.e. UACR ≥ 30 mg/g).[11] These assessments are indicated at first diabetes diagnosis and then at least annually thereafter or more often to assess the effectiveness of intervention.

Figure 3. Results of kidney function assessment by duration of diabetes, 2011-2015



Evidence of kidney dysfunction was prevalent in the patient population (Figure 3, Table 3). Decreased filtration (i.e. eGFR <60 mL/min/1.73m^2) presented in 14% of all patients. This prevalence increased over duration of disease. The same general trend was observed for increased albuminuria (i.e. UACR ≥ 30 mg/g), with evidence of kidney damage indicated in 36% of all patients.

Table 3 analyzes mean eGFR and UACR value among age group and duration categories. In addition, it shows risk estimates based on the odds of having decreased kidney function and evidence of kidney damage.

Table 3. Association between kidney dysfunction relative to age and duration of diabetes, 2011-2015

	Kidney function (eGFR, mL/min/1.73m^2)				Kidney damage (UACR, mg/g)			
	Mean	%CKD*	OR	p	Mean	%CKD*	OR	p
Age								
18-44	87.8	5.0%	referent		139.1	33.2%	referent	
45-64	78.8	12.6%	2.42	<0.01	140.4	34.7%	1.03	0.69
≥65	65.4	30.9%	7.68	<0.01	180.0	43.8%	1.49	<0.01
Duration								
<5 years	81.1	9.6%	referent		75.2	28.1%	referent	
5-9 years	80.0	12.3%	1.40	<0.01	105.1	32.2%	1.28	<0.01
≥10 years	75.3	20.4%	2.45	<0.01	236.4	46.5%	2.26	<0.01

*Patient meets definition of CKD function but may not be diagnosed with CKD

KIDNEY FUNCTION

Mean eGFR decreases across both age and duration of disease. Patients in the youngest age category (ages 18-44) had significantly better kidney function outcomes (eGFR) as compared to those in the oldest age category (ages ≥65). The odds of the oldest patients having kidney dysfunction (i.e. eGFR <60 mL/min/1.73m^2) was 7.7 times (OR=7.7, p<0.01) the odds of the youngest patients meeting these standards. In addition, the odds of the patients with a diagnosis ≥10 years meeting this same standard was 2.5 times (OR=2.5, p<0.01) the odds of patients having a diagnosis of <5 years.

The UACR test assesses urine albumin excretion and is reported as the ratio of milligrams of albumin to grams of creatinine. Normal albumin (normoalbuminuria) results, by IHS standards, are UACR ≥30 mg/g. According to the same guidelines, microalbuminuria, an early sign of kidney disease, is UACR 30-300 mg/g and macroalbuminuria is UACR >300 mg/g.

Mean UACR increased across both age and duration of diabetes and mean values for each of these categories met the definition of microalbuminuria. The odds of the oldest patients (ages ≥65) to have microalbuminuria were 1.5 times (OR=1.49, p<0.01) the odds of the youngest patients (ages 18-44) in meeting these standards. In addition, the odds of patients having been diagnosed (with diabetes) ≥10 years to have microalbuminuria were 2.3 times (OR=2.3, p<0.01) the odds of patients having been diagnosed <5 years to have normoalbuminuria.

Such screenings are imperative to detect early kidney dysfunction in diabetes patients. Impaired kidney function complicates the use of oral hyperglycemic therapies, such as metformin, a first-line therapy for type 2 diabetes. Metformin is the most common therapy prescribed to Audit patients with 64% of the sample having a current prescription (see Diabetes Therapy, p. 13).

In 2016, the U.S. Food and Drug Administration revised their guidelines for the indication of metformin for patients with reduced kidney function to include those with mild to moderate kidney impairment (eGFR <45 mL/min). Prior to these revisions, metformin was contraindicative to these patients due to risk of developing lactic acidosis or excess lactic acid in the blood.[12] These revised guidelines may expand patient eligibility by up to 40-50%.[13]

Lipid Management

Table 4. Lipid profile of persons with diabetes compared to non-diabetic, healthy individuals

Lipid component	Desirable cholesterol levels	Typical diabetes patient
LDL ("bad" cholesterol)	Less than 100 mg/dL	Normal, with greater number of small, dense particles
HDL ("good cholesterol")	60 mg/dL or higher	Low
Triglycerides	Less than 150 mg/dL	Elevated

Adults with diabetes have a 2-4 times higher risk of experiencing cardiovascular events than adults without diabetes.[1] While many factors account for this increase in risk, dyslipidemia (lipid abnormalities) is one major contributor. Blood lipids include low-density lipoproteins (LDL), high-density lipoproteins (HDL), and triglycerides. In addition, non-HDL cholesterol (calculated as total cholesterol minus HDL cholesterol) may be a stronger predictor of CVD than LDL cholesterol or triglycerides because it correlates highly with plaque promoting lipoproteins.[14]

Diabetic dyslipidemia commonly manifests as elevated triglycerides and low levels of HDL cholesterol (Table 4).[14] IHS SOC recommends annual lipid profile (i.e. LDL, HDL, non-HDL, triglycerides, and total cholesterol) for all patients with diabetes and subsequent treatment primarily with statin drugs when indicated.[15]

Figure 4. Mean lipid indicators by sex, 2011-2015

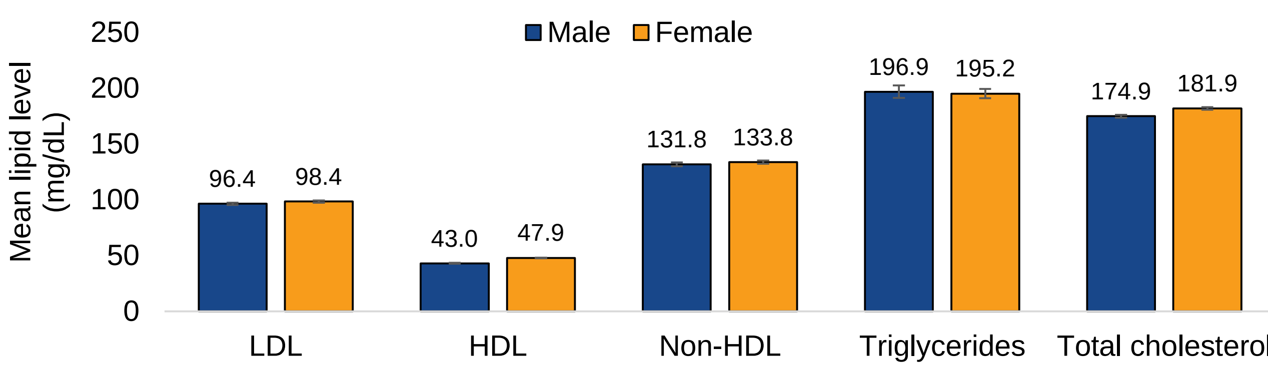


Figure 4 examines mean lipid indicators by sex for Audit patients. Both male and female patients had mean LDL levels within the desirable range (i.e. <100 mg/dL). Mean values for HDL were lower than desired (i.e. >60 mg/dL) and triglycerides were elevated for both sexes.

LIPID MANAGEMENT

Table 5 further summarizes the proportion of patients which met lipid targets. The majority of male and female patients met LDL (58%, 55%), HDL (50%, 64%), and non-HDL (54%, 50%) lipid goals, however there was a significantly lower proportion of females than males that met LDL (OR=0.88, p<0.01) and non-HDL (OR=0.89, p=0.02) goals. Less than half of patients (both males and females) met the triglyceride target and again, a significantly higher proportion of males (49%) reached the goal than females (45%; OR=0.89, p<0.01).

Table 5. Proportion of Audit patients that met lipid goals by sex, 2011-2015

	Male (referent)	Female	OR	p
LDL <100mg/dL	58.2%	54.5%	0.88	<0.01
HDL ≤40mg/dL (males)	50.4%		*	
HDL ≤50 mg/dL (females)		64.3%	*	
Non-HDL <130 mg/dL	53.6%	50.4%	0.89	0.02
Triglycerides <150 mg/dL	48.6%	45.4%	0.89	<0.01

*Not tested for signficant difference.

Table 6 analyzes the relationship between age and duration of diabetes with the odds of achieving LDL and triglyceride targets. Age was a significant predictor of both LDL and triglyceride outcome while duration of disease was significant for LDL outcome only. Mean LDL levels decreased across age category with significantly fewer patients ages 18-44 meeting LDL target (48%) as compared to those ages ≥65 (70%). The odds of a patient age ≥65 achieving LDL targets were 2.6 times the odds of a patient age 18-44 reaching that goal (OR=2.64, p<0.01).

A similar relationship was observed when comparing patients based on the duration of disease. Mean LDL levels also decreased across duration category with a significantly fewer patients with diabetes <5 years meeting LDL target (51%) than those with the disease for ≥10 years (63%).

Table 6. Association between lipid targets* and age, duration of diabetes, 2011-2015

	LDL				Triglycerides			
	Mean	Met Target	OR	p	Mean	Met Target	OR	p
Age								
18-44	103.0	47.7%	referent		222.5	42.6%	referent	
45-64	98.8	55.0%	1.32	<0.01	193.1	46.4%	1.11	0.04
≥65	86.2	70.4%	2.64	<0.01	168.5	53.4%	1.45	<0.01
Duration								
<5 years	100.5	51.0%	referent		200.8	46.3%	referent	
5-9 years	97.8	55.5%	1.20	<0.01	196.7	45.4%	0.97	0.63
≥10 years	93.8	62.6%	1.51	<0.01	189.8	48.1%	1.08	0.11

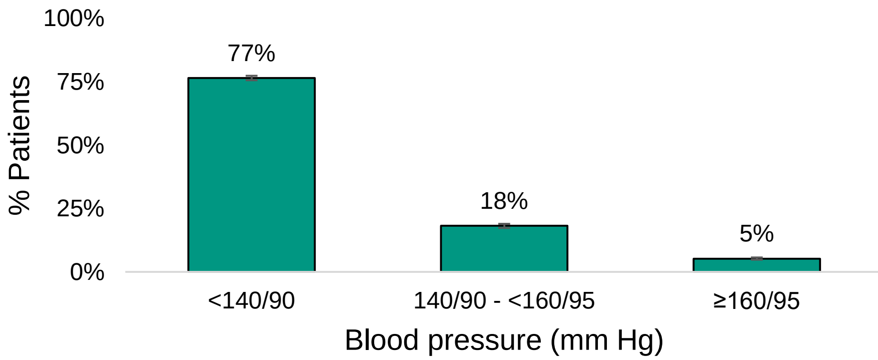
* LDL target <100 mg/dL, Triglyceride target <150 mg/dL

Mean triglycerides decreased across age category but there was no significant difference in the proportion of patients with diabetes <5 years meeting triglyceride target (46%) than those with the disease ≥10 years (48%). The odds of a patient age ≥65 achieving triglyceride targets were 1.5 times the odds of a patient age 18-44 reaching that goal (OR=1.45, p<0.01).

CARDIOVASCULAR HEALTH

Cardiovascular disease (CVD) is the leading cause of death in the United States for the total population as well as AI/AN adults. Adults with diabetes have heart disease death rates almost 2 times higher than adults without diabetes. Tobacco use, poor diet, obesity, excessive alcohol use, high cholesterol, and other risk factors can put individuals at higher risk for developing CVD. Targeting hypertension (HTN) and dyslipidemia have a signficant effect on lowering one's risk of CVD.[16]

Figure 5. Mean blood pressure*, 2011-2015

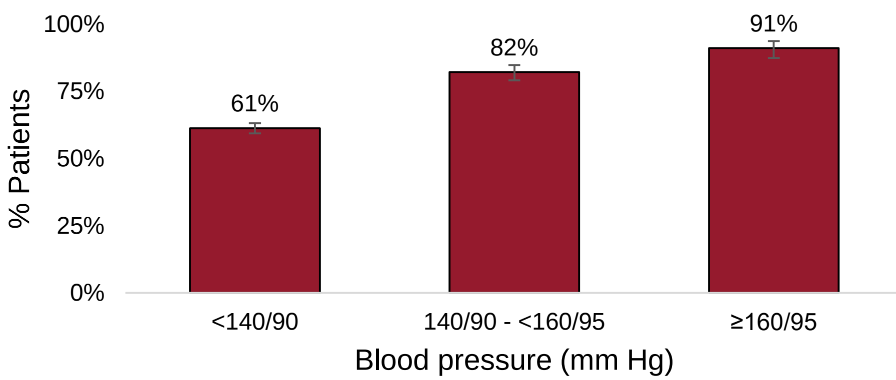


*Mean blood pressure taken at last 2-3 visits

IHS SOC recommends blood pressure (BP) screening at diabetes diagnosis and at every visit thereafter. Three out of four Audit patients (77%) had a mean blood pressure below 140/90. An additional 18% of patients were 140/90 - 160/95 and 5% were 160/95 or higher.

HTN is categorized as Stage 1 HTN, BP 140/90-<160/95, or Stage 2 HTN, BP 160/95 or higher.[17] Among all patients, 65% were previously diagnosed with HTN. Figure 6 highlights the proportion of patients with previously diagnosed HTN within mean BP category. According to this figure, 61% of patients with a mean BP below 140/90 had a previous diagnosis of HTN. Furthermore, 82% and 91% of patients with mean BP 140/90-<160/95 and mean BP 160/95 or higher had a previous diagnosis, repectively. This may indicate that a signficant proportion of the patient population is undiagnosed HTN, which puts the (undiagnosed) patient at significant risk for heart disease and stroke.[18]

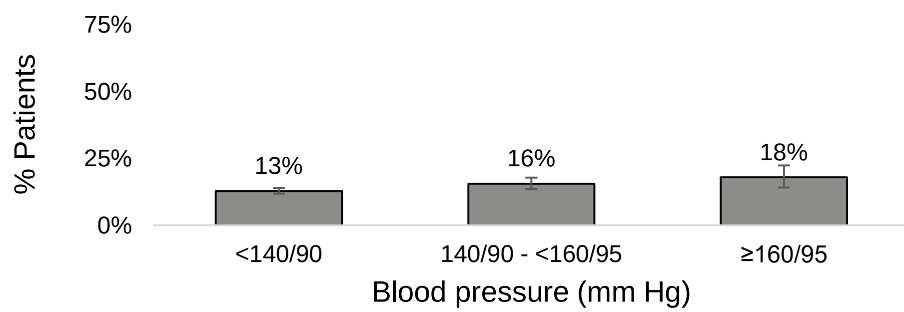
Figure 6. Porportion of previously diagnosed hypertensives within mean blood pressure category, 2014-2015



Cardiovascular Health

The risk for developing CVD may be 3-8 times higher for AI/AN patients with diabetes than those without the disease.[2] Since 2013, 13% of all Audit patients have been identified with this diagnosis (Table 7). Figure 7 illustrates how the proportion of patients diagnosed with CVD increases across BP category, from 13% of those with mean BP below 140/90 to 18% of patients with mean BP 160/95 or higher, however this difference is not statistically significant.

Figure 7. Porportion of previously diagnosed cardiovascular disease within blood pressure category, 2013-2015



BP control is essential in diabetes care as it reduces the risk for complications, including CVD and CKD.The etiology of these conditions are unique, however, it is not uncommon for diabetes patients to have multiple comorbid conditions. IHS SOC recommends lifestyle change as the first treatment option to manage these comorbidities before exploring pharmaceutical options. Angiotensin-converting enzyme (ACE) inhibitors or angiotensin II receptor blockers (ARB) are first-line medication prescribed for HTN management.[16] Daily aspirin therapy is recommended for diabetes patients with increased risk for CVD, depending on age and sex. In addition, statin thereapy is recommended for all patients with diabetes between ages 40-75 years and those with a comorbid CVD (regardless of age).[15]

Table 7 shows the proportion of patients with diagnosed comorbidities and prescription use for each group of selected populations. Females were signficantly less likely to be diagnosed with selected conditions and less likely to be prescribed selected therapies. The prevalence of selected conditions also increased across age category, along with prescription therapies. Comorbid conditions were prevalent with, for example, 54% of patients with kidney damage (i.e. UACR ≥30) and diagnosed CVD and 82% of patients with dianosed HTN also comorbid CVD.

Table 7. Comorbid conditions and therapy prescription among selected groups, 2011-2015

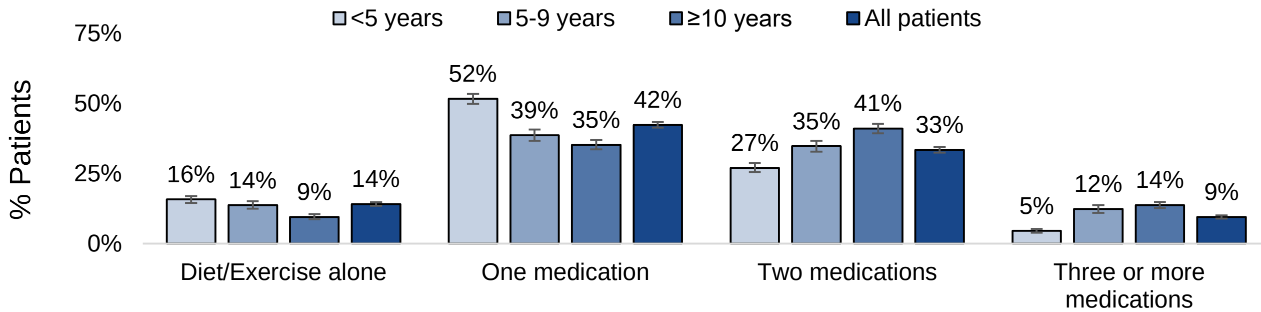
	UACR ≥30	Diagnosed HTN	Diagnosed CVD	Statin	Aspirin	ACE inhibitor or ARB
All patients	35.9%	65.2%	13.2%	46.0%	56.2%	67.5%
Sex						
Males†	40.7%	71.8%	17.0%	49.3%	61.5%	72.0%
Females	32.7%**	60.9%**	10.6%**	43.8%*	52.7%**	64.5%**
Age						
18-44†	33.2%	45.4%	3.5%	29.6%	38.9%	54.8%
45-64	34.7%	68.2%**	12.1%**	48.4%**	60.3%**	70.9%**
≥65	43.8%**	82.5%**	30.6%**	59.4%**	69.1%**	75.7%**
UACR ≥30	-	74.2%	19.5%	53.6%	65.5%	79.0%
Diagnosed HTN	41.6%	-	17.2%	52.0%	57.0%	76.5%
Diagnosed CVD	54.2%	82.4%	-	55.8%	68.9%	72.3%

Note: For multi-level categories (sex, age) *p<0.05, **p<0.01, †referent; no other signficance test were conducted

Diabetes Treatment

Many individuals with Type 2 diabetes, especially soon after diagnosis, are recommended lifestyle changes (e.g. diet and exercise) alone to manage their condition. The American Diabetes Association recommends initiating use of a pharmaceutical agent (e.g. Metformin monotherapy) only if these changes do not adequately lower blood glucose levels. If an A1c target is not achieved after approximately 3 months, a patient may be prescribed additional medications to use in combination with metformin.[19] However, taking multiple medications a day complicates diabetes self-management, and presents a risk of adverse interactions.[20,21]

Figure 8. Number of diabetes medications currently prescribed by duration of diabetes, 2011-2015



In Figure 8, 14% of all patients were prescribed diet and exercise alone to manage their condition. This proportion decreased over duration of diabetes with a significantly higher proportion of patients living with the disease for <5 years being prescribed lifestyle modification (16%) compared to those living with the disease for ≥10 years (9%). This supports the recommendation of lifestyle modificaitons as a first-line therapy option. Furthermore, a clear trend shows an increase in number of diabetes medications prescribed with an increase in duration of disease. Overall, approximately one in ten Audit patients were prescribed three or more medications with a significantly lower proportion of those being patients <5 years since diagnosis (5%) compared to those living with the disease for ≥5 years.

Table 8. Most common diabetes medications currently prescribed alone or in combination, 2011-2015

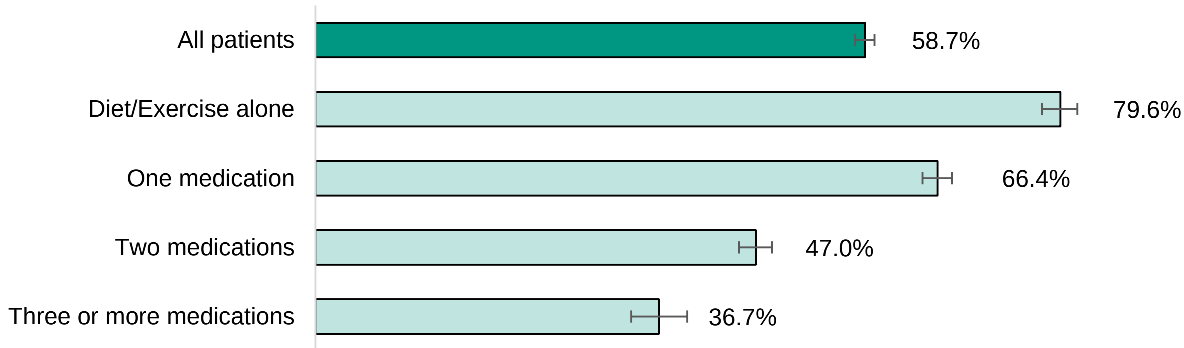
Medication	Prescription
Oral Therapies	
Metformin	64.4%
Sulfonylureas	25.5%
Thiazolidinediones	6.4%
DPP-4 inhibitors	3.2%
Meglitinides	<1%
SGLT2 inhibitors	<1%
Alpha-glucosidase inhibitors	<1%
Bile acid sequestrants	<1%
Injectable Therapies	
Insulin	36.8%
GLP-1 receptor agonists	2.1%
Amylin analogues	<1%

Diabetes medications include both oral and injectable therapies. Metformin, an oral medication, is the most commonly prescribed therapy for Audit patients (64%; Table 8). The most common injectable therapy is insulin, which is a first-line therapy for those with Type 1 diabetes, who do not produce insulin naturally.[19] Insulin may be prescribed to patients with Type 2 diabetes if other therapy options fail to control glucose levels. Other oral and injectible medications prescribed to Audit patients are listed in Table 8.

DIABETES TREATMENT

IHS SOC emphasizes the need for individualized treatment plans for patients based on a patient-centered approach to care.[8,22] Treatment options should consider patient (e.g. age), disease (e.g. duration) and drug characteristics, with the ultimate goal of reducing blood glucose levels while minimizing side effects such as hypoglycemia. Combination therapy may be considered if A1c control is not achieved with a single therapy alone. Each new class of noninsulin agents added to an initial therapy may lower A1c by 0.9-1.1%.[23]

Figure 9. Proportion of patients acheiving glycemic control (A1c <8.0%) by number of diabetes medications, 2011-2015



Over half of all Audit patients achieved the population target of A1c below 8.0% (Figure 9). This includes 80% of patients prescribed lifestyle modification alone achieving this standard. The proportion of patients who met this target declined as the number of diabetes medications increased: significantly more patients prescribed one medication met the standard (66%) than those prescribed two diabetes medications (47%) and those prescribed three or more diabetes medications (37%). This indicates that patients who were prescribed a higher number of diabetes medications were more likely to struggle with glycemic control. This is may be correlated with duration of disease.

SCREENINGS AND EDUCATION

Poor glycemic control may cause signficant microvascular damage throught the body. In fact, diabetes is the leading cause of kidney failure, nontraumatic lower limb amputations, and new cases of blindness among adults in the U.S.[24] Furthermore, AI/AN people with diabetes have 2-3 times more advanced periodontal disease than those without diabetes. Routine examination of a patient's mouth, eyes, and feet are part of IHS SOC in order to to identify microvascular damage as early as possible.

While the benefits of regular clinical examinations are well documented, rates for these services remain low among Audit patients (Table 9). Foot exams were the most sucessful exams completed on an annual basis with an average of 68% of patients recorded as having received an exam during the Audit period (2011-2015). One likely explanation may be the non-invase nature of the exam, relative to eye and dental exams which neccesitate specialized equipment. On average, only 42% and 28% of patients received an annual eye or dental exam, respectively.

Table 9. Documented examinations and education received by patients during Audit period, 2011-2015

Examinations	
Foot Exam	67.6%
Eye Exam	42.4%
Dental Exam	28.0%
Education	
Physical Activity Education	71.0%
Nutrition Education*	70.9%
Other Education	81.6%

*Instruction by registered dietician or other provider

Diabetes self-management education (DSME) is another critical strategy for reducing the risk of diabetes-related complications. IHS SOC recommends patients with diabetes receive individualized education (as formal educational programs or through brief encounters) at diagnosis and as needed thereafter. The Diabetes Audit tracks physical education and nutrition counseling, but DSME may also include "other": blood glucose monitoring, medication adherence, risk reduction, healthy coping, and problem solving.[25]

Most patients receive DSME with an average of 82% of patients received some form of diabetes-related education. In addition, on average 71% of patients were documented as receiving some physical activity instruction and nutrition counseling. These services are difficult to capture in the Diabetes Audit as it requires the provider to document the education in the medical records, even if it was a less formal counseling session. Therefore, it is possible that a higher proportion of patients are receiving these services than what is being reflected in the Diabetes Audit report.

Screenings and Education

Diabetes and depression are closely related and "bidirectional" whereas the presence of one increases the risk that the other will develop.[26] The comorbidity of depression and diabetes is further complicated as the effects of depression may influence an individual's ability to successfully manage their diabetes.[27] The estimated overall prevalence of depression in people with diabetes is 8%. However, the rate for AI/ANs is estimated to be 3 times higher at 28%. Furthermore, depression remains undiagnosed and untreated in two out of three patients who have diabetes. IHS SOC recommends screening adults with diabetes for depression at regular intervals, however, the optimum frequency for depression screening is unknown.[26]

The estimated prevalence of depression among patients was 32%, however, this is a self-reported indicator (Table 10). Depression was significantly more likely to be reported in females (37%) versus males (25%, p<0.01) as well as smokers (38%) versus non-smokers (30%, p<0.01). Previous studies have shown a significant association between depression diagnosis and substance use/dependence (including tobacco abuse) among AI/AN patients with diabetes. One explanation is that these patients may be less motivated to quit smoking or may be self-medicating with tobacco.[28]

Table 10. Active depression reported among selected groups, 2011-2015

	Active Depression	OR	p
All Patients	32.3%	-	-
Sex			
Male	24.8%	referent	
Female	37.3%	1.80	<0.01
Age			
18-44	32.1%	referent	
45-64	34.5%	1.12	0.03
≥65	25.3%	0.72	<0.01
Duration			
<5 years	28.6%	referent	
5-9 years	34.7%	1.32	<0.01
≥10 years	37.2%	1.48	<0.01
Smoking status			
Non-smoker	29.6%	referent	
Smoker	38.4%	1.48	<0.01
Blood sugar control			
A1c < 8.0%	32.0%	referent	
A1c ≥ 8.0%	33.5%	1.07	0.14

Both age and duration of diabetes were significant predictors of depression status. When compared to the youngest age category (18-44 year olds), middle-aged patients aged (45-64 years) were slightly more likely to report active depression (OR=1.12, p=0.03). However, the oldest patients (≥65 years) were significantly less likely to report depression, compared to the youngest patients (OR=0.72, p<0.01).

There is also a significant association with duration of diabetes. Patients who have had diabetes 5-9 years and those with the diabetes ≥10 years were more likely to report depression than those patients with diabetes <5 years (OR=1.32, p<0.01 and OR=1.48, p<0.01, respectively).

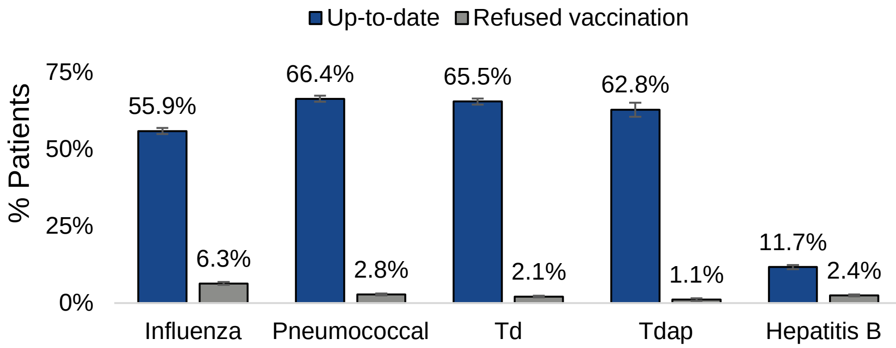
Lastly, not only may depression affect patient's self-management tasks such as medication adherence or lifestyle behaviors, but it can also have impacts on patient outcomes such as glucose levels.[26] There was no significant difference in patient A1c outcome by depression status in the sample (OR= 1.07, p=0.14).

IMMUNIZATIONS

Diabetes weakens one's immune system and puts patients at increased risk for acquiring certain vaccine-preventable diseases. Furthermore, some illnesses (e.g. influenza) can raise blood glucose to dangerous levels.[29] Specific immunizations tracked in the Diabetes Audit include: influenza (annually), pneumococcal (ever), tetanus/diphtheria ("Td" past 10 years), tetanus/diphtheria/pertussis ("Tdap" ever), and hepatitis B (ever completed 3-dose series).

Immunization rates varied among patients but were higher for vaccines that did not require annual administration. For instance, just over half of patients (56%) received a flu shot during the Audit period. A significantly higher proportion of patients were current with pneumococcal (66%), Td (65%), and Tdap (63%) vaccines. Hepatitis B had a significantly lower immunization rate compared with all other vaccines; only 12% of patients completed the 3-dose series. The highest proportion of refusals were for the flu vaccine (6%).

Figure 10. Immunization status including proportion of vaccine refusals, 2011-2015



In general, immunizations increase with age, the exception(s) being Tdap and hepatitis B (Table 11). A similar trend is seen in duration of disease, with immunization rates increasing for flu, pneumococcal and Td as duration of diabetes increases. IHS SOC recommends special considerations in administering hepatitis B vaccine to patients over the age of 60 which may explain the lower rates of vaccination in this sub-population.

Table 11. Proportion of patients with current immunizations by age and duration of diabetes, 2011-2015

	Influenza	Pneumococcal	Td	Tdap	Hepatitis B
Age					
18-44	48.2%	51.8%	58.9%	61.2%	12.2%
45-64	57.4%	69.3%	67.1%	64.5%	12.2%
≥65	62.5%	78.7%	69.9%	59.5%	9.2%
Duration					
<5 years	51.8%	54.6%	57.3%	62.8%	10.4%
5-9 years	56.8%	73.3%	72.9%	68.6%	12.1%
≥10 years	62.5%	80.4%	73.7%	65.2%	13.5%

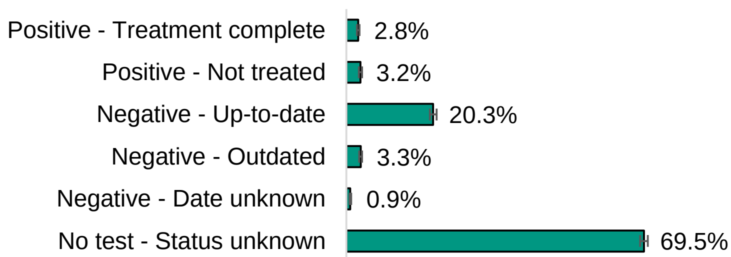
IMMUNIZATIONS

Diabetes has long been known to be a risk factor for active tuberculosis (TB) and reactivation of latent TB. In turn, TB infection can have a negative impact on glycemic control and drug-drug interactions can further complicate these comorbidities, leading to a reduction in the effectiveness of both TB and diabetes treatments.[30] A large proportion of people with diabetes are undiagnosed with TB, or diagnosed with TB too late.

IHS SOC recommends TB testing as least once after diabetes diagnosis in order to identify and better manage these conditions. AI/AN patients with diabetes have a particularly high risk of contracting TB. For example, TB infection rates for AI/ANs (total population) are approximately 2 times the U.S. average. Also, people with diabetes have a 3 times higher risk of TB than the general population.[31]

For 70% of patients, TB status was unknown (or screening was not offered). One reason for this high proportion may be the barriers in completing the PPD skin test which includes return visit to the provider 48-72 hours to have the results read.

Figure 11. Tuberculosis testing among patients, 2011-2015



Among all Audit patients 6% of the sample had a positive TB result on record (Figure 11). One out of five patients with a TB test on record, had a positive test result. Furthermore, only 50% of those who tested positive, successfully completed treatment (3% of total sample). Both males and females were equally likely to have a positive test results (Table 12), however, the risk of a positive outcome increased with age and duration of diabetes. Females were less likely to have had a TB test (OR=0.80, p<0.01), as were older patients (age 45-64: OR= 0.81, p<0.01 and age ≥65, OR=0.80, p<0.01) and those with a longer diagnosis of diabetes (duration 5-9 years: OR=0.59, p<0.01 and duration ≥10 years, OR=0.51, p<0.01).

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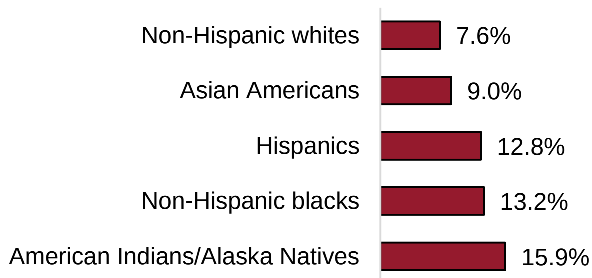
Table 12. Association of tuberculosis outcome between selected groups, 2011-2015

	Positive test			No test		
	%	OR	p	%	OR	p
Sex						
Male	5.7%	referent		72.3%	referent	
Female	6.2%	1.08	0.39	67.7%	0.80	<0.01
Age						
18-44	2.6%	referent		78.9%	referent	
45-64	5.8%	2.31	<0.01	68.4%	0.81	<0.01
≥65	12.0%	5.12	<0.01	68.1%	0.80	<0.01
Duration						
<5 years	4.3%	referent		75.2%	referent	
5-9 years	6.4%	1.52	<0.01	64.0%	0.59	<0.01
≥10 years	8.9%	2.21	<0.01	60.6%	0.51	<0.01

DISCUSSION

While still posing a significant threat, recent evidence suggests that the epidemic of diabetes among AI/ANs may have reached a threshold. For instance, the prevalence of diabetes among AI/AN adults increased only slightly from 15.2% in 2006 to 15.9% in 2012. During this same period, the general U.S. prevalence grew from 9.3% to 11.7%.[32] Therefore, the gap between AI/AN people and the general U.S. prevalence appears to be narrowing, however, it remains that AI/ANs have the highest age-adjusted prevalence of diabetes among all U.S. racial and ethnic groups (Figure 12).[4]

Figure 12. Diabetes prevalence among U.S. adults by race/ethnicity, 2010-2012



Source: 2010-2012 National Health Interview Survey and 2012 Indian Health Service's National Patient Information Reporting System

This report summarizes trends in clinical outcomes among AI/AN patients with diabetes from Urban Indian Health Organizations. The majority of Audit patients showed good glycemic control and met many lipid targets. Our analysis showed that 80% of patients prescribed lifestyle modifications alone to manage their diabetes met the population target of A1c below 8.0%. Additional progress could be made targeting the 30% of current smokers, the 92% overweight or obese, and possibly the 32% of patients with active depression. In addition, there remains room for improvement in routine foot, eye, and dental examinations, as well as offering diabetes self-management education to patients.

Two considerations should be noted while interpreting the results of this report. First, these findings do not reflect changes experienced by individual patients over time but rather reflect population characteristics. Second, while all facilities that receive SDPI funding are expected to participate in the Diabetes Audit, not all Audited patients are necessarily participating in SDPI-funded programs.[33] Table 13 includes a partial list of diabetes-related services offered at SDPI-participating facilities.

Table 13. Proportion of I/T/U* facilities with access to treatment and prevention services before and after SDPI implementation, 1997-2010

	Before SDPI funding (1997)	After SDPI funding (2010)
Diabetes clinics	31%	71%
Diabetes clinical teams	30%	94%
Diabetes patient registries	34%	94%
Nutrition services for adults	39%	89%
Access to registered dietitians	37%	77%
Culturally tailored education programs	36%	99%
Access to physical activity specialists	8%	74%
Adult weight management programs	19%	76%

*Indian Health Service (IHS), tribal, and urban (I/T/U) Indian health programs

DISCUSSION

There is evidence to suggest that these improvements in access to treatment and prevention services are having a positive impact on both personal and federal cost savings.[34] Care for patients diagnosed with diabetes account for more than one in five health care dollars in the U.S. One cost saving example reported by SDPI is an estimated 28% decline in end-stage renal disease (ESRD) cases in AI/AN diabetes patients from 1999-2006, with a single case of ESRD accounting for over $80,000 per year in Medicare cost.

Both the direct and indirect medical costs of diabetes are a substantial burden on society. Indirect medical costs include disability, work loss, and premature death. And while it's easier to monitor diabetes care and outcomes in quantitate values, it's also critical to focus on the health-related quality of life aspect as these factors may also impact clinical outcomes.[35] For example, modest weight loss may improve lipid or A1c indicators, while at the same time reduce pain, improve mobility, and increase mental health status, allowing a patient to more easily perform daily tasks.

Diabetes was virtually unknown in Native communities until after World War II when the first cases of the disease were reported to IHS providers.[36] Over the past half-century, the disease has caused substantial pain and hardship to the AI/AN community. Many studies have explored the disparities in disease burden experienced by AI/AN people. Likely contributors to the diabetes epidemic include genetic, environmental, and behavioral factors, however, the approximate impact of each of these forces is still under investigation.

Primary prevention efforts are supported by evidence of the significant impact of both environmental and behavioral risk factors in the development of diabetes. A 2006 study with the Pima Indians concluded that the development of Type 2 diabetes and obesity were in-large part preventable and primarily attributable to behavioral and lifestyle factors, and not genetic factors alone.[36,37] In response, a number of public health advocates have been leveraging a return to traditional AI/AN practices to address diabetes. These programs include the incorporation of physical activities such as farming and dancing and promoting more traditional foods such as wild game (e.g. elk, rabbit), berries, root vegetables, etc. This is seen as an important strategy in improving the physical, mental, social, and spiritual health of AI/ANs.

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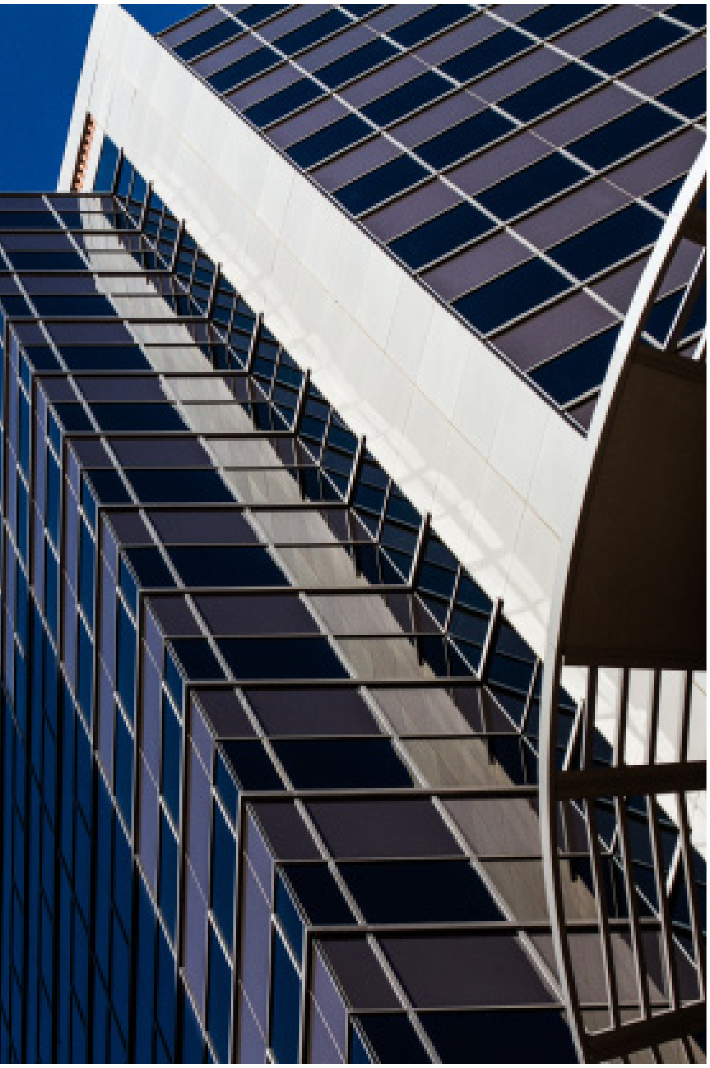

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