

Pediatric Type 2 Diabetes in Saskatchewan:

A Report to Inform a Coordinated
Provincial Response

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September 2020

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Executive Summary

Pediatric type 2 diabetes (T2D) is a rising issue facing Canada's Indigenous and non-Indigenous children, youth, parents, communities, and the entire healthcare system. Research has documented the increasing prevalence of T2D in communities around the world, including in Canada, with some of the highest incidence rates in pediatrics in the Prairie provinces. In Canada, the incidence rate of pediatric T2D has been reported as 1.53 per 100,000 children per year (under 18 years of age). In contrast, a more recent study reported the incidence rate in Manitoba, specifically, to be 20.55 per 100,000 children per year in Manitoba. At the time of this review, accurate, up-to-date data for Saskatchewan was not available. However, given the similarities between Saskatchewan and Manitoba (e.g., rural/urban divide, remote First Nations and Métis communities, similar population demographics), it is hypothesized the rates are similar. This is supported by anecdotal reports and clinical data coming from healthcare professionals that describe a high and increasing prevalence of pediatric T2D in Saskatchewan. This is particularly concerning since pediatric T2D is associated with many challenging lifelong comorbidities. Given this, it is essential that Saskatchewan develop an evidence-based, coordinated response, considering the strengths, gaps, and needs related to pediatric T2D within communities.

In order to support the creation of a coordinated response, in late 2019 the Saskatchewan Prevention Institute engaged in a partnership with Dr. Mark Inman (Pediatric Endocrinologist, Saskatchewan Health Authority) to develop this background document to inform future work regarding pediatric T2D in Saskatchewan. More specifically, the purpose of this partnership was to expand upon the limited availability of current evidence and data relevant to Saskatchewan, as well as increase the understanding of the strengths, gaps, and needs related to pediatric T2D within Saskatchewan. The goal of the resulting report is to inform the adaptation or creation of relevant resources for education and training for healthcare providers, and ultimately education for patients and families, within the Saskatchewan context. To do this, the following methods were employed.

1. **A literature review** of academic articles that outlined research related to pediatric T2D from a Canadian perspective. The goal was to gain an understanding of pediatric T2D in Canada and Saskatchewan, as presented in the literature, in order to inform future planning and resource development for Saskatchewan communities.
2. **A needs assessment survey and interviews** with healthcare professionals in Saskatchewan working directly with pediatric T2D (e.g., nurses, pediatricians, dietitians). The survey explored the current state of pediatric T2D knowledge among respondents, the barriers they face when trying to address the condition, their interest in relevant topics, and their delivery preferences for education and/or training. Following the survey, targeted interviews were conducted with healthcare professionals to help provide clarity to the survey responses.
3. **An environmental scan** to identify all Canadian-based pediatric T2D resources (e.g., educational materials) and programs (e.g., educational programming on diets). To our knowledge, this is the most up-to-date list of Canadian resources on pediatric T2D available to Saskatchewan healthcare providers.

Summary of Literature Review

In order to identify research that can inform practices in Saskatchewan, the literature review primarily focuses on Canadian-based research. The following topics are covered:

- Contributing (risk) factors for pediatric T2D
- Screening for pediatric T2D
- Management of pediatric T2D
- Complications related to a pediatric T2D diagnosis
- Pediatric T2D in First Nations and Métis populations
- Pediatric type 2 diabetes programming outcomes, barriers, and facilitators

Overall, the research suggests that the rate of pediatric T2D in Canada is climbing at an alarming rate. Of note, First Nations children and youth are disproportionately represented in the incidence statistics. In Manitoba, the incidence has been reported as high as 20.55 per 100,000 children per year, with those living in rural or remote settings particularly affected. In Manitoba for 2006-2011, it was found that 87% of youth (below 18 years) referred for care for T2D identified as First Nations. Research suggests that factors contributing to this increased risk for T2D among First Nations youth include poverty, the influence of colonialism, trauma, lack of trust, stigma, and geographical factors. Other potential contributing factors include genetics, as well as prenatal and perinatal environments.

Of particular concern are studies linking pediatric T2D with long-term comorbidities such as cardiovascular disease, hypertension, albuminuria, and depression. These findings stress the importance of a focus on prevention, as well as early screening and diagnosis, followed by effective intervention and management strategies. Evidence suggests that acute and chronic management can benefit from coordinated, multidisciplinary programming that includes frequent visits and supports for emotional and mental health, as well as self-care, such as peer-led interventions for increasing healthy lifestyles.

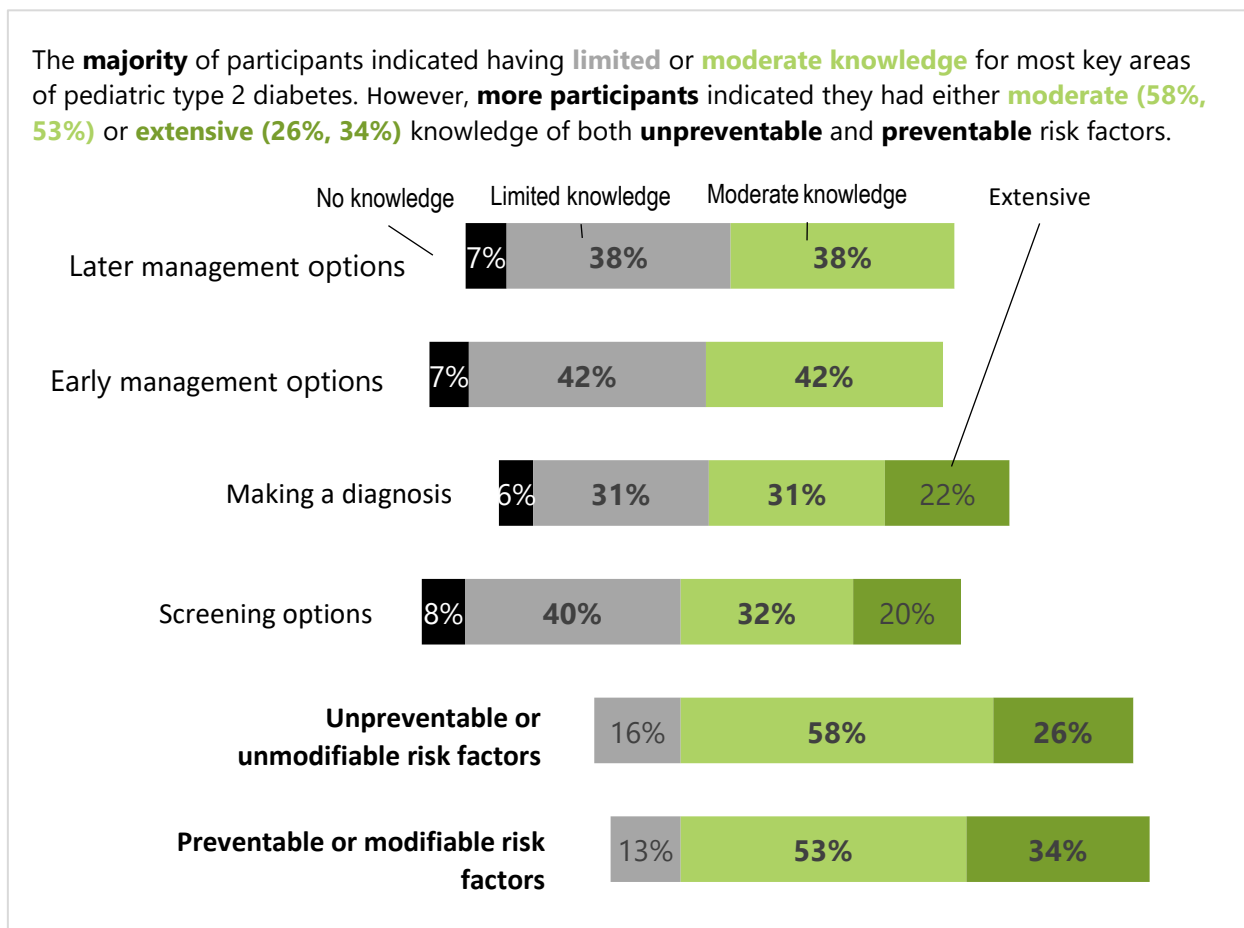
Summary of Needs Assessment Survey & Interviews

To identify existing strengths, gaps, and needs related to working with a population that has, or is at risk of, pediatric T2D, a needs assessment survey and interviews were completed. The survey was developed with input from the Saskatchewan Prevention Institute, Dr. Inman, and members of the LiveWell Pediatric Diabetes Team (Saskatoon, SK), and the Aboriginal Diabetes Initiative. An invitation to complete the survey was sent to healthcare professionals in Saskatchewan who were likely to provide care or supports to the pediatric T2D population. The survey received 74 complete responses from dietitians, nurses, and physicians from across the province. The majority of participants indicated that most of their work related to pediatric T2D was with a First Nations population (both on and off reserve), and over half of respondents do most of their work in a First Nations community (either on reserve or with a Tribal Council). Two targeted interviews with stakeholders who had a significant role in pediatric type 2 diabetes care in Saskatchewan were conducted to provide clarity to the survey findings. The purposes of the needs assessment survey and interviews were to:

- explore the level of interaction healthcare professionals have with pediatric T2D
- determine a baseline of knowledge of pediatric T2D

- explore barriers to providing care for pediatric T2D
- determine the barriers and facilitators for education and training in pediatric T2D
- learn areas of interest and preferred methods for education and training

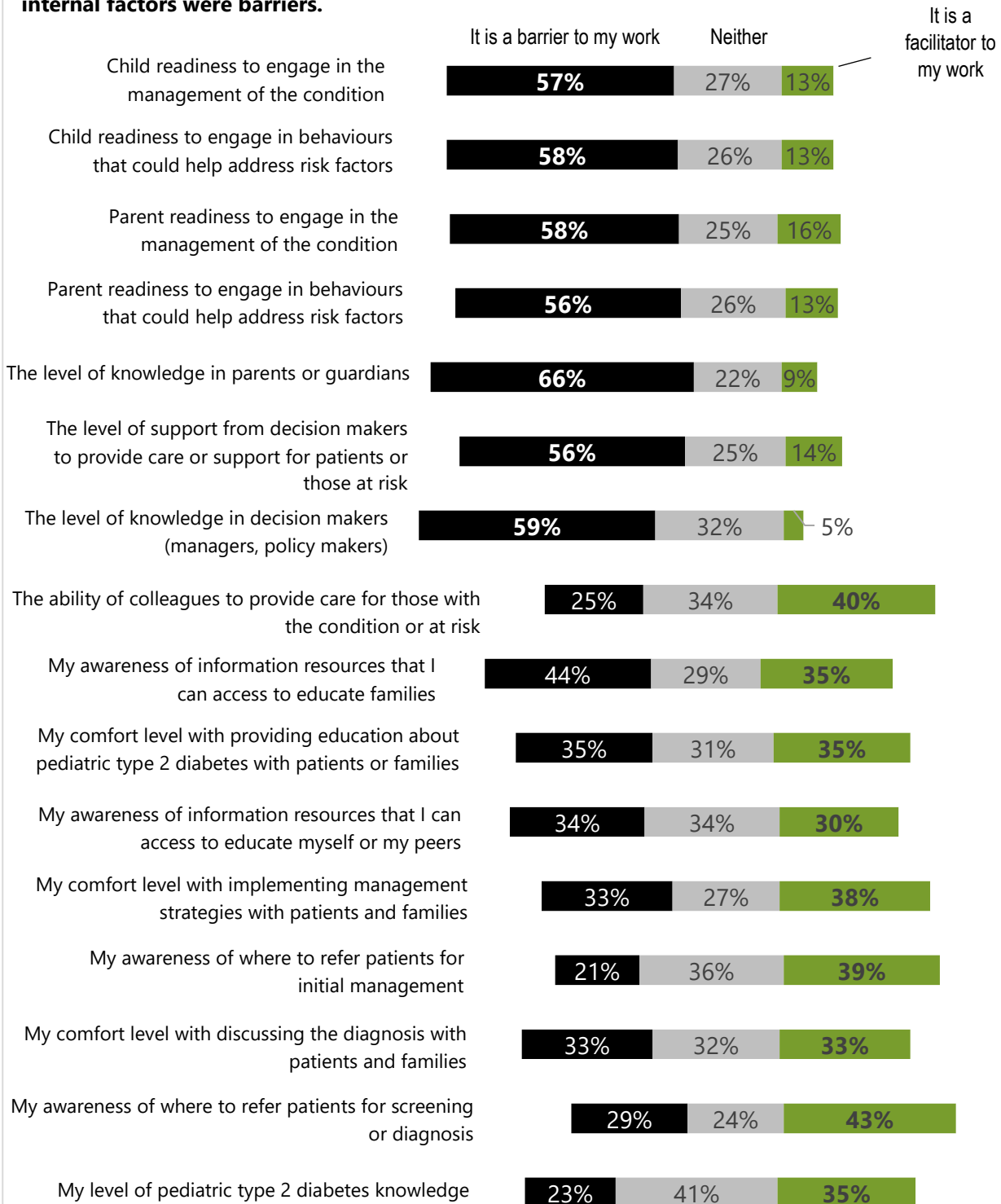
The results suggested that a significant amount of the sample who responded tend to work more with those at risk for pediatric T2D than they do with those who have already been diagnosed (56% vs. 30% responded with at least 1-2 times per month or more). Further, many of the participants believed they were somewhat (50%) or slightly familiar (30%) with the condition overall, but were quite evenly split, on a scale from very familiar (22%) to not at all familiar (23%), with pediatric T2D referral options in Saskatchewan. As is demonstrated below, evidence suggested that participants were more familiar with risk factors (both unpreventable and preventable) than they were with management options, diagnosing, or screening.



When asked about the barriers and facilitators they experience when addressing pediatric T2D in Saskatchewan, more participants indicated that internal factors (e.g., their own knowledge or awareness of the condition) were a facilitator, as opposed to external factors, which tended to be chosen more often as barriers. In particular, the level of knowledge in parents or guardians (66%), and the level of knowledge in decision makers (59%) were the most frequently chosen as barriers. Parent and child readiness to address risk factors or treat the condition emerged as the next most commonly selected

barriers (56-58% of the sample indicated these four factors were a barrier). When it comes to barriers to attending education/training to advance their knowledge in pediatric type 2 diabetes, participants listed a lack of options (55%), time (45%), awareness (43%), and funds (43%) as key barriers.

The **majority of barriers** to working with pediatric type 2 diabetes for participants were **external (e.g., child/parent readiness, decision maker support)**. In contrast, **more participants agreed that internal type factor (e.g., knowledge/awareness of condition)** were **more of a facilitator** when compared to external factors. There was, however, **still a large portion of participants believing internal factors were barriers**.



Summary of Environmental Scan

An environmental scan was completed to identify existing Canadian educational resources and programs on pediatric T2D that can be used or adapted for use in Saskatchewan.¹ Resources and programs included were limited to those that were developed in Canada, and the majority of items only focus on a pediatric population. Once an initial draft was completed, this was reviewed by local individuals working in the field in an attempt to identify anything missed. While attempts were made to be thorough, it is possible that some relevant resources or programs are missing from this table. The results of this scan will be used to help ensure that duplication is avoided when determining what resources are needed to meet the needs of those working with pediatric T2D in Saskatchewan. The results are also available for those looking for additional pediatric T2D resources.

It became clear during the scan process that there is a distinct lack of Canadian resources for those working in pediatric T2D. Across the country, only 17 sources were found that are directly or indirectly related to pediatric T2D, with the vast majority being education and/or awareness resources for youth, parents, and healthcare professionals. The results of the scan can be found within the full report, which is available to download from the [Saskatchewan Prevention Institute](#) website.

Recommendations

Based on the findings of the needs assessment, and informed by the findings of the literature review and environmental scan, the following recommendations can be made for addressing pediatric T2D in Saskatchewan:

✓ **Provide Additional Education on Pediatric T2D for Healthcare Providers**

Increase knowledge of healthcare providers in the following (in order of priority):

- Management of pediatric T2D (and where to refer for specialized, multidisciplinary management)
- Screening and diagnosis
- General knowledge of pediatric T2D and risk factors (lower in priority, as there is a relatively higher rate of knowledge in these areas, but there is still room for improvement)

✓ **Address Barriers to Providing Pediatric T2D Care**

High priority barriers are factors external to the respondents:

- Child, youth, and family knowledge and readiness to engage in prevention or management
- Decision maker's level of knowledge and support

¹Scan was done by searching online using the following search terms: pediatric type 2 diabetes, pediatric type 2 diabetes resources, pediatric type 2 diabetes guidelines, pediatric type 2 diabetes program[ing], pediatric type 2 diabetes Canada.

Next in priority are barriers related to need for information or skills by the respondents:

- Awareness of information resources to **educate families** and/or **educate self** and/or **peers**
- Comfort level with providing education about pediatric T2D, discussing diagnosis, or implementing management strategies with patients or families

The following areas are a strength for some respondents and a barrier for others. More respondents indicated they consider their knowledge in these areas a facilitator to providing care. However, many respondents still consider their lack of knowledge in these areas a barrier, making these topics still important to address:

- Pediatric T2D general knowledge
- Awareness of where to refer patients for screening or diagnosis
- Awareness of where to refer patients for initial management

✓ **Address Barriers to Providers Obtaining Education and Training in Pediatric T2D**

Barriers to education and training are (in order of frequency):

- Lack of options
- Lack of time
- Lack of awareness of where to access
- Insufficient funds

✓ **Address Areas of Interest for Education and Training**

There was strong interest in all topics asked about. Frequency chosen as a high interest is as follows:

- Culturally safe care for clients and families (82%)
- Management of pediatric T2D (82%)
- Screening/diagnosis (73%)
- Referral and access to care (72%)
- Risk factor reduction (61%)
- Basic pediatric T2D facts or knowledge (61%)

When asked to indicate their first choice for training, the top three are: 1) management of pediatric T2D, 2) screening and diagnosis, and 3) culturally safe care.

Both of the interviewees who were targeted for clarification of results, echoed the importance of culturally safe care. One stated:

“We can't just go to an Indigenous community and say, well here we are, we're going to save the world, right? We need to develop partnerships with these communities and figure out what they need, and then base our prevention efforts based on that.”

✓ **Deliver Training and Education to Healthcare Providers in Desired and Realistic Ways**

First choice for training and education methods (in order of frequency):

- Hands-on workshops or interactive sessions
- Webinar presentations
- Lecture-based presentations

- Clinical guides
- Online information or tools

Although online ways of sharing were not chosen as high in priority by survey respondents, the two interviews highlighted the value of online ways of sharing information, including social media. It is also important to note that ways of sharing and receiving knowledge is evolving rapidly, and that what is considered the most effective and desirable will likely change over time. In addition, although it is important to learn what respondents think, other factors also need to be considered when planning education and training strategies, including what is doable (e.g., inability to meet in-person during COVID-19), practical (e.g., weigh costs), sustainable (e.g., ongoing accessibility and ability to update), and what provides a foundation for other ways of sharing (e.g., clinical guides).

- ✓ **Create Resources for Children, Youth, and Parents to Increase Awareness and Understanding**
Respondents expressed high interest in information in both printed and online formats for children, youth, and families. These should provide basic awareness and understanding of pediatric T2D, including risk factor reduction and management. Also, the point was made to ensure information for children and youth is presented in a way that they can understand.
- ✓ **Consult with the Children, Youth, and Families Impacted by Pediatric T2D**
The contribution of factors such as colonization, lack of trust, and stigma to the development of pediatric T2D, and the challenges in addressing this condition, makes it particularly important that those impacted are consulted when developing messages and programs to address it. To understand how best to share information with the children, youth, and families impacted by T2D, it will be important to gain an understanding of their frame of reference (related beliefs, experiences, circumstances). This will contribute to the development of messages that are both respectful and impactful.
- ✓ **Monitor the Prevalence of Pediatric T2D in Saskatchewan, and Fund and Publish Research on Pediatric T2D in the Saskatchewan Context**
Ensuring there is accurate and up-to-date data and research regarding pediatric T2D in Saskatchewan will provide context and understanding that is important to effectively addressing it.

For more information, including a list of references, please refer to the full report. The full report can be found on the [Saskatchewan Prevention Institute](#) website.

Pediatric Type 2 Diabetes Literature Review

1. Introduction – The Prevalence of Pediatric T2D Around the World and in Canada

Pediatric type 2 diabetes (T2D) is a rising health crisis facing Canada's Indigenous and non-Indigenous children, youth, parents, and the entire healthcare system. A significant amount of peer-reviewed studies have documented the rising prevalence of T2D, and specifically pediatric T2D, in communities around the world, including in Canada, with some of the highest incidence rates in pediatrics in the Prairie provinces (i.e., Saskatchewan, Manitoba, Alberta; e.g., Alderete, Toledo-Corral, & Goran, 2014; Amed et al., 2010; Brown et al., 2015; D'Adamo & Caprio, 2011; Dart, Marten, et al., 2014; Gregory et al., 2010; Hadjiyannakis, & Henderson, 2018; Hale & Lynch, 2011; Halipchuk et al., 2018; Sellers et al., 2012; Oster et al., 2012; Panagiotopoulos et al., 2018; Urakami, 2018).

In Canada, the incidence of pediatric T2D has been reported as 1.53 per 100,000 children (defined as under 18 years of age) per year, based on physician reporting, from 2006 to 2008 (Amed et al., 2010). For Saskatchewan, in the same paper, the reported incidence rate was 0.4 per 100,000 children per year (Amed et al. 2010). However, clinical data suggests that this rate for Saskatchewan is not accurate, likely due to a lack of infrastructure and reporting mechanisms at the time. For the same time period, the reported incidence rate of pediatric T2D for Manitoba was 12.45 per 100,000 children per year (Amed et al., 2010). Given the similarities between Saskatchewan and Manitoba (e.g., rural/urban divide, remote Indigenous communities, similar population demographics), it seems likely that the rates for Saskatchewan and Manitoba would be more similar. This is supported by anecdotal reports and clinical data from healthcare workers in Saskatchewan who care for children and adolescents with pediatric type 2 diabetes. In addition, the rates in these two Prairie Provinces appear to be rising rapidly. One study looking at the rates in Manitoba found the incidence to be 20.58 per 100,000 children per year in 2010-11 (Sellers et al., 2012). More current and accurate rates for Saskatchewan are expected to be available soon, and it is believed that pediatric T2D rates in Saskatchewan will be among the highest in Canada.

Of concern, rising rates in pediatric T2D are associated with an increase in challenging lifelong comorbidities such as cardiovascular disease, hypertension, albuminuria, and depression (Dart, Wicklow, et al., 2014; Prendergast & Gidding, 2014; Sellers et al., 2016; Silverstein et al., 2012). As will be described later, these health issues often come sooner and are more prevalent than for those with type 1 diabetes (T1D) (e.g., Dart, Martens, et al., 2014; Dart, Wicklow et al., 2014; Panagiotopoulos et al., 2018).

Much of the evidence presented in this literature review highlights the fact that First Nations peoples are disproportionately represented in the incidence statistics. In Manitoba between 2006 and 2011, 87% of youth (below 18 years of age) referred to the Diabetes Education Resource for Children and Adolescent Centre (DER-CA) in Winnipeg (the only referral centre in Manitoba), identified as First Nations (Sellers, Wicklow, & Dean, 2012). The majority of these youth lived in rural or remote fly-in settings in Northern Manitoba (75%) and the remainder were from urban areas (25%). In 2011, the final year of their study, Sellers et al. found that the incidence of pediatric T2D cases had surpassed the incident cases for pediatric T1D.

The rising rate of pediatric T2D parallels the rapidly rising rates of obesity and diabetes for all ages in Canada, with Brown et al. (2015) claiming the overall rate of type 2 diabetes has nearly doubled since 2000. In Alberta, the estimated lifetime risk of developing T2D in adults was as high as 80% (8 in 10) for First Nations persons and was significantly higher when compared to the non-Indigenous population (5 in 10 lifetime risk; Turin et al., 2016). Using Saskatchewan Health data to examine diabetes rates (including T1D and T2D), Dyck et al. (2010) concluded that First Nations women experienced the highest rate in prevalence (20.3% of the study sample, compared to 5.5% in the non-First Nations sample). However, First Nations men still experienced a much higher prevalence rate (16%) when compared to non-Indigenous men (6.2%). Articles discussed later in this review describe how a variety of factors including poverty, genetics, environment, and colonialism contribute to the overrepresentation of T2D in First Nations children (e.g., Crowshoe et al., 2018, Halipchuck et al., 2018; McGavock et al., 2015; Prendergast & Gidding, 2014).

This literature review was commissioned to explore research relevant to the situation in Saskatchewan, to inform next steps in addressing pediatric T2D in Saskatchewan. Although extensive research has been completed with pediatric T2D populations across the world (e.g., Japan, United States), this literature review primarily outlines the evidence presented in Canadian-based studies on pediatric T2D, with the goal of providing a document that specifically informs the Saskatchewan context. With these aims in mind, this review covers:

- contributing (risk) factors for pediatric T2D
- screening of pediatric T2D
- management & treatment of pediatric T2D
- complications of pediatric T2D
- pediatric T2D & First Nations populations
- pediatric T2D programming outcomes, barriers, and facilitators

2. Contributing (Risk) Factors for Pediatric T2D

2.1 The Role of Genetics

In addition to numerous other factors, the risk of developing pediatric T2D appears to be influenced by genetic factors, at least in some cases. Both Morgan (2012) and Prendergast & Gidding (2014) argue that there are clear links between genetic factors and the onset of pediatric T2D. Morgan (2012) argued that, because a T2D diagnosis is not present in some obese children and that some are present in non-obese

children, that a certain degree of genetic influence must be considered. In his review, Morgan (2012) outlined a study examining transcription factor 7-link 2 variant genes (TCF7L2) that found evidence linking it to a significant increase in the risk of developing early onset T2D in the United States and in Finland. Although they called for additional reviews, Morgan (2012) described several studies that indicated that overweight individuals with TCF7L2 genes can have a 55%-70% higher likelihood of developing T2D within five years of being diagnosed with prediabetes. Furthermore, Prendergast & Gidding (2014) argued that genetics plays a large role in the development of pediatric T2D because they found evidence that approximately 50% of teenagers with a T2D diagnosis have a first-degree relative with the same diagnosis. When also considering second-degree relatives, it raised it to a 90% chance of a T2D diagnosis (Prendergast & Gidding, 2014). It has also been hypothesized that genetics may play a role in the high rate of pediatric T2D among certain First Nations groups (Sellers et al., 2012).

2.2 The Role of Obesity

Although many of the reviewed articles mentioned obesity as a risk factor for T2D, four articles covered in this review focused on obesity as a contributor to T2D (Dabelea & Harrod, 2013; Dea, 2011; Gregory et al., 2010; Sellers et al., 2012). To begin, Gregory et al. (2010) found evidence that those with T2D were more likely to be considered 'obese' compared to those with a T1D diagnosis (81% vs. 13%). Considering the rising rates of obesity in Western society in the past few decades, Dabelea and Harrod (2013) found an association between maternal obesity and T2D diagnoses in offspring. Similarly, Dea (2011) and Sellers et al. (2012) both pointed out that rising obesity rates in Canadian and American youth directly correlate with the rise of pediatric T2D rates. Though speculative, Sellers et al. (2012) theorize a 'vicious cycle' where increasing obesity and adult T2D rates contribute to higher rates of pregestational diabetes, which puts the offspring at a higher risk of experiencing early onset T2D.

Dabelea & Harrod (2013) also described a link between the current trends of increasing obesity and T2D in the United States. Not unlike Sellers et al. (2012), they call the link between obesity and T2D a 'vicious cycle' meaning that, as long as obesity rates continue to rise, so will T2D (including early onset T2D in children). Other articles from the United States (e.g., Dabelea, Mayer-Davis, & Lamichhane, 2008) support this claim, as they found that a combined 24.4% of T2D diagnoses in their youth sample was attributable to maternal diabetes or maternal obesity (with an additional 22% attributable to other maternal morbidities). They concluded their study by recommending further exploration to understand how to reverse the cycle.

2.3 Prenatal and Perinatal Factors

Two of the Canadian-based studies included in this review explored the relationship between prenatal and perinatal factors and T2D (Halipchuck et al., 2018 and Osgood et al., 2011). Using a population simulation model, Osgood et al. (2011) used Saskatchewan Health diabetes data from 1956-2006 to examine the hypothesis that gestational diabetes is a contributor to the T2D epidemic being experienced by Saskatchewan First Nations. They concluded that First Nations peoples living in Saskatchewan had between 19-30% chance of developing T2D if their mothers had gestational diabetes. When looking at the non-First Nations population, this dropped to just 6% in their simulations. Based on their findings, Osgood et al. (2011) argued that investing in addressing gestational diabetes for high-risk

women through prevention programming, as well as rapid diagnosis and effective treatment, would be important for reducing the prevalence of T2D in Saskatchewan, now and for future generations.

In addition, Osgood et al. (2011) found that breastfeeding had the potential for multiple benefits for prevention of T2D. First, breastfeeding appeared to lower the risk of child obesity and pediatric T2D in offspring, even for diabetic mothers. In addition, breastfeeding may help to delay or reduce the risk of developing T2D for mothers who had experienced gestational diabetes.

In Manitoba, researchers using data from the Population Health Research Data Repository from the Manitoba Centre for Health Policy examined the impact of both pregestational and gestational diabetes on pediatric T2D (Halipchuck et al., 2018). A cohort of children and youth diagnosed with type 2 diabetes between 1986 to 2011 were identified through the Diabetes Education Resource for Children and Adolescents Centre (DER-CA) (387 adolescents between ages 10 and 17 at age of diagnosis). The researcher examined data from the DER-CA and three other linked health-related databases. Most were from rural areas of Manitoba, with 41% being from Northern Manitoba. The authors concluded that, when compared to a control group, pregestational diabetes in mothers increased the odds of T2D for children by nearly six times, whereas gestational diabetes increased it by four times. Additional interesting results of comparisons between the pediatric T2D and control groups included the following:

- Those with pediatric T2D were less likely to have been born at term. Further, those born larger than the average gestational age weight were more likely to develop early onset T2D, especially if they were born before term (Halipchuck et al., 2018).
- The initiation of breastfeeding reduced the chances of developing childhood-onset T2D (Halipchuck et al., 2018). It was suggested that even breastfeeding for a few days may be protective for the offspring of a mother with diabetes. They noted that these results extended previous findings of theirs, which found that extended breastfeeding (more than one year) was associated with a decreased risk of T2D.

2.4 Socioeconomic Status

In addition to genetics, obesity, and prenatal/perinatal factors, pediatric T2D appears to be influenced by the socioeconomic status of parents. Specifically, Halipchuck et al.'s (2018) study looking at the Manitoba DER-CA cohort from 1986 to 2011 concluded that half (50.4%) of the mothers with children who have T2D fell into the lowest income category. In contrast, only 6.7% of parents with T2D children were in the highest income category, indicating that the risk for childhood-onset T2D decreases as the income of the parents rise. Dart, Martens et al. (2014) found similar results using the same clinical registry data from the DER-CA (except from 1986 to 2007). Specifically, they found 59% of the youth with T2D in Manitoba were part of the lowest economic category in the province (Dart, Martens et al., 2014). These Manitoba findings of a link between SES of the parents and the development of pediatric T2D are corroborated by a Montreal study (using Statistics Canada data) that found that the median income of families of children with T2D was significantly lower than those without T2D (Gregory et al., 2010).

2.5 Additional Contributing Factors

Several of the studies reviewed highlight that for youth, females are more likely to develop T2D than males (Dart, Martens et al., 2014; Prendergast & Gidding, 2014). Dart, Martens et al. found that 62% of the Manitoba cohort of youth with T2D were female. These findings are further clarified by studies looking at T2D rates for First Nations and non-First Nations. Various studies have found that young First Nations women are more likely to develop T2D (Dyck et al., 2010; Osgood et al., 2011; Sellers et al., 2016), but that over time these differences balance out, and beyond 60 years of age the incidence for First Nations men is slightly higher than for women (Dyck et al., 2010). Section 6 of this review will discuss research that describes the factors that contribute to the high incidence of pediatric T2D in First Nations children and youth.

3. Screening of Pediatric T2D

Despite several articles being published on T2D screening in America and around the world, there was little found that studied a Canadian context. One study tested an in-school screen in two high schools in Quebec; however, the screen did not identify any undiagnosed cases of T2D (Legault et al., 2007). It was hypothesized that this screening method did not reveal any additional cases of T2D due to the fact that the majority of participants were non-First Nations, and there is a much lower number of T2D cases among non-First Nations youth (Legault et al., 2007).

Within the *Diabetes Canada Clinical Practice Guidelines*, Panagiotopoulos et al. (2018) identified risk factors for the development of pediatric T2D to include a first- or second-degree relative with T2D, being a member of a high-risk population, obesity, and signs of insulin resistance. Panagiotopoulos et al. argued that, due to the fast pace at which complications of T2D arise, earlier screening for T2D is crucial for those at risk, in order to prevent acute and chronic complications. They recommend a combination of a glycated hemoglobin (A1C) and fasting or random blood glucose to screen for type 2 diabetes in children and youth. The authors acknowledge that fasting may be difficult for children but argued that the FPG test has a high yield rate when done correctly (Libman et al., 2008).

Bhatt et al. (2018) presented a summary of the Canadian screening, diagnostic, and management guidelines along with guidelines from North America, Europe, Africa, and Asia. Table 1 is a summary of screening guidelines from different areas of the world. The definitions of each of the acronyms in the table can be found in the footnote². A link to the full article can be accessed by using the DOI URL as found below the table.

² IR insulin resistance, AN Acanthosis nigricans, BMI Body mass index, ICA Islet cell antibodies, GAD anti Glutamic Acid Decarboxylase antibodies, IA2 Islet Antigen 2 antibodies, ICA Islet Cell Antibodies, IAA Insulin Autoantibodies, RPG Random Plasma Glucose, FPG Fasting Plasma Glucose, PCOS polycystic ovary syndrome, ALT Alanine aminotransferase, HbA1c Glycated hemoglobin, DKA diabetic ketoacidosis, OGTT Oral glucose tolerance test, NAFLD Non-alcoholic fatty liver disease, ADA American Diabetes Association

Table 1. Pediatric T2D Screening Guidelines from Around the World

Guidelines (name, country, year)	Frequency of screening	Recommended screening tests
Brazilian Diabetes Society (Brazil, 2016)	Every 2 years, starting at age 10	RPG (random plasma glucose), FPG, OGTT (oral glucose tolerance test); Evaluation of beta cell function by C-peptide; The detection of markers of pancreatic islet autoimmunity using autoantibodies including anti-GAD, Anti-IA2, ICA and IAA.
Diabetes Canada (Canada, 2018) – Canada’s national resource	Every 2 years (Consideration should be given for screening at a younger age in those at high risk)	Use a combination of an A1C and an FPG or random plasma glucose in children and adolescents with any of the following conditions (three or more risk factors in non-pubertal or two or more risk factors in pubertal children): <ul style="list-style-type: none"> • Obesity (BMI \geq 95th percentile for age and gender) • Member of a high-risk ethnic group (e.g., African, Arab, Asian, Hispanic, Indigenous or South Asian descent) • Family history of T2DM and/or exposure to hyperglycemia in utero • Signs or symptoms of IR (including acanthosis nigricans, hypertension, dyslipidemia, PCOS and NAFLD [ALT >3\times upper limit of normal or fatty liver on ultrasound]) • Impaired fasting glucose or impaired glucose tolerance • Use of atypical antipsychotic medications
German Diabetes Association (Germany, 2015)	N/A	FPG, RPG, OGTT
Hellenic Diabetes Association (Greece, 2013)	N/A	FPG, RPG, OGTT
Associazione Medici Diabetologi (Italy, 2014)	N/A	FPG, RPG, OGTT; HbA1c recommended
Japan Diabetes Society (Japan, 2013)	N/A	FPG, RPG, OGTT; HbA1c recommended
Latvijas Diabēta Asociācija (Latvia, 2007)	Every 2 years, starting at age 10 (or beginning of puberty)	FPG, RPG, OGTT
Diabetes Gaires (Lithuania, 2014)	N/A	Pancreatic autoantibodies should be tested for autoimmunity in suspected cases of T2DM to clarify the diagnosis. Pancreatic antibodies should be tested for all obese/overweight children > 13 years, when suspect clinical type 1 diabetes (weight loss, ketosis/ketoacidosis).
Malaysia Ministry of Health (Malaysia, 2015)	Starting at 10 years of age, or at onset of puberty	Fasting insulin and C-peptide has been used to aid in the diagnosis. However, their measurement should be interpreted with caution due to considerable overlap between type 1 diabetes, T2DM and monogenic diabetes at onset and within 2 years of diagnosis.
Netherlands Diabetes Federation (Netherlands, 2015)	N/A	Systematic screening is not recommended.

Guidelines (name, country, year)	Frequency of screening	Recommended screening tests
Diabetologia Kliniczna (Poland, 2015)	Obese children above 10 years of age or puberty, whichever is earlier	Random blood glucose, FPG, or OGTT
Scottish Intercollegiate Guidelines Network (Scotland, 2013)	N/A	FPG, OPGTT
Singapore Ministry of Health (Singapore, 2014)	N/A	FPG, Casual Plasma Glucose, OGTT
Endodiab (Slovenia, 2016)	Every 2-3 years	Random blood glucose, fasting insulin, OGTT
Society for Endocrinology, Metabolism, and Diabetes of South Africa (South Africa, 2017)	At 10 years old or onset of puberty, performed every 2 years after	FPG is preferred, but if borderline to OGTT
Diabetes Association of Thailand (Thailand, 2014)	Start screening at 10 years old	FPG, random plasma glucose, OGTT
National Institute for Health and Care Excellence (United Kingdom, 2016)	N/A	Random plasma glucose test, FPG, OGTT
American Diabetes Association (United States, 2016)	3-year intervals beginning at 10 years of age or onset of puberty	Random plasma glucose, FPG, OGTT
American Academy of Pediatrics (United States, 2013)	N/A	HbA1c test, fasting plasma glucose test, oral glucose tolerance test, random plasma glucose test

Source: Adapted from Bhatt et al. (2018).

Article with full table can be accessed at <https://doi.org/10.1186/s13643-018-0843-1>.

4. Management of Pediatric Type 2 Diabetes

4.1 General Management Strategies

Diabetes Canada recommendations for management of pediatric T2D include:

- Starting at diagnosis, ongoing intensive counselling and interventions on healthy behaviour, from an interprofessional pediatric health-care team made up of a pediatric endocrinologist (or pediatrician with diabetes expertise), diabetes educator and mental health professional.
- Regular, moderate to vigorous physical activity
- Target A1C $\leq 7.0\%$.

- In cases of severe metabolic decompensation or A1C \geq 9%, insulin therapy should be initiated as well as metformin
- In those who are metabolically stable and A1C $<$ 9%, then lifestyle measures and metformin should be initiated. If glycemic targets are not achieved within 3–6 months from diagnosis, then basal insulin should be initiated. Further progression of treatment with prandial insulin may be required.
- Screen for comorbidities at diagnosis and yearly, including dyslipidemia, hypertension and albuminuria, neuropathy, retinopathy, and other conditions associated with insulin resistance. (Panagiotopoulos et al., 2018)

Note - for full recommendations go to <https://guidelines.diabetes.ca/cpg/chapter35#sec3>

Bhatt et al. (2018) and Samaan (2013) identified issues with current pediatric T2D management guidelines around the world (including from Diabetes Canada), and common ways of managing T2D. In a systematic review of 21 pediatric T2D management guidelines (after screening down from 6,207 articles) using the AGREE II evaluation tool, Bhatt et al. (2018) concluded that only one third of them could be considered 'high quality'. The Diabetes Canada guidelines for management of pediatric T2D (as described above) was recommended for use, with one of the highest scores among the articles reviewed

Samaan (2013) reviewed several pediatric T2D management strategies and summarized the best ways to manage T2D. Based on the results of the TODAY study (Treatment options for type 2 diabetes in youth), a large, longitudinal, randomized, multicenter study, in which youth between 10 and 17 years were treated and followed for a minimum of 2 and maximum of 6 years, Samaan (2013) indicated that a multidisciplinary team forming a management plan for youth with T2D would be ideal. This meant that the clinician should engage educators, dieticians, social workers, therapists, psychologists, and others to help manage the comorbidities. Importantly, Samaan (2013) said that this plan needed to intimately include parents and/or guardians, account for their financial limits, and be culturally responsive. Unfortunately, there was no discussion on how to address the barriers of providing this type of care plan in remote communities, with limited resources, or with families/youth with little engagement; so although this may be the ideal approach, it is not necessarily the most realistic one in some contexts. In the end, however, it was proposed that the management strategy should include five broad goals: 1) glycemic control; 2) weight loss/maintenance; 3) healthy lifestyle skill set and habits (including a tailored nutrition plan, limits of screen time, and increased physical activity); 4) management of comorbidities; and 5) prevention of complications (Samaan, 2013).

5. Complications of Pediatric T2D

5.1 Depression

Depression is one complication and/or comorbidity that may arise for some youth with T2D. Silverstein et al. (2012) gave youth aged 10-17 years and diagnosed with T1D and T2D a scale to measure depression and found that 22% of T2D participants showed depressive symptoms (as compared to 13% of T1D participants). Interestingly, these symptoms were associated with low familial income and obesity in T1D participants but not in those with T2D diagnoses. To reinforce the recommendations from Samaan (2013) on the importance of a multidisciplinary team to manage T2D, of the 22% of youth who

were experiencing depressive symptoms, only 9% had received any psychological intervention within the past year.

5.2 Cardiovascular Risk

Prendergast and Gidding (2014) was the only study reviewed that focuses on a direct link between T2D and cardiovascular disease – though they base their argument on many other articles that present evidence of associations between the two through the well-documented mediating factor of obesity (e.g., Juonala et al., 2011). Prendergast and Gidding explain that, because a T2D diagnosis is often delayed until adolescence, the identification of cardiovascular risks may not be made until adulthood (Lee, 2008; Lee et al., 2004). In summary, Prendergast & Gidding claim that cardiovascular disease is the leading cause of death for patients with T2D and that early, consistent treatment in those with T2D is important to reducing the risk of death.

5.3 Renal Complications (Albuminuria & Hypertension)

According to Sellers et al. (2016), Dart, Wicklow et al. (2014), and Dart et al. (2012), albuminuria (i.e., a presence of the protein ‘albumin’ in urine, which is established as a sign of kidney disease) appears to be a significant complication of pediatric T2D. In a Canadian-based national prospective surveillance study, Sellers et al. (2016) found evidence of 50 cases of persistent albuminuria (defined as a higher than normal albumin-to-creatinine ration in urine samples) over a period of two years. When compared to national statistics on pediatric T2D, Sellers et al. (2016) concluded that the prevalence of albuminuria was approximately 5% nationally in pediatric T2D but that it was as high as 12.7% in Manitoba. Further, they determined that, of those who showed signs of persistent albuminuria, 64% were female, 80% self-identified as First Nations, and 76% of all cases were from patients in Manitoba. Similar to the findings of Halipchuck et al. (2018), a high proportion of those with persistent albuminuria were exposed to either gestational or pregestational diabetes (65% of all cases). Finally, 48% of all cases had a family history of diabetes-related renal disease, which is consistent with both Morgan (2012) and Prendergast and Gidding (2014).

Sellers et al. (2016), Samaan (2013), and Prendergast and Gidding (2014) all found evidence of hypertension as a comorbidity with pediatric T2D. Prendergast and Gidding (2014) cite Epstein and Sowers (1992) and argue that those with T1D typically develop hypertension over time, but that those who are diagnosed with T2D typically have hypertension at the time of their diagnosis. Additionally, the authors argue that hypertension, along with albuminuria, is one of the leading causes of end-stage renal disease and that management plans that directly target hypertension have been shown to reduce the effects of renal disease (De Boer et al., 2011; De Galan et al., 2009). They go on to describe the TODAY study group that found evidence that the prevalence of hypertension increased among youth with T2D from 11.6% at time of entry to study to 33.8% at time of completion (those entering were diagnosed less than 2 years prior, and time in study was between 2 and 6 years), regardless of which treatment they underwent. To further support these findings, Sellers et al. (2016) presented evidence that suggested 56% of their sample were also diagnosed with hypertension at the same time as their T2D diagnosis. Samaan (2013) reviewed studies that suggested 20-30% of youth with T2D had hypertension and that it can lead to end-stage renal disease.

The studies outlined in this review have highlighted numerous potential complications associated with pediatric T2D. It is important to note that many of the findings are based on correlations, which does not necessarily equal causation. Complications described include depression, cardiovascular disease, and renal complications. Other potential complications are not described in this review (i.e., retinopathy, hyperglycemic emergencies, obstructive sleep apnea, PCOS, non-alcoholic fatty liver disease, neuropathy).

5.4 Progression of Comorbidities of Pediatric T2D

Dart, Martens et al. (2014) used Manitoba data from the DER-CA database to examine the progression of pediatric T2D and found that youth with T2D were often diagnosed between the ages of 15-16, and 40-50% of those youth had elevated blood pressure when compared to youth without a T2D diagnosis or a T1D diagnosis (based on the last available datapoint in their database). Further, Dart, Martens et al. found evidence that youth with T2D have the highest risk of complications when compared to those with T1D or nondiabetic youth. Importantly, youth who are not diagnosed until they are older have a higher risk for complications than youth who are diagnosed at a younger age, because the condition can progress without intervention. The authors recommend early screening of albuminuria as one way to identify T2D and slow the progression of the disease.

Dart, Martens et al. (2014) were able to determine that, similar to those with T1D, those with T2D had a much higher risk of macrovascular and microvascular disease than non-diabetic controls. However, they also found that the time to develop both renal and neurological complications for youth with T2D was much faster when compared to youth with T1D. The authors point to renal disease as the most highly documented complication among youth with T2D. Their previous study demonstrated the high association between albuminuria and end stage renal disease, with up to 50% of youth with T2D developing it within 20 years of diagnosis (Dart, Sellers, Martens et al., 2012). A mediating factor for these risk factors appeared to be the regulation of glycemic control, which Dart, Martens et al. (2014) suggested should remain a central focus of treatment.

5.5 Screening for Comorbidities

Within the *Diabetes Canada Clinical Practice Guidelines* Panagiotopoulos et al., (2018) outlined screening methods to help identify comorbidities associated with pediatric T2D. These can be found in Table 2 on the next page. Healthcare workers may find the information presented in Table 2 useful as a guide to help identify and manage pediatric T2D comorbidities, especially the intervals for screenings.

Table 2. Guide for Identifying and Managing Pediatric T2D Comorbidities

Complication/Comorbid condition	Indications and intervals for screening	Screening test
Neuropathy	Yearly screening commencing at diagnosis of diabetes	Questioned and examined for: <ul style="list-style-type: none"> • Symptoms of numbness, pain, cramps and paresthesia • Vibration sense • Light touch and ankle reflexes
Retinopathy	Yearly screening commencing at diagnosis of diabetes	<ul style="list-style-type: none"> • 7-standard field, stereoscopic-colour fundus photography with interpretation by a trained reader (gold standard); or • Direct ophthalmoscopy or indirect slit-lamp fundoscopy through dilated pupil; or • Digital fundus photography
Nephropathy	Yearly screening commencing at diagnosis of diabetes	<ul style="list-style-type: none"> • First morning (preferred) or random ACR • Abnormal ACR requires confirmation at least 1 month later with either a first morning ACR or timed overnight urine collection for ACR • Repeated sampling should be done every 3 to 4 months over a 6- to 12-month period to demonstrate persistence
Dyslipidemia	Screening should commence at diagnosis of diabetes and yearly thereafter	Fasting TC, HDL-C, TG, calculated LDL-C
Hypertension	At diagnosis of diabetes and every diabetes-related clinical encounter thereafter (at least twice annually)	BP measurement using appropriately sized cuff
NAFLD	Yearly screening commencing at diagnosis of diabetes	ALT and/or fatty liver on ultrasound
PCOS	Yearly clinical screening commencing at diagnosis of diabetes in pubertal females	Clinical assessment on history and physical exam for oligo/amenorrhea, acne and/or hirsutism
OSA	At baseline, and yearly clinical screening	Symptoms suggestive of obstructive sleep apnea include: snoring, apneas, morning headaches, fatigue, daytime sleepiness, nocturia and enuresis
Depression	Screening at diagnosis and yearly thereafter	Clinical assessment on history of symptoms of depression, including fatigue, depressed or irritable mood, loss of interest or pleasure, feelings of worthlessness or guilt
Binge Eating	Screening at diagnosis and yearly thereafter	Clinical assessment on history: frequency of having lost control while eating, eating unusually large amounts

ACR, albumin-to-creatinine ratio; ALT, alanine aminotransferase; BP, blood pressure; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; NAFLD, non-alcoholic fatty liver disease; OSA, obstructive sleep apnea; PCOS, polycystic ovary syndrome; TC, total cholesterol; TG, triglycerides.

Source: Panagiotopoulos, Hadjiyannakis, and Henderson, 2018.

6. Pediatric T2D in First Nations Populations

6.1 Overrepresented Prevalence and General Characteristics

Nearly all the Canadian-based articles reviewed showed evidence that First Nations people are overrepresented in T2D statistics (Allan et al., 2008; Crowshoe et al., 2018; Dyck et al., 2010; Haman et al., 2010; Jacklin et al., 2017; Osgood et al., 2011; Seller et al., 2012; Sellers et al., 2016; Solis-Herrera et al., 2014; Spurr et al., 2017). Looking at T2D in all ages, research has found the First Nations population has much higher rates of T2D than the non-First Nations population. Osgood et al., (2011) concluded that in Saskatchewan, First Nations peoples made up anywhere between 19-30% of all T2D cases. This is concerning given that First Nations make up approximately 10.7% of the Saskatchewan population (Statistics Canada, 2016). Numbers compiled in 2011 from the Canadian Chronic Disease Surveillance System indicated that across Canada, First Nations individuals living on-reserve had a 17.2% age standardized prevalence rate of diabetes (10.3% living off-reserve), and Métis peoples had a 7.3% prevalence rate, compared to a prevalence rate of 5% for non-Indigenous peoples (Government of Canada, 2011). In Alberta, the estimated lifetime risk of developing T2D was as high as 80% (8 in 10) for First Nations persons, compared to the non-First Nations population, which has a 5 in 10 lifetime risk (Turin et al., 2016). These are alarming statistics overall, but particularly so for First Nations. Many of the studies reviewed do not focus on pediatric populations; however, diabetes in adults is linked to pediatric T2D because adults with diabetes may have developed the condition early in life and because women experiencing diabetes in pregnancy (both diabetes diagnosed before pregnancy and gestational

diabetes) contributes to the development of pediatric T2D in their offspring (Blotsky et al., 2019; Dyck et al., 2001; Halipchuk et al., 2018; Osgood et al., 2011; Sellers et al., 2016).

One study from Manitoba examined pediatric T2D in First Nations populations, looking at everyone who had been referred to the Diabetes Education Resource for Children and Adolescent Centre (DER-CA; the only referral centre for Manitoba), between 2006 and 2011, and found that 87.7% of the children and youth in Manitoba with T2D were First Nations (Sellers et al., 2012). In addition, the majority (75%) of the referred youth live in rural or remote areas. In this longitudinal study, Sellers et al. (2012) determined that the average age of diagnosis was 13 years old, but that 11.1% of First Nations children were diagnosed before they turned 10 years old (compared to 6.9% in the non-First Nations population). They found more female youth with pediatric T2D (64% of cases), setting them up for diabetes in any future pregnancy, which is relevant to the previously discussed contribution of diabetes in pregnancy to future T2D in offspring (Sellers et al., 2012).

Similar to the findings for youth, in both Manitoba and Saskatchewan T2D was especially pronounced for First Nations women (Sellers et al., 2016; Osgood et al., 2011). Using Saskatchewan Health data, Dyck et al. (2010) showed that the prevalence of diabetes was 4 times higher for First Nations women and 2.5 times higher for First Nations men when compared to the non-First Nations population. Specifically, they found that First Nations women experienced the highest rate in prevalence (20.3%, compared to 5.5% for non-First Nations women). Although First Nations men's rates are lower than women's, First Nations men also experienced a much higher prevalence rate (16%) when compared to non-First Nations men (6.2%).

As can be expected from the high and increasing rates of First Nations women with diabetes, with many being diagnosed prior to or during childbearing years, Saskatchewan data is also showing an increasing number of diabetes-exposed pregnancies. A recent study by Dyck et al. (2019) examined Saskatchewan Health data from 1980 to 2009 and found that over the 30 years, the proportion of diabetes-exposed pregnancies (both gestational and pregestational diabetes) increased among both First Nations and non-First Nations, but for First Nations women, the incidence is 2-3 times higher. The 10-year age standardized incidence of gestational diabetes increased from 3.53% for 1980-89 to 8.37% for 2000-09 for First Nations women, and from 1.55% to 3.13% for non-First Nations women. Again, this is particularly relevant when we recall the contribution of diabetes in pregnancy to the risk of pediatric T2D (Osgood et al., 2011).

6.2 Contributing Factors

There are a variety of factors that are believed to contribute to the disproportionate representation of T2D in First Nations children and youth, including prenatal environment, poverty, genetics, and colonialism. As described above, one of the major contributing factors to the high and increasing number of First Nations youth developing T2D are the high and increasing numbers that are being exposed to diabetes during pregnancy (Halipchuck et al., 2018; Sellers et al., 2012). In addition, low maternal income increases the risk of her offspring developing T2D (Halipchuck et al., 2018). This association may be mediated by the impact that poverty has on the mother's experience of and ability

to manage her diabetes, which in turn affects the impact of her condition on her developing fetus. In addition to the research reviewed earlier which describes evidence for the contribution of genetics to the development of pediatric T2D generally (e.g., Prendergast & Gidding, 2014), there is some evidence that genetics may play a role in the development of early onset T2D for some specific First Nations groups (Sellers et al., 2012, Sellers et al., 2016).

One major factor that has been proposed to contribute to the disproportionate prevalence of T2D in Indigenous populations is the role of colonization (Crowshoe et al., 2018; Haman et al., 2010; Jacklin et al., 2017). Directing the reader to many similar situations across the world, the authors argue that the systematic dismantling of Indigenous culture as part of Canada's colonization process has played a significant role in the health of Indigenous peoples across the entire country. This would have included restricting access to traditionally grown and sourced food (Haman et al., 2010). Specifically, Crowshoe et al. (2018) says:

In Canada, this involved: the outlawing of Indigenous gatherings and ceremonies at the end of the nineteenth and throughout the first half of the twentieth centuries; forced community relocations; mandatory residential school attendance where Indigenous languages were forbidden, and physical and sexual abuse were common; and discriminatory child welfare legislation that persists today. All have undermined Indigenous cultures and values, leading to lasting and intergenerational effects on mental health, family relationships and Indigenous ways of knowing and connecting to the land. (p. 297)

Crowshoe et al. (2018) argue that healthcare providers have to recognize the impacts of colonization in the treatment of T2D because it: 1) prevents the uptake of a healthier diet due to socioeconomic or geographical factors; 2) is associated with other adversities and traumas that affect the uptake of behaviour change and creates stigma around the diagnosis of T2D; and 3) may trigger memories of residential school experiences for some, especially when language such as 'test results' is used.

Building on this theme, Jacklin et al. (2017) conducted a study to see how the impacts and legacies of colonialization have affected current diabetes treatment for First Nations and Métis peoples. The authors interviewed Indigenous diabetes patients and found that trust and the history of healthcare plays a major role in what they do and do not disclose to clinicians, how often they visit clinics, and their personal comfort in the health system. Jacklin et al. (2017) described their findings:

We found that interactions and engagement with health services are influenced by personal and collective historical experiences with health care providers and contemporary exposures to culturally unsafe health care. Participants related such experiences to specific health policies and systemic discrimination in health care systems. Participants reported that rushed appointments, writing prescriptions or medicating complaints, not listening and negative judgments regarding Indigenous customs and communities created a lack of confidence in the health system and provider. Together, these experiences led to participants not disclosing all of their symptoms or health behaviours. (p.111)

To mitigate these challenges, Jacklin et al. (2017) advocated that the relationship between a patient and clinician was central to the effectiveness of diabetes treatment. Building on examples given by participants, they argued that the effects of past wrong doings can be mitigated by genuine, humble, and empathetic interactions. Further, authors strongly recommended education in culturally appropriate and trauma-informed care for those providing care of T2D populations.

Additional factors for clinicians to consider when working with First Nations and Métis T2D populations include: 1) recognizing the relationship between poverty, trauma, and an individual's capacity to manage a T2D diagnosis; 2) consider the patient's perspective of the clinician and the healthcare system; and 3) if the person is interested and able to do so, a consideration of connecting traditional ways of managing diabetes into the management plan (Jacklin et al., 2017; Crowshoe et al., 2018).

A study done in Manitoba looking at quality of life (QOL) for youth with T2D found a few things that may be relevant to addressing pediatric T2D in Saskatchewan (Allan et al., 2008). They found that living in a northern or isolated community was a predictor of lower QOL. In addition, it seemed that the youth were aware of the impact of poor diabetes control on their long-term health, and that seeing a family member with complications of the T2D was a predictor of poorer QOL, irrespective of their current diabetes control. It was suggested that a youth's sense of personal risk and future complications must be acknowledged and discussed openly with a counsellor. On the other hand, they found that First Nations youth with T2D were more optimistic and perceived a higher quality of life than their parents did for them (Allan et al., 2008). These findings can serve as a reminder of the resilience that youth can have, and the value of an open, yet strength-based approach, when working with youth.

Qualitative studies have been done looking at the experiences of First Nations people with diabetes and although the findings may not be completely transferable to the current context, as they were done in specific communities, and with different populations and in different contexts (adult T2D and diabetes in pregnancy), they provide perspectives to be considered when looking at how to work with Saskatchewan First Nations communities to address the high and increasing rates of pediatric T2D. When looking at the experiences of adults with T2D in British Columbia, Barton et al. (2005) identified the importance of consultation with the community, cultural awareness of healthcare providers, and the involvement of the impacted people in the development of intervention and prevention strategies. The authors suggested that doing these things could contribute to both cultural safety in the management of diabetes, as well as help to increase early detection. Speaking with First Nations women in Alberta who had experienced diabetes in pregnancy, Oster et al. (2014) learned about the value of a strong support system (including family, health care, cultural, and community), and the importance of awareness and education resources that would allow women to take some control of their health.

7. Pediatric T2D Programming

7.1 Lifestyle Interventions

Several lifestyle interventions emerged in the literature review and may provide ideas for the types of programming that may work in Saskatchewan. In a systematic review of interventions for youth with T2D, McGavock et al. (2015) outlined that, although few experimental trials have been published to help guide clinicians, there have been successful programs that target diet and physical activity. Specifically, they reviewed evidence that suggested that lifestyle interventions can help reduce weight and improve glycemic control but pointed out that for youth this effect was not sustained long-term. There is limited experimental evidence (in terms of number of studies and strength of evidence) indicating interventions that provide better management of pediatric T2D in the long term. Interestingly, these types of programs appear to have a longer-term effect for adults; it is only in children and adolescents that the benefits were not found to be sustainable. McGavock et al. (2015) theorize that the physiological and psychological differences between adult and pediatric populations play a role in the differences in effectiveness of lifestyle interventions. Specifically, the authors support their assertion by pointing out evidence suggesting a difference in the manifestation of T2D in youth, that is, that glucose-stimulated insulin secretion was three to five times faster in youth than it is in adults (McGavock et al., 2015). As insulin secretion is one way to control glycemic levels, the sensitivity of one's body to insulin plays a large role in the management of T2D. The authors argue that lifestyle interventions to date have not matched the differing rates of insulin secretion between adults and youth. Therefore, the changes for youth from those types of lifestyle interventions were not found to be as sustainable. Finally, McGavock et al. (2015) suggest that the only sustainable way to control insulin sensitivity in youth was bariatric surgery, which is not accessible for the majority of the Canadian pediatric population.

Perhaps one of the most relevant studies for addressing pediatric T2D came from Hunyh et al. (2015) who evaluated a program out of Manitoba called Beating Diabetes Together (BDT). This program was a 16-week pilot study of group-based lifestyle changes for First Nations youth in rural Manitoba with T2D. The curriculum involved a supportive environment where youth would get together with program leaders to learn how to cook traditionally while increasing their understanding of how food affects their body. In a series of 16 weekly sessions, participants spent an hour and a half learning about T2D, doing a practical activity with the knowledge they learned (e.g., cooking, label reading, physical activity), and eating healthy snacks. From semi-structured interviews, Hunyh et al. (2015) outlined the following:

- 1) Many participants spoke to researchers about the difficulty of managing T2D. Specifically, youth indicated that they had the necessary knowledge of diet and exercise, but that managing their T2D diagnosis mainly rested upon their shoulders and that could be an isolating feeling, especially around peers who do not have to adhere to such a diet. If they were to deviate from that diet, they described feeling guilty and defeated.
- 2) BDT helped to reverse feelings of isolation and defeat because it was done in a group setting where youth felt a common cause by working on managing their T2D together. Non-competitive equitable games were seen as necessary by parents of the youth because they helped increase

the physical activity levels in youth. Hunyh et al. (2015) recommended that these types of activities are implemented in T2D programming in the future.

3) Familial and peer support is crucial for the lifestyle management of T2D, but, similar to the findings of McGavock et al. (2015), they also explained that lifestyle interventions may not be enough to fully manage T2D.

7.2 Programming Barriers and Facilitators

Two articles outlined the barriers and facilitators for success from both the provider and youth perspective. Mcintosh et al. (2017) carried out a survey of pediatric diabetes workers in Canada asking them to identify the barriers and facilitators to successfully manage T2D through programming. A lack of funding and poor adherence to T2D management plans by patients/families were identified as major barriers, but follow-up interviews with workers from British Columbia revealed three main ways in which collaborative work on T2D can be carried out. They included:

1) **Working on a provincial level.** Similar to the recommendations made by Samaan (2013), Mcintosh et al. (2017) presented interview evidence that a collaborative, multidisciplinary approach has worked best to help manage T2D because it approaches the management plan from multiple perspectives. However, it was stressed that three main barriers have prevented the use of multidisciplinary approaches. These included: 1) geographical barriers to accessing care in rural and remote areas; 2) not having a way to communicate evidence-based T2D recommendations on a provincial level; and 3) lack of community capacity to treat T2D.

To address these barriers, participants stressed the importance of having outreach clinics in rural and remote communities (addressing geographical barriers), to create an online charting system to track screening of T2D (communicating recommendations), and education of local healthcare workers on T2D (addressing capacity). Mcintosh et al. argued that if those solutions could be implemented, it would reverse barriers to T2D management and improve the health of youth.

2) **Supporting emotional and mental health as part of management.** At the time of the interviews, participants felt as if mental and emotional health was underfunded and, as a result, ignored in some management plans. Interviewees argued that a lack of emphasis on mental health makes it harder for youth to control their glycemic levels and other management targets. Interviewees explained that the reason mental health is not currently being focused on was because there was a lack of access to psychosocial support (psychologists, social workers, etc.), because mental health is not an integrated part of regular visits to the clinician, and because there was no universal access to psychosocial support. Once again, Mcintosh et al. (2017) argued that if these barriers were addressed, management of T2D would become more effective.

3) **Frequent interactions with patients.** Interviewees described that the more often T2D patients were able to visit their clinics, the better the adherence was to T2D management strategies. McIntosh et al. (2017) explained that this was because the frequency of visits translated into more high-quality education sessions with the youth and family. According to interviewees, this allowed workers to identify problem areas in the management plan and address those before they became a larger issue. To complete more visits, interviewees stressed that more funding was needed to fully staff clinics and educate staff so they in turn could educate youth and families about T2D. It is likely that additional education and relationship building would help to increase healthcare workers' interactions with patients and increase general knowledge of T2D.

Similarly, McGavock et al. (2015) outlined barriers and facilitators for T2D care. Focusing mostly on self-care, the authors concluded that many youth who have T2D often experience fear and have high levels of responsibility. Specifically, qualitative evidence suggested that many youth with T2D are taking care of their siblings, who may also have T2D. Further, a sense of fear may be born out of a lack of support or bullying from their peers and families, which can reduce the willingness to change their lifestyles to one more suited to manage T2D. Building on this finding, McGavock et al. (2015) tested the effectiveness of peer-led interventions for increasing healthy lifestyles. Basing it on successful models of weight-loss programming, authors presented evidence that peer-led programming was better at not marginalizing youth and motivating them for the types of behavioural changes they needed to make to manage T2D. Interestingly, this was especially true when the programming was led by older peers.

Needs Assessment Survey and Interviews

1. The Purpose of the Survey and Who Answered It

1.1 The Purpose of the Pediatric T2D Needs Assessment Survey

As there has been limited research on pediatric type 2 diabetes (T2D) in Saskatchewan, a survey was commissioned to explore healthcare workers' opinions on the current training and education needs related to pediatric T2D. The survey was developed in consultation with staff from the Saskatchewan Prevention Institute and Dr. Mark Inman (Pediatric Endocrinologist, Saskatchewan Health Authority). Feedback on a draft of the survey was obtained from members of the LiveWell Pediatric Diabetes team (Saskatoon SK) and Nina Onyskevitch, Community Dietician from the Aboriginal Diabetes Initiative, First Nations and Inuit Health Branch. The survey was carried out from December 2018 to January 2019. The purpose of the survey was to:

- explore the level of interaction Saskatchewan healthcare workers have with pediatric T2D populations and to explore who comprises that pediatric population
- determine baseline level of pediatric T2D knowledge (e.g., facts, awareness) in those who responded
- explore the barriers participants are facing when providing care to those with pediatric T2D
- determine the barriers and facilitators related to obtaining additional education and training in pediatric T2D, as well as participants' level of interest in additional training

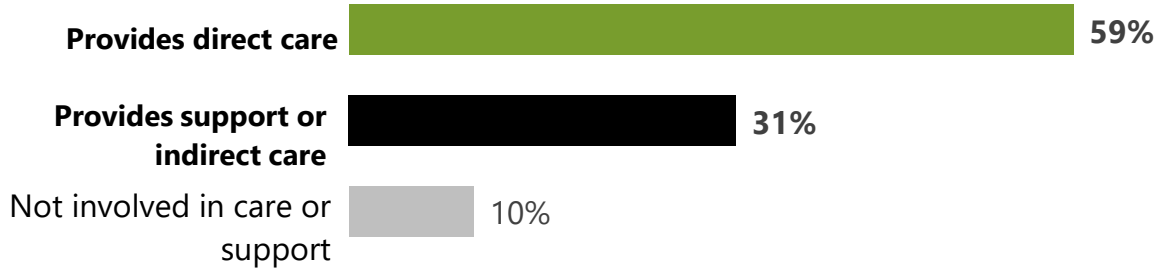
The results from each of these areas can be viewed on the following pages. To view a complete set of the survey questions, please refer to Appendix A.

1.2 Who Answered the Survey?

Dr. Mark Inman (Pediatric Endocrinologist, University of Saskatchewan) distributed the invitation to complete the online survey to a pre-determined list of potential participants throughout the province. This list included healthcare workers (e.g., pediatricians, diabetes educators, nurses, dieticians, etc.) who were likely to work with a pediatric T2D population, administrative staff and stakeholders involved in diabetes care, and other providers known to interact with diabetes patients and/or care. Recipients were also encouraged to forward the invitation and survey link to all colleagues who see pediatric patients with T2D or who are at risk of T2D, or who oversee programming/training/care related to pediatric T2D. The survey was open from December 16, 2019 to January 10, 2020. The survey received 99 responses, with 74 people completing the survey entirely (completion rate of 74%). On average, the survey took eight minutes to complete. Two follow-up interviews, selected based on their high level of pediatric T2D involvement as well as willingness/availability to complete the in-depth interview, were completed to help explore and clarify the survey results. Interviews lasted an average of 32 minutes and were completed with pediatric T2D experts in Saskatchewan.

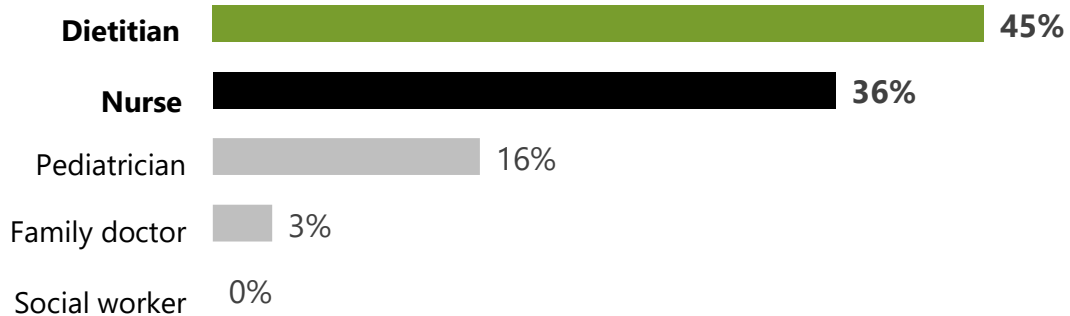
To help further explore who was answering the survey, participants were asked whether they provide direct care or indirect care/support to pediatric T2D populations. The majority of participants (59%) indicated that they provide direct care and 31% indicated that they provide indirect care or support. A further 10% indicated that they were not involved in any type of care or support related to pediatric T2D, which directed them to a survey termination page.

The **majority** of participants indicated they provide **direct** or **indirect** care (support) for pediatric type 2 diabetes patients.



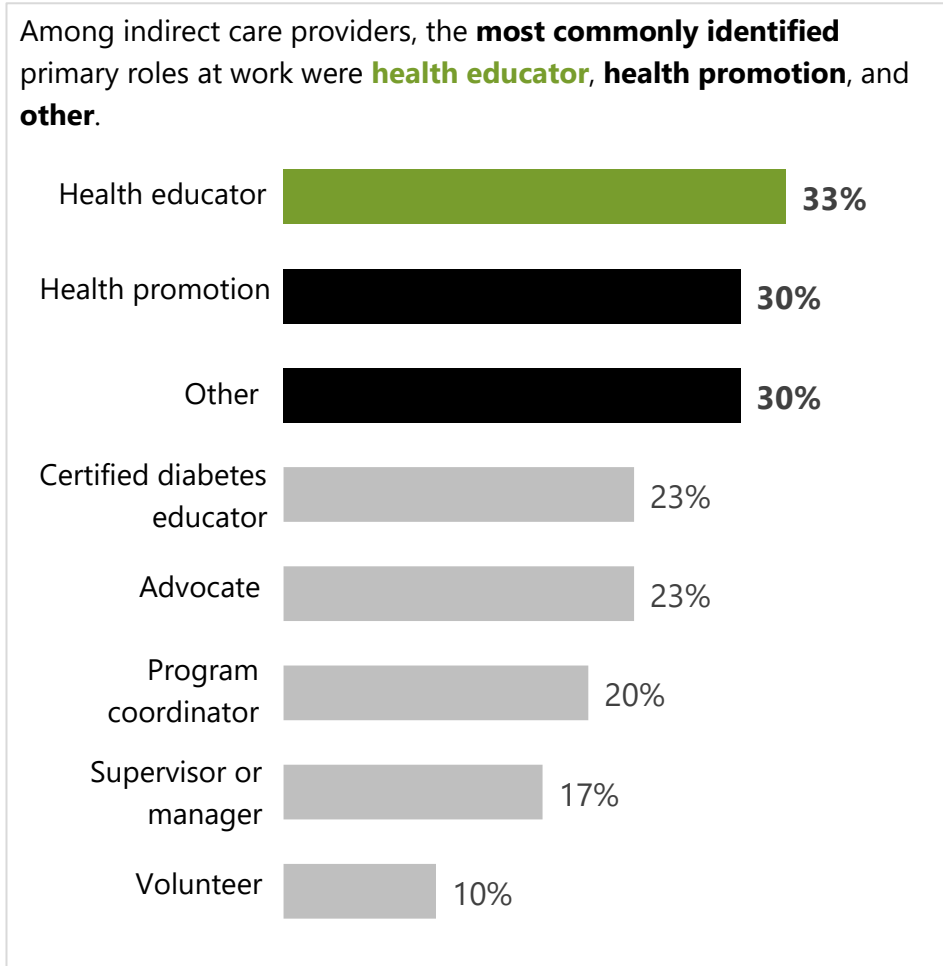
Of those who selected ‘direct care’, dietitians (45%) and nurses (36%) made up much of the participant sample, with pediatricians making up an additional 16%. Family doctors made up 3% of the sample and no one identified as a social worker in this sample (0%). Among direct care providers, just under half (48%) indicated that they were a certified diabetes educator.

Among those who provide direct care for pediatric type 2 diabetes, the **majority** identified as **dietitians** or **nurses**.

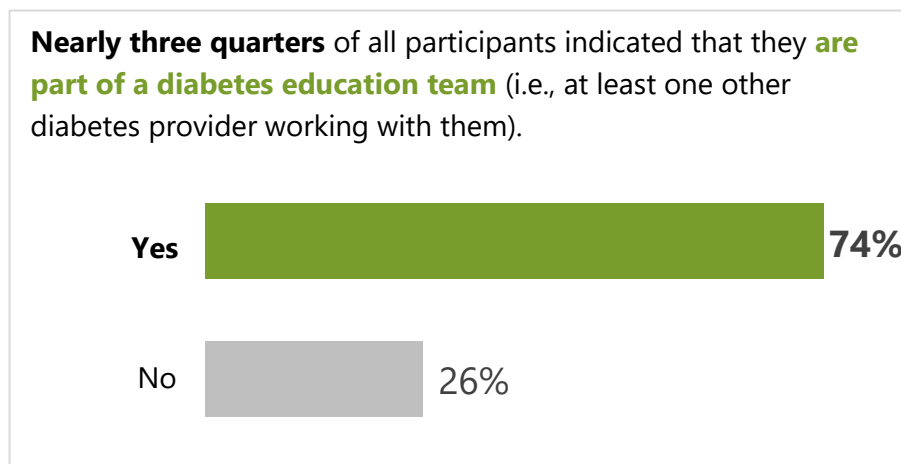


Participants who indicated they provided indirect care were asked to identify their primary roles at work. They were instructed to select all of the options which applied³. Health educator (33%), health promotion (30%), and ‘other’ roles (30%) emerged as the most commonly selected. ‘Other’ category responses included: 1) family physician and general physician; 2) community health nurse; 3) dietician; 4) home care nurse; 5) ADI support worker; 6) chronic disease management/prevention; and 7) nurse researcher.

³ Participants were able to select more than one answer, so percentages may total more than 100.

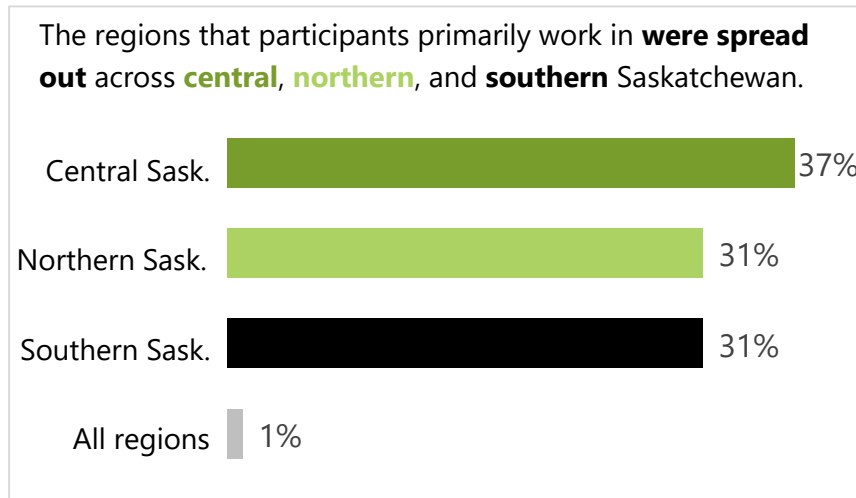


Nearly three quarters (74%) of all survey participants responded that they work in a diabetes education team.

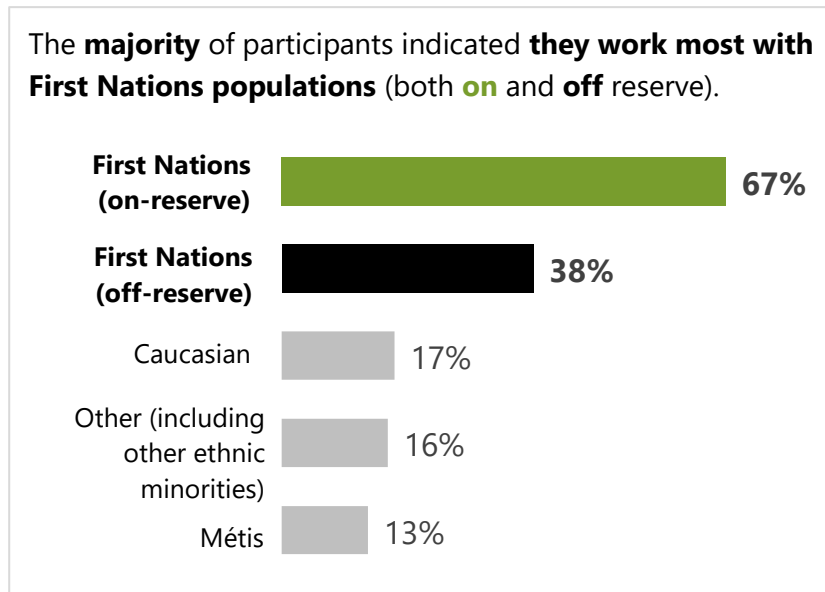


To help tailor future training and educational resources, we asked participants to identify which areas of the province they primarily work in, which populations they typically work with, and whether they work

most in urban, rural, or First Nations communities. Interestingly, there was a relatively even split in which areas of Saskatchewan the participants primarily work out of (central Saskatchewan = 37%; northern Saskatchewan = 31%; southern Saskatchewan = 31%).

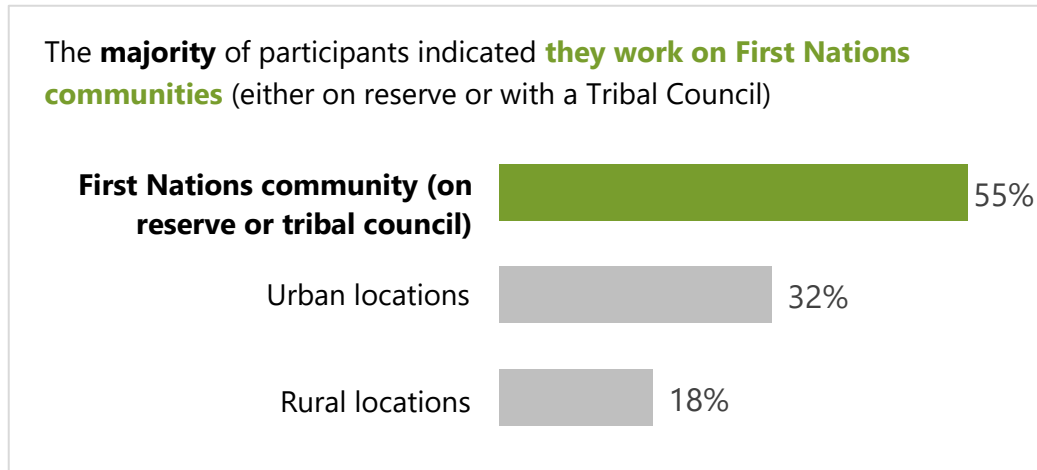


When asked which pediatric T2D population participants primarily work with⁴, First Nations pediatric populations both on (67%) and off reserve (38%) made up most of the selections.

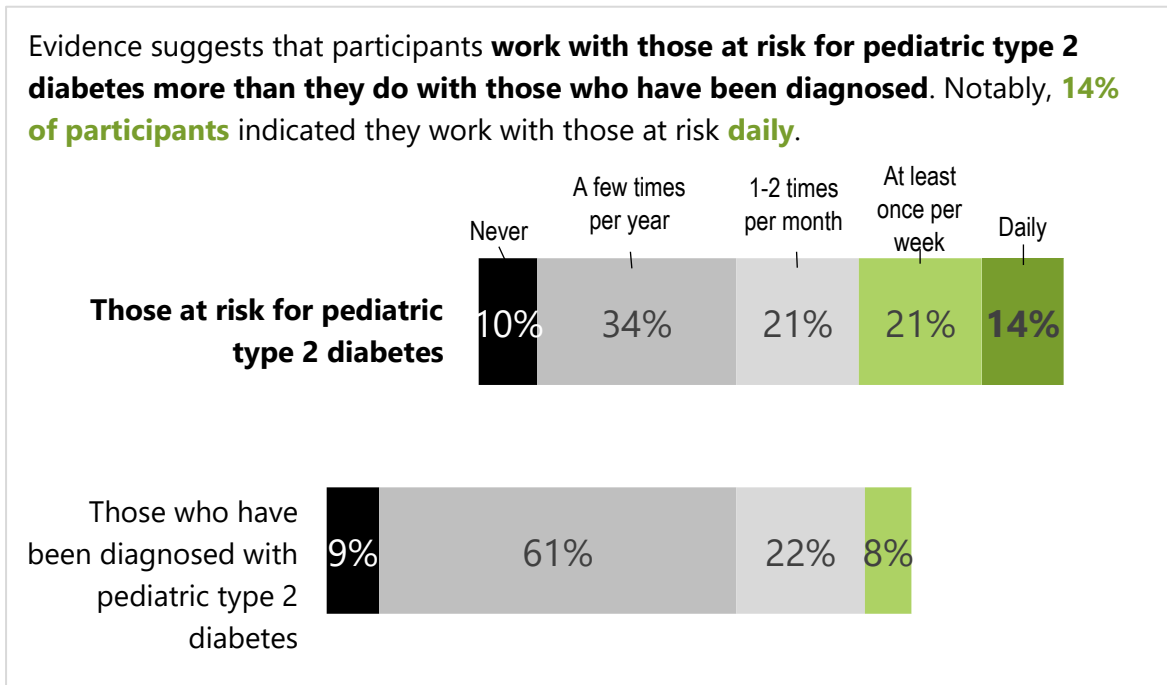


Similarly, 55% of all participants selected First Nations community (on reserve/Tribal Council) as the option that best describes the location where they do most of their work. Urban locations (10,000 people or more) made up 32% of the responses and rural locations (less than 10,000 people), was the least selected (18%)⁴.

⁴ Participants were able to select more than one answer, so percentages may total more than 100



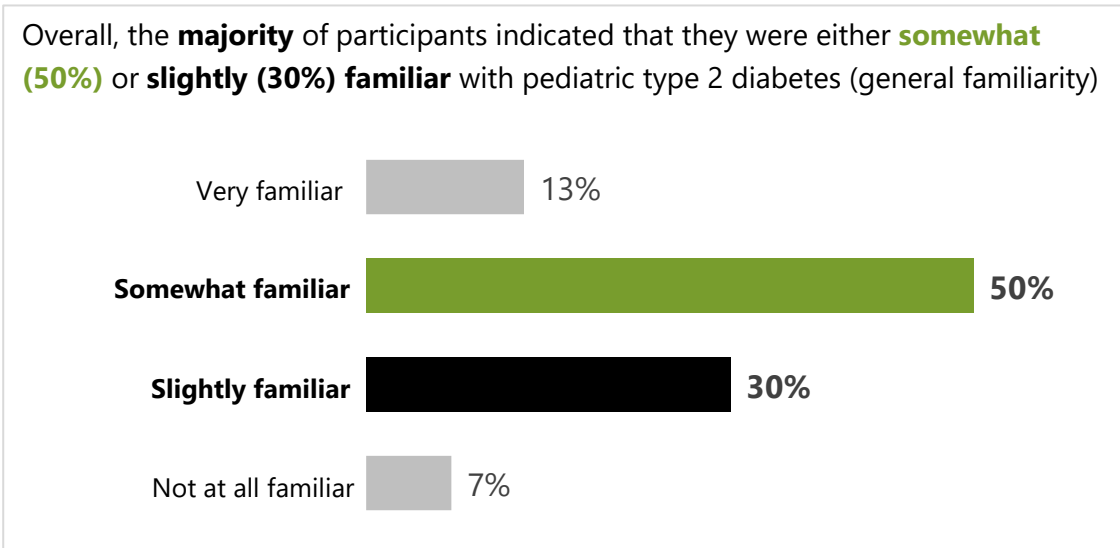
Participants were asked to provide their best guess on how often they work with pediatric populations. When asked to give a percentage indicating how many of their clients can be considered a pediatric population, **the average answer was 26%**, meaning that an average of 1 in 4 of participant’s clients may be infants, children, or youth. However, the responses ranged from less than 10% to 100%, so some of the participants work with children all the time, whereas others are seeing them infrequently. Participants also provided evidence that suggested they work with those who are at risk of a T2D diagnosis far more often than those who have already been diagnosed. Specifically, 21% of participants responded that they work with someone at risk of pediatric T2D at least once per week (compared to 8% working with those already diagnosed) and 14% indicated they do so daily (no one responded that they work with diagnosed populations daily).



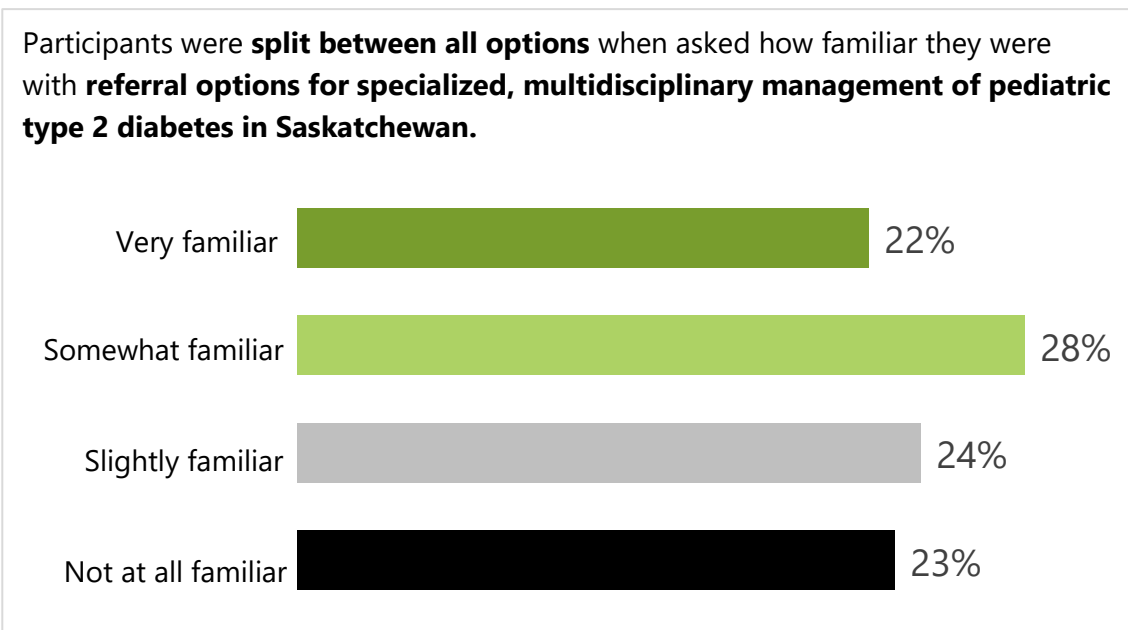
2. Pediatric T2D Knowledge and Familiarity

2.1 Participants' Self-Assessment of Their Knowledge of Pediatric T2D

To obtain a sense of the knowledge among participants in the basics of pediatric T2D, they were asked to respond to several questions assessing their internal knowledge of the condition. An overall question (i.e., how familiar are you with pediatric T2D?) revealed that many participants are slightly (30%) or somewhat (50%) familiar with pediatric T2D (i.e., general facts, knowledge). Only 13% of the sample answered 'very familiar' but, encouragingly, only 7% indicated that they were not at all familiar with pediatric T2D.

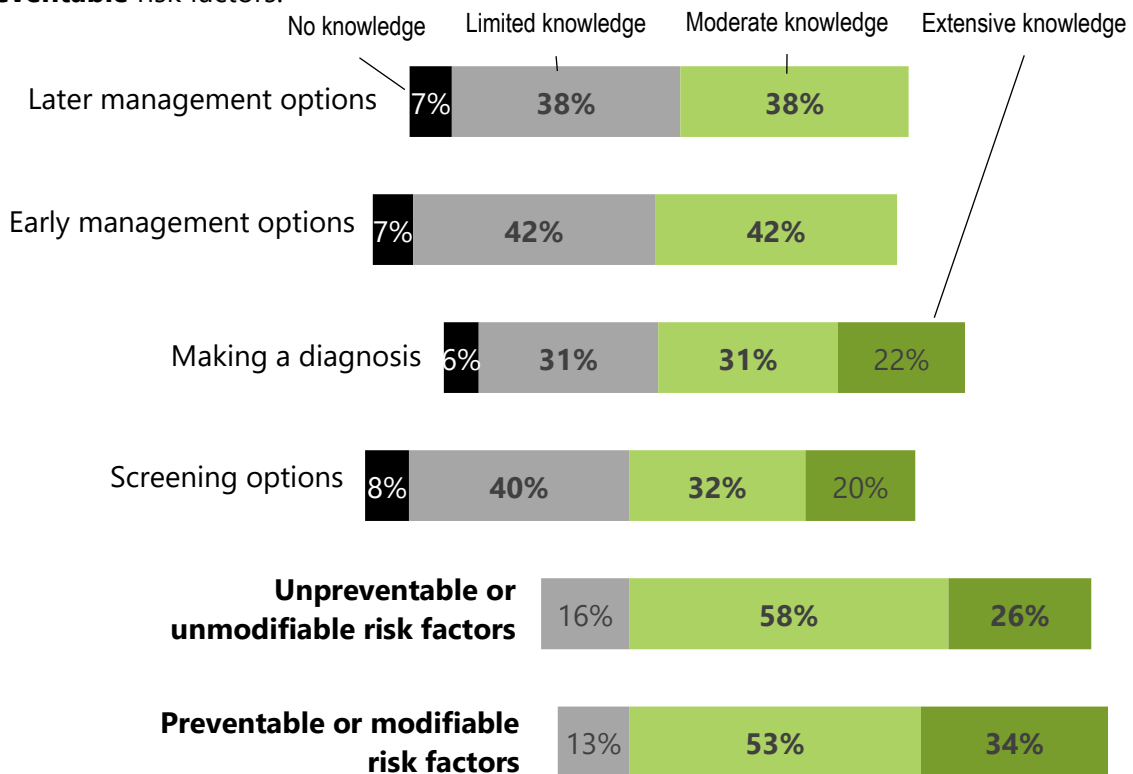


However, there was less self-reported familiarity among participants when asked about pediatric T2D referral options for specialized, multidisciplinary management of the condition. In comparison to general familiarity with pediatric T2D, for referral options, less than one-quarter of participants indicated being very familiar (22%), and equally as many indicated being not at all familiar (23%). A combined 52% responded that they were either somewhat (28%) or slightly (24%) familiar.



To gain a better sense of the knowledge of varying pediatric T2D management, screening, diagnosis, and risk factors, participants were asked to rate their level of knowledge on six factors. Interestingly, evidence suggested that participants have the highest level of knowledge for both unpreventable/unmodifiable risk factors (moderate knowledge, 58%; extensive knowledge, 26%) and preventable/modifiable risk factors (moderate knowledge, 53%, extensive knowledge, 34%). Making a pediatric T2D diagnosis (moderate knowledge, 31%, extensive knowledge, 22%) and screening options for pediatric T2D (moderate knowledge, 32%, extensive knowledge, 20%) were the second most selected factors. Participants rated themselves as lowest on later and early management options for pediatric T2D, with 38% and 42% of participants indicating ‘limited knowledge’ respectively.

The **majority** of participants indicated having **limited** or **moderate knowledge** for most key areas of pediatric type 2 diabetes. However, **more participants** indicated they had either **moderate (58%, 53%)** or **extensive (26%, 34%)** knowledge of both **unpreventable** and **preventable** risk factors.



The finding of participants rating themselves as most knowledgeable with risk factors but least knowledgeable with management options was supported by both interviewees, who stated:

"I would say people know most about the risk factors. But then the rest of what I'm hearing, especially from communities that I'm working with, is that we're just not equipped to deal with pediatric diabetes."

"I mean, we need to learn how to treat it better, but at the end of the day we know that kids who develop type 2 diabetes get more severe complications, and get these complications quicker. So, I think that we need to spend more money, if that's what we're looking at, is preventing it. So, we need to find out what do we need to do with these kids to prevent diabetes before they're actually diagnosed."

3. Barriers and Facilitators to Managing Pediatric T2D

One major purpose of this survey was to explore the barriers and facilitators healthcare workers are facing in their work with a pediatric T2D population. Therefore, participants were asked to respond to an extensive list of potential factors that may assist or impede in their work with pediatric T2D. The list included both internal factors (i.e., own awareness levels, comfort levels, knowledge) and external factors (e.g., readiness of children and families, support from decision-makers). Although nearly all the factors had many people indicating that it is a barrier to their work with pediatric T2D, the evidence suggested that external factors were more likely to be a barrier when compared to internal factors. For example, the level of knowledge in parents or guardians was the most commonly selected barrier (66%), followed closely by the level of knowledge in decision-makers (managers, policy makers, 59%). Both parent and child readiness to manage the condition (57%, 58% respectively) and engage in behaviours that address risk factors (58%, 56% respectively) were also highly selected as barriers.

One interviewee suggested a way to address the barrier of (lack of) knowledge within the community:

"I think a more aggressive campaign of information sharing and I think debunking some of those myths that come along with diabetes. So, some people feel like it's just inevitable, like we're going to get it eventually and there's nothing that we can do about it. So, there's that. And also, some of the myths surrounding once you have it, it's basically a life sentence and things aren't going to get better. And really talking about how if it's caught early and started treating well, outcomes can be really positive."

One interviewee suggested that stigma may be one barrier to parent readiness:

"Reducing diabetes stigma, because it still is pretty prevalent. So often people just assume, and especially it must be really hard for parents, but people just assume that it's a disease of laziness, or a disease of choice. So, they weren't eating healthy enough, they weren't working out enough, they weren't being physically active enough, and now they have diabetes. And that it's really a disease of choice, that it was just their poor choices that led to that. And then also if you think about that, it can also really plague a parent because if their kid has diabetes, it's basically is a comment on their parenting."

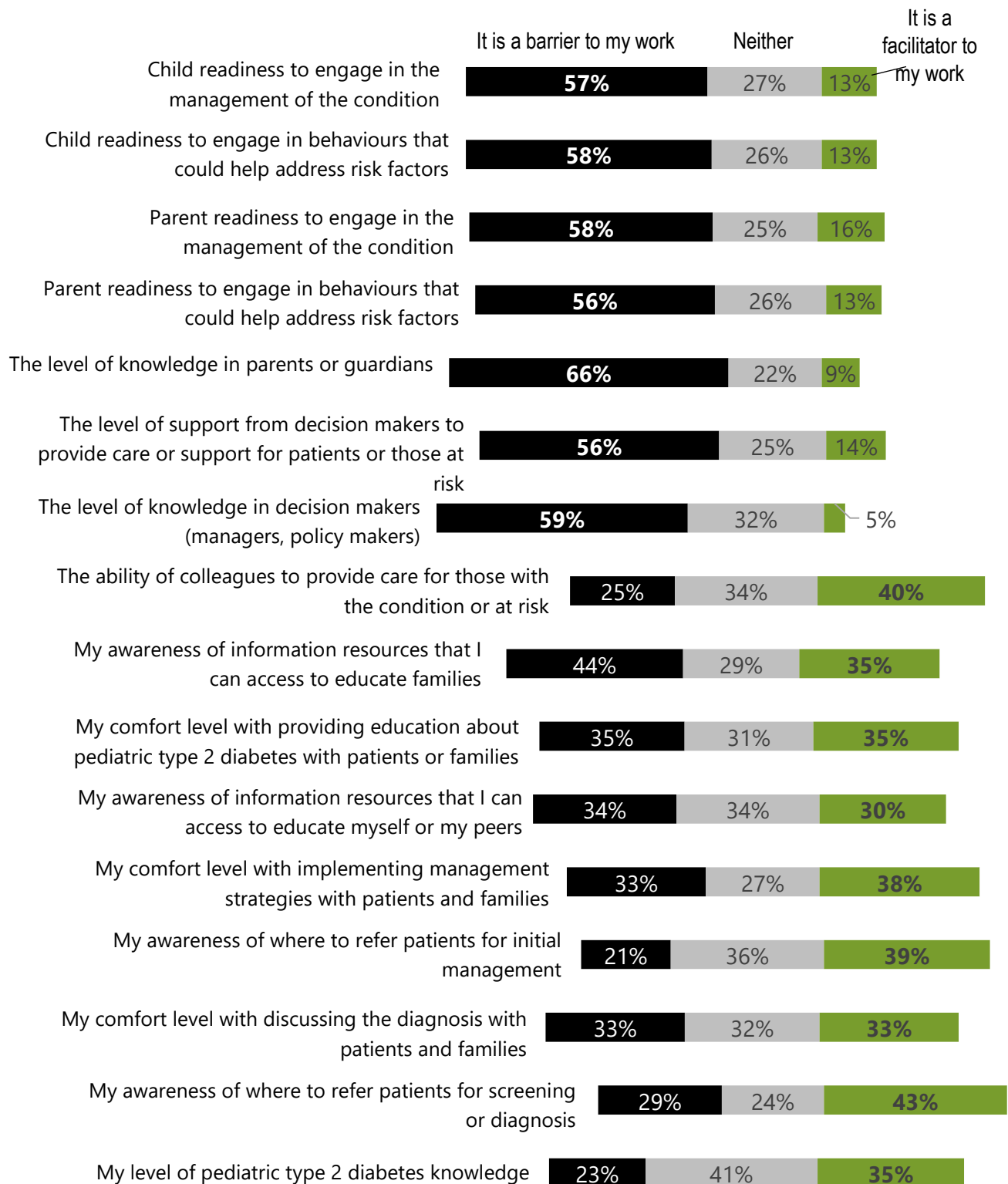
In contrast, the most selected facilitator for pediatric T2D was participants' own awareness of where to refer patients for screening or diagnosis (43%) followed closely by the ability of colleagues to provide care (40%). Interestingly, however, one interviewee pointed out that referrals between health systems (e.g., Federal and Provincial) aren't always a facilitator:

"Transfer of information is a huge barrier. Yeah...even knowing the ins and outs of what's happening in the health region, or the regional health authority. Because we don't know where to refer kids. And even if we do find a place to refer kids, the information isn't shared back and forth. So, there are health care professionals in community that can see kids in the community."

This interviewee went on to state that this was especially pronounced for Indigenous pediatric populations, who often are interacting with both Federal and Provincial health systems:

"So, they can see a dietician on Monday on reserve, and then they can go and see a physician the next day off reserve. And then the doctor is like, "Oh well, you need to see a dietician." So, then they'll refer them to a dietician and then they could go to a third dietician, or a second dietician on Wednesday off reserve. And so it's difficult when people can present for care in two different places and the systems don't talk with each other. The communication is a huge barrier and it would just be very helpful to have more of a coordinated team approach regardless of where that team works or who they're employed by."

The **majority of barriers** of working with pediatric T2D for participants were **external (e.g., child/parent readiness, decision maker support)**. In contrast, **more participants agreed that internal type factor (e.g., knowledge/awareness of condition)** were **more of a facilitator** when compared to external ones. There was, however, **still a large portion of participants believing internal factors were barriers**.



With respect to participants' comfort in managing pediatric T2D, there was a fairly even split between those viewing this as a facilitator and barrier, likely reflecting the variation in expertise in pediatric T2D across the province. One interviewee spoke from the perspective of those who find it to be a barrier:

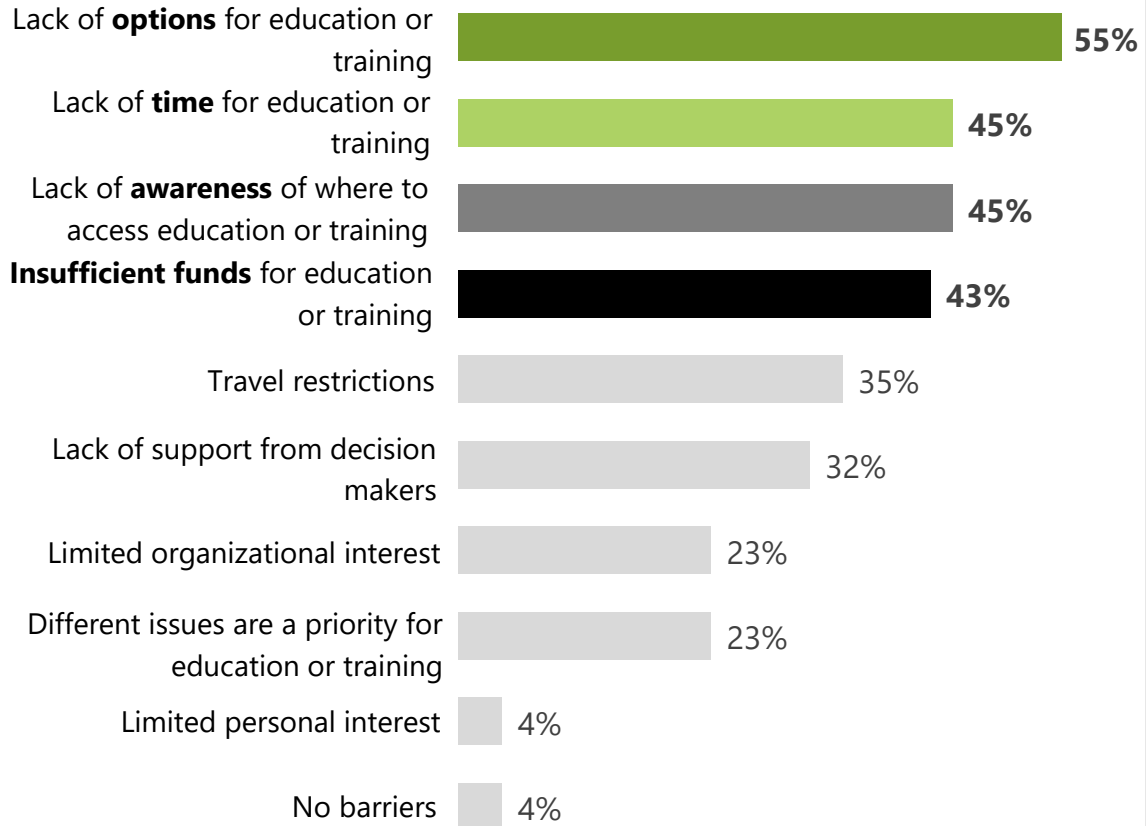
"We don't know how to treat, or how to help kids manage. Even looking at screening and diagnosis, there are no specific screening guidelines that are specific to children, just for adults. There's no screening, that isn't invasive, that can be done for kids...once we see kids in communities who have been diagnosed, we don't know how to treat or how to manage. Especially, because I think a lot of people, especially with type 2 diabetes, just assume that they're just little adults. But they're not. Their needs are very different."

Together, these results point to a significant number of barriers that will need to be addressed to effectively care for and manage pediatric T2D in Saskatchewan.

4. Training/Education Barriers & Areas of Interest

To help plan additional education or training opportunities for Saskatchewan healthcare workers, we asked participants to respond to the barriers that they face when trying to obtain additional pediatric T2D training or education. Once again, a significant portion of participants indicated a high number of barriers (only 4% of the sample indicated that there are no barriers). Specifically, a lack of options (55%) and time (45%) for training and education as well as awareness of where to access education or training (45%) emerged as the most commonly selected barriers. However, insufficient funds for education or training (43%) was also highly selected. Although not as commonly selected, travel restrictions (35%) and a lack of support from decision-makers (32%) also present barriers to some participants.

The **majority** of participants identified training or education barriers (**options, time, awareness, and insufficient funds**) to advancing their own knowledge or skills in pediatric type 2 diabetes.



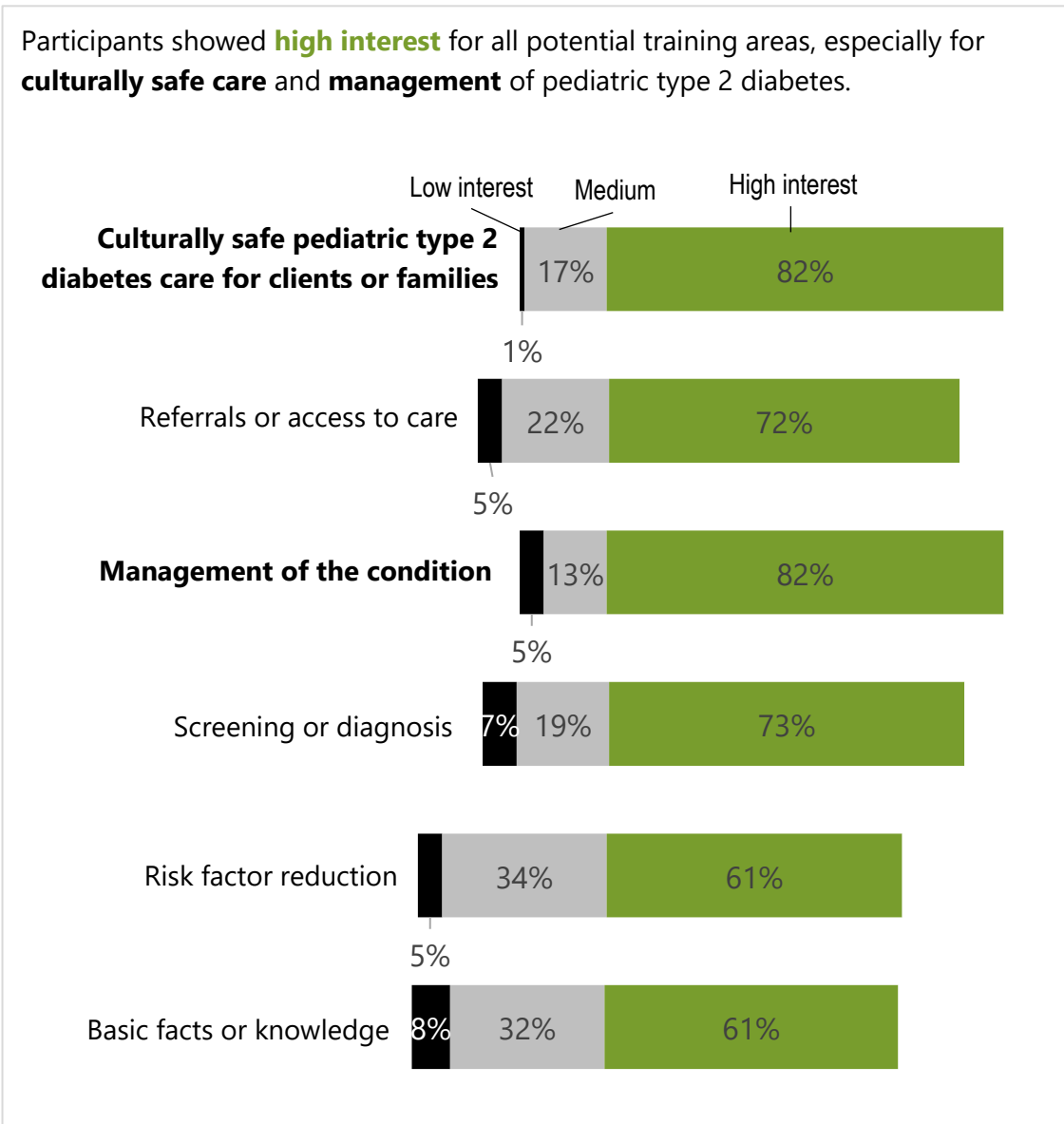
Interviewees commented on the distinct lack of available materials to help educate themselves and others on pediatric T2D:

"We'll use adult resources, or resources that are geared towards adults. Or if we're finding that we need something different we might create our own... but even then, we're actually looking at that and looking at what kind of resources are available, and they are very sparse."

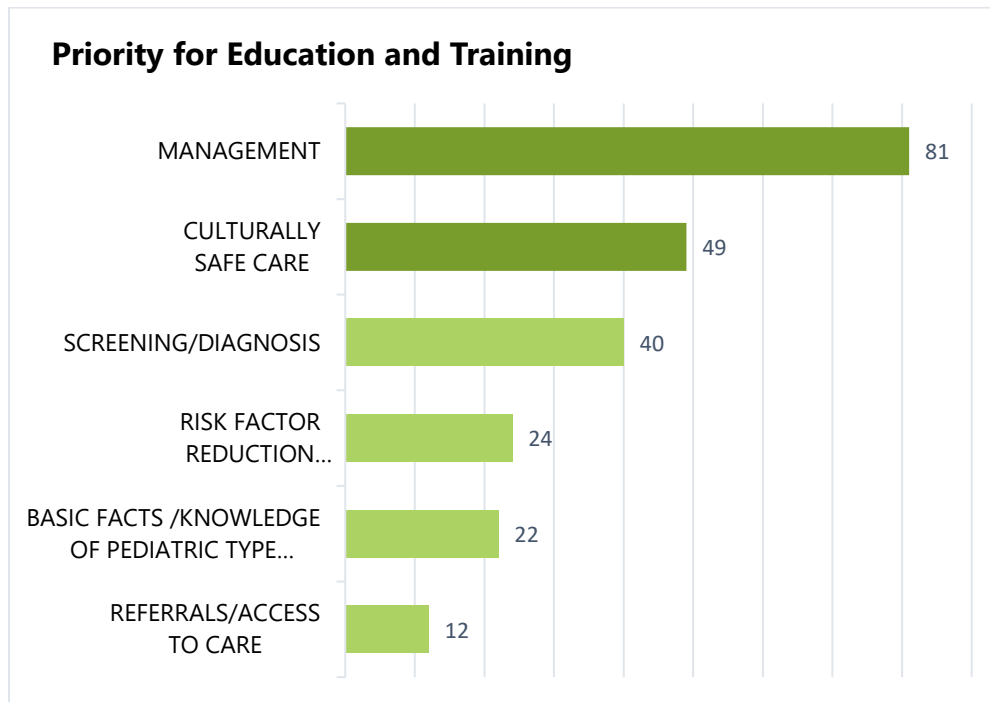
"We have type 2 pamphlets developed from the Ministry of Health for type 2 diabetes. But they're not specific to children. We need something that is specific to children diagnosed with type 2 diabetes. There's lots of resources out there for children with type 1 diabetes. But type 2, and type 1 are very different."

"I only really have used the Diabetes Canada clinical guidelines. That's kind of my bible moving forward. I've used that a lot. That's where I've gotten the majority of my information... Because those are the most updated, as far as I know, guidelines for type 2 diabetes."

When asked about level of interest in future education and training related to pediatric T2D, ‘high interest’ was most frequently chosen in all the potential topic areas. However, **culturally safe care for clients and families** (82%), and **management of pediatric T2D** (82%), both emerged as the topic areas in which ‘high interest’ was chosen more frequently than for the other topic options. That said, referrals and access to care (72%) and screening/diagnosis (73%) are also sought-after topics. Although not as frequently chosen as ‘high interest’ as the other topics listed, risk factor reduction (61%) and training on basic pediatric T2D facts or knowledge (61%) were still more frequently chosen as ‘high interest’, then ‘medium interest’ or ‘low interest’.



Participants were then asked to indicate their priority for training by indicating their first and second choices for education/training topics. When these choices were weighted and combined, **management of the condition**, followed by **culturally safe care** were ranked as highest priority.



The importance of culturally safe care for clients and families was echoed by both interviewees, who stated:

"We can't just go to an Indigenous community and say, well here we are, we're going to save the world, right? We need to develop partnerships with these communities and figure out what they need, and then base our prevention efforts based on that."

This person continued this thought later in the interview by saying:

"I think that what we have to think about is, in Saskatchewan we have a five-digit population who have diabetes. And so we need to think about culture and how we incorporate culture into our health interventions. And so if that means we can't just say you need to change all of this because that doesn't fit with their culture, how can we make it culturally appropriate?"

Survey participants were also asked to rate their preference on how future training or education materials for healthcare providers could be delivered. The most common first choice was hands-on workshops or interactive sessions (40%), followed by webinar presentations (25%) and lecture-based presentations (21%). The remaining options were quite low in preference (online written information, 3%; interactive online tools, 2%; written clinical guides, 8%; instructional video, 0%; printed materials, 0%).

To gauge interest in resources for parents and children/youth that healthcare providers could use when addressing T2D with families, participants were asked to indicate their interest in printed and online resources. Although interest in all types of additional information was high, evidence suggested that participants were most interested in printed resources aimed at parents (73%), followed by printed resources for children/youth (66%), then online resources for children/youth (63%), and online resources for parents (59%). Overall, these findings suggest that there is a high level of interest in creating a suite of printed and online resources for both parents and children/youth.

Of note, this data was all collected prior to the worldwide outbreak declaration of COVID-19, and we suspect some opinions may be changed as a result of the restrictions to travel and in-person meetings that have emerged and may be present for the foreseeable future.

Interviewees often commented that social media and online ways of providing information would be good approaches for children and youth:

“. . . kids, like adolescents, they're all on social media. So some type of social media message might be an idea of how to reach kids about the importance of being active or healthy eating, right?"

However, they also suggested other ways to share information:

"Radio ads, things that go home, and like newsletters, school newsletters, things like that. Pamphlets that can be handed out at health fairs, or other parent nights, or things like that. Social media is also really big."

"It would be social media, but also within the schools. I mean, schools need to be delivering those messages."

Interviewees were asked to identify the most beneficial topics that could be developed for parents, for children/youth, and for healthcare professionals. Both interviewees agreed that the best topic to focus on for parents would be basic education about pediatric T2D:

"Particularly for parents, I think just resources that really detail that pediatric diabetes is on the rise and that it can be aggressive and that it should be screened for and treated earlier."

"I think a lot of parents don't understand what is diabetes and how you get it, right? So I think that we need to start with just some basic education."

A similar answer emerged for youth, but both interviewees stressed the importance of portraying educational materials in a way that children and youth can understand:

"There's lots of different things that you can do with kids. I guess that it's hard to put a blanket out and say, 'Well all kids need this,' right? But I mean, again, if you're looking at the high-risk kids, they're overweight, right? So, let's focus on healthy eating and physical activity. I think that would help."

"I think resources that would help them understand. Well I guess it's hard to say. For people to understand... or for kids to understand the risk, that is written in their language and easy to understand. And written for them, essentially. Not taking an adult resource and making a couple changes here or there and saying it's a kid's resource."

Interviewees also suggested that accurate, easily searchable online information on basic education and management of pediatric T2D would be assets to healthcare professionals and other groups:

"Managing diabetes... So, you see a kid just newly diagnosed with type 2 diabetes, what are you talking about? And also, I guess it would be a suite of resources also that can be handed out to clients as well."

"If there were resources to teach, right? So, if we had resources online that people and teachers, all the staff, could access, then obviously the Prevention Institute wouldn't have to do all the teaching. The teachers could do it. It would be those resources, those activities, those presentations, they would be available to the healthcare professionals with the accurate information."

Environmental Scan

An environmental scan was completed to identify existing Canadian educational resources and programs on pediatric T2D that can be used or adapted for use in Saskatchewan. The scan was done by searching online using the following search terms: pediatric type 2 diabetes, pediatric type 2 diabetes resources, pediatric type 2 diabetes guidelines, pediatric type 2 diabetes program[ing], pediatric type 2 diabetes Canada. Resources and programs included were limited to those that were developed in Canada. It may be that not all resources and programs can be found online, so it is possible that some relevant resources or programs were missed. In an attempt to identify resources that were missed by the online search, input was sought from local individuals who work in pediatric T2D.

The results of this scan will be used to help ensure that duplication is avoided when determining what resources are needed to meet the needs of those working with pediatric T2D in Saskatchewan. The results are also available for those looking for additional pediatric T2D resources.

The results of the scan demonstrated that there is a distinct lack of Canadian resources for those working in pediatric T2D. Across the country, only 17 sources were found, providing resources that are directly or indirectly related to pediatric T2D, with the vast majority being education and/or awareness resources for youth, parents, and healthcare professionals. See the tables beginning on the following page for further details. There are 3 tables; the first has programs and resources from the Saskatchewan Health Authority, the second lists national resources and programs, and the third lists provincially based resources and programs.

Of note, based on discussion with Dr. Inman (Pediatric Endocrinologist, University of Saskatchewan), this report recognizes that there is an ongoing national collaborative across pediatric health care centers in Canada to create and sustain an online resource hub for pediatric type 2 diabetes and obesity prevention and early intervention tools. This is currently underway and will be more readily available in late 2020 and into 2021. This is documented in the report below (Meant to Prevent), but the online resource is still under construction.

Environmental Scan of Pediatric T2D Resources – Saskatchewan Health Authority

Source Organization	Type of Resource/Description	Population of Focus		Audience of Resource			Program or Resource Focus				Contact information
		All Ages	Child / Youth	Child / Youth	Parents	Health	Education & Awareness	Clinical Guidelines	Prevention	Screening, Diagnosis, Treatment & Management	
Jim Pattison Children’s Hospital - LiveWell Diabetes Program - promotes disease specific management (e.g., evidence-based optimal care delivery), and self-management for both type 1 and type 2 diabetes.	The LiveWell Pediatric Diabetes Program is a program that provides interdisciplinary, high quality, pediatric diabetes care to children and families throughout Saskatchewan (from diagnosis to transition to adult care). Made up of a team of medical specialists and support staff who provide acute and chronic clinical care as well as individual & group education. This program is based out of the LiveWell Chronic Disease Management offices in Royal University Hospital. Eligibility based on diagnosis or referral for screening for pediatric diabetes https://saskhealthauthority.libguides.com/diabetespediatric	✓								✓	Royal University Hospital 103 Hospital Drive Saskatoon, SK S7N 0W8 Phone: 306-655-5483 Email: live-well@saskatoonhealthregion.ca Website: https://www.saskatoonhealthregion.ca/locations_services/Services/cdm
	The webpage provides links to some useful information and apps to assist in the management of diabetes (type 1 and type 2)	✓		✓	✓		✓				
Moms & Kids Health Saskatchewan (Jim Pattison Children’s Hospital) - Pediatric Diabetes and Endocrinology Team	A team of pediatric diabetes and endocrinology specialists (nurse educators, dietitian educators, social workers, physicians, and administrative support staff) focused on pediatric diabetes (all forms). The team provides treatment for children and youth with diabetes and education to help families support their children’s health. They also provide support, resources for care, and treatment options to diabetes education centres and schools throughout Saskatchewan. *The team works out of the pediatric outpatient department at the Jim Pattison Children’s Hospital.		✓	✓	✓	✓	✓			✓	NA Talk to family doctor, pediatrician, nurse practitioner, nurse, or dietitian about getting more information and a referral to see the pediatric diabetes team.

Environmental Scan of Pediatric T2D Resources – National

Source Organization	Type of Resource/Description	Population of Focus		Audience of Resource			Program or Resource Focus				Contact information
		All Ages	Child / Youth	Child / Youth	Parents	Health	Education & Awareness	Clinical Guidelines	Prevention	Screening, Diagnosis, Treatment & Management	
Canadian Paediatric Society	A website that outlines the physical activity guidelines for children and youth. It can be used to help inform the physical activity treatment plans for those with pediatric T2D. See: https://www.cps.ca/en/documents/tag/physical-activity		✓			✓	✓			✓	Canadian Paediatric Society 100-2305 St. Laurent Blvd. Ottawa, ON K1G 4J8 Phone: 613-526-9397 Email: info@cps.ca Website: https://www.cps.ca/en/documents/tag/physical-activity
Diabetes Canada: a national charity that provides diabetes programming (education and support), clinical practice guidelines and management strategies, investments into research, and advocacy on government policies on diabetes.	Resources (general information on symptoms, management, how to talk with children, support services, links to healthy recipes, meal planning, physical activity, how to test blood sugar), see: https://www.diabetes.ca/managing-my-diabetes/kids-teens---diabetes/kids---type-2		✓		✓		✓			✓	Diabetes Canada 1300-522 University Ave. Toronto, ON M5G 2R5 Phone: 416-363-3373 Email: info@diabetes.ca Website: https://www.diabetes.ca/
	Clinical Practice Guideline outlining the clinical guidelines for screening & treating pediatric T2D, tools to use for screening, overall recommendations on managing pediatric T2D, and additional references, see: https://www.diabetes.ca/health-care-providers/clinical-practice-guidelines/chapter-35#panel-tab_FullText		✓			✓	✓	✓	✓	✓	
	Resource on the prevalence of T2D in Saskatchewan (not just pediatric). Covers the impact of diabetes on Canada, policy, programs, and services related to diabetes (from Govt of Saskatchewan), the challenges Saskatchewan faces to address T2D, and Diabetes Canada recommendations to the Government of Saskatchewan. See https://www.diabetes.ca/DiabetesCanadaWebsite/media/About-Diabetes/Diabetes%20Charter/2018-Backgrounder-Saskatchewan_JK_AB-edited-13-March-2018.pdf	✓					✓	✓			

<p>Government of Canada</p>	<p>Resource on diabetes in children and youth (includes type 1 and type 2). Includes management strategies, risk factors, complications, prevalence rates in Canada. See: https://www.canada.ca/en/public-health/services/chronic-diseases/reports-publications/diabetes/diabetes-canada-figures-a-public-health-perspective/chapter-5.html</p>		✓			✓	✓		✓	NA
	<p>House of Commons report on a diabetes strategy for Canada (April 2019). Contains information on type 2 diabetes and the complications/costs on the healthcare system. Focuses mainly on adults, but it does have some information on the role of pediatric type 2 diabetes on adult prevalence rates. See: https://tinyurl.com/u868vjo</p>	✓			✓	✓				
<p>Meant2Prevent: is a pediatric type 2 prevention project sponsored by Sunlife and the Canada's Children's Hospital Foundation. Their mandate is to empower families, youth, and healthcare professionals across Canada with evidence-based resources and tools to promote healthy living habits and prevent pediatric T2D.</p>	<p>Resources for healthcare professionals and families containing information on how to prevent pediatric T2D. Contains a significant amount of resources (pdfs, websites, tools, apps) on everything related to pediatric T2D. The kitchen page contains featured healthy recipes and nutrition articles).</p> <p>The health care professional page contains clinical tools and guidelines (e.g., the 5As of Pediatric Obesity Management Toolkit and Videos), resources on nutrition (including mobile apps and websites), information on physical activity and screen time (including apps, tips, websites), information on mental health, and information on sleep (see https://meant2prevent.ca/resources-for-health-professionals/).</p> <p>The family page contains information on nutrition and food, physical activity/screen time, mental health, sleep, and general information on obesity and T2D (see: https://meant2prevent.ca/resources-for-families/)</p>		✓		✓	✓		✓		<p>Website: https://meant2prevent.ca/</p>

<p>Sun Life: is a financial institution that sponsors diabetes education and prevention initiatives in Canada.</p>	<p>A resource article outlining the prevalence of pediatric T2D in Canada. Contains outlines on the manifestation differences of type 1 and type 2 diabetes in children. Also includes information on risk factors and prevention (e.g., healthy habits). See https://www.sunlife.ca/en/tools-and-resources/health-and-wellness/preventing-and-treating-illness/type-2-diabetes-in-children--are-your-kids-at-risk/</p>		✓		✓		✓		✓	<p>Address: N/A Phone: 877-786-5433 Email: N/A Website: https://www.sunlife.ca/</p>
<p>Sir Frederick Banting Legacy Foundation</p>	<p>Resource on the state of in-school support for youth living with diabetes (both type 1 and type 2, published in 2018). Contains information on the creation of adequate support policies (all provinces). Also contains the requirements for schools, challenges to implementing support, and advocacy. See: http://bantinglegacy.ca/wp-content/uploads/2018/09/In-School-Support-2018-Report.pdf</p>	✓			✓	✓				<p>Box 137 Alliston, ON L9R 1T9 Phone/Email: N/A Website: www.bantinglegacy.ca</p>
<p>Diabetes @ School: a website based on a partnership between the Canadian Paediatric Society, the Canadian Pediatric Endocrine Group, and Diabetes Canada.</p>	<p>A website that aims to give families, schools, and caregivers resources on type 1 diabetes but that also could apply to type 2 diabetes. They base their philosophy on safety, support, and success, which translates into "ways to navigate the site" including: 1) diabetes awareness; 2) diabetes literacy; and 3) diabetes expertise. See: https://www.diabetesatschool.ca/</p>	✓		✓		✓			✓	<p>Canadian Paediatric Society 100-2305 St. Laurent Blvd. Ottawa, ON K1G 4J8 Phone: 613-526-9397 Email: info@cps.ca Website: https://www.diabetesatschool.ca/</p>
<p>Government of Canada - Canadian Food Guide</p>	<p>A Government of Canada website that outlines the official recommended nutritional guide for the country. It can be used to help inform the diet of those with pediatric T2D, and those at risk. See: https://food-guide.canada.ca/en/</p>	✓		✓	✓	✓	✓		✓	<p>N/A</p>

Environmental Scan of Pediatric T2D Resources – Provincial

Source Organization (Province(s) Served)	Type of Resource/Description	Population of Focus		Audience of Resource			Program or Resource Focus				Contact information
		All Ages	Child / Youth	Child / Youth	Parents	Health	Education & Awareness	Clinical Guidelines	Prevention	Screening, Diagnosis, Treatment & Management	
Aboriginal Youth Mentorship Program (AYMP) funded by Public Health Agency of Canada (Manitoba)	A program called Aboriginal Youth Mentorship Program (AYMP) is targeted at Indigenous youth in Manitoba and encourages physical activity, education on pediatric T2D, and healthy eating (once per week, 90 minutes, peer led, health promotion program). See: https://cbpp-pcpe.phac-aspc.gc.ca/aboriginalwtt/aboriginal-youth-mentorship-program-aymp/		✓	✓			✓			✓	Canadian Paediatric Society 100-2305 St. Laurent Blvd. Ottawa, ON K1G 4J8 Phone: 613-526-9397/ Email: info@cps.ca Website: https://www.cps.ca/en/documents/tag/physical-activity
Canadian Feed the Children: an organization that works with Indigenous communities in Canada to increase access to traditional food practices and encourage healthy eating. (Saskatchewan, Alberta, New Brunswick, Manitoba)	A program that contains a multi-pronged approach to addressing poverty, health issues (including pediatric T2D, and food insecurity) in Indigenous communities through school nutrition programs, nutrition education, land-based education, empowering local food systems, and engaging the community. Based in Winnipeg, MB, Muskeg Lake Cree Nation, SK. See: https://canadianfeedthechildren.ca/where/canada/#our-response-section		✓	✓	✓		✓		✓		6 Lansing Square, Suite 123 Toronto, ON M2J 1T5 Canada Phone: 416-757-1220 Email: contact@canadianfeedthechildren.ca Website: https://canadianfeedthechildren.ca/where/canada/#our-response-section

<p>Diabetes Education Resource for Children and Adolescents (DER-CA) (Manitoba)</p>	<p>An annual report (2017) outlining updated statistics on pediatric type 1 and 2 diabetes in Manitoba. Also includes the up-to-date preventative programming occurring within DER-CA. See: https://umanitoba.ca/faculties/health_sciences/medicine/units/pediatrics/media/Annual_Report-2017_Final.pdf</p>		✓			✓	✓		✓	<p>FE307-685 William Avenue Winnipeg, MB R3E 0Z2 Phone: 204-787-3031 Email: N/A Website: http://umanitoba.ca/faculties/health_sciences/medicine/units/pediatrics/sections/diabetesendo.html</p>
<p>Diabetes Quebec: an organization focused on educating about diabetes, providing services, funding research, and advocacy.</p>	<p>Resource on the pediatric type 2 diabetes symptoms, screening (based on Diabetes Canada guidelines), treatment, & prevention. See: https://www.diabete.qc.ca/en/understand-diabetes/all-about-diabetes/types-of-diabetes/type-2-diabetes-in-children-and-adolescents/</p>		✓			✓			✓	<p>3750 Cremazie Blvd., suite 500 Montréal QC H2A 1B6 Phone: 514-259-3422 Email: info@biabete.qc.ca Website: https://www.diabete.qc.ca/en/</p>
<p>FRED (Foundation Ressources pour les enfants diabetiques) (Quebec)</p>	<p>Resource on both type 1 and type 2 diabetes. Contains statistics, infographics, and a table with pediatric diabetes myths, facts, and explanations. See: https://www.diabetes-children.ca/en/type-1-diabetes/t1d-t2d/</p>		✓			✓	✓			<p>306 St. Zotique St East, Suite 100 Montréal, QC H2S 1L6 Phone: 514-731-9683 Email: info@diabetes-children.ca Website: https://www.diabetes-children.ca/en/</p>
<p>Government of British Columbia (HealthLinkBC)</p>	<p>Resource on screening for pediatric type 2 diabetes (how-to). Contains brief information on risk factors and the degree to which they indicate the need for T2D screening. See: https://www.healthlinkbc.ca/health-topics/zj1183</p>		✓			✓			✓	<p>Address: N/A Email: healthlinkbc@gov.bc.ca Website: https://www.healthlinkbc.ca/</p>

<p>Government of Manitoba</p>	<p>A resource outlining the prevalence and costs associated with diabetes in Manitoba (includes adult and pediatric type 1 and type 2). See: https://www.gov.mb.ca/health/activeliving/docs/diabetes_facts.pdf</p>	<p>✓</p>				<p>✓</p>	<p>✓</p>			<p>N/A</p>
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Recommendations based on the findings of this report can be found in the Executive Summary.

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Appendix. Pediatric T2D Needs Assessment Survey Questions

1. Please select which best describes you.

- a) I provide direct care to pediatric type 2 diabetes patients/families (e.g., Physician, Nurse, Dietitian) – **Skip to question 2**
- b) I provide support/indirect care to pediatric type 2 diabetes patients/families, or those at risk of pediatric type 2 diabetes (e.g., Program Coordinator, Manager, Diabetes Advocate) – **Skip to question 3**
- c) I am not involved with pediatric type 2 diabetes patients/families, or those at risk of pediatric type 2 diabetes – **Survey termination page**

If answered direct care in Q1 - 2. What is your direct care role? If you do not see your role here, please go back to the previous page and select 'support' or 'not involved'.

- a) Family doctor
- b) Pediatrician
- c) Dietitian
- d) Social Worker
- e) Nurse

3. Are you a certified diabetes educator?

- a) Yes
- b) No

4. What are your primary roles at work? Select all that apply.

- a) Advocate for pediatric type 2 diabetes
- b) Certified Diabetes educator
- c) Health educator
- d) Health promotion
- e) Program coordinator
- f) Supervisor/manager
- g) Volunteer
- h) Other (please specify below)

5. What percentage of your typical patient/client/population volume is with a pediatric population? Use the slider to choose an average. Having the slider all the way left indicates no amount of volume and having the slider all the way right indicates the maximum amount.

- a) Slider from 1-100.

6. Overall, how familiar are you with pediatric type 2 diabetes (using a scale from 1 [not at all familiar] to 4 [very familiar])?

- a) Not at all familiar
- b) Slightly familiar
- c) Somewhat familiar
- d) Very familiar

7. On a scale from 1 (no knowledge) to 4 (extensive knowledge), please indicate how knowledgeable you are about the following key areas of pediatric type 2 diabetes. Check N/A if the factor is 'not applicable' to your work.

	No knowledge	Limited knowledge	Moderate knowledge	Extensive knowledge	N/A
Preventable/modifiable risk factors for pediatric type 2 diabetes					
Unpreventable/unmodifiable risk factors for pediatric type 2 diabetes					
The screening options for pediatric type 2 diabetes					
Making a diagnosis of pediatric type 2 diabetes					
Early management options for pediatric type 2 diabetes					
Later management options for pediatric type 2 diabetes					

8. On a scale from 1 (not at all familiar) to 4 (very familiar), how familiar are you with the referral options for specialized, multidisciplinary management of pediatric type 2 diabetes in Saskatchewan?

- a) Not at all familiar
- b) Slightly familiar
- c) Somewhat familiar
- d) Very familiar
- e) Other comments

9. On a scale from never to regularly, how often do you work with, or is your work related to, the following populations?

	Never	A few times per year	Monthly (1-2 times per month)	Weekly (at least once per week)	Daily (at least once per day)
Those at risk for pediatric type 2 diabetes					
Those who have been diagnosed with pediatric type 2 diabetes					

10. In the work you do with pediatric type 2 diabetes, please identify whether the following factors are barriers or facilitators to your work. By "facilitators" we mean things that make it easier to do the work. Check N/A if the factor is 'not applicable' to your work. Note - all statements below are regarding pediatric type 2 diabetes.

	It is a barrier to my work	Neither a barrier nor a facilitator	It is a facilitator to my work	N/A
My level of pediatric type 2 diabetes knowledge				
My awareness of where to refer patients for screening/diagnosis				
My comfort level with discussing screening options with patients and families				
My comfort level with discussing the diagnosis with patients and families				
My awareness of where to refer patients for initial management				
My comfort level with implementing management strategies with patients and families				
My awareness of information resources that I can access to educate myself and/or my peers				
My comfort level with providing education about pediatric type 2 diabetes with patients or families				
My awareness of information resources that I can access to educate families (parents and children)				
The ability of colleagues to provide care for those with the condition or at risk of developing the condition				
The level of knowledge in decision makers (such as managers, policy makers)				
The level of support from decision makers to provide care/support for patients with the condition or at risk of the condition				
The level of knowledge in parents/guardians				
Parent readiness to engage in behaviours that could help address the risk factors				
Parent readiness to engage in the management of the condition				
Child readiness to engage in behaviours that could help address the risk factors				
Child readiness to engage in the management of the condition				

11. What barriers do you face to attending education/training to advance your knowledge in pediatric type 2 diabetes? Select all that apply.

- a) Lack of time for education/training
- b) Travel restrictions
- c) Insufficient funds for education/training
- d) Limited personal interest
- e) Limited organizational interest
- f) Lack of support from decision makers
- g) Different issues are a priority for education/training
- h) A lack of awareness of where to access pediatric type 2 diabetes education/training
- i) A lack of options for education/training in pediatric type 2 diabetes
- j) No barriers

12. For the following topics, please indicate your level of interest in obtaining further education/training:

	Low interest	Medium interest	High interest	N/A
Basic facts/knowledge of pediatric type 2 diabetes				
Risk factor reduction for pediatric type 2 diabetes				
Screening/diagnosis for pediatric type 2 diabetes				
Management of pediatric type 2 diabetes				
Pediatric type 2 diabetes referrals/access to care				
Culturally safe pediatric type 2 diabetes care for clients/families				

13. Of the previous training/education areas, please select your top 2 choices.

- a) First Choice
 - a. Basic facts/knowledge of pediatric type 2 diabetes
 - b. Risk factor reduction for pediatric type 2 diabetes
 - c. Screening/diagnosis for pediatric type 2 diabetes
 - d. Management of pediatric type 2 diabetes
 - e. Pediatric type 2 diabetes referrals/access to care
 - f. Culturally safe pediatric type 2 diabetes care for clients/families
- b) Second Choice
 - a. Basic facts/knowledge of pediatric type 2 diabetes
 - b. Risk factor reduction for pediatric type 2 diabetes
 - c. Screening/diagnosis for pediatric type 2 diabetes
 - d. Management of pediatric type 2 diabetes
 - e. Pediatric type 2 diabetes referrals/access to care
 - f. Culturally safe pediatric type 2 diabetes care for clients/families

14. Please select your top 3 preferred methods of receiving educational/training opportunities and/or information resources for yourself and your colleagues using the lists below.

- a) Lecture-based presentations (in-person)
- b) Hands-on workshops/interactive sessions (in-person)
- c) Webinar presentation (recorded to view anytime)
- d) Online written information
- e) Interactive online educational tools
- f) Instructional video (e.g., YouTube)
- g) Printed materials (e.g., brochures, booklets)

15. To help you address pediatric type 2 diabetes, indicate your degree of interest in the following:

	Low interest	Medium interest	High interest	N/A
Printed resources aimed at parents				
Online resources aimed at parents				
Printed resources aimed at children and/or adolescents				
Online resources aimed at children and/or adolescents				

16. In what part of Saskatchewan do you primarily work in?

- a) Northern Saskatchewan
- b) Central Saskatchewan
- c) Southern Saskatchewan
- d) Provincial (all regions)

17. Do you work as part of a diabetes education team (i.e., there is at least one other diabetes provider working with you)?

- a) Yes
- b) No

18. Which best describes the population you do most of your pediatric type 2 diabetes work with? Select all that apply.

- a) Caucasian
- b) First Nations (on reserve)
- c) First Nations (off reserve)
- d) Metis
- e) Other (including other ethnic minorities)

19. In your work with pediatric type 2 diabetes, which best describes the location where you do most of your work?

- a) Urban locations (10,000 people or more)
- b) Rural locations (less than 10,000 people)
- c) First Nations Community (on reserve/tribal council)