The Diabetes Epidemic in Manitoba

We are continuing to lose the war to prevent diabetes, we need better solutions –

IT IS NOT JUST ABOUT SUGAR

Manitoba Liberal Caucus Report

Revised July 2014

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DEDICATION

This report is dedicated to all those living with diabetes, particularly in Manitoba. These individuals and their families live with the impact of the disease every day and the hope that we can find more effective treatments and ultimately, one day, cure them of it. We owe it to all Manitobans to find an effective way to prevent this disease, as well as to more effectively treat it and ultimately cure it.

ACKNOWLEDGEMENTS

Many individuals have helped us develop a better understanding of the diabetes epidemic in Manitoba and we are grateful for their input as well as their assistance in suggesting approaches that could better deal with this epidemic. Though by no means an exhaustive list, we would like to thank Andrea Kwasnicki and Karen Omichinski of the Canadian Diabetes Association, Drs Heather Dean, Elizabeth Sellers, Jon McGavock, Margaret England and Wayne Lautt, and many others, such as Albert and Deanna Ratt, who have participated in Forums or discussions on this important subject. The staff of the Liberal Caucus have spent countless hours helping with this report and a special thank you is extended to Liz Gonsalves, Sonia Charran and Mie Larsen for all their efforts.

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Summary: The Manitoba Liberal Caucus is dedicated to improving the lives of Manitobans and to a wise use of taxpayer dollars. The diabetes epidemic, the longest and most severe epidemic in the history of Manitoba, is a tragic example of many years of poor policy approaches by the NDP which have resulted in excessive expenditures to treat disease when prevention should have been front and centre. The Liberal Caucus prepared this report in response with updates as the epidemic continues. The number of people with diabetes in Manitoba has nearly doubled from 52,874 in 1998, to over 103,000 today. In fact, the most recent data show there were 8,913 Manitobans newly diagnosed with diabetes in 2013. This is a new record high incidence for a single year. The continuous escalation in the number of people living with and being newly diagnosed with diabetes in Manitoba shows that provincial efforts to date have not yet had an appreciable overall impact on the provincial epidemic. We examine and build the case that type 2 diabetes is, at least in part, a nutrient deficiency condition, and we look at data on the hepatic insulin sensitizing substance which is consistent with this theory. We also highlight the possible role for persistent organic pollutants in this epidemic. Using the NDP government's own data, we have found that they have been negligent in focusing sufficient attention to address this epidemic resulting in excessive costs of hundreds of millions of tax dollars. In this report we call for a Seven Point Plan to seriously address Manitoba's ongoing diabetes epidemic, to improve the health of Manitobans and to be more efficient and effective with the hard earned money that Manitobans pay in taxes.

A Seven Point Plan:

1) Develop an effective central leadership structure to address the epidemic – including strategic central information and innovation strategies

2) Immediately implement current best practices for preventing diabetes province-wide

3) Initiate a vigorous effort combining pilot programs and research to improve prevention

4) Fully review the critical issues that have not been tackled in the 1998 strategic plan that was proposed to address the diabetes epidemic (1)

5) Approach diabetes as a disease of nutrient deficiencies and not just nutrient excess

6) Incorporate recent findings involving the hepatic insulin sensitizing substance and other advances in improving prevention of diabetes

7) Develop and implement a comprehensive plan and budget to sufficiently address the epidemic moving forward

Introduction: In 1996 the government of Manitoba formally recognized the province's diabetes epidemic.(1) Since 1998 the epidemic has progressed with a steady and relentless increase in the number of cases from just over 50,000 to over 103,000 people diagnosed with diabetes in our province as of 2013 (data from the Canadian Chronic Disease Surveillance System, CCDSS)(2). The epidemic has affected thousands of lives, causing suffering and loss of life to a large number of Manitobans. Diabetes, possibly one of the most preventable conditions, is among the top ten causes of death in Manitoba.

Preparation for this report included a publicly shared consultation paper launched on October 5, 2013. The paper was based on preliminary literature research and data. The document was reviewed and updated online, on a weekly basis, throughout October 2013 and followed up with a forum hosted by Dr. Gerrard, at the Sir John Franklin Community Centre in River Heights on November 3, 2013. Combined with ongoing literature reviews and responses to Freedom of Information requests, a *Seven Point Plan* of formal recommendations has been developed with the intent to halt and reverse the epidemic of diabetes that has been raging in Manitoba since it was recognized 18 years ago.

As the graph in Figures 1 and 2 illustrate, efforts to address this epidemic and to turn the situation around have been largely ineffective. The trend must be taken extremely seriously, both from an individual human health perspective and from the perspective of the full social costs, including predictions that diabetes may make up the largest percent of health care spending by the end of the decade.(3) An editorial in The Lancet has emphasized that, "Clearly different strategies are needed to reach a wider population and deliver better results."(4) This report exposes failures by the NDP government to properly implement, update and improve the 1998 diabetes strategy. An improvement to the strategy is proposed in this report – seeing diabetes, at least in part, as a disease of nutritional deficiency.

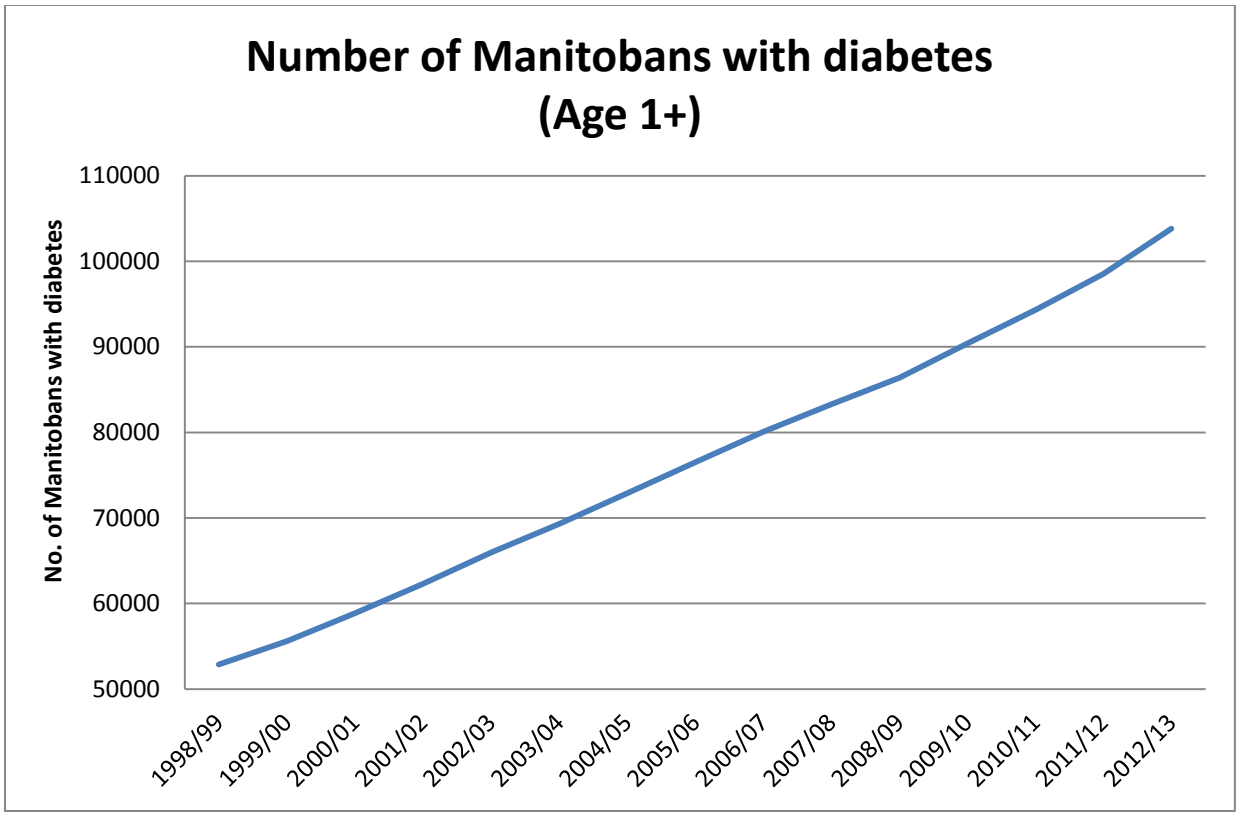


Figure 1: Prevalence of diabetes in Manitoba since 1998.
*data provided by MB Health in response to Freedom of Information requests (as per Canadian Chronic Disease Surveillance System, MB definition v 2012 and 2013)

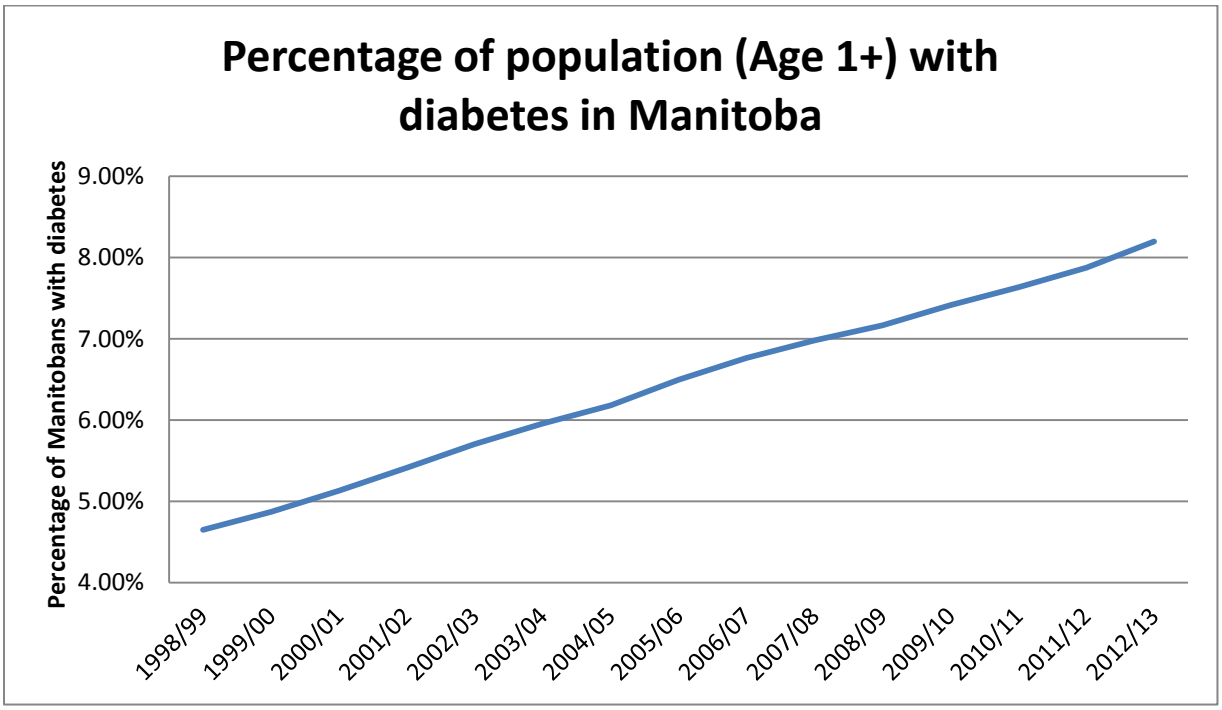


Figure 2: Prevalence of diabetes in Manitoba as a percentage of the population.(5)

Implementation of an effective approach to this epidemic would produce a graph like the one shown in Figure 3 where the increase in the number of people with diabetes starts to slow down, then plateaus and finally starts to decrease.

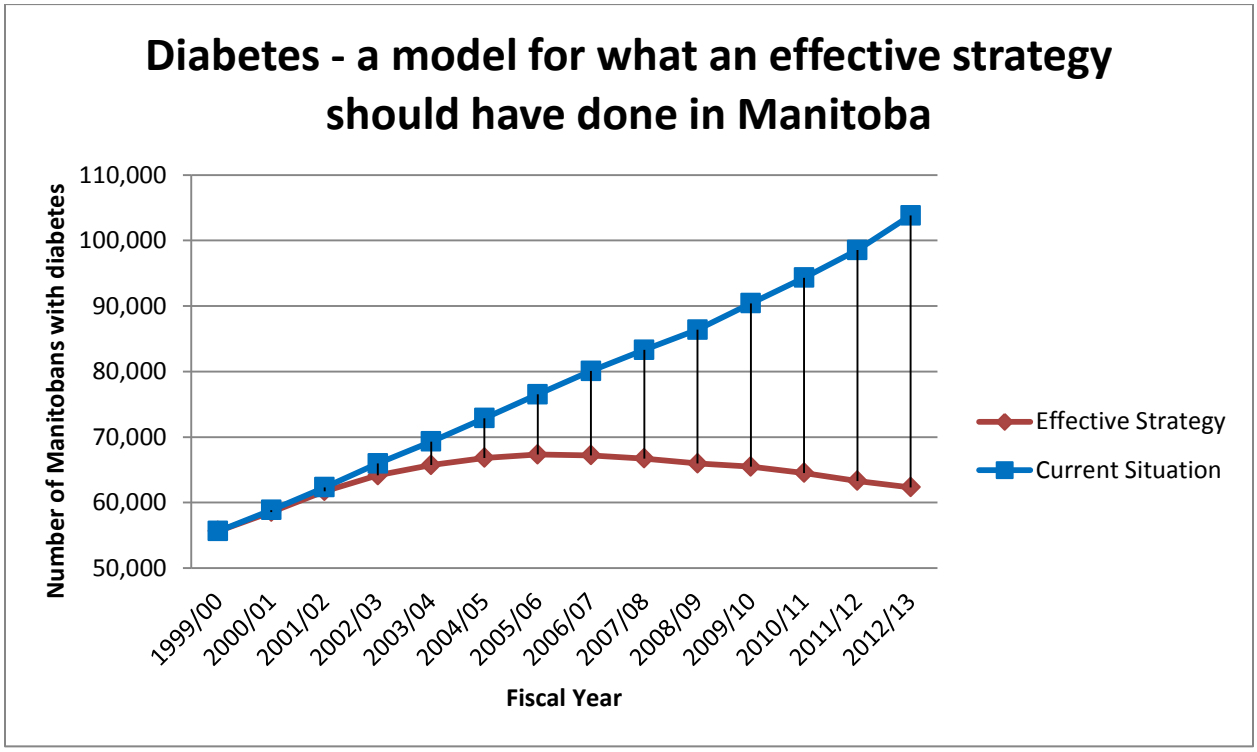


Figure 3: The impact of effective measures to reduce diabetes in Manitoba. This graph is based on a model which is explained in Appendix II

The results of effective measures taken to reduce diabetes as shown in Figure 3 would have meant at least 41,000 fewer people with diabetes today in Manitoba with the associated increased quality of life and economic productivity, as well as savings in health care costs.

Figure 4 illustrates an estimate of the number of new cases that would have been prevented if effective measures to reduce diabetes had been put in place in Manitoba.

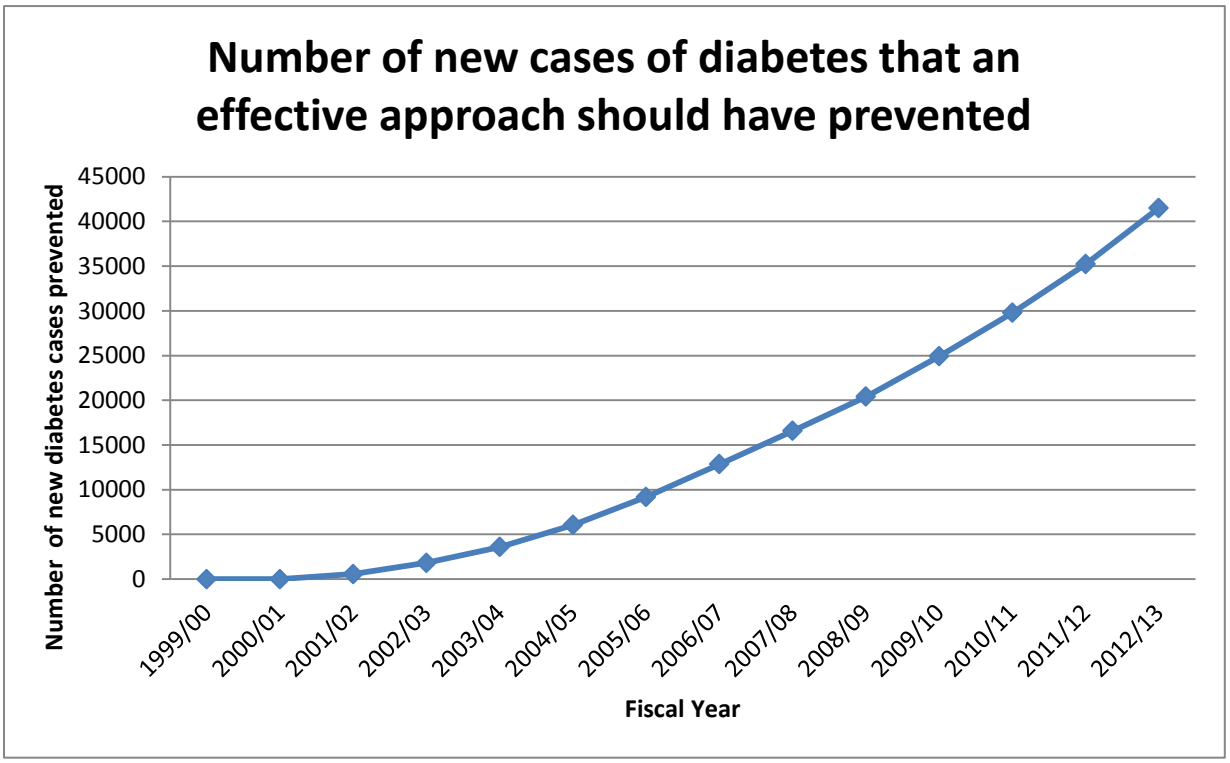


Figure 4: Estimated number of new cases of diabetes which could have been prevented if Manitoba had an effective approach to reducing diabetes as shown in Figure 3.
(model explained in Appendix II)

The increased number of almost 50,000 more Manitobans with diabetes in 13 years is comparable to the entire population of a city the size of Brandon developing diabetes in that time. Effective measures to reduce the incidence, as shown in Figure 3 could have resulted in over 41,000 fewer Manitobans with diabetes today (Figure 4).

Concern over the continued large number of people that are newly diagnosed with diabetes, was cause for the Liberal Caucus to

1) fully review the present situation,

2) review the implementation, or lack of implementation, of the provincial government's diabetes strategy, *Diabetes: A Manitoba Strategy*,(1)

3) produce a consultation document for use in public dialogues and as the basis for discussion at a public forum and

4) produce this report on the Diabetes Epidemic, which includes seven major recommendations.

A brief history of the diabetes epidemic

The Manitoba Diabetes Strategy developed in 1998 says: *"There is no evidence that diabetes occurred among Aboriginal people in Canada before 1940."(1)* Between1940 and 1996 (56 years), the situation changed dramatically with growing concern among the Indigenous population about the increasing incidence of diabetes in their communities. By the mid-1990s, diabetes had reached epidemic proportions among Indigenous people and senior citizens in Manitoba. The province formally declared diabetes to be an epidemic in 1996.(1,6) In 1997, the Assembly of Manitoba Chiefs (AMC) passed a certified resolution, FEB-97.05, calling for a partnership between First Nations, Manitoba Health and Health Canada to address the overall outstanding issues related to the diabetes epidemic and to "achieve positive results to the Diabetes Epidemic in Manitoba."(7) This epidemic, as shown in Figures 1 and 2, has continued to progress. Though the data represented in the figures above includes both type 1 and type 2 diabetes, the epidemic is occurring with type 2 diabetes. Type 2 diabetes represents approximately 90 per cent of all diabetes and traditionally occurred almost exclusively in adults. Today it also occurs in children.(8,9) There has been some progressive research into the prevention of insulin dependent, primarily early onset, type 1 diabetes (Appendix III). Since such a large proportion of diabetes in the province is attributed to type 2, this report focuses almost exclusively on type 2 diabetes.

In response to the epidemic, the Manitoba and Canada governments brought together five committees charged with engaging a wide range of expertise to examine the different areas involved in this "major public health issue". A working group co-chaired by Dr. Emoke Szathmary and one of Grand Chiefs George Muswaggon, Francis Flett and Sydney Garrioch, in respective succession, oversaw the work of the committees to deliver the document, *Diabetes – A Manitoba Strategy*, in 1998.(1)

The Strategy presented 53 recommendations of action addressing five primary areas:

1. Prevention
2. Education

3. Care
4. Research
5. Support

Diabetes – A Manitoba Strategy was widely seen as a positive contribution which paved the way to address the diabetes epidemic. When the NDP were elected to government in 1999, they recognized the quality of the strategy. On November 26, 2001, the NDP's Minister of Health said, "the Canadian Diabetes Association came out and gave Manitoba a 'B' rating on its diabetes strategy."(10) He again applauded the strategy on August 6, 2002 saying, "the strategy with respect to diabetes was developed in collaboration with the federal government. I am really pleased that the former Minister of Health characterized Manitoba's strategy as the best in the country with respect to diabetes."(11) This was reiterated once more by the Minister, on November 28, 2002, when he said, "Manitoba got rated as having, in terms of diabetes and diabetes prevention, one of the best strategies in the entire country."(12)

In spite of Manitoba having developed a strong strategy to address the diabetes epidemic in 1998, progress in actually addressing the epidemic has not been evident. There are four possible reasons for this:

1. The diabetes epidemic is impossible to reverse.
2. The Manitoba strategy was not as good as it was made out to be and had some significant shortcomings.
3. Manitoba had an excellent strategy, but it was never implemented.
4. The Manitoba strategy was based on diabetes as a disease of excess consumption, rather than being seen, at least in part, as a disease caused by nutrient deficiency(ies).

Examining these possibilities:

1. **Is the diabetes epidemic impossible to reverse?** While the NDP may want to give the impression that the diabetes epidemic is so intractable that nothing they could have done would have reversed it, the fact is that several studies have shown that employing lifestyle changes alone can prevent approximately 60 per cent of individuals at risk from developing diabetes. Effective lifestyle interventions for at risk individuals include physical activity (moderate exercise for 30 minutes a day), a diet that includes frequently ingested "whole-grain products, vegetables, fruits, low-fat milk and meat products, soft margarines and vegetable oils rich in monounsaturated fatty acids" and following through with consultations by a nutritionist.(13) These results have been repeated in a number of trials achieving a reduction in diabetes incidence (new cases) ranging between 29 to 67 per cent.(13-16) A community-based approach also resulted in a 65 per cent reduction of incidence for type 2 diabetes.(17) It is therefore very possible to reverse this epidemic. It just has not been done yet.

   The fact that a near linear progression is displayed for the number of Manitobans with diabetes in Figure 1 is evidence that the diabetes prevention efforts in Manitoba have not, to date, had a province-wide impact. While debate continues over whether there is an ongoing upward trend or a slight decrease in incidence, the overall incidence remains astonishingly high – much higher than it was 10 years ago (see Appendix I).(18) Further, there does not yet appear to be a single community in Manitoba where there is significant evidence that preventive efforts have been made to reduce diabetes substantially within that community. There are now some efforts in schools which have demonstrated potential, and the Diabetes Integration Project is showing some promise for a number of communities. These efforts are to be applauded, but they fall short of the province-wide effort needed to turn this epidemic around.

2. **Could the strategy have been improved?** A review of the strategy today suggests that it was an excellent strategy for its time. There may be certain elements which could have been improved, and likely would have been improved, if there had been an ongoing process for updating the strategy and if there had been clear central direction and vision for it. The failure cannot be primarily ascribed to a bad strategy.

3. **Was the strategy implemented?** A careful evaluation of the strategy, with input from many knowledgeable and experienced individuals in a variety of areas of diabetes care and research, suggests there was a major failure by the NDP government to implement critical elements of the strategy. This is reviewed in Appendix IV. In addition, there was a critical failure in leadership by the NDP in prioritizing diabetes treatment and prevention. A review of throne speeches and budgets of the government from 1999 to present illustrates the lack of attention to diabetes (Appendix V). In fact, instead of prioritizing diabetes, the NDP have ended the once present Diabetes Unit in Manitoba Health and moved this to become a small part of their Chronic Disease Unit - further evidence of a shift away from diabetes. Diabetes has also been removed from the list of public health priorities on Manitoba's Public Health web site. There now needs to be a clarion call to address diabetes.

4. **Should diabetes be approached as a condition of excess sugar and excess calories alone?** In *Diabetes - A Manitoba Strategy*, the question of what diabetes is, is answered in the first statement with, "Diabetes is a disease that results in too much sugar in the blood." Consistent with this, the general view is that diabetes is a condition which arises from consuming too much sugar and too many calories, with accompanying dietary recommendations to reduce sugar and calorie intake. Rather than being primarily a disease of excess consumption, diabetes may be viewed as a disease in which critical nutrients (fiber, vitamin D, plant derived micronutrients [phytochemicals] and possibly other micronutrients)

are deficient. In this view of the disease, the continuing “hunger” and “overconsumption of food” which are seen as a part of the disease may originate, at least in part, from the human body seeking to continually address these nutrient deficiencies. Expanding the view of diabetes to include a deficiency condition may be the basis of our approach to this disease which will have greater success in ending the diabetes epidemic that is rampant in Manitoba.

A Seven Point Plan

1) Develop an effective central leadership structure to address the epidemic – including strategic central information and innovation strategies.

Local efforts are important, but addressing an epidemic needs a central coordination of all those efforts, just as occurred with the H1N1 Flu epidemic. It is critical to determine what needs to be done centrally - leadership is required in defining standards and determining best practices. In order for this to occur a centralized system for information and innovation is necessary to enable data collection, monitoring and analysis. There should be a central coordinating team which includes the Minister of Health, the Minister of Healthy Living, RHA leaders, Aboriginal leaders and experts in diabetes care and research. There should be a centralized information strategy to gather data on what is happening, to collect statistical information on the progress of the epidemic and the progress of community based efforts to address the epidemic. A centralized innovation or research component is also important to assess research which is being done, to identify gaps which must be addressed and to ensure a strong research program is appropriately funded and supported in Manitoba.

2) Immediately implement current best practices for preventing diabetes province-wide.

Studies to date show that best practices can provide a very substantial impact on the reduction of diabetes. The study by Tuomilehto *et al*. is a good example of current best practice.(13) They used the following protocol and achieved a 58 per cent reduction in the development of diabetes.

***"The subjects in the intervention group were given detailed advice about how to achieve the goals of the intervention, which were a reduction in weight of 5 percent or more, in total intake of fat to less than 30 percent of energy consumed, and in intake of saturated fat to less than 10 percent of energy consumed; an increase in fiber intake to at least 15 g per 1000 kcal; and moderate exercise for at least 30 minutes per day. Frequent ingestion of whole-grain products, vegetables, fruits, low-fat milk and meat products, soft margarines, and vegetable oils rich in monounsaturated fatty acids was recommended. The dietary advice was tailored to each subject on the basis of three-day food records completed four times per year. Each subject in the intervention group had seven sessions with a nutritionist during the first year of the study and one session every three months thereafter."*(13)**

The province needs to engage all physicians, nurses, and diabetes educators to implement such an approach as best practice province-wide. We should be moving from existing solid research to effecting change at the community and provincial level. The approach of taking this best practice to a community level can be helped with attention to the efforts of Hirati and colleagues who achieved a 65 per cent reduction in the community they worked with.(17) It would be most effective to work with those active at a grassroots level across the province that already have considerable experience in implementing changes in lifestyle.

Central messaging of the effort to reduce diabetes is necessary throughout the province for consistency, but there must be flexibility for local initiatives to adapt

the central approach to local circumstances. For example, in the study by Tuomilehto and colleagues, there was a general approach to nutrition coupled with on-the-ground advice from nutritionists to adapt the general advice to the individual.(13) As an example for Manitoba , if replacing soft drinks with milk is desirable, then addressing the availability of or access to milk (i.e. very high milk prices in some communities) becomes a key factor. There is a need to update central information regularly based on developments in knowledge in Manitoba and around the world. Responses received since the October 5th launch of the consultation paper, have indicated a program previously existed that had people working together in pairs, for motivation and accountability, to make lifestyle changes that reduce their risk factors. This effort was developed between Health Canada and Youville Centre, St. Boniface, in 2001/02 and implemented in 2002/03, but the effort fizzled out because the funding was discontinued. Many fragmented efforts like this have been developed, but either were discontinued or not sufficiently built upon to reverse the epidemic.(19) Interestingly, some 12 years later, this “buddy” approach is being resurrected as if it were a new initiative.(20) Not surprisingly it is once again being found as an effective approach. Will it soon be forgotten again or do we have the wisdom this time to build on success instead of discarding it?

To determine the impact of change, the province needs to establish a monitoring program which can provide the number of new cases of diabetes in Manitoba each month, and the location (community) of the individuals, while being respectful of privacy legislation. Information on the number of new cases of diabetes in Manitoba and the total number of Manitobans with diabetes continues to be months or years out of date. As of June 17, 2014, the most recent information available on the Manitoba Health (Annual Statistics) website was from fiscal year 2012/2013, over one year ago.(21) Dealing with an epidemic requires up to date information on what is happening around the province. This information needs to be available at least monthly, to those involved in coordinating the diabetes epidemic response. This data may be obtained through existing approaches using the Canadian Chronic Disease Surveillance

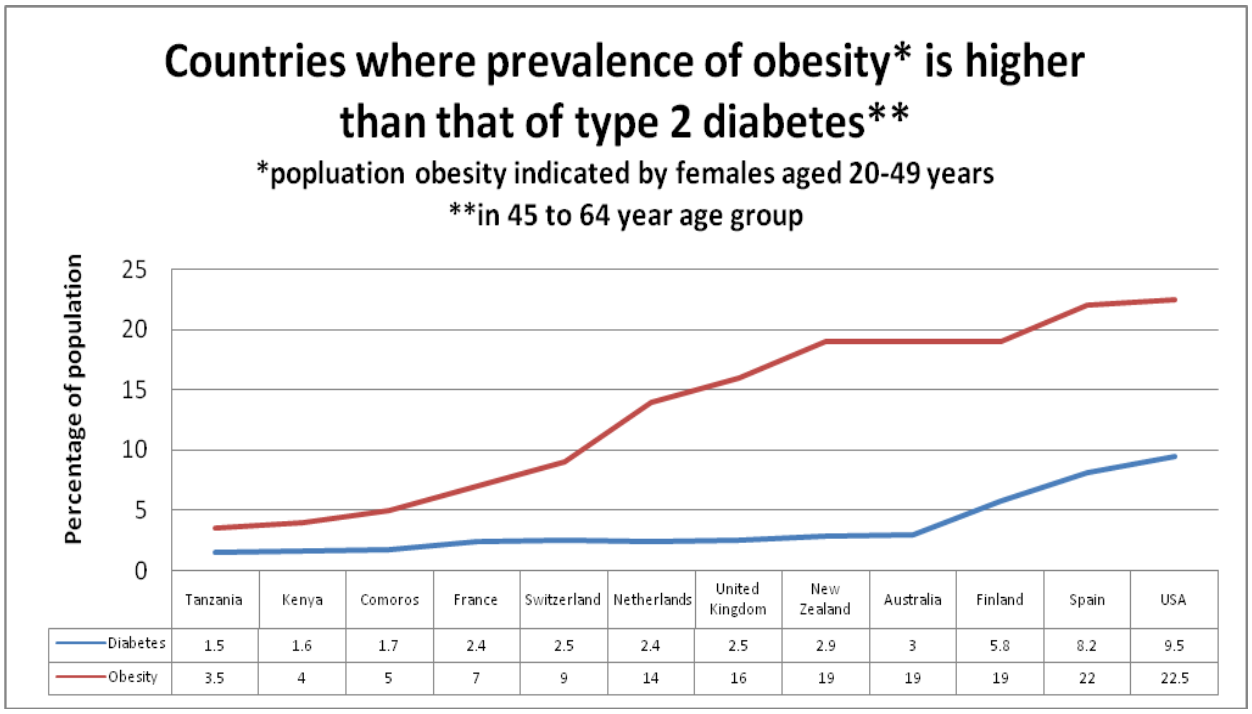
System (CCDSS) data, or it may need the development of a new dataset, or it could be focused initially on a subset of representative communities in different areas of the province. A number of other countries have developed registries for diabetes, and these could also be possible models.

The measurement of Hemoglobin A1c has been found to be an effective method for diagnosing and monitoring diabetes. Increased hemoglobin A1c levels have been associated with increased mortality from diabetes and with increased all-cause mortality independent of whether diabetes is present. This is therefore a useful way of monitoring for general health as well as for diabetes and should be used more broadly to monitor and improve the health of Manitobans.(22,23)

3) Initiate a vigorous effort combining pilot programs and research to improve prevention.

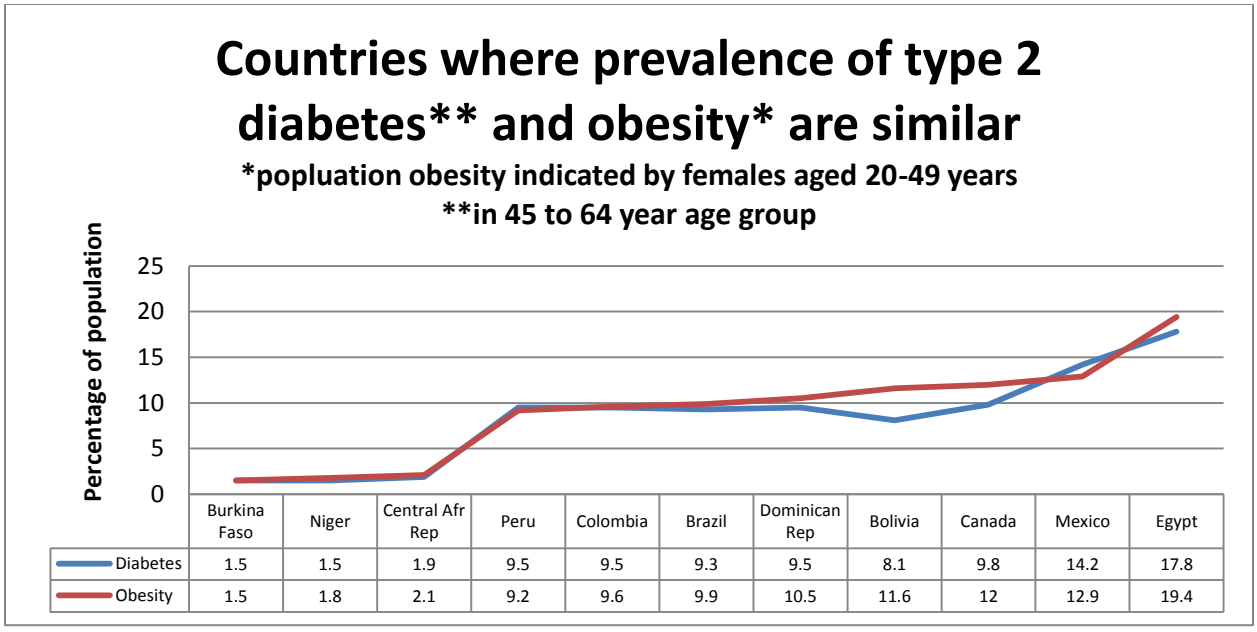
In addressing the issue of the optimum diet to prevent diabetes, it is important to consider the possibility that the optimum diet for prevention may be and probably is different from the optimum diet to treat diabetes.(24) Indeed, with the wide array of dietary recommendations coming from varied sources, it would appear quite important to have a common message throughout the province as to the optimum general diet to prevent diabetes.

In moving beyond an approach which can prevent 60 percent of diabetes, it is vital to move beyond addressing just obesity and ensuring other factors important to reducing diabetes are considered. While reducing obesity is important, addressing physical activity and obesity may not be the only factors which are important to reduce diabetes incidence and prevalence. The lack of a close relationship between the rates of obesity and the rates of diabetes in quite a number of countries provides evidence that factors other than obesity may be important to identify and address as well (Figures 5 – 7). In addition, since addressing general physical activity and nutrition issues to reduce obesity have been associated with up to a 60 per cent reduction in diabetes, additional factors to bring that reduction as close to 100 per cent as possible, should be examined. For example, in the United Kingdom, the rate of obesity in the population is 16 per cent while the rate of diabetes is only 2.5 per cent.(25) One possibility is that people in the United Kingdom consume or are exposed to something that prevents diabetes. For example, black tea has been found to be associated with up to a 40 per cent reduction in diabetes risk and incidence.(26,27) While the evidence to date, regarding the preventative qualities of black tea with regards to diabetes is not conclusive, it is sufficient to be looking seriously at what other factors play a role in diabetes prevention, and to ensure that such factors are considered in the approach to the current diabetes epidemic in Manitoba. It is worth noting that a recent trial testing the concept of peer (or buddy) support also shows promise.(20) It will be important to renew and continue this approach to broaden it rather than to drop it as was done in 2002.



	Tanzania	Kenya	Comoros	France	Switzerland	Netherlands	United Kingdom	New Zealand	Australia	Finland	Spain	USA
Diabetes	1.5	1.6	1.7	2.4	2.5	2.4	2.5	2.9	3	5.8	8.2	9.5
Obesity	3.5	4	5	7	9	14	16	19	19	19	22	22.5

Figure 5: Countries where prevalence of obesity is higher than that of type 2 diabetes.(25)



	Burkina Faso	Niger	Central Afr Rep	Peru	Colombia	Brazil	Dominican Rep	Bolivia	Canada	Mexico	Egypt
Diabetes	1.5	1.5	1.9	9.5	9.5	9.3	9.5	8.1	9.8	14.2	17.8
Obesity	1.5	1.8	2.1	9.2	9.6	9.9	10.5	11.6	12	12.9	19.4

Figure 6: Countries where prevalence of type 2 diabetes and obesity are similar.(25)

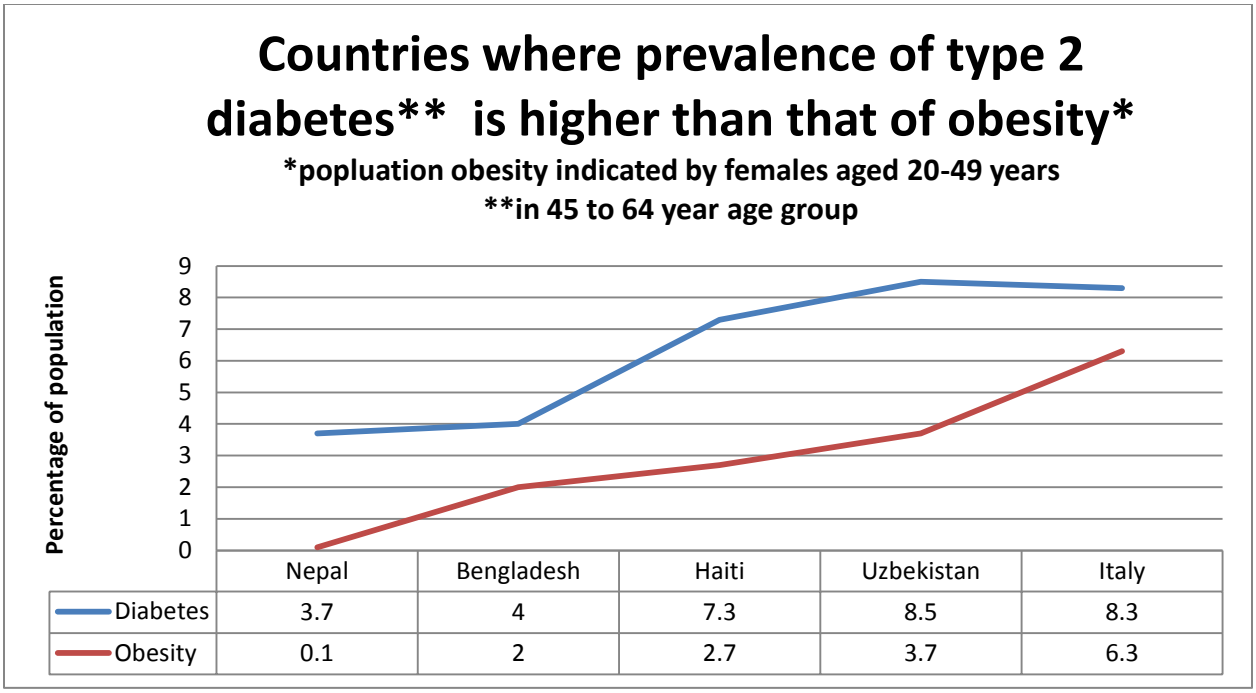


Figure 7: Countries where prevalence of type 2 diabetes is higher than that of obesity.(25)

It is also important to note that the studies using diet management have not solely emphasized sugar and calorie consumption. Tuomilehto *et al.* emphasized eating high fibre, whole wheat products.(13)

Identifying how critical each of the components of the diet can be is essential in order to provide the best nutritional advice. On one hand, seafood has been found in some studies to be associated with lower rates of diabetes.(25) Other studies have questioned this association, however, but it may be that a particular component or components of seafood (vitamin D, DHA, EPA) or a combination of these may be active in reducing diabetes. Each of these factors will need to be evaluated in a Manitoba setting. This is part of what the central coordination effort needs to ensure is happening.

In an examination of studies which have undertaken a systemic review and/or meta-analysis of lifestyle factors associated with changes in the risks of diabetes the following was found:

Dietary and lifestyle (in addition to physical activity) examples found to be associated with a reduction in the incidence of diabetes

Consumption of whole grains: 21% reduction in type 2 diabetes(28)

Consumption of black tea and/or coffee: 16 - 42% reduction in type 2 diabetes(26,27)

Vitamin D: 33% - 43% reduction in type 2 diabetes(29-31)

Breastfeeding: 39% reduction in type 2 diabetes(32)

Whole Fruits and Vegetables: While fruits and vegetables overall, have only a very small association with a reduction in diabetes, regular consumption of certain fruits and green leafy vegetables has demonstrated an association with a reduced incidence of diabetes. Regular consumption of blueberries has been associated with a 26% reduction in diabetes; grapes, raisins and prunes with an 11-12% reduction in diabetes; apples, pears, bananas and grapefruit with a 5 – 8% reduction in diabetes.(33) Green leafy vegetables were found to be associated with a 14% reduction in diabetes.(34) Soybeans were found to be associated with a 48% reduced incidence of diabetes, soy milk with a 39% reduction and other legumes, peas and lentils were associated with a 24% reduction.(35)

Nuts: 27% reduction in type 2 diabetes(36)

Magnesium: 22% reduced risk of diabetes(37)

Dietary and lifestyle (other than physical inactivity) examples found associated with an increase in diabetes

Cigarette Smoking: 44% increase in type 2 diabetes(28)

Meat: generally – 17% to 58% increase in the risk of developing diabetes(28,38)

red meat – 21% increased risk(28)

processed meat – 41% increased risk(28)

Sugar sweetened beverages (i.e. soft drinks): 22 - 26% increased risk of developing type 2 diabetes(39,40)

Fruit juices: 8% increase in the likelihood of developing diabetes(33)

White (non-whole grain) bread: 37% increase in the risk for developing type 2 diabetes(41)

White rice: 12 – 55% increased risk(42)

Potatoes and French fries: potatoes - 14% increased risk(43)

- one daily serving = 18% increased risk(43)

french fries - 21% increased risk(43)

- two weekly servings = 16% increased risk(43)

Eggs: consumption of one or more eggs per day has been associated with a 58% increase in the risk of developing diabetes for men and a 77% increased risk for women. No significant effect was found with lower consumption.(44)

Persistent organic pollutants*: up to 3,770% increase in type 2 diabetes dependent on exposure to six persistent organic pollutants (POPs)(45)

*six POPs: 2,2',4,4',5,5'-hexachlorobiphenyl

1,2,3,4,6,7,8-heptachlorodibenzo-*p*-dioxin

1,2,3,4,6,7,8,9-octachlorodibenzo-*p*-dioxin

oxychlordane

p,*p*'-dichlorodiphenyltrichloroethane

trans-nonachlor

Addressing these specific dietary and lifestyle components has the potential to prevent greater numbers than 60 per cent of those at risk from developing type 2 diabetes. Certain aspects of the above findings in relation to risk deserve additional comment.

First, there is a growing recognition that avoiding white (processed) foods like white bread, white rice and potatoes and replacing them with whole grain foods is an important aspect of preventing diabetes. Dr. Ebbert's article for the Mayo Clinic recommends adding pasta to the list of white foods.(46) While this is logical where pasta is made from white flour, data on the specific risk of eating pasta from white flour have not been found to date.

There is also a growing body of evidence that an important part of the nutritional deficiency, to the extent that it exists, may reflect a deficiency in critical antioxidant nutrients. Thus, the impact of blueberries and of tea, in particular, may be linked to the antioxidant active phytonutrients they contain.(47,48)

Finally, the study on persistent organic pollutants (POPs) looked at serum concentrations (amount in blood) of six POPs and the subsequent development of type 2 diabetes. The very high proportionate increased risk with the highest

serum concentration levels of POPs is striking, as is the relative absence of type 2 diabetes in those with the lowest concentration levels, including those with low levels who were obese.(45) Additional studies also support this association between exposure to POPs and the development of type 2 diabetes.(49,50) Clearly, more research is needed into this association. The prevalence of type 2 diabetes and the fact that high serum POPs are likely to be unevenly distributed in Manitoba may suggest this province is an important location to examine this concept further. More research is also needed on sources of the POPs in Manitoba – in our food and our environment. It should also be noted that the accumulating evidence suggests that obesity may enhance the ability of POPs to lead to the development type 2 diabetes, so that addressing prevention through physical activity and nutrition should still be effective in preventing diabetes even if POPs are a contributing factor.(51)

Low Calorie and low fat diets compared to a low carbohydrate diet. In addition to evaluating the specific dietary and lifestyle factors above, the attempt to achieve a greater than 60 per cent reduction in diabetes should also look at a pilot (research-based) study which examines a low carbohydrate based diet as opposed to the low calorie, low fat diet which is the best practice diet studied by Tuomilehto and colleagues above.(13) There are two reasons why this should be examined. First, there is evidence in comparative studies that a low carbohydrate diet may be more effective in achieving improved glucose metabolism than a low calorie, low fat diet.(52,53) Second, as Dr. Jay Wortman has pointed out, the low carbohydrate diet may be closer to a traditional Indigenous diet.(54) One must be careful not to misinterpret a low carbohydrate diet to mean a diet with a high increase in certain other food groups. Replacing carbohydrates with a high protein or a high fat diet has the potential to increase the risk for cardiovascular and other diseases and therefore, needs to be approached with caution.

There is, however, good reason to closely examine the traditional Indigenous diet. The low historic incidence of diabetes among Indigenous people, and

emerging scientific evidence shows that components of such a diet (for example, blueberries) may have a beneficial impact in reducing the incidence of diabetes. It is possible that this may be true for other foods in the traditional diet as well. It may be of particular interest, for example, to study the impact of teas which were used historically (such as Labrador and Balsam tea), and to look at the traditional practice in some communities of providing fish soups to pregnant mothers and infants.

It would be prudent to seriously consider the inclusion and use of psychological services which have been shown to effectively assist individuals with lifestyle changes. For some it is not just about changing what you eat but how food and nutrition is viewed and understood. Understanding what motivates an individual and helping that person to use that motivation to make the necessary lifestyle changes to prevent diabetes requires psychological counselling for some.

Overall, a pilot (research-based) project approach is needed, in which there is a vigorous focus on achieving and constantly improving upon current best practices as stated in **Point 2** above. For the quickest results, the project should be initiated in communities where there is a relatively high rate of diabetes.

4) Fully review the critical issues that have not been tackled in the 1998 strategic plan that was proposed to address the diabetes epidemic.

As with all effective approaches, a re-evaluation keeps it relevant. It first needs to be determined if the recommendations still apply today. Whatever is relevant should then be implemented and assessed with measureable outcomes to determine success and appropriate adjustment, as required. Whatever is no longer relevant either needs to be abandoned or modified to make it relevant and beneficial. It should then be implemented and continually assessed so that a dynamic and effective approach can be maintained and followed.

5) Approach diabetes as a disease of nutrient deficiencies and not just nutrient excess.

The excess nutrient hypothesis: The common view of type 2 diabetes is that it is a disease of excess sugar, excess readily absorbable carbohydrate, or excess fat. Statements like, “Research shows that excess body fat is the most significant cause of diabetes” are common.(55) Nutrients considered to contribute to the development of diabetes when consumed excessively include sugar, carbohydrates (particularly refined grains), red meats, eggs, potatoes and high fat dairy products – in essence the so-called “Western Diet” (see factors associated with increased risk above). Consistent with this view is a study which showed a 59 per cent increase in the risk of developing diabetes on this diet (96 per cent increased risk if a person showed a low level of physical activity).(56) Consumption of the sugars, fructose and glucose, has been shown to be associated with an increase in risk for developing type 2 diabetes, as has the increased consumption of sugar sweetened beverages like soft drinks.(57) While associations of sugar or sugar-sweetened beverage consumption with type 2 diabetes exist, these associations alternate in risk with other factors, often with a higher relative increase or decrease in risk. This suggests that other factors and the “nutrient deficiency” concept need to be considered seriously and examined more thoroughly.(38,41,58)

The nutrient deficiency hypothesis: Evidence also suggests that a deficiency of one or more nutrients may be the basis for type 2 diabetes. (see Appendix VI). Fiber, vitamin D, magnesium and micronutrients, particularly those from plants (called phytochemicals), are nutrients among which deficiencies have been associated with an increased risk for type 2 diabetes. Consistent with the nutrient deficiency hypothesis is evidence that consumption of refined white bread (which lacks the nutrients present in whole grain breads) increases the risk for diabetes, while whole grain cereal consumption decreases the risk.(41) Recommendations have included replacing white bread, white rice, potatoes

(eaten without the skin) and “white” pasta with foods which retain critical micronutrients. Additional evidence consistent with this hypothesis is that addition of food components which contain important micronutrients (for example, green leafy vegetables, soybeans, other beans, lentils, peas, blueberries and nuts) is associated with a lower incidence of diabetes. The fact that not a single substance can completely prevent diabetes suggests that if the nutrient deficiency hypothesis is, at least in part, correct there are probably multiple deficiencies which can lead to diabetes.

The concept that diabetes can be a result of a deficiency condition is supported by studies of thiamine-responsive megaloblastic anemia (TRMA) syndrome, a genetic condition in which the intracellular concentration of thiamine (vitamin B1) is low because of a deficiency in the protein which transports thiamine into the cell.(59) This thiamine deficiency condition is characterized by three specific clinical features one of which is the development of diabetes.(60) Treatment involves the lifelong administration of vitamin B1 to patients with TRMA because their cells are extremely sensitive to thiamine depletion.(59) The thiamine dosages used to treat the disease thereby also ameliorate the associated diabetes.(60)

This idea that diets lacking critical micronutrients predispose a person to the development of type 2 diabetes is part of the basis for proposing a high nutrient density (HND) diet as a critical measure in the prevention of diabetes.(55,61) There has not yet been a randomized trial comparing the HND diet to the current best practice established by Tuomilehto *et al.*, but such a trial should be performed in light of the testimony by Fuhrman that this diet can achieve remarkable improvement in many individuals with type 2 diabetes.(13,55)

Viewing diabetes as a deficiency disease is potentially consistent with the remarkable finding of a decreased risk of diabetes in those who drink black tea. Black tea is known to contain plant derived chemicals including flavonoids such as catechins, theaflavins, and thearubigins, which have been suggested to be effective natural micronutrients in reducing diabetes risk.(62,63) This would also

be consistent with evidence that low levels of vitamin D and magnesium are associated with an increased risk of type 2 diabetes.(31,37,64) Also consistent with the nutrient deficiency hypothesis is the observation that breastfeeding and its natural nutrients are associated with a decreased risk of type 2 diabetes as the child ages.(32)

Additionally, at least a proportion of individuals given the high nutrient diet mentioned above appear to lose their craving for food, to feel "full" or satiated, and are able to maintain an improved weight, in some instances without increasing physical activity.(55)

Diabetes as a disease of excess or deficiency?: It is possible that the failure to reduce the incidence and prevalence of diabetes and end the epidemic in Manitoba has been made more difficult by viewing diabetes as primarily a condition which results from excess consumption of sugar and fats. A focus on dietary change which adds nutrients that may be lacking and which can prevent diabetes may have greater success.(65) If addressing the nutrient deficiency can result in decreasing the continual sensation of hunger in people and subsequently reduce over-consumption of sugar, calories and fats, this approach could then be effective in addressing what may be a secondary consequence of the deficiency – excess weight.

An approach which focuses on addressing nutrient deficiencies may also have the potential to engage food providers (from food processors, to wholesalers, to retail groceries, to restaurants) in a more effective way. For obvious reasons, a focus on reducing consumption has been a difficult message to deliver for those involved in selling food.

It must be emphasized that this discussion does not take away from employing the "Best practice" diet used by Tuemilehto *et al*. The concept of diabetes as a deficiency disease may actually explain why the inclusion of whole grains and vegetables in the diet, employed in that study, was successful in preventing 60 per cent of diabetes. Approaching diabetes as a "deficiency" condition also

should not take away from the present day emphasis on physical activity and reducing sugar consumption because these have been clearly shown to aid in preventing diabetes. The fact that no physical activity regime has been shown to be 100 per cent effective in preventing diabetes is also consistent with attention to nutrition, including nutritional deficiencies, being important in diabetes prevention. Further, one of the nutrients mentioned in this report, vitamin D, can be obtained by getting physical activity outdoors. At least in this way, it may help address the body's need for critical nutrients. Physical activity has also been shown to improve a variety of physiological functions and mental health, which may directly and indirectly contribute to improved nutrition, improved health and diabetes reduction.

Lastly, it needs to be emphasized that the prevention of diabetes can almost certainly be improved by decreasing consumption of foods associated with an increased risk of diabetes at the same time as increasing consumption of foods which contain the critical nutrients that may be lacking.

6) Incorporate recent findings involving the hepatic insulin sensitizing substance and other advances in improving prevention of diabetes

A substance (HISS – Hepatic Insulin Sensitizing Substance) has been identified which is produced by the liver in response to insulin production (from food intake) and which stimulates glucose uptake in the skeletal muscle, heart and kidneys thus reducing the level of glucose in the blood when a meal is eaten. It has been suggested that type 2 diabetes results from a reduction or lack of HISS so that glucose is not taken up as efficiently into cells and levels remain high in the blood. It has been found that the addition of a cocktail of antioxidants or increased physical activity can protect HISS production. This is consistent with the concept that diabetes may result in part from a nutrient deficiency in which critical antioxidants (present in foods like blueberries and beverages like tea) are lacking. Interestingly the results of studies with HISS suggest both physical activity and antioxidants may act by affecting the same pathway - the production of HISS. If true, this supports findings in clinical trials where the effects of physical activity and nutrition are not as additive or synergistic as one might expect.(66) Linking such knowledge with findings in relation to the risks of developing type 2 diabetes can be helpful in the development of a full understanding of the mechanisms at work. This knowledge can in turn lead to improved prevention of diabetes.

7) Develop and implement a comprehensive plan and budget to sufficiently address the epidemic moving forward

A central budget for specifically addressing the diabetes epidemic in Manitoba needs to be developed. This budget should include a major innovative effort in reversing the tide of the diabetes epidemic in Manitoba – to produce changes along the lines of those shown in Figure 3. The recommendations arising from the points above and from any gaps identified need to be reflected in Budget 2015.

The fully integrated plan should include broad approaches for all Manitobans. The plan should, at the same time, set some priorities to address individuals and communities at higher risk for the development of type 2 diabetes and to provide leading examples of nutritional and lifestyle change.

For example, women born to mothers with type 2 diabetes have been shown to be at high risk for the development of type 2 diabetes. This group of children should be identified at birth and the help provided to them should begin at birth, including emphasizing the impact of breastfeeding to decrease type 2 diabetes. The numbers of children with type 2 diabetes is being followed very closely in Manitoba so they can be a useful marker for the effectiveness of interventions in this group. Following such high risk children with hemoglobin A1c monitoring can provide an early warning sign as well.

A priority should also be to address the issue of hospital food – as an example of what is needed for optimum health and for prevention of diabetes. Hospital food should offer the optimal nutrition for patient health and serve as an example of food to prevent and decrease diabetes.

Such examples of targeted efforts could provide leadership in addressing the diabetes epidemic.

Cost of the diabetes epidemic and savings from prevention

To look at an estimate of the cost of the diabetes epidemic and the savings from prevention, we have used a simplified assumption based on the cost estimate performed by the Diabetes Costing Project highlighted in ***Diabetes - a Manitoba Strategy***.(1)

In an analysis of the economic costs of diabetes, the 1998 report measured selective health care costs and showed that these specific health care costs for a person with diabetes averaged out to slightly more than twice the average cost per person compared to someone without diabetes each year.(1) The actual numbers were $1,011 for a person without diabetes and $2,169 for a person with diabetes in the general population.(67) For a status (Aboriginal) individual, the relative annual health care costs are higher - $1,359 for a person without diabetes and $3,656 for a person with diabetes (higher average costs reflect additional expenses related to remote northern communities – travel, etc.).(67) For the purpose of estimating all provincial health care costs for diabetes, a 2:1 ratio was used to compare costs for a person with diabetes to a person without diabetes in Manitoba. This simplistic ratio may underestimate the cost of diabetes, but it provides a useful approximation to look at the cost of diabetes today and how it has changed since 1998.

Using the above approximation, the economic cost for people with diabetes in 1998/1999 (52,874 diabetics in Manitoba) is estimated at $189 million; $94 million (i.e. one half) of that is the excess amount for specific diabetes related costs (see Appendix VII).(68) Today, this has increased to an estimated 104,000 people with diabetes in Manitoba (an estimate based on the most recent Freedom of Information response citing 103,831 Manitoba residents with diabetes for fiscal year 2012/13). The estimated cost of care for that number of individuals with diabetes in 2012/13 is $802 million, with $401 million of that being excess costs due specifically to diabetes alone.(69)

If an effective approach to the epidemic had been implemented in 1998, and the graph shown in Figure 3 was the outcome, the 2012/13 excess diabetes-related costs would have been $401 million which would mean a savings of $166 million in health costs for that fiscal year as a result of preventing a significant number of people from developing diabetes. The cumulative impact of the results shown in Figure 3 would be an estimated savings of over $700 million (Figure 8).

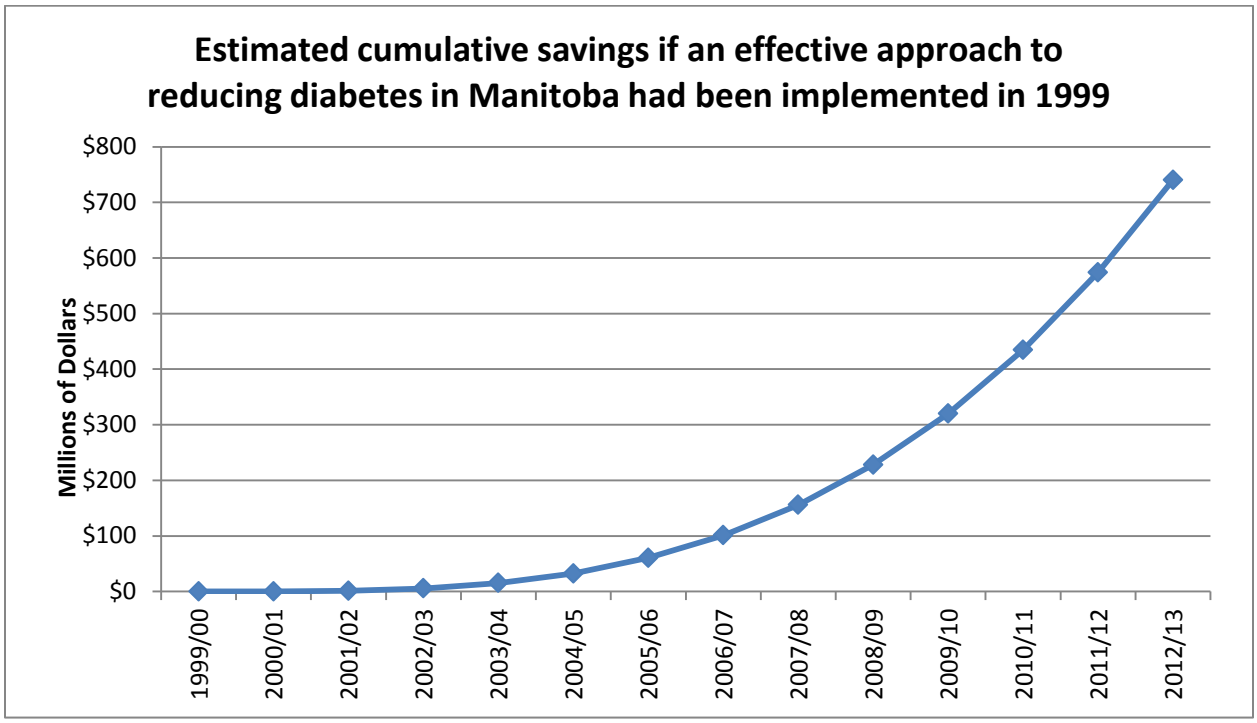


Figure 8: Estimated cumulative potential health care cost savings with an effective approach to addressing the diabetes epidemic.(69-82)

While only an estimate, it does give a rough idea of the cost of the diabetes epidemic today and the savings that can be achieved by prevention.

Conclusion: Manitoba has had a diabetes epidemic since 1996.(1) This epidemic has continued unabated for 18 years. The number of Manitobans with diabetes has nearly doubled to over 103,000 since 1998. The individual tragedies are far beyond simple numbers. The costs to our health care system are enormous. This report questions why Manitoba has failed to achieve a reduction in the incidence and prevalence of diabetes. Though an excellent strategy was developed in 1998, it was never fully implemented province-wide. There continues to be a lack of the central coordination necessary to properly address the diabetes epidemic. Central coordination is paramount to building best practices throughout Manitoba, to improving best practices in an ongoing effort and to monitoring the rates of new cases of diabetes closely to achieve the success which has been elusive to date.

The report also looks beyond sugar and compiles evidence that nutritional deficiencies may be a significant contributor to the development of diabetes. A seven point plan is provided to appropriately address the diabetes epidemic and prevent the ravages of this disease from affecting thousands upon thousands more Manitobans.

Appendix I: Rebutting the Premier's statement that the incidence of diabetes is declining

In the 2013 Throne Speech, the NDP government said that, "the number of people being diagnosed with ...diabetes has ... declined".(83) There have been two approaches used to derive the incidence of diabetes in Manitoba which we will examine here. What we have found is that the analysis cited by the Premier has limitations, and at best, uses averages of data that are not current. The more up to date and inclusive information from the Canadian Chronic Disease Surveillance System shows a continuing increase in the incidence of diabetes in Manitoba to the point where the most recent year currently available (2012/13) is the highest in the number of new cases of diabetes diagnosed in the history of our province.

The Canadian Chronic Disease Surveillance System (CCDSS)

The CCDSS provides surveillance data on diseases across Canada including diabetes. The criteria to include a diagnosis of diabetes as "counted" are at least one hospitalization or two physician coded visits for diabetes in a two year period. The data provided by this system shows clearly that the incidence of diabetes is increasing in Manitoba (Figures 9 and 10).

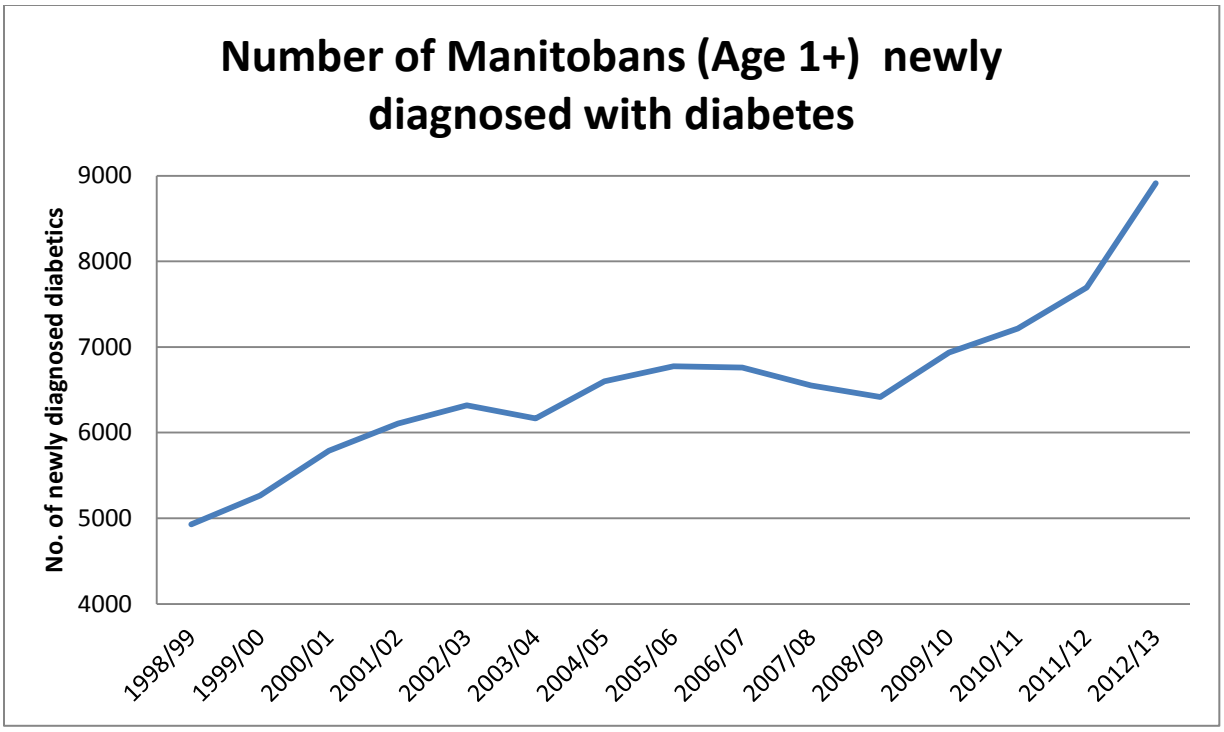


Figure 9: Incidence of diabetes in Manitoba since 1998.
*data provided by MB Health in response to a Freedom of Information request (as per CCDSS Manitoba definition v2012 and 2013).

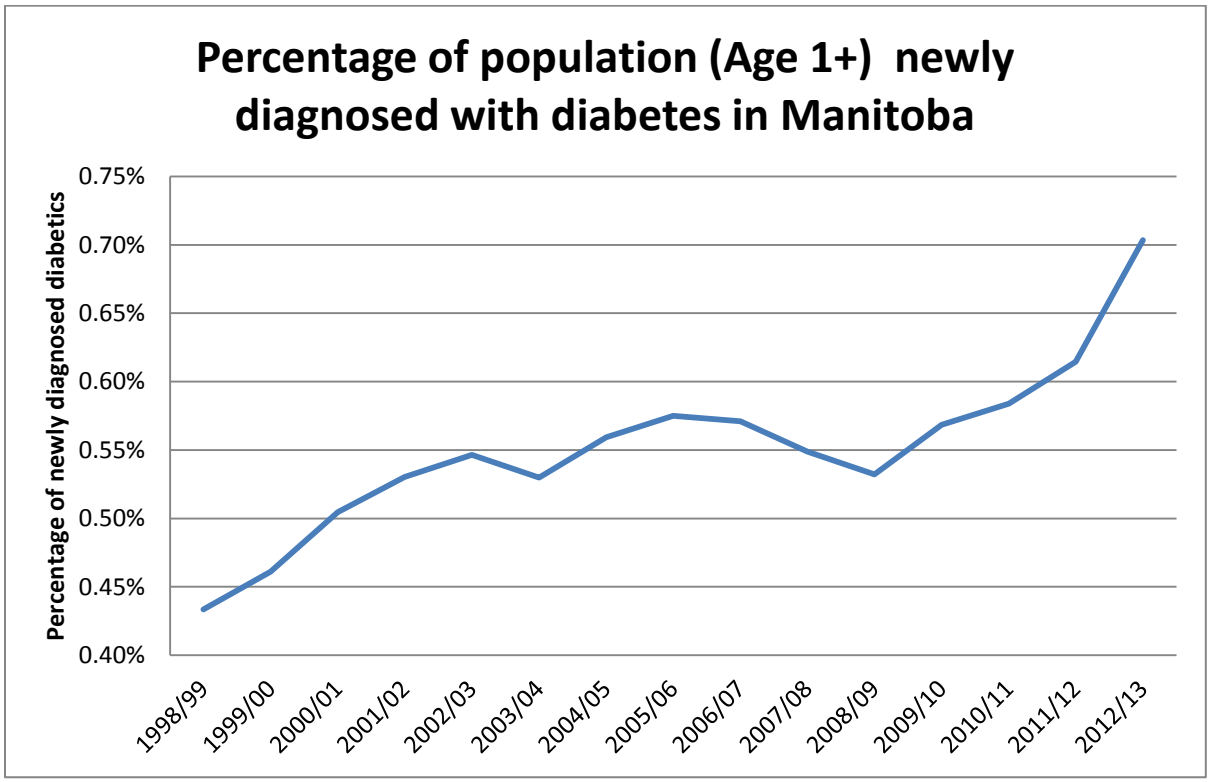


Figure 10: Incidence of diabetes in Manitoba as a percentage of the population (as per CCDSS database).(5)

The Manitoba Centre for Health Policy (MCHP) Data Analysis

The MCHP analysis shows that the number of new cases of diabetes in Manitoba was 5,943 in the period 2004/5 to 2006/7, and that the number of new cases of diabetes in Manitoba decreased to 5,837 in the period 2009/10 to 20011/12. These numbers are much lower than the number of new cases of diabetes in Manitoba using the CCDSS definition which found 6712 cases (average) for 2004/5 to 2006/7 and 7,281 (average) for 2009/11 to 2011/12.

Which analysis is correct?

The question of which analysis gives us the most accurate reflection of the change in incidence is important. Using CCDSS data the incidence is going up. Using MCHP data, the incidence has gone down.

There are two major differences between the CCDSS and MCHP analyses. First the CCDSS data include all individuals who are age one or more, while the MCHP data includes only individuals age 19 and up (i.e. all those under the age of 19 years are excluded). While the number of cases of diabetes in those under 19 is clearly increasing from an average of 132 in 2004/05-2006/7 to an average of 164 in 2009/10-2011/12 the total number of new cases in this age group is only a fraction of the difference between the CCDSS and MCHP data. The second major difference between the data sets is that MCHP data only includes individuals who had been living in Manitoba for all ten years before the year in which the new cases were determined. For example, to include a new diagnosis of diabetes in the MCHP data for 2004 the individual (over 18 years old) must have lived in Manitoba all throughout 1993 to their diagnosis in 2004. While this was done to be more certain the diabetes had never been previously diagnosed, it created a problem in that many newcomers to Manitoba, or people who moved away from Manitoba for a period were not included. With the sizable number of new immigrants to Manitoba, the MCHP analysis will miss these people, and over a ten year period this could amount to as many as108,000 Manitobans or more than 9% of our population being missed.(84,85)

These observations show that the CCDSS data is the most inclusive available while the MCHP data has critical limitations which restrict its usefulness and accuracy when describing the full population of Manitoba. At this time, the most recent CCDSS data, for 2012/13, is more current than the MCHP data. In 2013, there were 8,913 Manitobans newly diagnosed with diabetes. This incidence is far higher than previous years and consistent with the conclusion that diabetes incidence is continuing to increase in our province.

While we may not be able to fully resolve the differences between the MCHP and CCDSS data sets, we can say that the most up to date and comprehensive information available (from CCDSS) shows that the incidence of diabetes in Manitoba continues to increase and must be considered the most up to date and complete information at this time. We therefore strongly urge caution in misinterpreting the limited data from the MCHP to suggest the incidence of diabetes in Manitoba is decreasing.

Furthermore, it is very misleading and inaccurate for the Premier to propose that Manitoba is doing well in preventing diabetes by suggesting that the incidence is decreasing. In fact, we note that the CCDSS numbers in this report are the ones provided by the Manitoba government in response to the Freedom of Information requests. The Premier has ignored his own data, data which are more up to date and more inclusive, by making such an erroneous claim. The bottom line is that there are far too many people being diagnosed and living with diabetes in Manitoba. What is needed is action. Now.

Appendix II: Model of an effective province-wide approach to the diabetes epidemic

This model, illustrated in Figures 3 and 4, assumes that the effort to prevent diabetes will have a relatively small impact in the first two years as it slowly builds province-wide (5 per cent reduction of new cases in year one and 10 per cent reduction in year two). It begins to accelerate from the second year to reach the point where the overall prevalence of diabetes will decrease until, over time, the number of new cases becomes fewer than the number of people who die from diabetes and diabetes related conditions. At the latter stage, the total number of people with diabetes in Manitoba will begin to decline.

The model recognizes that a current best practice approach exists which has demonstrated, that with fairly modest changes in physical activity and diet, it is possible to prevent up to 60 per cent of new cases of type 2 diabetes.(13) The model assumes that such best practices can reasonably be disseminated province-wide in seven years from the start of a full-bore campaign to reduce diabetes in Manitoba. The campaign would include the necessary public advertising, and involve working with every single physician and nurse practitioner in Manitoba to ensure all their patients, who do not have diabetes, are provided the best advice/strategies for preventing diabetes. It would also include ensuring the diabetes reduction campaign is addressed by nurses throughout Manitoba. Such a campaign would also need to involve nutritionists and dieticians as well as psychological service providers from around the province as key players. The best practice model would require periodic consultations for individuals with one of these nutritional specialists – with seven consultations in the first year and one consultation every three months thereafter. Since it would not be possible to have such individual consultations for every Manitoban who does not have diabetes, there would need to be an on-line site which could focus information and facilitate consultations around the province. The design and implementation of such a site would be critical to addressing the epidemic, as would the effective use of nutritionist and diabetes educator resources all over Manitoba.

The model also assumes that, over time, the ability to prevent type 2 diabetes will improve until it reaches the level of 85 per cent reduction of new cases by year 12. Such progress is to be expected given improvements in research and in the understanding of best practice approaches to prevent type 2 diabetes over the course of the effort to combat the epidemic of diabetes in Manitoba.

The model also includes the assumption that the number of new cases of diabetes diagnosed in a given year, minus the increase in the total number of people with diabetes in that year (i.e. the increase in the total number of Manitobans living with diabetes in 2002 compared to 2001) is a reasonable estimate of the number of people with diabetes who die each year in Manitoba.

Some will say that the timing in this model is ambitious. Those who think this is not possible should review the work of Dr. Heather Dean who demonstrated that in two weeks of a physical activity and dietary intervention program she was able to completely reverse the disease and normalize blood glucose levels in every single one of a group of adolescents with type 2 diabetes.(86) Achieving such results province-wide in two weeks would be impossible – but achieving an 85 per cent reduction in new cases of type 2 diabetes in 13 years in Manitoba is reasonably feasible given the major effort that should be directed at this epidemic in our province. To date, the diabetes epidemic is the longest in duration and most severe epidemic, in terms of the number of people affected, that we have ever encountered in our province's history. It is time to marshal the political will and the resources to make a difference. We can. We must.

Appendix III: Prevention of type 1 diabetes

Recent scientific studies have suggested that low vitamin D levels are associated with increased type 1 diabetes.(87-90) This research brought to light the possibility that vitamin D supplementation in those who have low levels may reduce the incidence of type 1 diabetes. More research is needed to confirm this. In general, however, eliminating vitamin D deficiency and insufficiency can be supported on the grounds of good health practice.

Appendix IV: Diabetes Strategy Report Card

Diabetes Strategy of 1998 – and outcomes

Goal Prevention	Ranking (0-10)*	Outcome
1) Develop community-based **Diabetes Primary Prevention Programs**, particularly targeting seniors and Aboriginal people	3	While some community based activities are being undertaken, there remains no evidence that the epidemic has been turned around in any community (diabetes prevalence is increasing).
2) Develop comprehensive community-based **Diabetes Screening Programs**.	5	The Diabetes Integration Project is federally funded to screen people in First Nation Communities; Manitoba is far from having province-wide community-based screening.
3) Develop a **Manitoba Nutrition Strategy** to ensure the availability of nutritious foods and promote healthy food choices	6	There has been progress in developing school nutrition programs, and in providing community gardens in northern Manitoba; the province-wide nutrition strategy needed for the diabetes epidemic remains absent.
4) Develop a **Manitoba Physical Activity Strategy** to provide appropriate physical activity opportunities for all and to encourage individuals and families to incorporate activity into their daily lives.	7	Healthy Living Manitoba has been reasonably effective in promoting and improving fitness province-wide, particularly in schools and some targeted communities.
5) Provide **Tax Reduction Incentives** to individuals, families and communities practicing diabetes prevention.	0	No such program exists.
6) Develop a **Public Awareness Campaign** about the prevention of Type 2 Diabetes	3	Although public awareness of diabetes is growing, there has been no ongoing public awareness campaign around the epidemic and actions people need to take.

7) Develop **Healthy Public Policies** that support healthy lifestyle choices, active living and health-enhancing environments	4	There has been a lot of talk but no action from the provincial government to ensure that every department is developing its business plans with a core healthy living approach and effective province-wide healthy living policies.

Average rank - Prevention **4**

Education

1) Establish a **Standardized Multi-Level Diabetes Education Program** to expand the pool of qualified diabetes educators from community to specialist levels.	5	There has been some effort in expanding the pool of qualified diabetes educators; there still are not enough nutritionists province-wide to fully address the epidemic.
2) Develop a mandatory **Multi-Level Certification Program** for diabetes educators.	6	Since 2006, a Certification Maintenance by Credit Portfolio for diabetes educators maintains educator certification by taking 250 credits or writing the CDE exam every 5 years.
3) Expand and enhance the community-based **Standardized Client Education Program** (Diabetes Education Resource Program).	2	Much more work is needed as there are not enough programs and not enough educators province-wide.
4) Incorporate **Education About Diabetes** throughout the continuum of health care provider education.	3	There have been improvements but Manitoba is still not adequately engaging all health providers in a diabetes prevention approach.
5) Develop a **Refresher Program** for all health care providers in the work force to update their knowledge about diabetes.	2	The need remains for a constantly updated, single, central website portal, where health care providers can go to get current information on diabetes prevention.
6) Encourage all health professional associations in Manitoba to require **Continuing Education** about diabetes	3	Programs for continuing diabetes education exist, but it remains non-mandatory for all health care professionals to be up to date with diabetes prevention.

7) Include information about diabetes and chronic diseases in all **School Health Curricula.**	5	Healthy lifestyle information in health curricula is increasing, but there remains a lag for specific information about diabetes.
8) Ensure the safety and health of students with diabetes in all school settings by utilizing the Canadian Diabetes Association **School Standards of Care** (1998).	8	There has been reasonable improvement though gaps remain with room for improvement.
9) Increase the **Number of Aboriginal Students** participating in, and graduating from, health care provider programs (see RCAP 1996 Recommendation 3.3.16)	6	There is some progress in improving Aboriginal post-secondary education participation generally, including in health areas.
10) Include information about diabetes and other chronic diseases in the health component of the **Teacher Certification and Training Program.**	2	With some information provided for teachers on health care and diabetes issues, there is much room for improvement.
11) Develop a **Public Awareness Campaign** about the complications of diabetes.	5	Programs for assessing and dealing with complications are improving, but there has not been an adequate public relations push in this area.
12) Co-ordinate an annual **Diabetes Symposium.**	1	There has not been an annual provincial diabetes symposium.
13) Develop a **Diabetes Resource Library.**	4	The Neil John McLean Library has an adequate collection; there is no specific diabetes resource library.
14) Develop **Healthy Public Policies** that support the concept of education as a fundamental component of diabetes prevention, care, research and support.	3	Manitoba is still in the early stages of the development of such public policies.

Average rank - Education **4**

Care

1) Develop **Manitoba Diabetes Care Recommendations** for the care of people with diabetes, consistent with the Canadian Diabetes Association Clinical Practice Guidelines.	9	This success is primarily due to efforts of the Canadian Diabetes Association's development of clinical practice guidelines; Manitoba also has Manitoba Diabetes Care Recommendations.
2) Develop comprehensive **Diabetes Complications Screening and Care Programs.**	7	Screening for diabetes complications is improving in Manitoba, particularly with recent efforts in screening for renal disease. Manitoba Diabetes Care Recommendations (2011) do a good job of addressing screening for complications as part of the care of individuals with diabetes.
3) Standardize the collection and communication of clinical data about people with diabetes through the development of a **Clinical Data Form.**	6	For children with diabetes there has been a standard clinical data form used since 1986. For adults, there is room for improvement.
4) Improve the **Co-ordination of Services** among hospitals and communities, Regional Health Authorities and other services providers.	5	There has generally been good progress in dealing with referrals for specialist care, but the general quality of prevention, screening and care varies considerably from one regional health authority to another.
5) Develop the **Diabetes Health Care team** with an interdisciplinary structure and broad mandate for the education and management of diabetes and the prevention of its complications.	7	There is a highly coordinated effort for children with diabetes; The care for adults is more varied.
6) Incorporate access to **Traditional Aboriginal Healing** practices and healers for Aboriginal people with diabetes and their families, if desired by the individuals concerned.	5	There is some activity to include traditional Aboriginal healing; integration of traditional Aboriginal healing practices with current province-wide approaches could be more advanced.
7) Assess the validity of all **New Therapies** proposed for diabetes.	7	Manitoba's track record for supporting new therapies for diabetes is reasonable.

8) Provide **Children with Diabetes and Their Families** the care necessary to optimize their quality of life.	9.5	The care for children and families in Manitoba is exceptional, and one of the best in Canada
9) Provide **Seniors with Diabetes and Their Families** the care necessary to optimize their quality of life.	8	Care for seniors with diabetes in Manitoba is generally of high quality, though more challenging than with young individuals because of increased complications.
10) Develop **Innovative Ways of Funding** the expansion of diabetes care services.	7	Some innovations have occurred in Manitoba (e.g. expansion of dialysis care), but getting new ideas into effective practice needs to be improved.
11) Develop **Healthy Public Policies** that address standards of care, barriers in accessing care and continuity of care.	6	Manitoba has a wide variety of scattered programs which address barriers to accessing care and continuity of care issues, but this falls far short of the comprehensive approach needed and expected in an epidemic situation.

Average rank - Care **7**

Research

1) Develop a **Manitoba Diabetes Surveillance System.**	3	There are surveillance programs around the province, but not a province-wide surveillance system, and data on the number of new cases of diabetes in Manitoba and the total number of people with diabetes is often years out of date (At the time of this report we were unable to find these data online at all).
2) Develop **Indicators, Benchmarks, Outcomes and Standards** for diabetes prevention, education, care, research and support.	3	While the Manitoba Centre for Health Policy (MCHP) has been helpful in developing useful indicators in other areas, this has not been done specifically for diabetes; in fact, the MCHP has yet to produce a comprehensive report on diabetes in Manitoba.

3) **Evaluate** community-based interventions and initiatives in prevention, education, care, research and support.	1	There is no singular place on the internet where one can find an evaluation of all the scattered programs which have been set up with respect to diabetes in Manitoba.
4) Increase the **Diabetes-Specific Funding for Research** to make it proportional to the cost of diabetes care in Manitoba.	0	This has not been done.
5) Establish a **Manitoba Centre for Diabetes Research.**	4	There are researchers in Manitoba who are doing excellent research on diabetes, and there is a group focusing on diabetes at the Manitoba Institute for Child Health, but there is no actual "Manitoba Centre for Diabetes Research" as there is for cancer at Cancer Care Manitoba.
6) Develop a **Code of Ethics** for community-based diabetes research.	8	Though there is not a specific Manitoba code of ethics for community-based diabetes research, practices have evolved through the University of Manitoba Faculty of Medicine Research Ethics Board which provide a very strong review of such proposals and have achieved much of what is needed in ensuring high ethical standards for this research.
7) Develop **Research Skills and Experience** for health care providers.	3	While there are opportunities provided for this, there is not a formal program to develop research skills and experience for community-based health care providers.
8) Establish a **Manitoba Diabetes Information Warehouse**.	2	This has not been done; there are collections of information such as at the Manitoba Centre for Health Policy.
9) Produce an annual **Diabetes in Manitoba** report	1	Diabetes in Manitoba 1989-2006; Report of Diabetes Surveillance and Diabetes in Manitoba a Call to Action were produced in 2009; no annual report has been produced.

10) **Inform the Public** about the research process through a public campaign by researchers and non-government organizations.	1	There has not been a formal process for informing the public about the research conducted in Manitoba, and no annual symposium with public presentations.
11) Develop **Healthy Public Policies** that support diabetes research in Manitoba.	1	Very little has been done by the provincial government in the way of public policy to support diabetes research

Average rank - Research **2**

Support

1) Develop holistic and community-based diabetes **Support Systems** that address cultural, emotional, spiritual and physical health issues and needs.	5	A variety of scattered efforts exist in Manitoba, but there is a lack of the province-wide coordination needed.
2) Increase the number of **Community Diabetes Workers and Health Care Providers** from Aboriginal and other cultural, age and linguistic groups in which there is a disproportionate prevalence of diabetes.	5	A FIPPA response indicated that no such statistical data (ethnicity) is collected. Anecdotally, there have been increased numbers of First Nation and Metis individuals training in health related areas.
3) Address the inequities in **Access to Support Services** across the province.	7	Varied programs exist, including mobile screening programs for diabetes to provide care, screening support and education, for people in rural communities.
4) Address **Jurisdictional Issues.** (among federal, provincial, municipal and Aboriginal governments)	5	There has been a modest improvement in federal-provincial cooperation, particularly with respect to dialysis in Indigenous communities.
5) Inform **Leaders** at all levels and throughout the province, about the *Manitoba Diabetes Strategy*.	2	The document, *Manitoba - A Diabetes Strategy,* is available on the provincial website, and is referenced from time to time in the media; there has been little public effort to promote the strategy, to report on progress, or to follow many of the recommendations of the strategy.

6) Develop **Psychosocial Supports** for people with diabetes.	4	Very modest progress has been seen overall; the Diabetes Integration Project is making progress in this area.
7) Develop **Peer Counselling Support** services in all communities.	4	Some scattered efforts have occurred including **Get Better Together! Manitoba**
8) Develop **Advocacy Programs** for special-needs groups, including children, seniors and Aboriginal people.	3	The Canadian Diabetes Association has been active in advocating for all those with diabetes, but there has been little provincial government focus specifically on diabetes in recent years; the province has moved to address "chronic illness" in general rather than diabetes specifically.
9) Expand **Pharmacare Programs** to increase coverage for diabetes medications and supplies.	5	There has been modest progress in coverage of insulin pumps and supplies for children as well as supplies for adults.
10) Develop **Healthy Public Policies** that support people living with diabetes and its complications, their families and communities.	6	A lack of adequate provincial coordination has limited the overall success of efforts.

Average rank - Support **5**

Overall grade **4**

* Rankings determined by Dr. Jon Gerrard

Appendix V - Throne Speech and Budget Address mention of diabetes from 1999-2013

Throne Speech	Mention of Diabetes	Budget Address	Mention of Diabetes
November 1999	None	-	
December 2000	None	May 2000	Yes[3]
November 2001	None	April 2001	None
November 2002	None	April 2002	None
November 2003	None	April 2003	None
November 2004	Yes[1]	April 2004	Yes[4]
October 2005	Yes[2]	March 2005	Yes[5]
November 2006	None	March 2006	Yes[6]
June/ November 2007	None	April 2007	Yes[7]
November 2008	None	April 2008	None
November 2009	None	March 2009	None
November 2010	None	March 2010	None
October 2011	None	April 2011	None
November 2012	None	April 2012	None
November 2013	Yes[8]	April 2013	None
-		March 2014	None

[1] Throne Speech, Monday, November 22, 2004:

> Provincial government plans to launch diabetes prevention strategy to help First Nations communities and Regional Health Authorities develop diabetes programs. [The new strategy was never launched. To this day *Diabetes - A Manitoba Strategy* remains the only full government strategy document released]

[2] Throne Speech, Thursday, October 27, 2005:

> Provincial government plans to partner with Federal government to improve outcomes for Aboriginal health in relation to issues like chronic diseases such as diabetes.

[3]Budget, Wednesday, May 10, 2000:

> Budget plan for health care will aim to improve diabetes programs in order to improve Aboriginal health outcomes.

[4]Budget, Monday, April 19, 2004:

> According to the Canadian Diabetes Association, Manitoba has one of the best treatment programs for diabetes in Canada.

[5] Budget, Tuesday, March 8, 2005:

> Mention of the programs in place to promote healthy living in relation to the Diabetes Prevention Strategy launched that year.

[6] Budget, Monday, March 6, 2006:

> Province works to make diabetes care associated costs more affordable to Manitobans by removing the retail sales tax on lancets and blood glucose monitors.

[7] Budget, Wednesday, April 4, 2007:

> Province is working to reduce the rate of diabetes in the Aboriginal population.

[8]Throne Speech, Tuesday, November 12, 2013:

> Notes a decline in incidence of diabetes and hosting a national diabetes conference (organized by CDA); announces forthcoming release of framework to avoid complications of diabetes and kidney disease.

Appendix VI: The origin of the diabetes as a deficiency disease concept

One of the first people to suggest that diabetes is a deficiency disease was Denis Burkitt, who is well known internationally for his efforts linking “Western” diets to diseases, including diabetes. He was focused on a deficiency of fibre in the diet. Today, based on the best evidence currently available, diabetes - to the extent that it is a deficiency disease - must represent a broader deficiency than just fibre with phytonutrients found in plants and possibly vitamin D being, at minimum, critical.

Nevertheless, Burkitt’s initial observations were a key to Dr. Gerrard’s consideration that diabetes may be primarily a deficiency disease. Burkitt’s work that began this journey for Dr. Gerrard occurred several years ago, while reading a book on the life of Denis Burkitt which referenced his work on “western diseases”. The book, *Bukitt Cancer-Fiber: How a humble surgeon changed the world!*, contained the following passage from a meeting in 1972 with Dennis Burkitt and two of his collaborators, Peter Cleave and Hugh Trowell.

“*There were still misunderstandings between even Cleave and the collaborators, Burkitt and Trowell.*

“When the three met, Denis again tried to point out the importance of fiber-depleted diets above excessive sugar as paramount in causing Western diseases.

’*As you know, Peter,”” he reminded Cleave, when he once more opened the controversial subject, ‘for the past several years I’ve been collecting data from a thousand mission hospitals around the world besides personally going on fact-finding safaris to Africa, Asia and North and South America. I’ve conducted and compared countless countries transit-time stool studies in the Western and Third Worlds. As a result both Trowell and I firmly believe that fiber-deficiency can be identified as a missing important factor in the Western diet and that it plays an enormously important role in causing western diseases, even diabetes.’*

'I know, you've stressed this before Denis, many times,' said Cleave.

'I've spent endless hours in researching medical literature on the subject of fiber.' Hugh added, 'and we're not alone in suspecting a fiber-deficient diet causes many bowel disorders.'

'All right, but I'd like to point out some statistics from both World Wars,' Cleave declared. 'During the wars there was a sugar shortage, and diabetic deaths fell during 1914-1918 and again in 1941-48.'

"Denis agreed, but suggested, 'Let's look at another principle factor of the wartime diet.' He was using facts accrued by Trowell. 'You'll remember Peter, that the government requested the millers to extract less bran from the wheat so as to produce more flour. Instead of the fiber-depleted white bread which people had previously eaten, during the war all were eating "National Loaf" an eighty-five percent whole wheat bread.'

"Hugh added the clincher, 'When sugar consumption went back to prewar levels in 1953, the diabetes incidence didn't rise. This was because the high-fiber National Loaf was still the staple and remained so until 1954. It wasn't until after the bakers reintroduced white bread that diabetes flourished again in 1956.'

Subsequent work, as illustrated in the studies quoted in this report has shown that consumption of whole grains is associated with a decreased risk of diabetes and it has been emphasized by at least one author that one of the most sensible changes to make to decrease diabetes risk may be changing from white bread to whole wheat bread.(41)

Appendix VII: Diabetes Health Cost Estimate

Example for Manitoba 1998/99

Number of people with diabetes 52,874

Manitoba population 1,137,489(85)

Health care budget $2,122,000,000(68)

Diabetic:non-diabetic cost ratio = 2:1

The calculation assumes that the double cost for diabetes gives the equivalent of a ”total population” in which people with diabetes are counted twice thus adding an extra 52,874 people to the actual provincial population of 1,137,489 in 1998/99.

“total population” in Manitoba = 1,137,489 + 52,874

= 1,190,363

Average cost per person of “total population” = average cost for non-diabetic

$2,122,000,000 / 1,190,363 = $1782.65

Cost for 52,874 diabetics = $1782.65 * 52,874 * 2 (2:1 ratio)

= $188,511,672.20

Excess cost for diabetes = $188,511,672.20 / 2

= $94,255,836.10

References:

(1) Manitoba Diabetes Strategy Steering Committee. Diabetes: A Manitoba strategy. 1998.

(2) Public Health Agency of Canada. Surveillance: Canadian Chronic Disease Surveillance System. 2014; Available at: http://www.phac-aspc.gc.ca/surveillance-eng.php. Accessed 06/17, 2014.

(3) United Health - Centre for Health Reform & Modernization. The United States of Diabetes: Challenges and opportunities in the decade ahead. 2010.

(4) Type 2 diabetes--time to change our approach. Lancet 2010 Jun 26;375(9733):2193-6736(10)61011-2.

(5) Statistics Canada. CANSIM Table 051-0001: Estimates of population, by age group and sex for July 1, Canada, provinces and territories annual (persons unless otherwise noted). 2012; Available at: http://www5.statcan.gc.ca/cansim/a26?lang=eng&retrLang=eng&id=0510001&paSer=&pattern=&stByVal=1&p1=1&p2=37&tabMode=dataTable&csid=. Accessed 10/30, 2013.

(6) Manitoba Government. Diabetes strategy to be developed: Diabetes and its issues discussed at symposium at St. Boniface Hospital. 1996.

(7) Certified resolution FEB-97.05 - Re: Diabetes epidemic in Manitoba First Nations. Assembly of Manitoba Chiefs
Chiefs Health Assembly; 1997.

(8) World Health Organization. Definition, diagnosis and classification of diabetes mellitus and its complications. Part 1: Diagnosis and classification of diabetes mellitus. 1999.

(9) World Health Organization. **Diabetes: Fact sheet N°312
**. 2013; Available at: http://www.who.int/mediacentre/factsheets/fs312/en/. Accessed Sepetmeber/2013, 2013.

(10) LEGISLATIVE ASSEMBLY OF MANITOBA - Monday, November 26, 2001. Third Session of the Thirty-Seventh Legislature - Debates and Proceedings: Monday, November 26, 2001; 2001.

(11) LEGISLATIVE ASSEMBLY OF MANITOBA - Tuesday, August 6, 2002. Third Session of the Thirty-Seventh Legislature - Debates and Proceedings: 6:30 p.m., Tuesday, August 6, 2002; 2002.

(12) LEGISLATIVE ASSEMBLY OF MANITOBA - Thursday, November 28, 2002. Fourth Session of the Thirty-Seventh Legislature - Debates and Proceedings: 1:30 p.m., Thursday, November 28, 2002; 2002.

(13) Tuomilehto J, Lindstrom J, Eriksson JG, Valle TT, Hamalainen H, Ilanne-Parikka P, et al. Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. N Engl J Med 2001 May 3;344(18):1343-1350.

(14) Knowler WC, Barrett-Connor E, Fowler SE, Hamman RF, Lachin JM, Walker EA, et al. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. N Engl J Med 2002 Feb 7;346(6):393-403.

(15) Ramachandran A, Snehalatha C, Mary S, Mukesh B, Bhaskar AD, Vijay V, et al. The Indian Diabetes Prevention Programme shows that lifestyle modification and metformin prevent type 2 diabetes in Asian Indian subjects with impaired glucose tolerance (IDPP-1). Diabetologia 2006 Feb;49(2):289-297.

(16) Kosaka K, Noda M, Kuzuya T. Prevention of type 2 diabetes by lifestyle intervention: a Japanese trial in IGT males. Diabetes Res Clin Pract 2005 Feb;67(2):152-162.

(17) Harati H, Hadaegh F, Momenan AA, Ghanei L, Bozorgmanesh MR, Ghanbarian A, et al. Reduction in incidence of type 2 diabetes by lifestyle intervention in a middle eastern community. Am J Prev Med 2010 Jun;38(6):628-636.e1.

(18) Fransoo R, Martens P, The Need To Know Team, Prior H, Burchill C, Koseva I, et al. The 2013 RHA indicators atlas. 2013.

(19) Gerrard J. To Life! Partnering for Wellness - a program to prevent diabetes which was doing very well until the funding was cut - how many more programs were there which were started but never carried through?. 2013; Available at: http://manitobaliberals.blogspot.ca/2013/10/to-life-partnering-for-wellness-program.html. Accessed 11/06, 2013.

(20) Santos RG, Durksen A, Rabbanni R, Chanoine JP, Lamboo Miln A, Mayer T, et al. Effectiveness of peer-based healthy living lesson plans on anthropometric measures and physical activity in elementary school students: a cluster randomized trial. JAMA Pediatr 2014 Apr 1;168(4):330-337.

(21) Manitoba Health: Health Information Management. Annual Statistics 2012-2013. 2014.

(22) Khaw KT, Wareham N, Bingham S, Luben R, Welch A, Day N. Association of hemoglobin A1c with cardiovascular disease and mortality in adults: the European prospective investigation into cancer in Norfolk. Ann Intern Med 2004 Sep 21;141(6):413-420.

(23) Selvin E, Coresh J, Golden SH, Brancati FL, Folsom AR, Steffes MW. Glycemic control and coronary heart disease risk in persons with and without diabetes: the atherosclerosis risk in communities study. Arch Intern Med 2005 Sep 12;165(16):1910-1916.

(24) Gerrard J. Is the best diet to prevent diabetes the same as the best diet to treat diabetes? 2013; Available at: Is the best diet to prevent diabetes the same as the best diet to treat diabetes?. Accessed 11/06, 2013.

(25) Nkondjock A, Receveur O. Fish-seafood consumption, obesity, and risk of type 2 diabetes: an ecological study. Diabetes Metab 2003 Dec;29(6):635-642.

(26) van Dieren S, Uiterwaal CS, van der Schouw YT, van der ADL, Boer JM, Spijkerman A, et al. Coffee and tea consumption and risk of type 2 diabetes. Diabetologia 2009 Dec;52(12):2561-2569.

(27) Odegaard AO, Pereira MA, Koh WP, Arakawa K, Lee HP, Yu MC. Coffee, tea, and incident type 2 diabetes: the Singapore Chinese Health Study. Am J Clin Nutr 2008 Oct;88(4):979-985.

(28) Psaltopoulou T, Ilias I, Alevizaki M. The role of diet and lifestyle in primary, secondary, and tertiary diabetes prevention: a review of meta-analyses. Rev Diabet Stud 2010 Spring;7(1):26-35.

(29) Pittas AG, Dawson-Hughes B, Li T, Van Dam RM, Willett WC, Manson JE, et al. Vitamin D and calcium intake in relation to type 2 diabetes in women. Diabetes Care 2006 Mar;29(3):650-656.

(30) Lim S, Kim MJ, Choi SH, Shin CS, Park KS, Jang HC, et al. Association of vitamin D deficiency with incidence of type 2 diabetes in high-risk Asian subjects. Am J Clin Nutr 2013 Mar;97(3):524-530.

(31) Mitri J, Muraru MD, Pittas AG. Vitamin D and type 2 diabetes: a systematic review. Eur J Clin Nutr 2011 Sep;65(9):1005-1015.

(32) Owen CG, Martin RM, Whincup PH, Smith GD, Cook DG. Does breastfeeding influence risk of type 2 diabetes in later life? A quantitative analysis of published evidence. Am J Clin Nutr 2006 Nov;84(5):1043-1054.

(33) Muraki I, Imamura F, Manson JE, Hu FB, Willett WC, van Dam RM, et al. Fruit consumption and risk of type 2 diabetes: results from three prospective longitudinal cohort studies. BMJ 2013 Aug 28;347:f5001.

(34) Carter P, Gray LJ, Troughton J, Khunti K, Davies MJ. Fruit and vegetable intake and incidence of type 2 diabetes mellitus: systematic review and meta-analysis. BMJ 2010 Aug 18;341:c4229.

(35) Villegas R, Gao YT, Yang G, Li HL, Elasy TA, Zheng W, et al. Legume and soy food intake and the incidence of type 2 diabetes in the Shanghai Women's Health Study. Am J Clin Nutr 2008 Jan;87(1):162-167.

(36) Lovejoy JC. The impact of nuts on diabetes and diabetes risk. Curr Diab Rep 2005 Oct;5(5):379-384.

(37) Dong JY, Xun P, He K, Qin LQ. Magnesium intake and risk of type 2 diabetes: meta-analysis of prospective cohort studies. Diabetes Care 2011 Sep;34(9):2116-2122.

(38) Sluijs I, Beulens JW, van der ADL, Spijkerman AM, Grobbee DE, van der Schouw YT. Dietary intake of total, animal, and vegetable protein and risk of type 2 diabetes in the European Prospective Investigation into Cancer and Nutrition (EPIC)-NL study. Diabetes Care 2010 Jan;33(1):43-48.

(39) Malik VS, Popkin BM, Bray GA, Despres JP, Willett WC, Hu FB. Sugar-sweetened beverages and risk of metabolic syndrome and type 2 diabetes: a meta-analysis. Diabetes Care 2010 Nov;33(11):2477-2483.

(40) InterAct consortium. Consumption of sweet beverages and type 2 diabetes incidence in European adults: results from EPIC-InterAct. Diabetologia 2013 Jul;56(7):1520-1530.

(41) Hodge AM, English DR, O'Dea K, Giles GG. Glycemic index and dietary fiber and the risk of type 2 diabetes. Diabetes Care 2004 Nov;27(11):2701-2706.

(42) Hu EA, Pan A, Malik V, Sun Q. White rice consumption and risk of type 2 diabetes: meta-analysis and systematic review. BMJ 2012 Mar 15;344:e1454.

(43) Halton TL, Willett WC, Liu S, Manson JE, Stampfer MJ, Hu FB. Potato and french fry consumption and risk of type 2 diabetes in women. Am J Clin Nutr 2006 Feb;83(2):284-290.

(44) Djousse L, Gaziano JM, Buring JE, Lee IM. Egg consumption and risk of type 2 diabetes in men and women. Diabetes Care 2009 Feb;32(2):295-300.

(45) Lee DH, Lee IK, Song K, Steffes M, Toscano W, Baker BA, et al. A strong dose-response relation between serum concentrations of persistent organic pollutants and diabetes: results from the National Health and Examination Survey 1999-2002. Diabetes Care 2006 Jul;29(7):1638-1644.

(46) Ebbert J. Tuesday Q & A: Reducing four white foods may make it easier to eat less, lose weight. 2013; Available at: http://newsnetwork.mayoclinic.org/discussion/tuesday-q-a-reducing-four-white-foods-in-your-healthy-diet-may-make-it-easier-to-eat-less-lose-weigh?6868697=1. Accessed 04/10, 2014.

(47) Beresniak A, Duru G, Berger G, Bremond-Gignac D. Relationships between black tea consumption and key health indicators in the world: an ecological study. BMJ Open 2012 Nov 8;2:10.1136/bmjopen-2011-000648. Print 2012.

(48) Wedick NM, Pan A, Cassidy A, Rimm EB, Sampson L, Rosner B, et al. Dietary flavonoid intakes and risk of type 2 diabetes in US men and women. Am J Clin Nutr 2012 Apr;95(4):925-933.

(49) Taylor KW, Novak RF, Anderson HA, Birnbaum LS, Blystone C, Devito M, et al. Evaluation of the association between persistent organic pollutants (POPs) and diabetes in epidemiological studies: a national toxicology program workshop review. Environ Health Perspect 2013 Jul;121(7):774-783.

(50) Wu H, Bertrand KA, Choi AL, Hu FB, Laden F, Grandjean P, et al. Persistent organic pollutants and type 2 diabetes: a prospective analysis in the nurses' health study and meta-analysis. Environ Health Perspect 2013 Feb;121(2):153-161.

(51) Lee DH, Steffes MW, Jacobs DR,Jr. Can persistent organic pollutants explain the association between serum gamma-glutamyltransferase and type 2 diabetes? Diabetologia 2008 Mar;51(3):402-407.

(52) Samaha FF, Iqbal N, Seshadri P, Chicano KL, Daily DA, McGrory J, et al. A low-carbohydrate as compared with a low-fat diet in severe obesity. N Engl J Med 2003 May 22;348(21):2074-2081.

(53) Vernon MC, Mavropoulos J, Transue M, Yancy WS, Westman EC. Clinical experience of a carbohydrate-restricted diet: effect on diabetes mellitus. Metab Syndr Relat Disord 2003 Sep;1(3):233-237.

(54) Wortman J. Dr. Jay's Blog: The story so far... 2013; Available at: http://www.drjaywortman.com/blog/wordpress/about/. Accessed 11/28, 2013.

(55) Fuhrman J. The End of Diabetes: The eat to live plan to prevent and reverse diabetes. 1st ed. New York: HarperCollins Pbulsihers; 2013.

(56) van Dam RM, Rimm EB, Willett WC, Stampfer MJ, Hu FB. Dietary patterns and risk for type 2 diabetes mellitus in U.S. men. Ann Intern Med 2002 Feb 5;136(3):201-209.

(57) Montonen J, Jarvinen R, Knekt P, Heliovaara M, Reunanen A. Consumption of sweetened beverages and intakes of fructose and glucose predict type 2 diabetes occurrence. J Nutr 2007 Jun;137(6):1447-1454.

(58) Janket SJ, Manson JE, Sesso H, Buring JE, Liu S. A prospective study of sugar intake and risk of type 2 diabetes in women. Diabetes Care 2003 Apr;26(4):1008-1015.

(59) Oishi K, Diaz GA. Thiamine-Responsive Megaloblastic Anemia Syndrome. In: Pagon RA, Adam MP, Ardinger HH, Bird TD, Dolan CR, Fong CT, et al, editors. GeneReviews(R) Seattle (WA): University of Washington, Seattle; 1993.

(60) Neufeld EJ, Fleming JC, Tartaglini E, Steinkamp MP. Thiamine-responsive megaloblastic anemia syndrome: a disorder of high-affinity thiamine transport. Blood Cells Mol Dis 2001 Jan-Feb;27(1):135-138.

(61) Dunaief DM, Fuhrman J, Dunaief JL, Ying G. Glycemic and cardiovascular parameters improved in type 2 diabetes with the high nutrient density (HND) diet. Open Journal of Preventive Medicine 2012;2(3):364-371.

(62) Huxley R, Lee CM, Barzi F, Timmermeister L, Czernichow S, Perkovic V, et al. Coffee, decaffeinated coffee, and tea consumption in relation to incident type 2 diabetes mellitus: a systematic review with meta-analysis. Arch Intern Med 2009 Dec 14;169(22):2053-2063.

(63) InterAct Consortium. Tea consumption and incidence of type 2 diabetes in Europe: the EPIC-InterAct case-cohort study. PLoS One 2012;7(5):e36910.

(64) Pittas AG, Lau J, Hu FB, Dawson-Hughes B. The role of vitamin D and calcium in type 2 diabetes. A systematic review and meta-analysis. J Clin Endocrinol Metab 2007 Jun;92(6):2017-2029.

(65) Coulston AM, Boushey CJ, Ferruzzi M. Nutrition in the Prevention and Treatment of Disease. . 3rd ed. Amsterdam: Academic Press; 2013.

(66) Chowdhury KK, Legare DJ, Lautt WW. Lifestyle impact on meal-induced insulin sensitization in health and prediabetes: a focus on diet, antioxidants, and exercise interventions. Can J Physiol Pharmacol 2013 Feb;91(2):91-100.

(67) Manitoba Diabetes Strategy Steering Committee. Diabetes: A Manitoba strategy
Appendix A: page 56. 1998.

(68) Gilleshammer, Harold (Hon) (Minister of Finance). The Province of Manitoba Annual Report for the year ended March 31, 1999: Public Accounts - Volume 3 (Summary Financial Statements: Consolidated Statement of Revenue and Expense). 1999.

(69) Struthers, Stan (Hon) (Minister of Finance). The Province of Manitoba Annual Report for the year ended March 31, 2013: Public Accounts - Volume 1 (Summary Financial Statements: Consolidated Statement of Revenue and Expense). 2013.

(70) Selinger, Greg (Hon) (Minister of Finance). The Province of Manitoba Annual Report for the year ended March 31, 2000: Public Accounts - Volume 1 (Summary Financial Statements: Consolidated Statement of Revenue and Expense). 2000.

(71) Selinger, Greg (Hon) (Minister of Finance). The Province of Manitoba Annual Report for the year ended March 31, 2001: Public Accounts - Volume 1 (Summary Financial Statements: Consolidated Statement of Revenue and Expense). 2001.

(72) Selinger, Greg (Hon) (Minister of Finance). The Province of Manitoba Annual Report for the year ended March 31, 2002: Public Accounts - Volume 1 (Summary Financial Statements: Consolidated Statement of Revenue and Expense). 2002.

(73) Selinger, Greg (Hon) (Minister of Finance). The Province of Manitoba Annual Report for the year ended March 31, 2003: Public Accounts - Volume 1 (Summary Financial Statements: Consolidated Statement of Revenue and Expense). 2003.

(74) Selinger, Greg (Hon) (Minister of Finance). The Province of Manitoba Annual Report for the year ended March 31, 2004: Public Accounts - Volume 1 (Summary Financial Statements: Consolidated Statement of Revenue and Expense). 2004.

(75) Selinger, Greg (Hon) (Minister of Finance). The Province of Manitoba Annual Report for the year ended March 31, 2005: Public Accounts - Volume 1 (Summary Financial Statements: Consolidated Statement of Revenue and Expense). 2005.

(76) Selinger, Greg (Hon) (Minister of Finance). The Province of Manitoba Annual Report for the year ended March 31, 2006: Public Accounts - Volume 1 (Summary Financial Statements: Consolidated Statement of Revenue and Expense). 2006.

(77) Selinger, Greg (Hon) (Minister of Finance). The Province of Manitoba Annual Report for the year ended March 31, 2007: Public Accounts - Volume 1 (Summary Financial Statements: Consolidated Statement of Revenue and Expense). 2007.

(78) Selinger, Greg (Hon) (Minister of Finance). The Province of Manitoba Annual Report for the year ended March 31, 2008: Public Accounts - Volume 1 (Summary Financial Statements: Consolidated Statement of Revenue and Expense). 2008.

(79) Selinger, Greg (Hon) (Minister of Finance). The Province of Manitoba Annual Report for the year ended March 31, 2009: Public Accounts - Volume 1 (Summary Financial Statements: Consolidated Statement of Revenue and Expense). 2009.

(80) Wowchuk, Rosann (Hon) (Minister of Finance). The Province of Manitoba Annual Report for the year ended March 31, 2010: Public Accounts - Volume 1 (Summary Financial Statements: Consolidated Statement of Revenue and Expense). 2010.

(81) Wowchuk, Rosann (Hon) (Minister of Finance). The Province of Manitoba Annual Report for the year ended March 31, 2011: Public Accounts - Volume 1 (Summary Financial Statements: Consolidated Statement of Revenue and Expense). 2011.

(82) Struthers, Stan (Hon) (Minister of Finance). The Province of Manitoba Annual Report for the year ended March 31, 2012: Public Accounts - Volume 1 (Summary Financial Statements: Consolidated Statement of Revenue and Expense). 2012.

(83) LEGISLATIVE ASSEMBLY OF MANITOBA - Tuesday, November 12, 2013. Third Session of the Fortieth Legislature - Speech from the Throne; 2013.

(84) Statistics Canada. CANSIM Table 051-0004: Components of population growth, Canada, provinces and territories annual (persons). 2013; Available at: http://www5.statcan.gc.ca/cansim/a26?lang=eng&retrLang=eng&id=0510004&pattern=&csid=. Accessed 07/21, 2014.

(85) Statistics Canada. CANSIM Table 051-0001: Estimates of population, by age group and sex for July 1, Canada, provinces and territories annual (persons unless otherwise noted). 2013; Available at: http://www5.statcan.gc.ca/cansim/a26?lang=eng&retrLang=eng&id=0510001&pattern=&csid=. Accessed 07/22, 2014.

(86) Dean HJ. Dancing with many different ghosts: treatment of youth with type 2 diabetes. Diabetes Care 2002 Jan;25(1):237-238.

(87) Chakhtoura M, Azar ST. The role of vitamin d deficiency in the incidence, progression, and complications of type 1 diabetes mellitus. Int J Endocrinol 2013;2013:148673.

(88) Dong JY, Zhang WG, Chen JJ, Zhang ZL, Han SF, Qin LQ. Vitamin d intake and risk of type 1 diabetes: a meta-analysis of observational studies. Nutrients 2013 Sep 12;5(9):3551-3562.

(89) Munger KL, Levin LI, Massa J, Horst R, Orban T, Ascherio A. Preclinical serum 25-hydroxyvitamin D levels and risk of type 1 diabetes in a cohort of US military personnel. Am J Epidemiol 2013 Mar 1;177(5):411-419.

(90) Holick MF. Vitamin D: importance in the prevention of cancers, type 1 diabetes, heart disease, and osteoporosis. Am J Clin Nutr 2004 Mar;79(3):362-371.