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Type 2 Diabetes in Indigenous Youth Living in Remote Communities

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A B S T R A C T

Type 2 diabetes (T2D) was first noted in Indigenous pediatric populations in the early 1980s. Indigenous children are disproportionately affected, experiencing higher rates of adverse outcomes than children with type 1 diabetes or adults with T2D. Nurse practitioners must manage the screening, diagnosis, and treatment of T2D among Indigenous youth living remotely.

Despite the high rates of type 2 diabetes (T2D) among Indigenous children, the current clinical practice guidelines (CPGs) are inadequate to address the management of T2D in this population. Current guidelines recommend that all children have access to specialist pediatric diabetes care.[1,2] However, it has been found that Indigenous children living in remote communities do not have the same access to specialist care as their urban counterparts. One study found that 18.6% of Indigenous children with diabetes living in remote areas have at least 1 visit with a pediatrician or endocrinologist after diagnosis versus 56% of Indigenous children with diabetes living in urban areas.[3] Health care services in remote communities are often provided by advanced practice nurses at nursing stations with limited access to resources. Along with the lack of access to care, other social determinants of health (SDOHs) experienced by Indigenous populations further increase the risk of T2D among Indigenous youth.[4] Indigenous youth are disproportionally affected by T2D and experience higher rates of adverse outcomes of disease than youth with type 1 diabetes (T1D) and people who have developed T2D in adulthood.[3]

Nurse practitioners (NPs) working in remote areas play a vital role in the care of youth, especially those with T2D who require close management and lack access to specialists in rural settings. NPs must be knowledgeable regarding the culturally relevant screening and medical management of this chronic illness. The purpose of this article is to support NPs in providing culturally appropriate and evidence-based care to Indigenous children with T2D living in remote communities.

Epidemiology

T2D was first diagnosed among youth in the early 1980s when cases were identified among both Pima Indians in Arizona and First Nations in Manitoba.[5,6] At that time, T2D was thought to be an adult-onset disease and had not yet been recognized in other pediatric populations globally. Many factors were believed to contribute to this health disparity in geographically distant Indigenous communities. Both groups had similar histories of colonization, which included the loss of their land, culture, and languages. As a result of colonization, traditional ways of obtaining food became scarce, and Indigenous people began to rely on processed foods. The lack of nutritious food contributed to high rates of obesity among Indigenous children.[5,6]

Since T2D was first identified among Indigenous children, the prevalence has risen in the general population; however, the burden associated with this disease continues to be greatest among Indigenous children around the world. One study performed in the United States found the incidence of T2D in youths 10 to 19 years old was significantly elevated in American Indian populations compared with overall, with an incidence of 32.8 and 13.8 per 100,000, respectively.[7]

A Canadian study found that the prevalence of diabetes was 50% higher among Indigenous youth compared with non-Indigenous children.[3] In addition, youth with T2D tend to experience higher rates of complications, including retinopathy, kidney failure, and peripheral neuropathy, compared with youth diagnosed with T1D.[8] These health complications present significant challenges for Indigenous people living in remote communities because of limited access to care that often requires displacement from their homes/communities and an overall reduction in quality of life.

Etiology/Risk Factors

There is an undeniable link between SDOHs and T2D among Indigenous children.[4] Remote Indigenous communities often have high rates of poverty, low levels of education, and poor access to nutritious foods and health care services.[9] These SDOHs increase the risk of T2D and create barriers to self-management of a chronic disease.

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Obesity is known to be the greatest risk factor for the development of T2D, with 95% of children diagnosed with T2D meeting criteria for obesity.[2] Obesity rates among Indigenous children in Canada are significantly higher than those among non-Indigenous children.[4] In addition, exposure to diabetes in utero increases the risk of obesity and T2D later in life. A study that examined the prevalence of T2D among people exposed to diabetes in utero determined that 44.9% of the participants had developed T2D postpuberty, with higher rates in females.[10] These findings are significant, especially considering the number of Indigenous populations affected by high rates of obesity in males and females.

Although many risk factors of T2D can be modified, many genes have been identified as nonmodifiable risk factors. Specifically, 14 maturity-onset diabetes of the youth genes have been recognized as increasing the risk of T2D in youth.[11] Among those 14 genes is the G319S variant of the *HNF1α* gene, which is 1 particular nonmodifiable risk factor that affects Indigenous populations, specifically the Oji-Cree First Nations people of Canada.[12] This variant of the *HNF1α* gene has a strong association with the development of T2D at younger ages. It was more recently noted that blood glucose abnormalities seen with this genetic variant are most likely due to alterations in the beta cells of the pancreas.[12]

Indigenous youth living in remote communities experience a multitude of risk factors for T2D. Health care services in remote communities are often accessed for episodic or emergent complaints[4] and do not address the need for primary prevention and screening for T2D. NPs working in remote Indigenous communities must be knowledgeable about the risk factors that affect Indigenous youth to ensure appropriate screening for T2D.

Screening

T2D can present with a range of symptoms, including thirst, frequent urination, fatigue, and blurred vision. However, one third of children with T2D are asymptomatic at the time of diagnosis.[13] Youth with T2D have significantly higher rates of hypertension, high total cholesterol, and microalbuminuria at or shortly after diagnosis compared with their T1D counterparts.[8] This is likely because of a period of asymptomatic disease that occurs in T2D when microvascular damage may occur. Asymptomatic disease is a problem in remote communities where there is a paucity of resources because these children are unlikely to present to health care settings. NPs must understand the necessity for screening and, more specifically, who needs to be screened within this high-risk pediatric population.

Current guidelines recommend screening all youth at the onset of puberty or at 10 years of age, whichever comes first, who are overweight or obese and have additional risk factors for diabetes.[1,2] Additional risk factors that are an indication for screening include being a member of a high-risk population, a history of T2D in first- or second-degree relatives, impaired glucose tolerance, polycystic ovarian syndrome, in utero exposure to diabetes, acanthosis nigricans, hypertension, dyslipidemia, nonalcoholic fatty liver disease, and psychotropic medications.[1] Unfortunately, these guidelines do not take into consideration that Indigenous children in remote communities are developing diabetes at younger ages, with 11% being diagnosed before the age of 10 years.[2] Because Indigenous youth are members of a high-risk population, screening would be indicated for all Indigenous youth when only 1 other risk factor is present. Accordingly, screening of Indigenous youth should occur every 2 years and should begin at age 8 when 2 or more risk factors are present and at puberty when 1 or more risk factors are identified.[14]

Screening guidelines for T2D among youth are highly variable across different countries. Although the use of glycated hemoglobin (A1C) for screening and diagnosis of T2D among youth remains controversial and has its limitations, recent guidelines from the American Diabetes Association stipulate that A1C, fasting plasma glucose (FPG), random plasma glucose, and 2-hour plasma glucose during the oral glucose tolerance test are acceptable methods of screening in this population.[1] A1C testing for the screening and diagnosis of T2D in youth has been controversial because it has been shown to be inaccurate in populations with hemoglobinopathies or when hemolyzed.[2] It is recommended to use A1C along with another diagnostic test to improve the detection of T2D.[2] Access to and costs associated with screening tests can be a barrier to performing adequate screening in remote populations. Australasia guidelines suggest using point-of-care (POC) A1C testing as the first line of screening for T2D among youth.[13] This type of testing is a cost-effective, in-office test administered by NPs that is comparable to laboratory A1C testing and can reduce barriers associated with limited accessibility.[15] POC testing in remote communities may improve access to screening and provide more timely results. Although POC screening has been found to have a high degree of accuracy, many jurisdictions have not approved POC testing for diagnostic purposes.[14] Therefore, a positive POC test will still require adequate laboratory follow-up with FPG/random plasma glucose, A1C, or 2-hour plasma glucose during the oral glucose tolerance test to confirm the diagnosis. Testing should be done at a minimum of every 2 years when results are negative and more often if patients' weight increases or if other risk factors are present.[1]

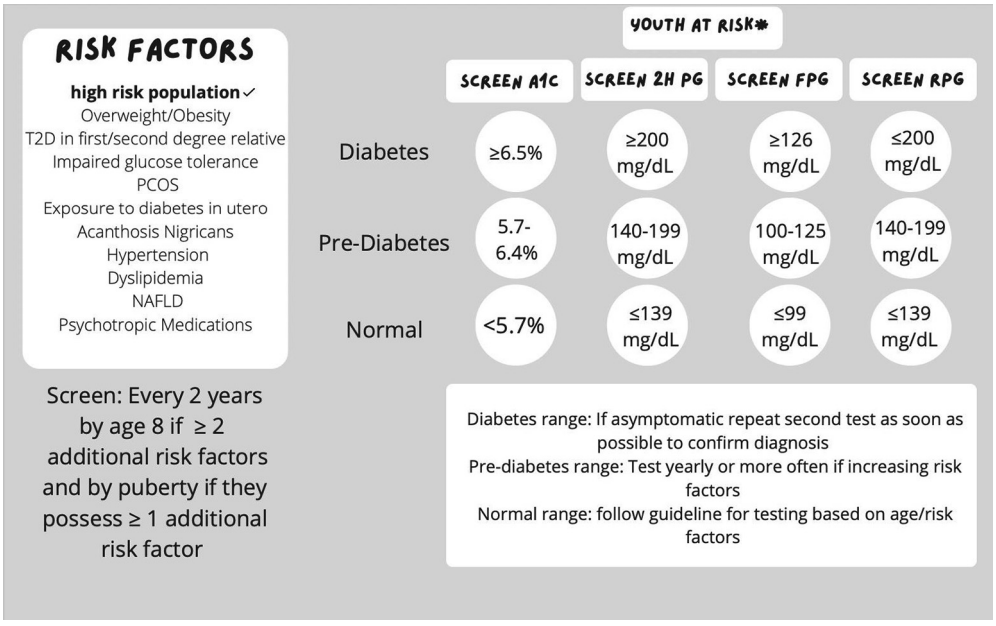
It is critical that NPs identify T2D in Indigenous youth early in the disease trajectory to mitigate the morbidity and mortality experienced by this high-risk population. The First Nations Community Based Screening to Improve Kidney Health and Prevent Dialysis (FINISHED) screening project investigated for kidney disease and diabetes in asymptomatic Indigenous youth 10 to 17 years old who were living in rural and remote communities in Manitoba. Of the 324 youth screened, 12.6% were found to have diabetes, and 20% were identified as having chronic kidney disease.[16] During the study period, these communities had increased accessibility to screening, which also increased screening for other diseases and improved rates of primary care follow-up. NPs working in remote communities should consider developing and leading active screening programs to increase awareness of and provide opportunities for community-based screening. NPs must work toward identifying prediabetes and early stages of diabetes among youth so they can provide earlier interventions and prevent long-term complications.

Diagnosis

The diagnostic criteria for T2D in youth are detailed in Table 1. Notably, the criteria are the same as the criteria to diagnose adult patients with T2D. If 1 test is found to be abnormal, a second confirmatory test is required unless there are symptoms of overt hyperglycemia. The confirmatory test should be completed as soon as possible and should not delay the initiation of treatment. Diagnosis can be confirmed with 2 different concurrently administered tests (such as A1C and FPG) or with the same test repeated consecutively on 2 different days.

Pancreatic autoantibody testing (glutamic acid decarboxylase) should be ordered in all patients who present with overt hyperglycemia, who exhibit symptoms of catabolism, or who do not have a typical phenotype for T2D (obesity).[2] Because 10% to 20% of youth with suspected T2D are found to be antibody positive, Diabetes Canada suggested that autoantibody testing be considered in all youth with a diagnosis of T2D.[2] It is important to consider T1D even in overweight children with hyperglycemia, and the diagnosis

Table 1
Risk Stratification and Diagnostic Criteria for Type 2 Diabetes (T2D) in Youth[1,2,17]



2-h PG = 2-hour plasma glucose during the oral glucose tolerance test; A1C = glycated hemoglobin; FPG = fasting plasma glucose; NAFLD = nonalcoholic fatty liver disease; RPG = random plasma glucose; PCOS = polycystic ovarian syndrome.

should be considered based on symptoms and family history along with phenotype. Autoantibody testing should be completed in Indigenous youth who present with significantly elevated glucose levels, signs of acidosis,weight loss or other clinical indications. It is reasonable to delay autoantibody testing for asymptomatic Indigenous youth in order to direct all efforts toward the rapid initiation of treatment.

Psychological Impact

NPs must recognize the significant psychological impact that a diagnosis of T2D can have on Indigenous youth. Indigenous youth living in remote communities are exposed to the effects of diabetes on their family and community members from a very young age. The psychological impacts of diabetes on youth are related to a variety of factors, including previous exposure to the effects of this disease on families/communities, the SDOHs, and the regular challenges of adolescence; these factors are compounded in youth who also need to navigate the management of a chronic illness.[1,18] A focus group that examined the experiences of 8 adolescents living with diabetes found all but 1 participant admitted to feeling fear, dread, and devastation when learning of their diagnosis.[18] Poor overall mental health can be a barrier to diabetes management and overall well-being; therefore, screening for depression and distress should be performed at the time of diagnosis and on a regular basis thereafter using a validated tool such as the Patient Health Questionnaire-4 or the Diabetes Distress Scale.[13,19] Peer mentoring has been shown to lessen the experience of stigma and isolation and should be considered, when possible, for all youth with T2D.[13] Furthermore, clinicians should avoid the use of language that implies blame because this contributes to the stigma experienced by youth with T2D.[13] It is important that NPs recognize and acknowledge the existence of stigma associated with T2D, take specific action to screen for diabetes-related distress among affected youth, and eliminate any stigmatizing language to deliver safe care to this population.

Goals of Care

After a formal diagnosis is obtained, NPs must establish an individualized, patient-specific target A1C level. It is important to note that youth with T2D less commonly experience hypoglycemia, even when taking insulin.[20] In addition, the diagnosis of T2D at a young age means that patients have longer exposure to elevated plasma glucose levels and are likely to experience earlier signs of adverse effects.[8] For these reasons, it is appropriate to suggest a more stringent target A1C of less than 6.5% in this population.[19] It is apparent within the literature that this target A1C is not being met in Indigenous youth; 1 study found that the average A1C in Indigenous children was 9.1%, with over 50% of Indigenous children having an A1C greater than 8.5%.[3] Elevated A1Cs place these children at a significantly higher risk of developing short- and long-term effects of elevated blood glucose. The management of T2D in Indigenous youth is further complicated by the lack of resources in remote locations as well as the paucity of approved medications for youth compared with the treatment options available to adults.

Treatment

The current guidelines recommend that the first-line treatment of T2D in youth should include both pharmacologic and lifestyle interventions.[1] However, it is important to note that pharmacologic interventions fail to control T2D in more than 50% of affected youth.[21] In remote Indigenous communities, NPs must consider the cultural strengths and barriers that affect T2D management. Many Indigenous cultures view wellness within a paradigm that encompasses physical, spiritual, emotional, and mental health. Cultural interventions can be adopted with the assistance of

community members to manage T2D and may include dancing, hunting, storytelling, ceremonies, or traditional hunting/gathering.[22] Promoting these lifestyle choices that incorporate Indigenous cultural practices that encourage movement and nutritious dietary choices is essential to providing holistic diabetes care.[22] NPs working with Indigenous populations should draw on cultural strengths to empower patients and improve the management of this chronic illness.

Pharmacologic

Metformin is the first-line pharmacologic treatment for T2D in youth. Metformin should be initiated at the time of diagnosis in asymptomatic youth when A1C is less than 8.5% unless contraindicated. Contraindications to metformin use include an estimated glomerular filtration rate < 30 mL/min/1.73 m^2 and a hypersensitivity reaction to medication or components of the formulation. This medication can be started at 500 mg orally once daily and then titrated up to a maximum dose of 2,000 mg/day.[1] Gastrointestinal upset is the most common adverse effect associated with metformin and can be reduced through slow upward titration, taking the medication with food, or the use of an extended-release formulation.[1,19]

Liraglutide and once-weekly exenatide, both glucagon-like peptide-1 receptor agonists, are another pharmacologic option for Indigenous youth with T2D. Subcutaneous glucagon-like peptide-1 receptor agonists work by stimulating insulin secretion and decreasing glucagon levels in the body. As of 2019, Liraglutide has been recommended in CPGs for youth with T2D who are at least 10 years of age.[1] In a placebo-controlled trial, twice as many youth taking liraglutide over a 52-week period were found to reach an A1C level < 7% compared with the placebo group.[23] The most common side effect associated with liraglutide is gastrointestinal upset.[23] Liraglutide can be added to a patient's medication regimen when metformin (± basal insulin) is not sufficient to reach their target A1C. The maximum recommended dose of liraglutide for youth is 1.8 mg subcutaneously daily.[1] Liraglutide has not been specifically studied in Indigenous youth; however, because of its expected effects on improving beta cell function and successful use for weight loss, it is likely to be beneficial in this population.[23] In the US, exenatide is approved for use in youth > 10 years of age with T2D.[24] Exenatide has not yet been approved in Canada for use in the pediatric populations.

Basal insulin should be initiated in youth who are unable to reach their target A1C with metformin (± liraglutide), who have an A1C greater than 8.5% at diagnosis, or who have symptomatic hyperglycemia (polyuria, polydipsia, or nocturia).[1] The starting dose of basal insulin should be 0.5 U/kg/d, which can then be titrated to reach target FPG levels of 72 to 108 mg/dL (4-6 mmol/L).[1] Weight gain is a known side effect of insulin administration and should be discussed with the patient and family before the initiation of this intervention.

Youth who are started on insulin and their caregivers must receive counseling on the proper administration of this medication, monitoring of blood glucose levels, and the prevention and identification of hypoglycemic events. Glucose monitoring should be individualized based on the medication regimen of the patient; however, emphasis must be placed on the importance of checking blood glucose if hypoglycemic symptoms present.[1] Common symptoms of hypoglycemia include trembling, palpations, sweating, anxiety, hunger, nausea, and tingling.[25] Both youth and caregivers must be aware of these symptoms and how to manage hypoglycemic events.

Nonpharmacologic

Targeting of modifiable risk factors is another first-line intervention in the management of T2D and should accompany the initiation of appropriate pharmacologic treatments. Lifestyle changes, including weight loss of 7% to 10%, dietary modifications, and enhanced exercise regimens, are key components of nonpharmacologic care in youth with T2D. These interventions alone have not been historically effective at maintaining glycemic levels within target ranges. To be effective at managing chronic illness, lifestyle modifications require multisystem-level changes, education, and close follow-up by NPs.

It is recommended that youth with T2D receive age and culturally appropriate education and direction regarding disease management.[1] NPs working in remote communities must tailor their care to meet the needs and culture of the community they serve. A multidisciplinary team should be used whenever possible and should include an NP, a pediatric endocrinologist, a dietitian, and a mental health professional.[2]

It is fundamental that Indigenous children and their families be involved in decision making regarding the nonpharmacologic management of T2D.[2,26] Treatment programs should be directed at the development of healthy habits for both the family and the community.[2] The Canadian health care system has a history of segregating Indigenous people in hospitals under inhumane conditions for the purposes of medical experimentation.[9] NPs must be aware of this history in order to safely navigate the health care needs of this population; it is essential to involve patients, their families, and community members in decision making to provide safe, competent, and ethical care.

Community-based initiatives are important and should be aimed at increasing activities that promote culturally appropriate lifestyle management of T2D. Community-based initiatives have been studied and implemented within Indigenous communities to promote healthy lifestyles among youth.[26] Current T2D guidelines for youth highlight the importance of engaging in 60 minutes of physical activity per day and resistance training 3 times per week while also recommending a reduction in sedentary behavior and an emphasis on healthy dietary habits and smoking cessation.[1]

SDOHs

In order to optimally manage T2D, NPs must take into consideration the effects of the SDOHs on the inequities experienced by Indigenous populations. In addition to the American Diabetes and Canadian Diabetes Associations' youth with T2D diet and exercise guidelines, the food security and supply recommendations should be incorporated into a plan of care to address challenges in remote communities. The historical colonization of Indigenous peoples led to poverty, food insecurity, limited access to health care services, low levels of health literacy, and high rates of unemployment.[9] NPs can address these inequities by adopting a multisystem-level approach to care. For example, NPs can take steps toward addressing food insecurity by working with local grocery stores and members of the community to promote nutritious options, offer cooking classes, initiate school-based nutrition programs, and provide education about gardening/traditional foods.[27] In addition, NPs employed in remote communities can play an active role in advocating for change at a policy level. It is not possible to manage T2D without making significant changes and reducing the social disadvantages experienced by Indigenous people living in remote communities.

Table 2
Complications, Screening, and Important Considerations[1,2,13,14,19]

Complication	Screening	Important Considerations
BP	Use appropriate BP cuff; monitor at diagnosis and every subsequent visit.	Goal BP < 90th percentile for age, sex, and height or < 130/90 in adolescents over 13 years old; avoid use of ACE inhibitors/angiotensin receptor blockers in youth of childbearing age who are not using reliable contraception.
Nephropathy	Urine albumin-creatinine ratio, estimated glomerular filtration rate, and serum potassium at diagnosis and on a yearly basis	Point-of-care testing available for creatinine; early referral to pediatric nephrologist when kidney function declining
Retinopathy	Dilated fundoscopy at time of diagnosis and yearly thereafter	If not accessible in community, retinal photography can be used to improve access to screening.
Nonalcoholic fatty liver disease	ALT/AST at diagnosis and then annually	Screen for ETOH use in pediatric population and other risk factors (hepatitis); if liver enzymes are consistently elevated, refer to gastrointestinal specialist.
Sleep apnea	Assess for signs of sleep apnea (snoring, increased morning fatigue, and episodes of apnea); screen at diagnosis and then annually thereafter.	If risk present, refer to pediatric sleep specialist for evaluation.
Dyslipidemia	Lipid panel screen at diagnosis and then annually	If abnormal, first-line treatment includes improving glucose levels and nutrition therapy. Statins may be considered if LDL cholesterol remains > 130 mg/dL (3.36 mmol/L) for 6 months despite lifestyle management. Statins should be avoided in people with reproductive potential who are not on contraception.
Psychosocial	Screen using assessment tools, such as the PHQ-9 and the Diabetes Distress Scale, at the time of diagnosis and as needed; assess for eating disorders.	Essential to assess for contributing factors, such as food insecurity, housing instability, financial barriers, and lack of family/community support
Pregnancy	Contraceptive counseling to be initiated prepuberty and at all visits thereafter.	Significant adverse pregnancy outcomes experienced in patients with uncontrolled blood glucose; an A1C target < 7% when planning pregnancy and < 6.5% during pregnancy optimizes outcomes.
Neuropathy	Foot examination including pulses, pinprick, 10-g monofilament sensation test, vibration sensation, and ankle reflexes at diagnosis and annually	32.4% of youth with T2D develop neuropathy within 15 years of diagnosis.

A1C = glycated hemoglobin; ACE = angiotensin-converting enzyme; ALT = alanine transaminase; AST = aspartate transaminase; BP = blood pressure; ETOH = ethanol alcohol; LDL = low-density lipoprotein; PHQ-9 = Patient Health Questionnaire-9; T2D = type 2 diabetes.

Referral

NPs working in remote communities must operate in close collaboration with diabetes specialists and conduct appropriate diabetes follow-up with their patients. Referral to a pediatric diabetes specialist needs to occur at the time of diagnosis.[1] Unfortunately, patients and their families will often need to travel outside of their community to access specialist diabetes care, which presents significant barriers. The use of telehealth in remote communities has been shown to effectively reduce health care expenses while also eliminating the need for patients/families to travel outside of their own communities.[28] Using telehealth for the provision of pediatric T2D care can reduce the barriers experienced by this population.

Follow-up/Monitoring of Illness

Youth diagnosed with T2D are at a higher risk of experiencing complications later in life compared with their counterparts with T1D.[8] Youth-onset T2D is associated with high rates of micro- and macrovascular changes, which tend to rapidly progress by the third decade of life.[4] When individuals living in remote communities experience complications of T2D, they are often displaced from their communities to access the required care. In order to minimize the burden on these populations, NPs must screen for and try to prevent complications of T2D as well as provide optimal recommendations for diabetes management at the time of diagnosis and routinely thereafter (Table 2).

Conclusion

Indigenous youth have experienced significant burdens related to T2D for over 40 years with no clear path to resolution. NPs play a vital role in lessening the barriers to adequate diabetes care for youth living in remote areas. NPs must provide evidence-based screening, diagnosis, and medical management of T2D, in conjunction with pediatric endocrinologists. The use of CPGs alone will not address the social and cultural needs of Indigenous youth living with T2D in remote communities. Instead, emphasis must be placed on advocating for multisystem-level changes, developing community-led initiatives, and providing culturally safe care to ensure optimal health outcomes for this population.

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