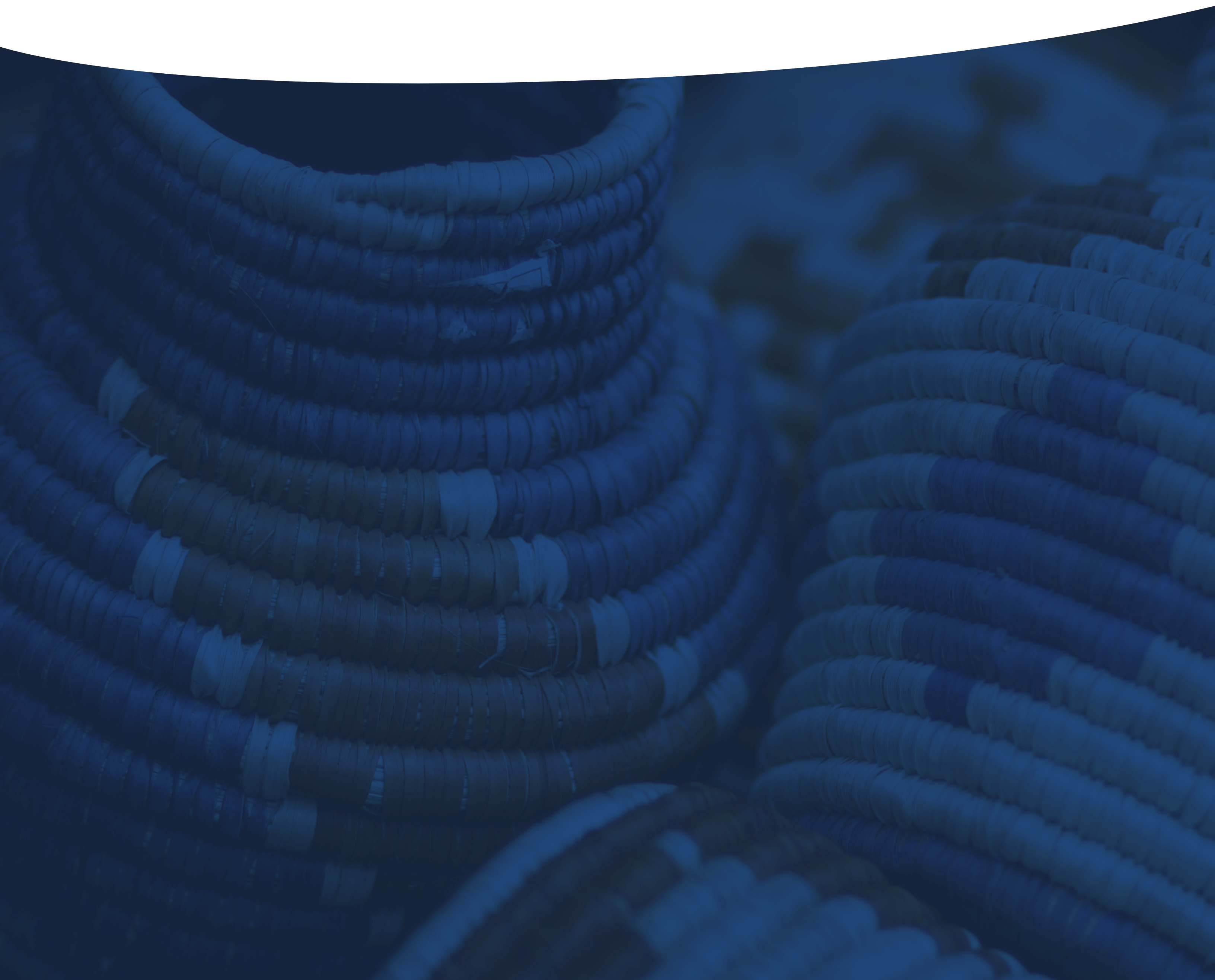
Urban Diabetes Care and Outcomes Summary Report, Audit Years 2012-2016

Aggregate Results from Urban Indian Health Programs

August 2017

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



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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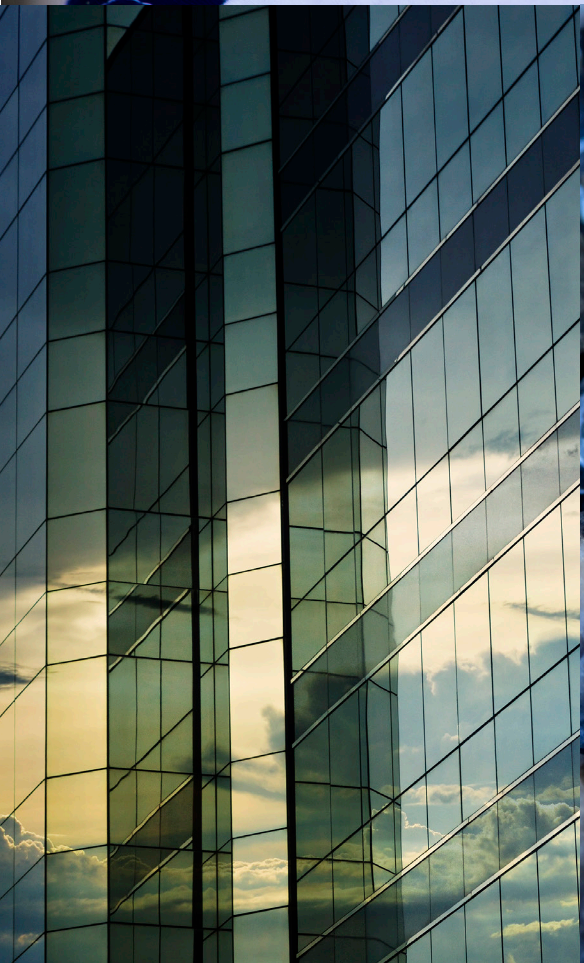
UIHI acknowledges the Special Diabetes Program for Indians (SDPI) for the contributions to AI/AN health at Urban Indian Health Programs across the country. These advances in diabetes care and outcomes are evident throughout both urban and rural Indian Country since 1997.

The Urban Indian Health Institute would like to thank the staff at Urban Indian Health Programs for the excellent work they do each day for, and on behalf of their communities.

TABLE OF CONTENTS


Executive Summary

In 1997, Congress responded to the growing burden of type 2 diabetes in the American Indian and Alaska Native (AI/AN) population by funding the Special Diabetes Program for Indians (SDPI). [1] This report documents SDPI data for 30 Urban Indian Health Programs (UIHP) participating in the Diabetes Care and Outcomes Audit to detail current strengths and issues in diabetes care. This report contributes to understanding the overall status of diabetes management in Indian Country by giving a picture of trends in urban areas.

Data for this analysis was collected and submitted to the IHS by participating UIHPs for the years 2012-2016. The IHS Division of Diabetes Treatment and Prevention (DDTP) then provides these data to the Urban Indian Health Institute for analysis and reporting purposes.

Key Findings

- **Almost one third of all Diabetes Audit patients (31%) achieved glycemic control (defined as A1c < 8.0%) by the end of the Audit Period (2016).**
- **76% of Diabetes Audit patients achieved blood pressure targets (BP < 140/90 mmHg).**
- **79% of patients prescribed lifestyle modification alone (diet and exercise) achieved glycemic control (A1c <8.0%).**
- **Over 80% of Audit patients received diabetes self-management education.**
- **Nearly 3 out of 4 patients received nutrition counseling and physical education (72% and 74% respectively).**
- **Nearly 1 in 3 Audit patients are dealing with depression (32%).**
- **37% of Audit patients received dental screening examinations, 52% received foot exams and 67% received retinal exams**
- **The majority of Audit patients did not complete PPD (tuberculosis) screening (72%).**

During the Audit period of 2012-2016, UIHPs have maintained or experienced marked improvements in important diabetes clinical care outcomes. Glycemic control, mean blood pressure, and coverage of diabetes nutrition counseling and physical activity education are some of the notable improvements in this report. Additionally, these findings demonstrate the resilience and perseverance of those in the urban Indian community who currently live with, treat and manage diabetes.

The Special Diabetes Program for Indians has significantly contributed to improved health of AI/AN with diabetes in the last twenty years. With 25% of the 2012-2016 Diabetes Audit population under 45 years old, now is a critical time to support continued funding of diabetes programming in Indian Country to ensure life-saving services for current and future generations. For continued success in diabetes care and achieving outcome targets, UIHI recommends the following:

- Investigating barriers and support systems to completing the PPD skin test.
- Supporting lifestyle modification as a first-line therapy, since more than seven out of ten patients prescribed this option achieved glycemic control.
- Improving quality of life and health for patients dealing with depression and diabetes.
- Investing in clinical and community programs targeting pre-diabetes (A1c between 5.7-6.4%).

INTRODUCTION

Importance of SDPI: Re-Writing History

The Diabetes Epidemic

In 1963 the first research study was done that identified diabetes as an epidemic in the Pima Indians of Arizona.[1] Until then, the legacy of genocidal policies that affected AI/AN metabolic health had not been widely acknowledged in the arena of public health. By 2015, 15.1% of AI/AN adults (aged 18 and older) were diagnosed with type 2 diabetes, compared to only 7.4% of Non-Hispanic White (NHW) adults, making the national prevalence of diabetes among AI/ANs more than double that of NHW Americans. [2]

The national prevalence of diabetes among AI/ANs is more than double Non-Hispanic White (NHW) Americans

Source: Vital Signs, CDC, 2017

Compared to the general population, AI/ANs with diabetes are more likely to experience diabetes-related complications such as kidney failure, heart disease, and death.[3] AI/AN populations are also present in greater numbers among high risk categories of diabetes precursors such as poor nutrition, insufficient physical activity, heart disease, depression, and obesity.[4] SDPI has addressed such issues in AI/AN health disparities through critically needed programs and surveillance. Clinical measures of these risk categories are therefore measured in the Diabetes Audit, in addition to the standard indicators of diabetes and its complications.

Financial Rewards

In addition to saving lives, SDPI has been responsible for an astronomical reduction in federal spending for patients with diabetes and diabetes-related complications. As estimated by the National Indian Health Board, it is 2.3 times more expensive to treat diabetic patients than a comparable population without diabetes.[5] The increase in evidence-based and community-directed initiatives in Indian country have provided critical resources to improve diabetes prevention, treatment, and education.

As a result of the SDPI, inexpensive yet highly cost-saving measures have been established for diabetes care and prevention. Some examples are the establishment of diabetes-focused clinical teams, diabetes patient registries, culturally tailored diabetes education tools, nutrition services for children and youth, physical activity programs for school-age youth, and weight management programs for adults.[7]

INTRODUCTION

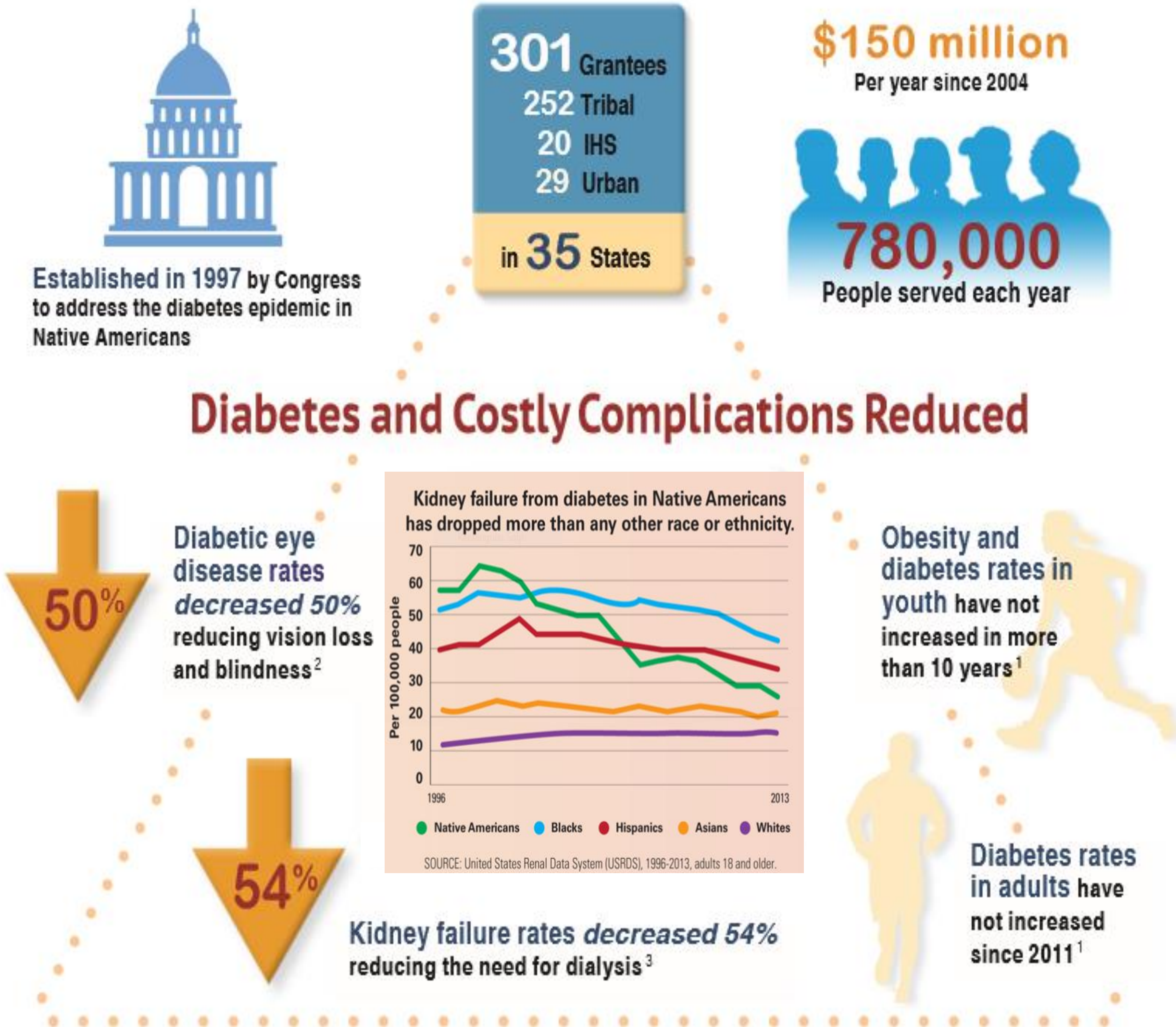


Figure 1. Special Diabetes Program for Indians Financial Returns on Investment

Source: Changing the Course of Diabetes, IHS SDPI, 2017.
https://www.ihs.gov/sdpi/includes/themes/newihstheme/display_objects/documents/factsheets/SDPI_FactSheet_July2017.pdf

Diabetes: Between 1996 and 2014, mean A1c dropped in the AI/AN population from 9.0% to 8.1%. This improvement in glycemic control was paramount in saving costs associated with uncontrolled blood sugar such as microvascular damage, neuropathy, and cardiovascular disease.[6]

Cholesterol: Mean LDL (“bad cholesterol”) declined by 22% from 1998 to 2014. This reduction in LDL, has clear implications in reducing Medicaid and Medicare spending for more serious conditions such as hypertension, heart attack, and stroke.[7]

INTRODUCTION

Retinopathy: Figure 1 shows that between 1996 and 2013 diabetic eye disease rates decreased by 50%, reducing the social and economic costs of vision loss and blindness.[8]

End Stage Renal Disease (ESRD): Reduction of kidney disease was arguably the most significant financial return from SDPI. During the period between 1999 and 2006 incidence of ESRD declined by 28% in AI/AN populations, the greatest reduction among any racial / ethnic group in the United States. The impact of this was reducing the most expensive treatment associated with diabetes, hemodialysis (kidney dialysis,) estimated to cost approximately $80,000 per person. In 2013 Medicare spending to treat diabetes-related kidney failure was $14 billion dollars.[2] Additionally, clinical qualifiers of pre-diabetes, such as obesity have dramatically reduced in AI/ANs since the beginning of SDPI (Figure 1).

These are all important benchmarks in moving towards the end of an epidemic, a realistic possibility with continued support from SDPI.

In essence, the Special Diabetes Program for Indians has re-written the history of metabolic disease for American Indians and Alaska Natives, which had otherwise been in critical condition.

INTRODUCTION

Background

Diabetes was virtually unknown in AI/AN communities until after World War II when the first cases of the disease were reported to IHS providers.[9] The legacy of historical determinants that is particular to AI/AN peoples, such as genocide, forced migration, geographical containment, separation of family units, and large-scale cultural suppression until as recently as the 1970s contribute to the stress on immunological and psychological inner resources of AI/AN individuals.[10] The role of "non-directed dietary change," or imposed adoption of post-colonial foods and alcohol, as well as loss of the reservoir of traditional knowledge on wellness practices has also been found to be a contributor to metabolic disease for AI/ANs.[11] However, the approximate impact of each of these determinants on population health is still being explored.

Methods

Data Collection

Data for this report were collected between January 1, 2012 and December 31, 2016 at participating UIHPs (Audit Years 2012-2016). All patients included in this report had a diagnosis of diabetes, were self-identified as AI/AN, and had at least one visit to the UIHP during the Audit period. Patients were excluded if they received a majority of their primary care outside the UIHP. Patients currently on dialysis *and* receiving the majority of their primary care at the dialysis unit were also excluded. Death before the end of the Audit period, pregnant women, pre-diabetics, or patients who moved from the service area were also not included in the Diabetes Audit report.

The data used for the Diabetes Audit is uploaded by UIHPs to the Resources and Patient Management System, or RPMS, which is the electronic health record system used by the IHS to gather epidemiological information and personal health information. This database aids in the management of clinical and administrative information for all IHS healthcare facilities using RPMS. SDPI grantees, such as the Urban Indian Health Programs have continuous access to Diabetes Audit data through the *WebAudit,* a web portal created to provide an online resource. Generally, it is used when retrieving data for annual and periodic audits throughout the year.

Analysis

Results are reported as five-year aggregates on selected indicators to account for small sample sizes from individual facilities. Rounding was used in presenting proportions, therefore the sum of all percentages may not equal 100. Prevalence estimates 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 it is 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; therefore, 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, 95% CIs that did not overlap were used to suggest a significant difference. It should be noted that this is not a formal statistical comparison. Measures of association were used for multivariate analysis where a certain modifiable or non-modifiable exposure was tested regarding IHS DDTP required key measures. Chi-squared tests and logistic regression were used to establish significance of these predictors.

Odds ratios were calculated for some indicators and defined as the ratio of the odds of an event occurring in one group to the odds of it occurring in another group. The odds ratio specifies the likelihood or probability of a condition or event for one group compared to another group. An odds ratio of 1 indicates that the condition or event under study is equally likely to occur in both groups. An odds ratio greater than 1 indicates that the condition or event is more likely to occur in the first group than the second group. An odds ratio less than 1 indicates that the condition or event is less likely to occur in the first group than the second group.

Stata version 13.1 (Stata Corp., College Station, Texas) was used to perform all statistical analyses. All statistical testing was done at a p-value of 05.

Limitations

This report combines patient data from Audit Years 2012-2016 for 30 facilities shown in Map 1. This is done to increase sample size and ensure confidentiality of patients and facilities. This method increases statistical power, but has its limitations, some of which are listed below.

In addition, some measures have a high proportion of missing values which can skew results. Calculating standard error with CIs helps to account for uncertainties. Focusing on retrieval or improving documentation of missing data at each facility will raise quality of future reports. Missing data for a given facility may be related to patients' use of multiple health care providers in different health care systems, a lack of ability to collect data on certain measures, small populations in certain disease categories, and insufficient resources to report said outcomes.

Further limitations include the nature of single point surveillance by cross-sectional data collection. The Diabetes Audit provides a snapshot of overall progress among diabetes patients across UIHPs. Due to the nature of urban-rural migration in AI/AN populations, it is assumed that patients may move between rural tribal communities and urban centers. Therefore, random selection of patients attempts to create a representative sample from UIHPs. This will limit bias or modification of results from sampling error.

Percentages in this report are computed as a weighted proportion of all audited records, unless otherwise specified. Some measures have a high proportion of missing values; which are generally excluded or noted. Challenges in capturing data at a given facility may be due to patients' use of more than one health care system and provider, or site-specific limitations in collecting data.

INTRODUCTION

The Diabetes Audit does not collect demographic data on socioeconomic indicators such as education, income, housing, employment status, or mobility; which may provide context around diabetes patient outcomes. Additionally, health indicators not captured by the Diabetes Audit include disability, death, retinopathy and neuropathy. Identifying and collecting additional indicators may provide a more detailed understanding of the progress and challenges of UIHPs.

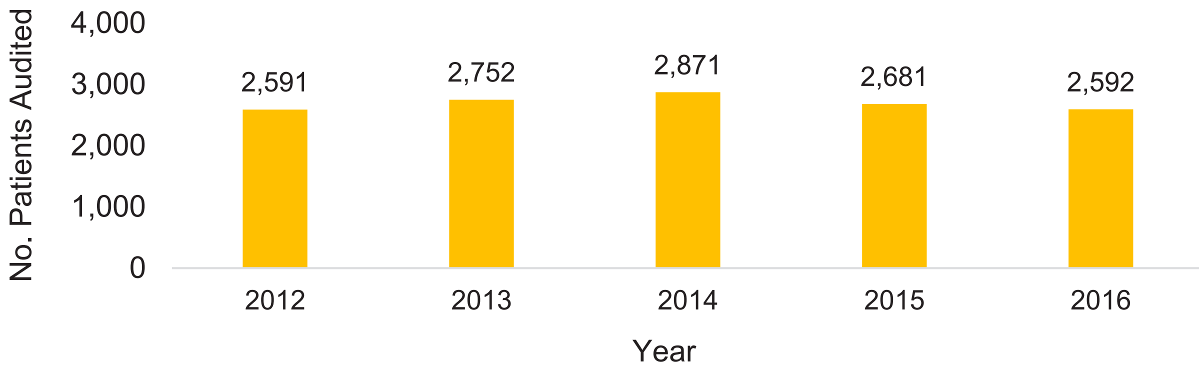
In summary, we have listed the methods and some limitations in working with the IHS Diabetes Care and Outcomes Audit data. While acknowledging that aggregated data cannot distinguish all the specific details of individual programs, in addition to other limitations, we have used all measures to maximize statistical power. This report simply shows proportion estimations, means, odds ratios, and associations based on this unique population of urban Indians who are utilizing UIHPs.

BEST PRACTICE & REQUIRED KEY MEASURES

This report is based on the 2016 IHS Diabetes Best Practices;[9] first developed in 2001 by a workgroup coordinated by the IHS DDTP. Since the Diabetes Audit primarily focuses on clinical care outcomes rather than community outcomes, this report provides information about clinical best practices only. Please visit the IHS website for more detailed information: https://www.ihs.gov/sdpi/sdpi-community-directed/diabetes-best-practices/#BPTOPICS.

Figure 2 shows the number of patients audited between Years 2012-2016. The Diabetes Audit used data from 13,487 patient records from 30 UIHPs providing registry data. Of the outcomes displayed in this report, 19% were recorded in 2016.

Figure 2. Number of Patients Audited (ages ≥18 years), 2012-2016



Source: IHS, Diabetes Care and Outcomes Audit, 2012-2016

The following information is included in the report:

- ✓ **Description of the Best Practice topic and its relevance to diabetes**.
- ✓ **IHS SOC recommendations**
- ✓ **Required Key Measures**: Measures were selected by the IHS workgroup for each *Best Practice* topic area as important indicators that can be used to measure a diabetes program's progress and outcomes. When Diabetes Audit data can be used to evaluate these measures, a graph of aggregate UIHP data is presented, along with a brief description of the results.

Commonly Used Abbreviations	
IHS	Indian Health Service
SOC	Standards of Care
DDTP	Division of Diabetes Treatment and Prevention
SDPI	Special Diabetes Program for Indians
SOS	SDPI Outcomes System
RKM	Required Key Measure
DM type 2, type 2 diabetes, diabetes	Diabetes Mellitus Type II

Source: IHS Standards of Care (SOC), https://www.ihs.gov/diabetes/clinician-resources/soc/

BEST PRACTICE & REQUIRED KEY MEASURES

Best Practice (BP)	Required Key Measure (RKM)
Glycemic Control	Percent of individuals with most recent A1c <8.0%
Blood Pressure Control	Percent of individuals who have mean blood pressure <140/<90 mmHg. - The treatment goal of <140/<90 mmHg is appropriate for most people with diabetes, but some patients may require individualized goals.
Chronic Kidney Disease Screening and Monitoring	Percent of individuals who have both a Urine Albumin-to-Creatinine Ratio (UACR) and estimated Glomerular Filtration Rate (eGFR) completed.
Lipid Management in Cardiovascular Disease	Percent of individuals who are prescribed a statin.
Eye Exam – Retinopathy Screening	Percent of individuals who receive an eye examination. - An eye exam includes a dilated eye exam by an optometrist or ophthalmologist or by using digital retinal imaging.
Foot Exam	Percent of individuals who receive a comprehensive foot exam. - A foot exam includes assessment of sensation and vascular status.
Dental Exam	Percent of individuals who receive a dental exam. - Performed by a dental professional.
Aspirin or Other Antiplatelet Therapy in Cardiovascular Disease	Percent of individuals who are prescribed aspirin or other antiplatelet therapy.
Physical Activity Education	Percent of individuals who receive physical activity education.
Nutrition Education	Percent of individuals who receive nutrition education. - Performed by a Registered Dietitian or other health or wellness program staff.
Diabetes-related Education	Percent of individuals who receive education on any diabetes topic, either in a group or individual setting. - Includes nutrition education, physical activity education, and any other diabetes education.
Depression Screening	Percent of individuals who are screened for depression.
Immunizations	Percent of individuals who have received the following vaccines: Influenza, Pneumococcal, Tetanus/Diphtheria (Td) in the past 10 years, Td and Pertussis (Tdap), Hepatitis B series (3 dose).
Tobacco Use Screening	Percent of individuals who are screened for tobacco use.
Tuberculosis Screening	Percent of individuals who have ever had a TB test result documented.

Source: IHS Standards of Care (SOC), https://www.ihs.gov/diabetes/clinician-resources/soc/

URBAN INDIAN HEALTH PROGRAMS

About the Urban Indian Health Institute

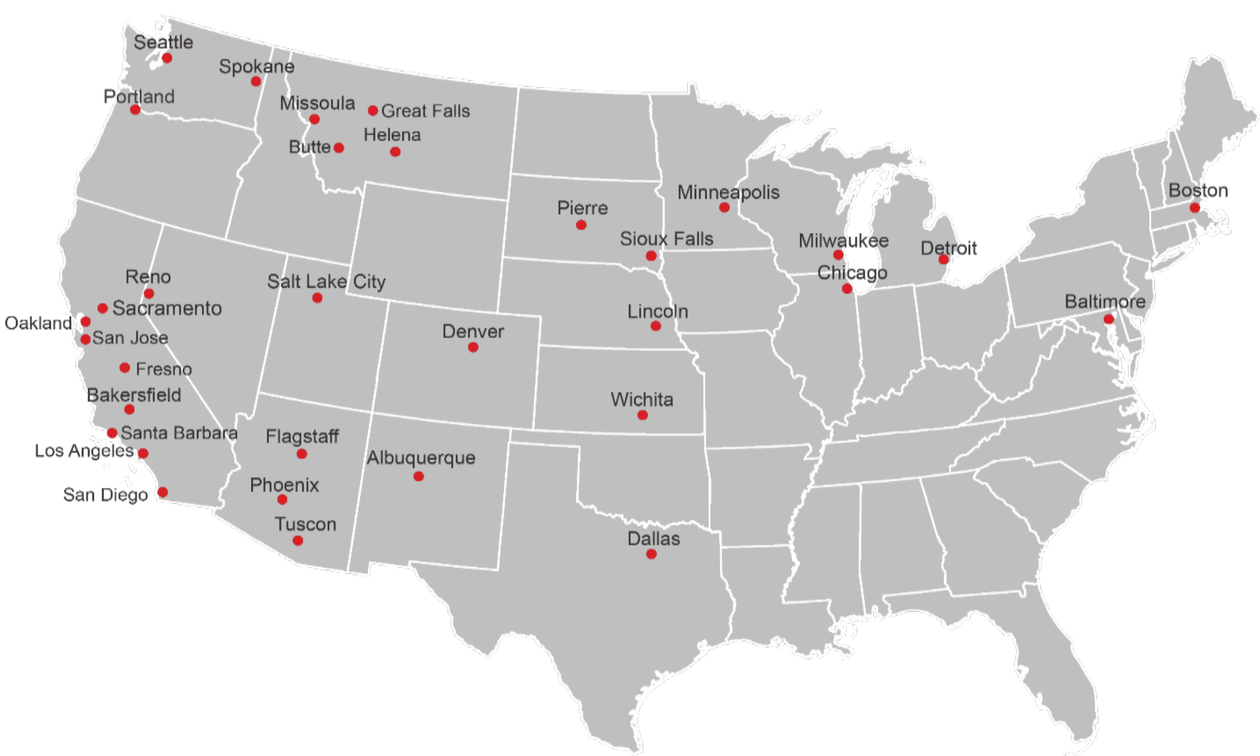
The UIHI, a division of the Seattle Indian Health Board provides centralized nationwide management of health surveillance, research, and policy regarding the health status of urban AI/AN people. The UIHI serves the national network of 33 Urban Indian Health Programs (UIHPs) through assisting these programs in investigation of health data and creating materials or data products for information intended for diverse audiences.

The UIHI offers technical assistance and can assist UIHP diabetes programs to:

- ✓ Develop talking points based on UIHP aggregate data or facility-level diabetes outcomes data;
- ✓ Offer technical assistance to translate audit findings for use in funding proposals;
- ✓ Provide additional data or graphs on subgroups of interest (e.g. mean A1c values for patients with depression);
- ✓ Discuss areas for improvement in data collection or data entry practices; and
- ✓ Provide guidance for the analysis or collection of other sources of data on diabetes patients.

For questions or comments about the UIHI or the Diabetes Audit Summary Report please call (206) 812-3049 or email info@uihi.org.

Map 1. Urban Indian Health Programs



Source: Urban Indian Health Institute, http://www.uihi.org/urban-indian-health-organization-profile

DEMOGRAPHICS

This section describes general characteristics of the Diabetes Audit population, such as age, duration of diabetes, sex, type of diabetes, body mass index, and smoking, because they are risk factors closely linked with increased risk of complications.

Age: The mean age among Audit patients was 53 years old. Most patients (58%) were in the 45-64 age category (Table 1).

Duration of Diabetes: Nine percent of the sample were within their first year of diagnosis. Approximately a quarter of the population have had diabetes 6-10 years. The patient with longest duration since diagnosis was 61 years (mean: 8.7 years) (Table 1).

Sex: The sample consisted of more females (60%) than males (40%) (Table 1).

DM type: While type 1 diabetes accounts for 0.3% of all diagnosed cases in the general population,[12] it accounts for 2% of this patient sample. Ninety-eight percent of Audit patients have been diagnosed with type 2 diabetes (Table 1).

Body Mass Index (BMI): 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. IHS SOC recommends patients with BMI>25 be referred to structured weight loss programs. During the Audit period, 92% of patients were overweight or obese, a major risk factor for DM type 2 [13]. In addition, the mean BMI among the population reviewed was 34.8 (Table 1).

More than 9 in 10 Audit patients were overweight or obese.

Source: IHS Diabetes Care and Outcomes Audit, 2012-2016

Smoking: Current tobacco usage was reported by 31% of Audit patients (Table 1). IHS SOC notes that a brief tobacco intervention can increase quit rates by as much as 80%.[14] Tobacco use is another 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 diabetes than nonsmokers. Furthermore, smoking also makes diabetes harder to control; increasing risk of diabetes-related complications including heart and kidney disease, reduced blood circulation, retinopathy, and peripheral neuropathy.[15]

DEMOGRAPHICS

Table 1. Patient Characteristics, 2012-2016

Category	Mean	Proportion
Age (years)	53.0	
Age group (range 18-98 years)		
18-44		25.0%
45-64		57.6%
≥65		17.3%
Sex		
Male		40.0%
Female		60.0%
Diabetes type		
Type 1		2.1%
Type 2		97.9%
Duration (years)	8.7	
Duration (range 0-61 years)		
<1 year		8.6%
1-5 years		34.4%
6-10 years		24.8%
11-15 years		15.6%
≥15 years		16.7%
BMI (kg/m^2) (range 15-85)	34.8	
BMI category (3-levels) *		
Normal		7.8%
Overweight		21.4%
Obese		70.8%
Smoking status		
Non-smoker		68.6%
Smoker		31.4%

*Normal, BMI<25.0; Overweight, BMI 25.0-29.9; Obese, BMI≥30.0
Source: IHS Diabetes Care & Outcomes Audit, 2012-2016

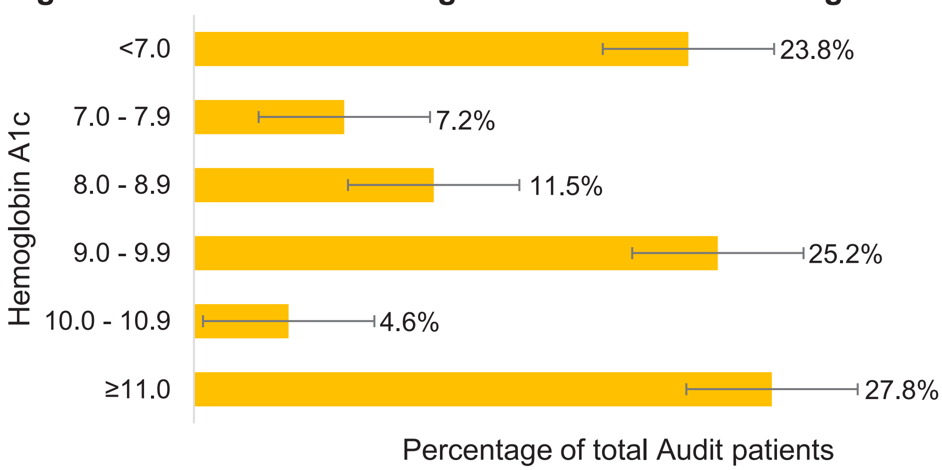
BEST PRACTICE I: GLYCEMIC CONTROL

Definition: Diabetes Mellitus is defined by uncontrolled blood sugar (glycemic) levels, specifically elevated blood sugar (hyperglycemia).[16] This is caused by an inability in the body to use or produce the hormone insulin. When insulin is not functioning, sugar that is consumed builds up in the blood stream, instead of being digested and utilized in the body.[17]

Glycemic targets and Measures: Glycated Hemoglobin A1c (A1c) test is the standard clinical assessment for glycemic control or blood sugar levels. A1c is expressed as the percentage of blood sugar bound to hemoglobin (a protein in the red blood cells), an average taken from the preceding 120 days. This test is done by a medical provider in a clinic or hospital. Patients with A1c levels of 6.5% or greater are classified as diabetic. A1c levels above 9.0 warrant timely care to prevent more serious complications.[18] Acute (current) glycemia level can be tested at home with blood glucose meters, requiring a small drop of blood from the finger.[18] It is normal for glycemic levels to vary throughout the day, therefore, A1c is used as a more robust indicator for disease management.[16]

IHS guidelines: IHS recommends a range for A1c target, rather than a specific value to allow the flexibility needed for patient safety. A range also controls for limitations of A1c testing accuracy.[8] In the general U.S population, people with diabetes aim to achieve a glycemic target (A1c goal) of below 7.0%.[16] 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.[19] Therefore, in this report, A1c targets are defined as an A1c level below 8.0%, to create an achievable goal that does not warrant drastic (and possibly harmful) treatment in order to measure progress. 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.[14]

Figure 3. Most Recent Hemoglobin A1c Results Among Patients, 2012-2016



KEY MEASURE:
Percent of individuals with most recent A1C <8.0%

Source: IHS Diabetes Care & Outcomes Audit, 2012-2016

Figure 3, above, shows glycemic control by A1c outcome of 2012-2016 Diabetes Audit patients. Glycemic control (A1c < 8.0%) was achieved by 31% of patients. The remaining (69%) had A1c levels of 8.0% or greater. Among patients outside the glycemic target range (A1c > 8.0%), one quarter had an A1c level within the range of 9.0-9.9%, and more than one quarter had A1c levels greater than or equal to 11.0%. A1c levels above 10.0% require urgent attention to avoid long-term complications and tissue damage.[20]

BEST PRACTICE I: GLYCEMIC CONTROL

Table 2. Glycemic Control (A1c <8%) and Selected Risk Factors, 2012-2016

	Mean A1c (%)	OR	p-value
Sex			
Male	8.0	referent	
Female	8.0	1.05	0.28
Age (years)			
18-44	8.4	referent	
45-64	8.0	1.48	<0.001
≥65	7.4	2.66	<0.001
Duration of diabetes			
<5 years	7.6	referent	
5-9 years	8.0	0.64	<0.001
≥10 years	8.4	0.46	<0.001
BMI category (3-levels)			
Normal	8.1	referent	
Overweight	8.0	1.12	0.20
Obese	8.4	1.05	0.55
Smoking status			
Non-smoker	8.0	referent	
Smoker	7.9	1.01	0.72

Source: IHS Diabetes Care & Outcomes Audit, 2012-2016

Table 2 describes demographic characteristics of the 2012-2016 Audit patient group.

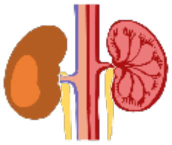
Sex: Among Diabetes Audit patients, sex was not associated with glycemic control.

Age: As age increased, mean A1c decreased. Patients in the youngest age category of 18-44 years had the highest mean A1c (8.4%), indicating that these patients need further attention in achieving glycemic control. Patients in the oldest age category, 65 and above, were 2.7 times more likely to have glycemic control. Patients in the 45-64 age group were 1.5 times more likely to achieve glycemic control compared to the youngest age group. A1c outcomes were better for older patients, compared to younger patients. Onset of diabetes at an older age, in general means patients are less likely to experience complications that develop after living with the disease for many years.[7]

Duration of Diabetes: Mean A1c increased with duration of diabetes. Recently diagnosed patients (within the last five years) had the lowest mean A1c (7.6%). Patients with a longer duration of diabetes (between 5-9 years) were 36% less likely to achieve glycemic control than a newly diagnosed patient (OR=0.6, p<0.01). Patients with diabetes for 10 or more years had a mean A1c of 8.4%, and are 54% less likely to achieve good glycemic control than patients with diabetes less than five years (OR= 0.5, p<0.01).

BMI: BMI was not associated with glycemic control.

Smoking: Smoking behavior was not associated with glycemic control.



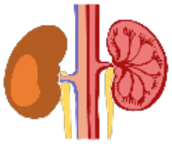
BEST PRACTICE II: CHRONIC KIDNEY DISEASE MANAGEMENT

Definition: Chronic Kidney Disease (CKD) is identified as elevated levels of blood sugar that disrupt the body's filtration system, causing it to filter blood at a slower rate. Diabetes significantly increases risk of developing CKD. 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.[21]

Renal Targets and Measures: 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).[13] These assessments are indicated at first diabetes diagnosis and then at least annually thereafter to assess the effectiveness of intervention. The UACR test assesses urine albumin excretion and is reported as the ratio of milligrams of albumin to grams of creatinine. By IHS standards normal albumin (normo-albuminuria) excretion is 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.

IHS Guidelines: IHS SOC recommends both estimated glomerular filtration rate (eGFR) and urine albumin-to-creatinine ratio (UACR) to screen, diagnose, and monitor the progress of CKD. Both eGFR and UACR can be used to assess the effectiveness of intervention (medication, hemodialysis, or other).

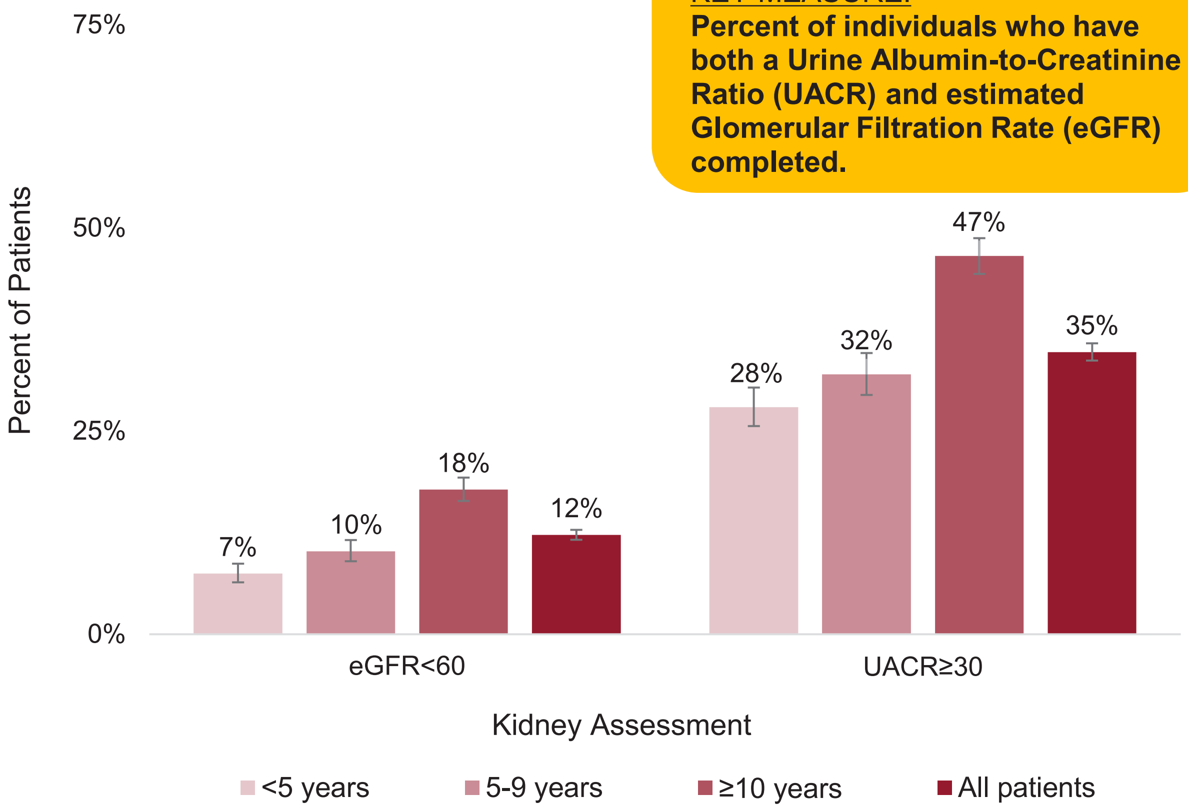
Two out of every 3 cases of renal disease among AI/AN people can be directly linked to DM type 2.[2]



BEST PRACTICE II: CHRONIC KIDNEY DISEASE MANAGEMENT

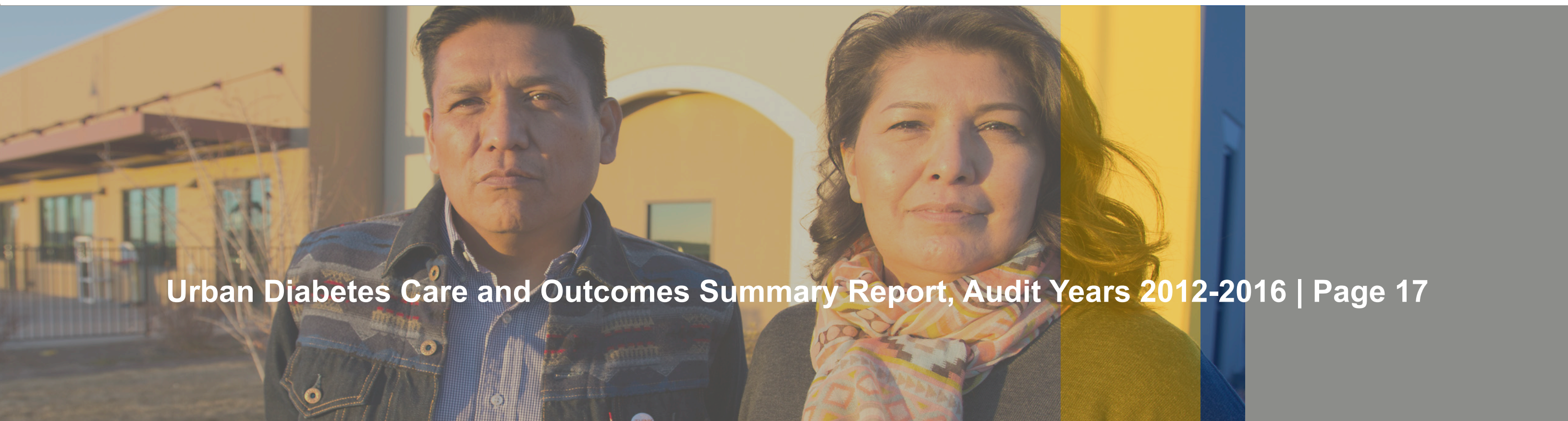
Figure 4. Percent of Patients With Unmet Renal Targets (eGFR and UACR) by Duration of Diabetes, 2012-2016

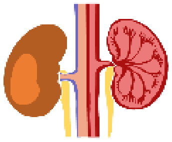
KEY MEASURE:
Percent of individuals who have both a Urine Albumin-to-Creatinine Ratio (UACR) and estimated Glomerular Filtration Rate (eGFR) completed.



Source: IHS Diabetes Care & Outcomes Audit, 2012-2016

Figure 4 highlights the proportion of patients who have kidney dysfunction (eGFR<60mg/dL) and kidney disease (UACR>= 30mg/g) by duration of diabetes. Overall, the proportion of patients achieving eGFR was higher than the proportion achieving UACR targets (88% vs. 65%). Ninety percent of patients diagnosed with diabetes within the last 5-9 years achieved eGFR >60 mg/dL whereas only 68% achieved UACR targets. Of patients with a duration of diabetes for 10 or more years, 82% achieved eGFR targets and only 53% achieved UACR targets.





BEST PRACTICE II: CHRONIC KIDNEY DISEASE MANAGEMENT

Table 3. Association Between Kidney Dysfunction Relative to Age and Duration of Diabetes, 2012-2016

	Kidney Dysfunction (eGFR <60 L/min/1.73m²)				Kidney Damage (UACR >= 30 mg/g)			
	Mean	**%CKD**	**OR**	**p-value**	**Mean**	**%CKD**	**OR**	**p-value**
Age (years)								
18-44	94.0	3.0%	referent		134.6	32.6%	referent	
45-64	82.4	10.4%	3.73	<0.001	144.0	35.0%	1.11	0.15
≥65	66.8	29.4%	13.67	<0.001	166.8	43.0%	1.53	<0.001
Duration								
<5 years	85.9	7.5%	referent		75.7	28.0%	referent	
5-9 years	84.03	10.2%	1.41	<0.002	100.5	32.0%	1.21	<0.024
≥10 years	78.18	17.8%	2.69	<0.001	236.0	46.6%	2.25	<0.001

Source: IHS Diabetes Care & Outcomes Audit, 2012-2016

Table 3 shows the percentage of kidney dysfunction (eGFR <60 mL/min/1.73m^2) and kidney damage (UACR >=30 mg/g) by age and duration of diabetes in the Diabetes Audit population. Table 3 also shows the likelihood among subgroups of experiencing these two conditions.

Age: As age increases, mean eGFR decreased. The oldest patients (≥65 years) were 13.7 times more likely to experience kidney dysfunction than the youngest patients (18-44 years) (OR=13.7, p<0.001). As age increases, mean UACR increased. The oldest patients (≥65 years) were 1.5 times more likely than the youngest patients (18-44 years) to experience kidney damage (OR=1.5, p<0.001). Approximately one third of patients in the youngest (18-44) and middle (45-64) age groups had kidney damage (33% and 35%), and 43% of the 65 and older group.

Duration of diabetes: As duration of disease increases, mean eGFR decreased. Patients with a diagnosis of diabetes of 10 or more years were 2.7 times more likely to experience kidney dysfunction than patients with a diagnosis of less than 5 years (OR=2.7, p<0.001). Patients diagnosed with diabetes for 10 or more years were 2.3 times more likely to have microalbuminuria compared to those with a diagnosis of less than 5 years (OR=2.3, p<0.001).

Metformin and CKD

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 Diabetes Audit patients (64%, Table 8, page 27). In 2016, the U.S. Food and Drug Administration revised 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/1.73m^2). Previously, metformin was not suggested for CKD patients due to risk of developing lactic acidosis or excess lactic acid in the blood.[52]

BEST PRACTICE III: LIPID MANAGEMENT

Definition: Blood lipids include low-density lipoproteins (LDL), high-density lipoproteins (HDL), and triglycerides. Lipid management is critical because adults with diabetes have a 2-4 times higher risk of experiencing cardiovascular events than adults without diabetes.[7] While many factors account for this increase in risk, dyslipidemia (lipid abnormalities) is one major contributor. Diabetic dyslipidemia commonly manifests as elevated triglycerides and low levels of HDL cholesterol (Table 4).[22] Non-HDL cholesterol is also shown in the data below. Non-HDL is calculated as total cholesterol minus HDL cholesterol. This measure may be a stronger predictor of cardiovascular disease (CVD) than LDL cholesterol or triglycerides because it correlates highly with plaque promoting lipoproteins.[22]

Lipid Targets and Measures: In this report, four categories of blood lipids are tracked. The four clinical metrics are LDL, with a target level of less than 100 mg/dL; HDL, with a target level of greater than or equal to 60mg/dL; triglycerides, which are desirable to maintain at a blood concentration below 150 mg/dL; and non-HDL, which are ideal at a concentration below 130 mg/dL.

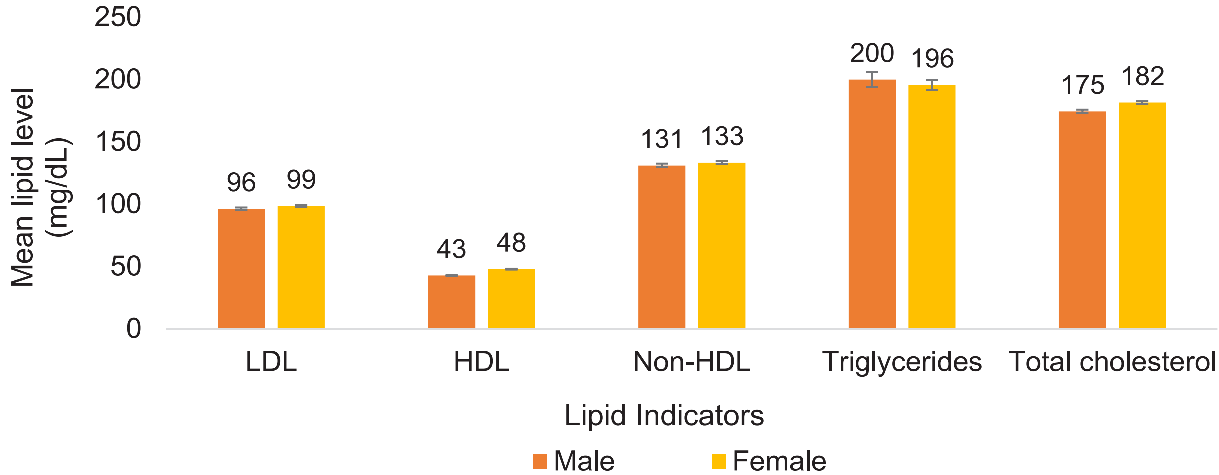
IHS Guidelines: IHS SOC recommends an annual lipid profile (i.e. LDL, HDL, non-HDL, triglycerides, and total cholesterol) for all patients with diabetes and subsequent treatment primarily with statin drugs when indicated.[23]

Table 4. Lipid Profile Standards, 2012-2016

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
Non-HDL	Less than 130 mg/dL	Elevated[24]

Source: American Heart Association, Cholesterol Abnormalities and Diabetes

Figure 5. Mean Lipid Indicators by Sex, 2012-2016



Source: IHS Diabetes Care & Outcomes Audit, 2012-2016

Figure 5 highlights lipid levels by sex. The mean LDL level for males was 96 mg/dL and 99 mg/dL for females; both groups met the target of < 100 mg/dL, and were not significantly different from each other. Mean HDL levels for male and female patients (43 mg/dL and 48 mg/dL, respectively) were not significantly different, and were both below the desired level. Figure 5 shows that improvement of HDL outcomes is an area in need of attention for Diabetes Audit patients at UIHPs. There was no significant difference in mean non-HDL and total cholesterol levels by sex. Non-HDL and triglyceride targets were not achieved for both sexes, suggesting that these two indicators may also be an area for further attention.

Table 5. Lipid Target Achievement by Sex, 2012-2016

	Male (referent)	Female	OR	p-value
LDL <100mg/dL	57.7%	55.2%	0.90	<0.03
HDL >40mg/dL (males)	48.5%		*	
HDL >50 mg/dL (females)		36.1%	*	
Non-HDL <130 mg/dL	53.3%	51.0%	0.91	0.09
Triglycerides <150 mg/dL	48.5%	45.2%	0.88	<0.01

*Not tested for signficant difference.
Source: IHS Diabetes Care & Outcomes Audit, 2012-2016

Table 5 shows proportion of patients, and likelihood of achieving lipid targets by sex.

Sex: Females were approximately 10% less likely to reach LDL (OR=0.9, p<0.03), non-HDL (OR=0.9, p=0.09), and triglyceride (OR=0.9, p<0.01) targets than males. While it is ideal to keep LDL, non-HDL, and triglycerides under a certain value, it is ideal to keep HDL ("good cholesterol") above >60 mg/dL for both males and females. The lower limit for HDL with regard to cardiovascular risk differs by sex. For males, the lower limit for risk is less than or equal to 40 mg/dL and for females the risk level increases at or below 50 mg/dL[25]. The proportions of Diabetes Audit patients achieving target levels for HDL were 49% of males and 36% of females. The odds, or likelihood, of sex being a predictor of achieving HDL above risk level was not determined due to differing HDL levels that determine risk for males and females.

BEST PRACTICE III: LIPID MANAGEMENT

Table 6. Lipid Targets, Age and Duration of Diabetes, 2012-2016

	LDL <100 mg/dL				Triglycerides <150 <100 mg/dL			
	Mean	**Met Target**	**OR**	**p-value**	**Mean**	**Met Target**	**OR**	**p-value**
Age (years)								
18-44	103.7	47.8%	referent		226.9	41.7%	referent	
45-64	98.9	55.0%	1.33	<0.001	194.4	46.6%	1.22	0.001
≥65	86.1	70.8%	2.64	<0.001	169.9	52.6%	1.55	<0.001
Duration								
<5 years	100.7	51.3%	referent		201.6	46.3%	referent	
5-9 years	98.0	55.4%	1.18	<0.012	199.5	44.5%	0.93	0.27
≥10 years	94.0	61.9%	1.54	<0.001	191.2	48.3%	1.08	0.18

* LDL target <100 mg/dL, Triglyceride target <150 mg/dL
Source: IHS Diabetes Care & Outcomes Audit, 2012-2016

Table 6 shows mean lipid level values, the proportion of Audit patients that met targets and the likelihood of achieving LDL and triglyceride targets by age and duration of diabetes.

Age: As age increased the proportion of patients meeting LDL and triglyceride targets increased. The oldest patient age group (≥ 65 years) were 2.6 times more likely to achieve LDL targets than the youngest group, aged 18-44 years (OR=2.6, p<0.001). Significantly fewer patients ages 18-44 met LDL targets (48%) as compared to those age ≥65 years (71%). The proportion of patients meeting triglyceride targets also increased with age, though approximately half or less than half of patients did not meet triglyceride targets among all age groups. Older patients (≥ 65) were 1.6 times more likely to meet triglyceride targets than the youngest group (OR=1.6, p<0.001).

Duration of diabetes: As duration of diabetes increased, proportion of patients meeting LDL targets increased. Significantly fewer patients with diabetes less than 5 years met LDL target (51%) than those with the disease for 10 or more years (62%). There was no significant difference in the likelihood of achieving triglyceride targets between patients with a shorter or longer duration of diabetes.

- *There are more Audit patients (both male and female) in the risk category for HDL than in the normal to healthy range for HDL levels. Males were more likely than females to achieve LDL and triglyceride targets.*
- *Mean LDL value for the youngest age group was not within the target range (LDL <100 mg/dL), and the mean LDL value for the 44-65-year age group was close to exceeding the target range.*
- *Patients diagnosed with diabetes for a longer duration had lower mean LDL levels than all other age groups.*

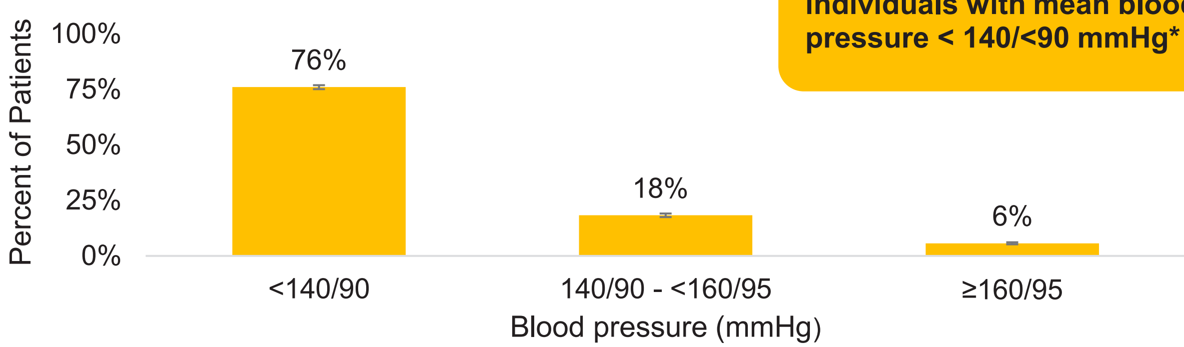
BEST PRACTICE IV: BLOOD PRESSURE CONTROL

Definition: Blood pressure (BP) control is essential in diabetes care. The condition of high blood pressure (systolic/diastolic blood flow > 140/90) is known as hypertension (HTN). An extended period of high blood pressure increases risk for health problems, including cardiovascular disease (CVD). [26] This is particularly important in the Diabetes Audit because adults with diabetes have CVD-related death in almost double the proportion of adults without diabetes.[27] 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 and dyslipidemia therefore have a signficant impact on lowering one's risk of CVD.[28] The risk for developing CVD may be 3-8 times higher for AI/AN patients with diabetes than those without the disease.[3]

Blood Pressure Control and Measurement: Normal blood pressure is defined as 120/80 mmHg. Therefore, any reading above 120/80 mmHg is classified as prehypertension. In a medical setting, hypertension is generally classified as stage 1 HTN, in which BP is in the range of 140/90 mmHg to <160/95 mmHg; and stage 2 HTN in which BP is 160/95 mmHg or higher.[29]

IHS Guildelines: IHS SOC recommends BP screening at diabetes diagnosis and at every doctor's visit thereafter. IHS SOC recommends lifestyle change (see Best Practice: Diabetes Therapy pg 27-30) 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.[28] Daily aspirin therapy is recommended for diabetes patients with increased risk for CVD, depending on age and sex. In addition, statin therapy is recommended for all patients with diabetes between ages 40-75 years if diagnosed with CVD.[23]

Figure 6. Mean Blood Pressure*, 2012-2016

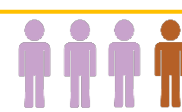


KEY MEASURE: **Percent of individuals with mean blood pressure < 140/<90 mmHg***

*Mean blood pressure taken at last 2-3 visits
Source: IHS Diabetes Care & Outcomes Audit, 2012-2016

Figure 6 shows that 76% of Diabetes Audit patients reached the BP target (mean blood pressure below 140/90 mmHg). Stage 1 HTN was found in 18% of patients (BP of 140/90mmHg - 160/95 mmHg). Stage 2 HTN was found in 6% of patients (BP of 160/95 mmHg and above).

3 out of 4 Audit patients achieved blood pressure in the target range (BP <140/90mm Hg)



BEST PRACTICE IV: BLOOD PRESSURE CONTROL

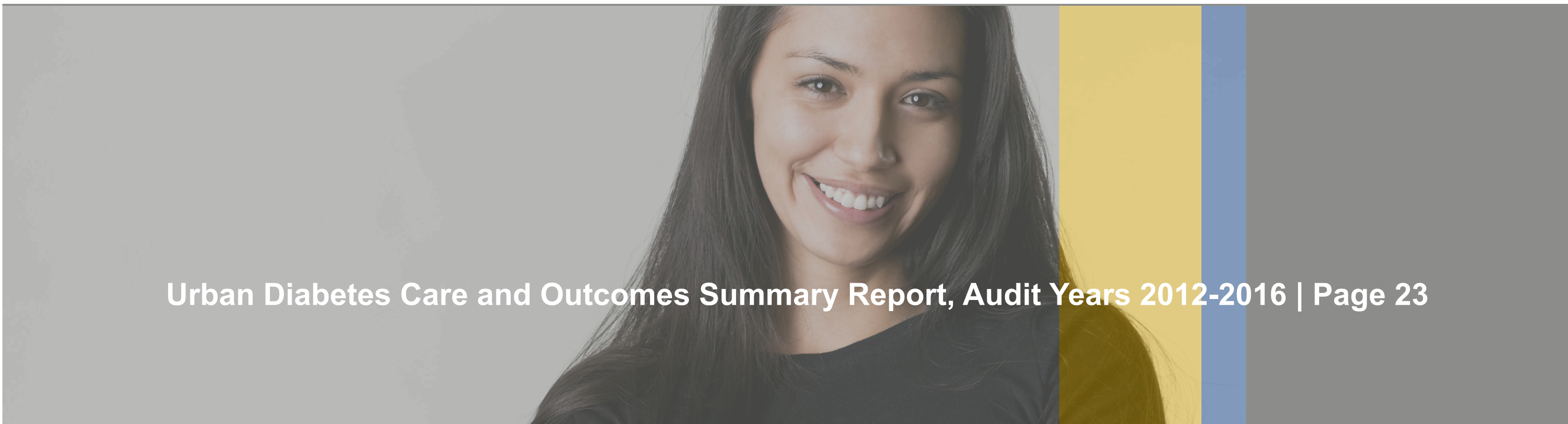
Table 7. Comorbidities and Therapy Prescription in Selected Groups, 2012 -2016

	UACR ≥30mg/g	Diagnosed HTN	Diagnosed CVD	Statin	Aspirin	ACE inhibitor or ARB
All patients	35.8%	66.9%	14.7%	46.1%	52.6%	66.2%
Sex						
Males	40.2%	73.0%	18.4%	49.4%	57.8%	70.5%
Females	32.7%	62.9%	12.1%	43.8%	49.1%	63.3%
Age						
18-44	32.6%	46.9%	5.1%	30.0%	34.7%	52.9%
45-64	35.0%	70.0%	13.7%	48.5%	56.3%	69.3%
≥65	42.5%	84.8%	30.9%	58.8%	66.3%	74.9%
UACR ≥30 mg/g	-	76.4%	20.1%	56.3%	63.0%	78.1%
Diagnosed HTN	40.0%	-	19.7%	52.3%	55.4%	76.0%
Diagnosed CVD	50.5%	85.4%	-	55.8%	65.4%	70.3%

Source: IHS Diabetes Care & Outcomes Audit, 2012-2016

KEY MEASURE: Percent of individuals who take a statin

Table 7 addresses comorbidities (the presence of two or more chronic diseases together) and therapies for HTN and CVD across sex, age, and diagnosis of kidney disease. As noted above, ACE inhibitors or ARB are a class of medications prescribed for hypertension. Statins, shown above, are a group of medications that block the production of cholesterol (lipids) and are therefore prescribed for CVD. Aspirin based medications are blood thinners, and prescribed for both HTN and CVD.[26] The groups above were selected to to identify the proportion of Audit patients with comorbidities and prescribed medications.



BEST PRACTICE IV: BLOOD PRESSURE CONTROL

Sex: The proportion of females diagnosed with HTN (63%) and CVD (12%), and prescribed selected therapies were all less than males in the Diabetes Audit group (Tables 7).

Age: The proportion of patients that were comorbid with HTN, CVD, and kidney damage, increased with age. Prescribed medications for these conditions also increased with age in the Diabetes Audit patient population (Table 7).

Kidney Damage: Of patients with kidney damage (UACR ≥30mg/g), approximately three quarters had hypertension, and 78% were using ACE inhibitors or ARB. A lower proportion (20%) were diagnosed with CVD. More than half of patiens with kidney disease were on statins and aspirin (Table 7).

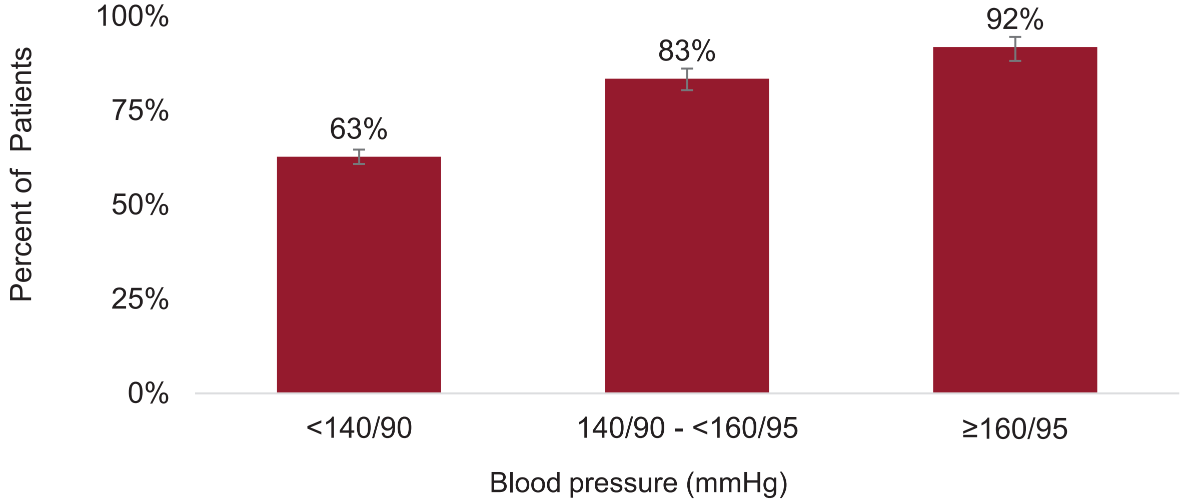
Diagnosed HTN: More than half of patients diagnosed with HTN were also taking statins and aspirin during the Audit period. Approximately three out of four (76%) were taking ACE inhibitors/ARB (Table 7).

Diagnosed CVD: Half of Diabetes Audit patients diagnosed with CVD were comorbid with kidney disease and 85% were comorbid with HTN. In accordance with high levels of CVD in this patient population, 56% were taking statins and 65% were taking an aspirin. These data were not collected for 2012. Results for CVD patients have been collected since 2013 (Table 7).

Almost half of Diabetes Audit patients (46%) are taking a statin to treat CVD.

BEST PRACTICE IV: BLOOD PRESSURE CONTROL

Figure 7. Proportion of Patients Previously Diagnosed with Hypertension by Blood Pressure* Category, 2014-2016



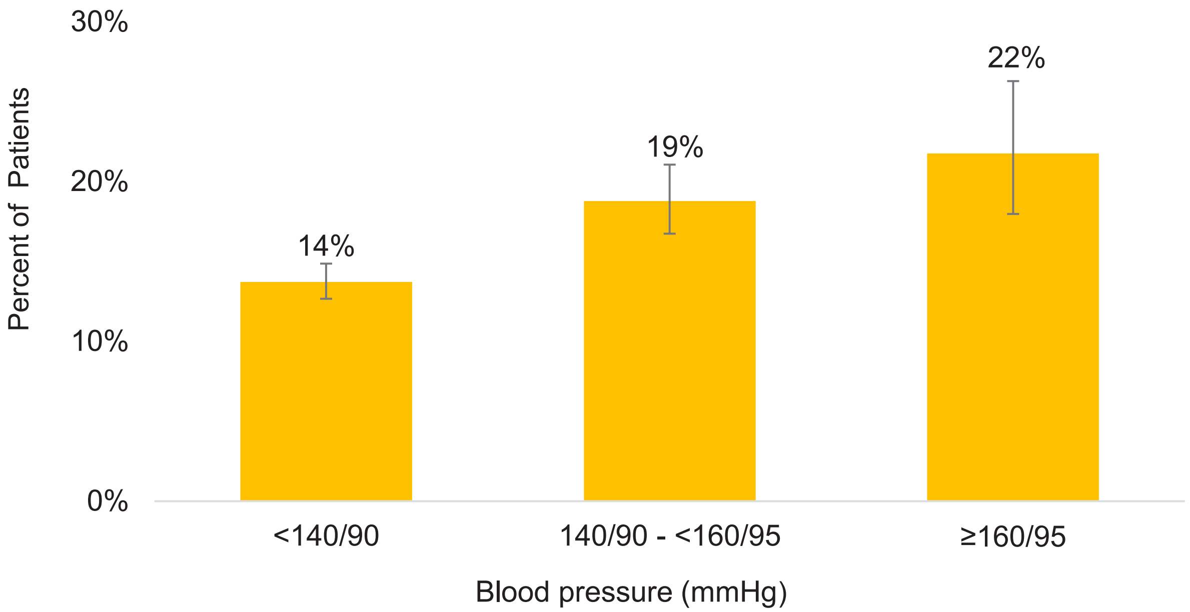
*Mean blood pressure taken at last 2-3 visits
Source: IHS Diabetes Care & Outcomes Audit, 2014-2016

Figure 7 highlights the proportion of patients with previously diagnosed HTN within mean BP category.

Of patients who reached BP targets (<140/90 mmHg), 63% were previously diagnosed with HTN. Approximately 8 out of ten patients in the high BP range (140/90 mmHg - <160/95 mmHg) and approximately nine out of ten patients with mean BP 160/95 mmHg or higher, had a previous diagnosis of hypertension, and still have the diagnosis. This figure shows the need for ways to support diabetic patients with HTN. This figure is also a reminder of the urgency to continue screening for HTN and CVD during diabetes followup care, since untreated HTN can lead to CVD and stroke.[30] It should be noted that the data in this figure was only available from the latter half of the Diabetes Audit period (2014-2016).

BEST PRACTICE IV: BLOOD PRESSURE CONTROL

Figure 8. Porportion of Patients with Previously Diagnosed Cardiovascular Disease by Blood Pressure Category, 2013-2016



Source: IHS Diabetes Care & Outcomes Audit, 2013-2016

Figure 8 highlights the proportion of patients diagnosed with CVD by blood pressure category. Of Diabetes Audit patients identified with CVD, 14% were in normal BP range (<140/90 mmHg), whereas, approximately two fifths of Diabetes Audit patients could be classified with stage 1 (19%) and stage 2 (22%) hypertension. Given that CVD is a newer indicator in Diabetes Audit data, Figure 8 only applies to Audit years 2013 - 2016.

BEST PRACTICE V: DIABETES THERAPY

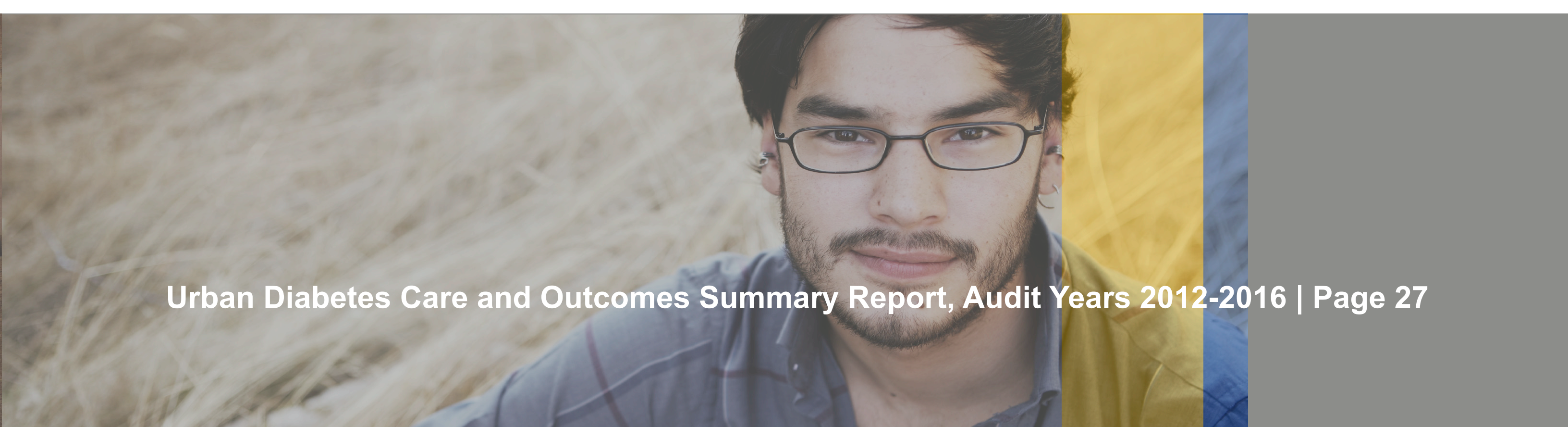
Definition: Diabetes medications include both oral and injectable therapies. Metformin, an oral medication, is the most commonly prescribed therapy for Audit patients (64%; Table 8). The most common injectable therapy is insulin, which is a first-line therapy for patients who lose the ability to produce insulin, or do not produce insulin naturally, such as patients with type 1 diabetes.[31] 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. Diet and Exercise alone (with no other prescription medications) are also considered a diabetes therapy in the Diabetes Audit.

Table 8. Most Common Diabetes Medications Prescribed Alone or in Combination, 2012-2016

Medication	Prescription
Oral Therapies	
Metformin	64.1%
Sulfonylureas	23.9%
Thiazolidinediones	0.5%
DPP-4 inhibitors	3.4%
Meglitinides	4.7%
SGLT2 inhibitors	0.3%
Alpha-glucosidase inhibitors	0.1%
Bile acid sequestrants	0%
Injectable Therapies	
Insulin	36.9%
GLP-1 receptor agonists	1.9%
Amylin analogues	<1%

Source: IHS Diabetes Care & Outcomes Audit, 2012-2016

More than 6 out of 10 patients take Metformin orally.



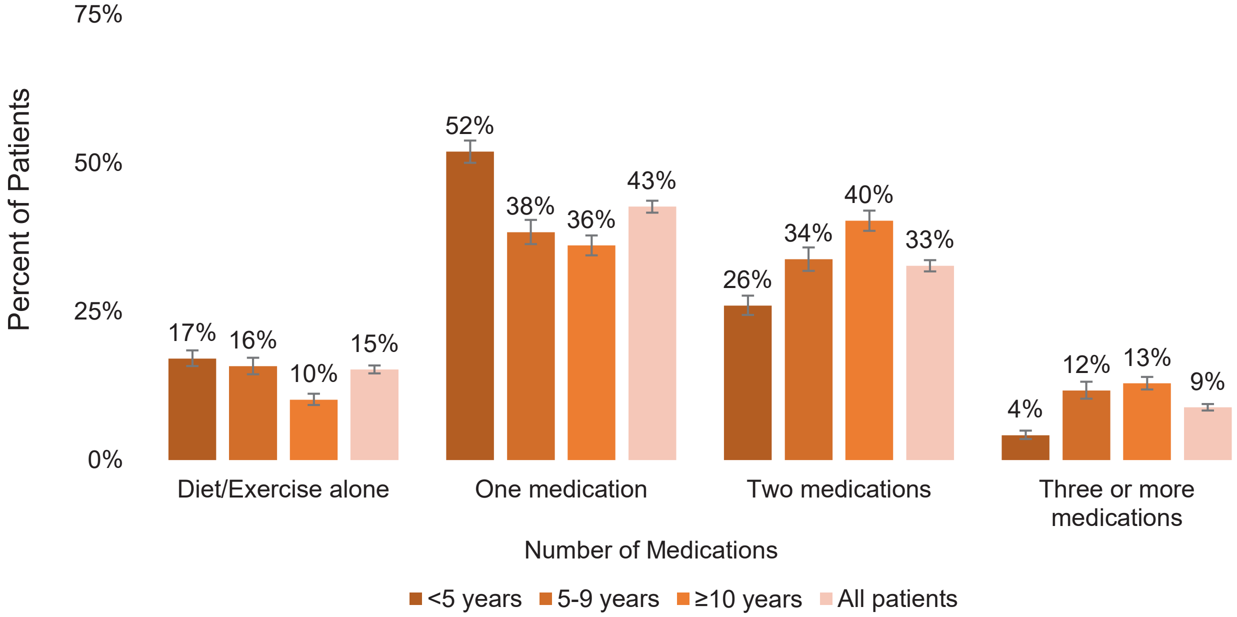
BEST PRACTICE V: DIABETES THERAPY

IHS Guidelines: IHS SOC recommends that individuals with Type 2 diabetes are prescribed lifestyle changes (e.g. diet and exercise) to manage their condition before prescription medication. The American Diabetes Association recommends initiating use of a pharmaceutical agent (e.g. metformin monotherapy) only if these lifestyle 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.[31] However, taking multiple medications complicates diabetes self-management, and presents a risk of adverse interactions.[32] [33]

IHS SOC emphasizes the need for individualized treatment plans for patients based on a patient-centered approach to care.[34, 35] 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%.[36]

Lifestyle modification has been shown to reduced incidence of Type 2 diabetes in a diverse population.[7] IHS and ADA provide lifestyle interventions that include a combination of diet and exercise recommendations. A key recommendation for diabetic patients is a combination of aerobic and resistence exercises for insulin resistance and type 2 diabetes. An example of one such routine is power-walking and weight training. Walking 7900 steps daily is suggested for male adults, 8300 steps daily for female adults, and 12000 steps daily for children.[37] Many other resources for lifestyle interventions exist online, including a culturally informed physical activity toolkit made by IHS called “The Physical Activity Kit (PAK)”, which can be found at: https://www.ihs.gov/hpdp/pak/.

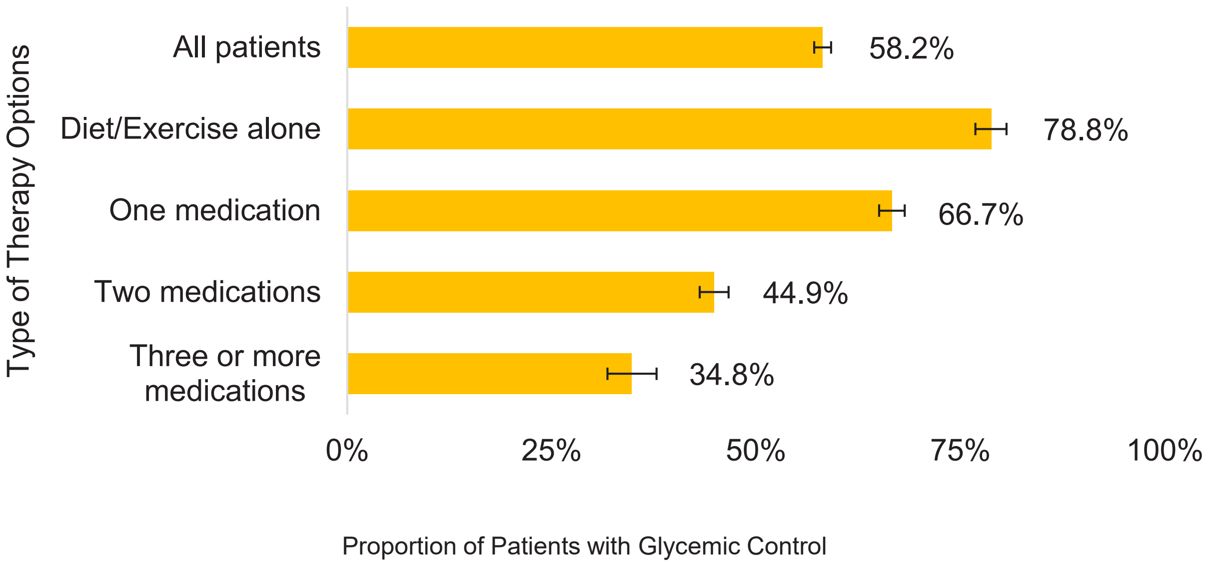
Figure 9. Diabetes Therapies Prescribed by Duration of Diabetes, 2012-2016



Source: IHS Diabetes Care & Outcomes Audit, 2012-2016

Figure 9 shows four therapy categories: diet and exercise alone, and patients prescribed one, two, and three or more medications by their healthcare provider. Among all Diabetes Audit patients, 15% were prescribed diet and exercise alone. A greater proportion of recently diagnosed patients (within <5 years of diabetes diagnosis) were prescribed lifestyle modification (17%) compared to those living with diabetes for ≥10 years (10%). Approximately one in ten Audit patients were prescribed three or more medications. Only 4% of patients with shorter disease duration (<5 years) were taking three or more medications compared to 12% and 13% for the other age groups. Overall, Audit patients with a longer duration of diabetes were taking more prescribed medications for diabetes.

Figure 10. Proportion of Patients Achieving Glycemic Control (A1c <8.0%) by Therapy Options, 2012-2016



Source: IHS Diabetes Care & Outcomes Audit, 2012-2016

Almost 60% of all Diabetes Audit patients (Figure 10) achieved A1c below 8.0%. The proportion of Audit patients who met the A1c target declined across different therapy options with those taking three or more medications having the lowest proportion achieving an A1c level < 8.0%. Of patients achieving A1c below 8.0%, 79% were prescribed lifestyle modification alone. A significantly higher proportion of patients prescribed one diabetes medication (67%) met the target A1c level than those prescribed two medications (45%) or those prescribed three or more medications (35%). The findings illustrated in Figure 10 support the recommendation to prescribe lifestyle modification as a first-line therapy, since more than seven out of ten patients prescribed this option achieved glycemic control.

BEST PRACTICE VI: SCREENING EXAMINATIONS & HEALTH EDUCATION

Definition: Poor glycemic control may cause significant microvascular damage, obstructing circulation to small blood vessels in the body. The three areas of the body that are most vulnerable to microvascular damage are the eyes, mouth, and toes. Three complications of advanced diabetes are retinopathy (eye damage), periodontal disease (dental issues), and peripheral neuropathy (loss of sensation and tissue damage in the toes and fingers).[18] In the United States general population, diabetes is the leading cause of kidney failure, nontraumatic lower limb amputations, and new cases of blindness among adults. Furthermore, AI/AN with diabetes have 2-3 times more advanced periodontal disease than AI/AN without diabetes. [38]

KEY MEASURE:
Percent of individuals receiving

- **Screening examinations: dental, eye, comprehensive foot (sensation and vascular status)**
- **Education: nutrition, physical activity, diabetes-related topics (in group or individual setting)**

IHS Guidelines: Routine examination of a patient's mouth, eyes, and feet are part of IHS SOC recommendations, which allows for early identification of microvascular damage. These are three medical screenings that are included in the Diabetes Care and Outcomes Audit data to track whether these complications are being diagnosed and treated. IHS SOC recommends patients with diabetes receive individualized education (either as formal educational programs, or through brief visits with a provider) at diagnosis and as needed thereafter. The Diabetes Audit tracks physical education, nutrition counseling, and diabetes self-management education (DSME) which may also include "other" blood glucose monitoring, medication adherence, risk reduction, healthy coping, and problem solving.[39] DSME is a critical strategy for reducing the risk of diabetes-related complications.

8 out of 10 patients received diabetes self-management education (DSME)

Some key principles of DSME are:

- Describing the *diabetes disease process* and *treatment options*
- Incorporating *nutritional management* into lifestyle
- Incorporating *physical activity* into lifestyle
- Using *medication(s)* safely and for maximum therapeutic effectiveness
- *Monitoring blood glucose* and other parameters and interpreting and using the results for self-management decision making
- Preventing, detecting, and treating *acute complications*
- Preventing detecting, and treating *chronic complications*
- Developing personal strategies to address psychosocial issues and concerns
- Developing personal strategies to promote health and behavior change[39]

BEST PRACTICE VI: SCREENING EXAMINATIONS & HEALTH EDUCATION

Table 9 shows medical screening coverage for foot, eye, and dental exams, as well as Diabetes related education, including topics on physical activity, nutrition, and DSME recorded in the 2012-2016 Audit period.

Table 9. Screening Examinations and Education Received, 2012-2016

Examinations	
Foot Exam	67.7%
Eye Exam	52.1%
Dental Exam	36.5%
Education	
Physical Activity Education	73.5%
Nutrition Education*	71.7%
DSME (Diabetes Self-Management Education)	80.9%

*Instruction by registered dietician or another provider
Source: IHS Diabetes Care & Outcomes Audit, 2012-2016

Foot exams were received by 68% of patients in the Audit group.

Approximately 52% of patients received an annual eye examination.

Dental exams were received by 37% of patients across all UIHPs. Out of the three routine examinations for diabetes patients, dental coverage was the lowest. Expansion of dental services or improved data collection on dental coverage is an area of need at UIHPs across the country.

Most patients (81%) received DSME. Physical activity education and nutrition counseling were received by more than 70% of all patients.

It is possible that a higher proportion of patients are receiving the above educational items than is reflected in the Diabetes Audit, due to diverse ways that counseling is offered, documented, and received in medical settings.[39]

Nearly 3 out of 4 patients received nutrition counseling and physical education

BEST PRACTICE VII: DEPRESSION SCREENING AND MANAGEMENT

Definition: Depression is defined as a chronic mood disorder that causes a loss of interest in daily activities and a feeling of sadness.[40] A diagnosis of diabetes or depression has been found to increase the risk of developing the other.[26] The comorbidity of depression and diabetes is further complicated as the effects of depression may influence an individual's ability to successfully manage diabetes.[41]

IHS Guidelines: IHS SOC recommends screening adults with diabetes for depression at regular intervals; however, the optimum frequency for depression screening is unknown. The estimated overall prevalence of depression in all people with diabetes is 8%.[41] The rate for AI/ANs is estimated to be more than three times higher at 28%. Furthermore, depression remains undiagnosed and untreated in two out of three patients who have diabetes.[42]

KEY MEASURE:
Percent of individuals who are screened for depression

Table 10. Active Depression Reported, 2012-2016

	Active Depression	OR	p-value
All Patients	32.4%	-	-
Sex			
Male	25.0%	referent	
Female	37.4%	1.80	<0.01
Age			
18-44	32.7%	referent	
45-64	34.3%	1.08	0.16
≥65	25.7%	0.71	<0.01
Duration			
<5 years	28.3%	referent	
5-9 years	34.6%	1.34	<0.01
≥10 years	37.9%	1.55	<0.01
Smoking status			
Non-smoker	30.0%	referent	
Smoker	38.1%	1.44	<0.01
Blood sugar control			
A1c < 8.0%	31.5%	referent	
A1c ≥ 8.0%	34.0%	1.12	0.02

Source: IHS Diabetes Care & Outcomes Audit, 2012-2016

Table 10 shows the proportion of Diabetes Audit patients with active depression (self-reported) across select demographic and risk factors. The estimated prevalence of depression among all Audit patients was 32%. Table 10 also shows likelihood of subgroups having depression.

Nearly 1 in 3 Audit patients are dealing with depression

BEST PRACTICE VII: DEPRESSION SCREENING AND MANAGEMENT

Sex: A higher proportion of females reported depression than males (37% vs. 25%, p<0.01). Females were approximately two times more likely to report depression compared to males (Table 10).

Age: The youngest age category (18-44 years old), were as likely as middle-aged patients (45-64 years) to report depression (OR=1.1, p=0.16). The oldest patients (≥65 years) were significantly less likely to report depression than the youngest patients (OR=0.7, p<0.01, Table 10).

Duration of Diabetes: Patients who were diagnosed with diabetes in the last 5-9 years and those diagnosed ≥10 years ago were more likely to report depression than those patients diagnosed less than five years ago (OR=1.3, p<0.01; OR=1.6, p<0.01, respectively) (Table 10).

Smoking: Previous studies have shown a significant association between diagnosis of depression and substance use (including tobacco abuse) among AI/AN patients with diabetes.[43] Among Diabetes Audit patients with depression, 38% were smokers. Smokers were 1.4 times more likely to report depression than non-smokers (Table 10).

Glycemic Control: Patients with depression were slightly less likely to meet A1c targets of A1c < 8.0% (OR=1.1, p=0.02). Depression impacts self-management tasks such as medication adherence, other positive health behaviors, and has impacts on physiological outcomes such as glucose levels.[42] Therefore, it is important to attend to depression in diabetes patients to improve both quality of life and physical

A greater proportion of Diabetes Audit patients with active depression did not achieve glycemic control.

BEST PRACTICE VIII: IMMUNIZATION

Definition: 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). Diabetes puts a strain on the immune system, increasing the risk for acquiring certain vaccine-preventable diseases. Some illnesses (e.g. influenza) can raise blood glucose to dangerous levels.[44]

IHS Guidelines: IHS SOC recommends special considerations in administering hepatitis B vaccine to patients over the age of 60.

KEY MEASURE:
Percent of individuals who received

- **Influenza vaccine**
- **Pneumococcal vaccine**
- **Tetanus/Diphtheria**
- **Tetanus/Diphtheria/ Pertussis**
- **Complete Hepatitis B series**

Table 11. Immunizations by Age and Duration of Diabetes, 2012-2016

	Influenza	Pneumococcal	Td	Tdap	Hepatitis B
Age (years)					
18-44	47.4%	53.0%	59.5%	60.8%	14.0%
45-64	57.0%	69.4%	68.7%	65.9%	14.5%
≥65	62.4%	80.0%	72.2%	63.8%	11.9%
Duration					
<5 years	51.4%	54.8%	58.9%	63.0%	12.0%
5-9 years	55.7%	74.3%	74.5%	69.9%	15.1%
≥10 years	62.9%	82.2%	76.9%	69.7%	16.6%

Source: IHS Diabetes Care & Outcomes Audit, 2012-2016

Table 11 shows immunizations current to the Audit period by age group and duration of diabetes.

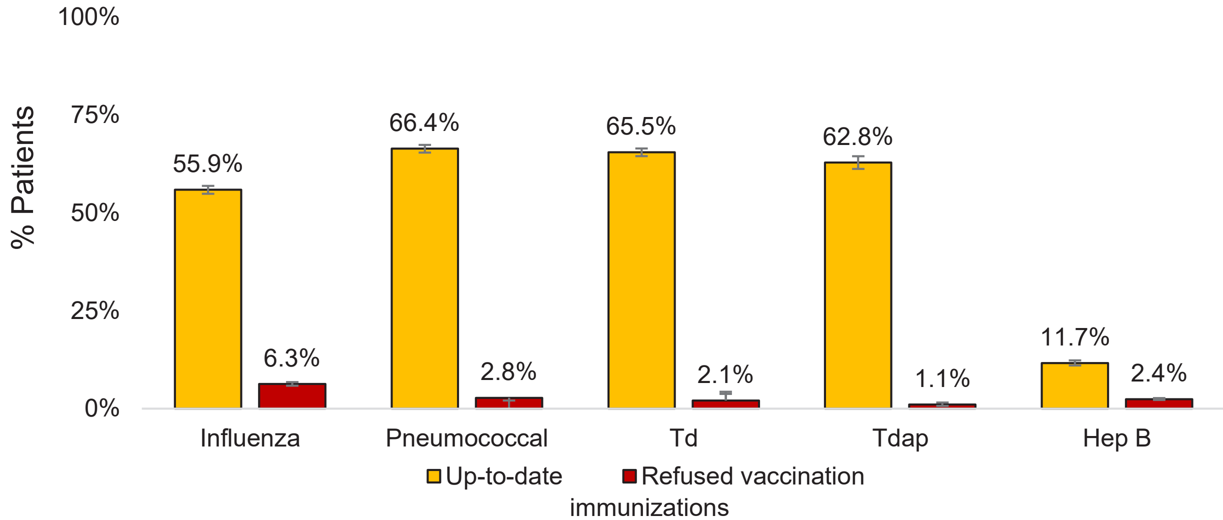
Age: Generally, the proportion of immunized patients increased with age in the Audit period. The exceptions to this pattern were the Tdap and hepatitis B series. It is expected that Tdap immunization is done regardless of age, as it is only administered once in life. Further research is warranted to understand what barriers patients are facing in completing all three visits, and how to support them.

Duration of disease: The proportion of patients immunized either increased or remained the same across duration of diabetes for all vaccines. Less than one fifth of Diabetes Audit patients completed a Hepatitis B series immunization, regardless of the amount of time the patient had been diagnosed with diabetes.

While immunization is generally not high among any age or duration of diabetes group, it is evident that the youngest and most recently diagnosed patients need special attention and encouragement to pursue and complete their immunizations.

BEST PRACTICE VIII: IMMUNIZATION

Figure 10. Immunization status including proportion of vaccine refusals, 2012-



Source: IHS Diabetes Care & Outcomes Audit, 2012-2016

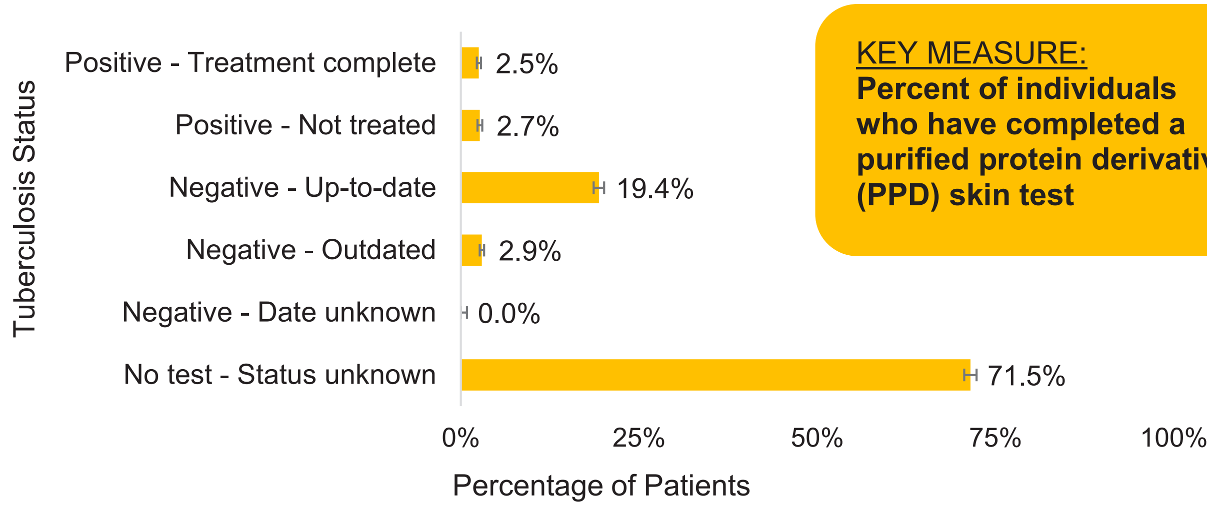
Figure 11 shows that the proportion of completed immunizations were higher for vaccines that did not require annual visits. Approximately 56% of patients received a flu shot during the Audit period. A higher proportion of patients were current with pneumococcal (66%), Td (66%), and Tdap (63%) vaccines. A significantly lower proportion of patients completed the 3-dose hepatitis B series (12%), as compared to all other vaccines. The highest proportion of refusals were for the flu vaccine (6%). Overall, coverage was above 50% for all immunizations except the hepatitis B series. This figure demonstrates a remaining need for increased immunization coverage in the Diabetes Audit patient population to minimize the harm of preventable diseases.

BEST PRACTICE IX: TUBERCULOSIS SCREENING AND MANAGEMENT

Definition: Tuberculosis (TB) is an infection caused by inhalation of the microorganism *Mycobacterium tuberculosis*. It is highly contagious and can be fatal if untreated. Often, the fundamental risk factors for diabetes, such as poverty or limited access to comprehensive healthcare are also the same for active tuberculosis and reactivation of latent TB. In turn, TB infection can have a negative impact on glycemic control. Drug interactions can further complicate these comorbidities, leading to a reduction in the effectiveness of both TB and diabetes treatments.[45] A large proportion of people with diabetes are undiagnosed with TB, or diagnosed with TB too late.

IHS Guidelines: IHS SOC recommends TB testing at least once after diabetes diagnosis to identify and better manage these conditions. AI/AN patients with diabetes have a particularly elevated risk of contracting TB. Tuberculosis infection rates for AI/ANs in the total US population are approximately twice the U.S. average.[45] Additionally, people with diabetes have a 2-6 times higher risk of contracting TB than the general population.[46]

Figure 12. Tuberculosis Testing Among Patients, 2012-2016



KEY MEASURE:
Percent of individuals who have completed a purified protein derivative (PPD) skin test

Source: IHS Diabetes Care & Outcomes Audit, 2012-2016

Of patients that tested positive for TB, only 50% were treated.

Figure 12 shows that TB status was unknown for the majority of patients (72%). For 5% of Audit patients, TB status was positive, half of which completed treatment, and approximately half of which did not begin or complete treatment. Approximately 3% of Audit patients had an outdated TB test. This figure suggests that there is a greater need for follow-up on TB testing for Diabetes Audit patients. Improving PPD screening will not only protect diabetic patients who are vulnerable to TB, but also elders and children who are at greater risk for contracting TB.

Table 12. Tuberculosis Outcome in Selected Groups, 2012-2016

	Positive test			No test in record		
	Percent	**OR**	**p-value**	**Percent**	**OR**	**p-value**
Sex						
Male	4.8%	referent		74.6%	referent	
Female	5.4%	1.15	0.15	69.4%	0.77	<0.01
Age (years)						
18-44	2.2%	referent		74.4%	referent	
45-64	5.1%	2.37	<0.01	70.1%	0.81	<0.01
≥65	9.8%	4.79	<0.01	71.9%	0.88	<0.07
Duration of Diabetes						
<5 years	3.8%	referent		77.4%	referent	
5-9 years	5.8%	1.58	<0.01	65.6%	0.56	<0.01
≥10 years	7.8%	2.17	<0.01	61.9%	0.47	<0.01

Source: IHS Diabetes Care & Outcomes Audit, 2012-2016

Table 12 highlights the proportion of patients with a positive TB test by sex, age, and duration of diabetes. Table 12 also shows likelihood of having a positive TB reading, as well as likelihood of having a TB test on record with the patients' UIHP medical provider.

Sex: Both males and females were equally likely to have positive test results, where TB tests were recorded. Females were 23% less likely to have a TB test on record (OR=0.8, p<0.01).

Age: The likelihood of testing positive for TB increased with age among Audit patients. The oldest age group (≥65 years) was 4.8 times more likely than the youngest age group (18-44 years) to test positive for TB. Also, older patients were less likely to have a TB test result on record (Table 12).

Duration of diabetes: Patients with a longer duration of DM type 2 were more likely to test positive for TB. Those diagnosed with diabetes 5-9 years ago were about 1.6 times more likely than recently diagnosed patients (less than 5 years ago) to have a positive test result. Patients diagnosed with diabetes 10 or more years ago were more than twice as likely to have a positive test result compared to those diagnosed in the last 5 years (OR=2.2, p<0.01, Table 12). Likelihood of having a TB test on record decreased with duration of diabetes. Patients having diabetes for 5 or less years were approximately twice as likely to have a TB test on record, when compared to patients having diabetes greater than 5 years.

An majority of Audit patients did not complete their PPD screening. Females, patients between 44-65 years of age, and those with a longer duration of diabetes (5 or more years) were the least likely to have a test result on record. A possible reason for low completion of TB testing may be the necessity for a follow-up visit within 72 hours to assess results. Research is warranted to understand the barriers in completing the PPD skin test, and how to support Diabetes Audit patients in completing this important screening exam.

DISCUSSION

This report summarizes select data from the SDPI "Best Practices" key measures among AI/AN patients from Urban Indian Health Programs. The data indicate great progress, such as the 79% of patients prescribed lifestyle modifications alone to manage their diabetes who met the glycemic target of A1c below 8.0%. Additional progress could be made by giving special attention to the 31% of patients identified as current smokers, the 92% of patients considered overweight or obese, and the 32% of patients with active depression. In addition, there remains room for improvement in routine foot, eye, and dental examinations, immunizations, TB screenings, and documentation of these screening exams.

Even with remarkable fiscal savings and health gains in the last two decades, there is still much to do in the way of diabetes prevention and management for urban Indians. AI/AN adults still have the highest age-adjusted national prevalence of diabetes in the country among all racial and ethnic groups.[47] Care for patients diagnosed with diabetes account for more than one in five health care dollars in the U.S. [5] Both the direct and indirect costs of diabetes are a significant part of medical spending in the United States. Direct costs, being those mentioned in the introduction, and indirect medical costs being due to disability, work loss, and premature death and other issues. Among AI/AN adults, diabetes has remained at a plateau, indicating that current population-level efforts are working, but there are many individuals continuing to battle with diabetes. During this same period, the prevalence of DM type 2 has risen from 9.3% to 11.7% in the general U.S population,[12] demonstrating the success of SDPI in narrowing disparities between AI/ANs and the general population, as well as AI/AN resilience.

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.[48] 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%

Source: SDPI, https://www.ihs.gov/diabetes/?CFID=61424395&CFTOKEN=50607989

DISCUSSION

As seen in this report, many gains have been made since the first identified case of diabetes in Indian country. After 20 years of the Special Diabetes Program for Indians (SDPI), benefits have been well documented. Nevertheless, it is also difficult to quantify prevention of diabetes and adverse complications, as well as the vast improvements in overall wellbeing for so many patients. Therefore, an area of improvement in the Diabetes Audit could be the addition of qualitative items to understand *quality of life*, an important predictor of clinical outcomes.[49] For example, measuring '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. Other areas that are warranted in understanding clinical outcomes are spiritual health, emotional well-being, and cultural connectedness.

In the words of Anishinaabe economist and earth activist, Winona LaDuke, "Diabetes is caused by the rapid transition from traditional foods to industrialized foods, and increasingly, that is occurring across this country, where dietary related illnesses are becoming dominant sources of ill health." LaDuke talks about increasing biodiversity of food plants as a traditional way of combatting metabolic disease, especially among AI/ANs, but also in the general population. She speaks about how the economic, environmental and cultural legacy of colonialism have made "a huge health impact," as well, due to "this loss of access to our traditional foods." [50]

A 2006 study with the Pima Nation concluded that onset of Type 2 diabetes and obesity were in-large part preventable and primarily attributable to environmental and circumstantial factors, not to genetic factors alone.[51] In response to such findings, a number of public health initiatives have leveraged a return to traditional AI/AN practices to address diabetes. These programs include the incorporation of physical activities such as agriculture, dance, and traditional foods, including wild game (e.g. elk, rabbit), berries, root vegetables, etc. by regional variation. Clinical tools that use traditional ecological knowledge have also been developed for health education into culturally appropriate materials. This type of strategy is paramount in re-establishing the physical, mental, social, and spiritual health of AIs/ANs. Therefore, it is important to utilize both the findings from the Diabetes Audit and as well as culture-supporting tools to generate a more comprehensive response to the diabetes epidemic for urban Indians.

UIHI encourages the use of this report for grant writing, program planning, and identifying clinical and community needs. We hope that this will be a useful instrument in furthering the work of Urban Indian Health Programs, community based organizations, hospital providers, wellness programs, public health planners, health advocates, and patients, so that they may approach diabetes with the information and confidence to reclaim AI/AN health.



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NOTES



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