Manitoba Centre for Health Policy

Type 2 Diabetes in Manitoba

Autumn 2020



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About the Manitoba Centre for Health Policy

The Manitoba Centre for Health Policy (MCHP) is located within the Department of Community Health Sciences, Max Rady College of Medicine, Rady Faculty of Health Sciences, University of Manitoba. The mission of MCHP is to provide accurate and timely information to healthcare decision-makers, analysts and providers, so they can offer services which are effective and efficient in maintaining and improving the health of Manitobans. Our researchers rely upon the unique Manitoba Population Research Data Repository (Repository) to describe and explain patterns of care and profiles of illness and to explore other factors that influence health, including income, education, employment, and social status. This Repository is unique in terms of its comprehensiveness, degree of integration, and orientation around an anonymized population registry.

Members of MCHP consult extensively with government officials, healthcare administrators, and clinicians to develop a research agenda that is topical and relevant. This strength, along with its rigorous academic standards, enables MCHP to contribute to the health policy process. MCHP undertakes several major research projects, such as this one, every year under contract to Manitoba Health, Seniors and Active Living. In addition, our researchers secure external funding by competing for research grants. We are widely published and internationally recognized. Further, our researchers collaborate with a number of highly respected scientists from Canada, the United States, Europe, and Australia.

We thank the Research Ethics Board on the Bannatyne Campus at the University of Manitoba, for their review of this project. MCHP complies with all legislative acts and regulations governing the protection and use of sensitive information. We implement strict policies and procedures to protect the privacy and security of anonymized data used to produce this report and we keep the provincial Health Information Privacy Committee informed of all work undertaken for Manitoba Health, Seniors and Active Living.

The Manitoba Centre for Health Policy

Data Insight Informing Solutions

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Table of Contents

About the Manitoba Centre for Health Policy	i
Acknowledgements.	
Table of Contents	v
List of Tables	ix
List of Figures.	xiii
Acronyms	.xvi i
Executive Summary.	xix
A Focus on First Nation Populations.	xix
What This Report Contains	XX
Findings	XX
Chapter 3: Incidence and Prevalence of Any Diabetes and Type 2 Diabetes in Manitoba	xx
Chapter 4: Demographics and General Health Status of Manitobans with Type 2 Diabetes	xxii
Chapter 5: Health Services Use among Manitobans with Type 2 Diabetes	xxii
Chapter 6: Type 2 Diabetes-Related Care and Complications	XXIII
Chapter 7: Cardiovascular Health of Manitobans with Type 2 Diabetes	XXIV
Chapter 9: Maternal and Neonatal Outcomes among Women with Type 2 Diabetes.	
Chapter 10: Mental Health Outcomes among Manitobans with Type 2 Diabetes	xxvi
Conclusions and Recommendations	xxvii
Type 2 Diabetes	
Chapter 1: Introduction and Background	1
Objectives of This Report.	2
Organization of the Chapters	2
Chapter 2: Methods and Interpretation	
Data Used in this Report	
Identifying the Cohort of Manitobans with Type 2 Diabetes	4
Findings from the Use of the Enhanced Definition for Type 2 Diabetes	
Groupings for the Analyses	/ و
Presentation of Results Comparing First Nation Manitobans to All Other Manitobans	8
Geography.	
Chapters 3-7	
Chapters 8-10	
Rates and Adjustments	14
Study Years.	
Chapter 3: Incidence and Prevalence of Any Diabetes and Type 2 Diabetes in Manitoba	17
Historical Rates of Any Diabetes (Based on the NDSS Definition) in Manitoba	
Incidence and Prevalence of Any Diabetes among Adult Manitobans by Age Group	
Incidence and Prevalence of Type 2 Diabetes in Manitoba	∠⊺
Incidence and Prevalence of Type 2 Diabetes among Adult Manitobans by Age Group	
Incidence and Prevalence of Type 2 Diabetes among Manitobans by Income Quintile	
Incidence and Prevalence of Type 2 Diabetes among Manitobans by Health Region	
Crude Rates of Type 2 Diabetes by Tribal Council Area.	
Crude Rates of Type 2 Diabetes among Children Only	

Chapter Summary and Recommendations Overall Summary and Recommendations Summary and Recommendations for First Nation Manitobans with Type 2 Diabetes	
Chapter 4: Demographics and General Health Status of Manitobans with Type 2 Diabetes	
Geographical Distribution	39
Age and Sex Distribution.	
Total Mortality Rate	42
Premature Mortality Rate	44
General Disease Burden – Charlson Comorbidity Index	46
Weighted Mean Charlson Comorbidity Index by Age	46
Chapter Summary	
Chapter 5: Health Services Use among Manitobans with Type 2 Diabetes	
Primary Care Provider Ambulatory Visit Rates	
Percent of Manitobans with Zero Ambulatory Care Visits in One Year	
Continuity of Care	
Distribution of Continuity of Care Index Values	
Specialist Visit Rates	
Association between Continuity of Care and Specialist Visits	
Hospitalizations Overall	60
Association between Continuity of Care and Hospitalizations	62
Hospitalizations for Ambulatory Care Sensitive Conditions	
Association between Continuity of Care and Ambulatory Care Sensitive Hospitalizations	65
Chapter Summary and Recommendations	
Overall Results and Recommendations	
Summary and Recommendations for First Nation Manitobans with Type 2 Diabetes	
Chapter 6: Type 2 Disbetes Belated Care and Complications	60
HbA1c Levels (Clucese Centrel)	
Methods	
Treatment and Screening for Diabetic Petinopathy	
Treatment for Diabetic Retinopathy	
Screening for Diabetic Retinopathy (Contact with an Eve Care Provider)	7/
Data Limitations	
Mathode	
Association between Continuity of Care and Retinopathy Screening	
End-Stage Renal Disease and Screening for Albuminuria	
Screening for Urine Albumin-to-Creatinine Ratio (Urine ACR)	
Association between Continuity of Care and Urine ACR Screening	
Lower Limb Amputations	
Influenza Vaccination	
Association between Continuity of Care and Influenza Vaccination	۵۵
Chapter Summary and Recommendations	
Overall Results and Recommendations	
Summary and Recommendations for First Nation Manitobans with Type 2 Diabetes	
Chapter 7: Cardiovascular Health of Manitobans with Type 2 Diabetes	
Acute Myocardial Infarction (Heart Attack)	
Ischemic Heart Disease	
Heart Failure	
Hypertension (High Blood Pressure)	
Chapter Summary and Recommendations	102
Overall Results and Recommendations	
Summary and Recommendations for First Nation Manitobans with Type 2 Diabetes	102

Chapter 8: Type 2 Diabetes in Children in Manitoba	
Methods	
Results	
Hospitalizations and Medical Comorbidities in Children with Type 2 Diabetes	
Mental Health	
Educational Attainment among Children with Type 2 Diabetes	
Involvement with Child and Family Services (CFS)	
Summary and Conclusions	119
Policy Recommendations.	119
Chapter 9: Maternal and Neonatal Outcomes for Wemen with Type 2 Diabetes	101
Methods	
Pregnancy Outcomes among Manitoba Women with Type 2 Diabetes	122
Births to Women with Type 2 Diabetes	
Fertility Rates	123
Perinatal Mortality.	
Comparing Women with Type 2 Diabetes to Diabetes-Free Matches	
Antenatal Hospitalizations	
Travel for Delivery	
Delivery-Related Outcomes for Manitoban Women with Type 2 Diabetes and their Infants	
Neonatal and Maternal Outcomes	
Overall Summary and Recommendations.	
Summary and Recommendations for First Nation Manitobans with Type 2 Diabetes	
	(
Chapter 10: Mental Health Outcomes among Manitobans with Type 2 Diabetes	
Conort Characteristics.	
Chapter Summary and Recommendations.	
Overall Summary and Recommendations.	
Summary and Recommendations for First Nation Manitobans with Type 2 Diabetes	144
Chapter 11: Conclusions and Recommendations	
References	
Glossary	

List of Tables

Table E.1: Summary of Incidence and Prevalence Rate Comparisons for Type 2 Diabetes ComparingFirst Nation Manitobans to All Other Manitobans by Age Group and Health Region
Table E.2: Summary of Healthcare Use Among First Nation Manitobans and All Other Manitobans with Type 2 Diabetesxxi
Table E.3: Age- and Sex-Adjusted Percent of Recommended Care Received by First Nation Manitobans and All Other Manitobans with Type 2 Diabetesxxii
Table E.4: Summary of Health Complications Among First Nation Manitobans and All Other Manitobans with Type 2 Diabetesxxiv
Table E.5: Summary of Mental Health Indicators Among First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetesxvv
Table 2.1: Organization of First Nation Communities into Tribal Council Areas in This Report11
Table 3.1: Prevalence of Any Diabetes Among Adult Manitobans by Age Group
Table 3.2: Mean/Median Age for Incident Diabetes (Any Type) Among Adult Manitobans by Fiscal Year
Table 3.3: Relative Rate of Incident Type 2 Diabetes in 2015/16-2016/17 compared to 2011/12-2012/13
Table 3.4: Relative Risk of Incident Type 2 Diabetes for Health Region Compared to Manitoba Average Among First Nation Manitobans and All Other Manitobans
Table 3.5: Relative Risk of Prevalent Type 2 Diabetes for Health Region Compared to Manitoba AverageAmong First Nation Manitobans and All Other Manitobans
Table 3.6: Relative Risk of Incident Type 2 Diabetes for First Nation Manitobans Compared to All Other Manitobans35
Table 3.7: Relative Risk of Prevalent Type 2 Diabetes for First Nation Manitobans Compared to All Other Manitobans35
Table 3.8: Incidence of Type 2 Diabetes Among First Nation Manitobans by Tribal Council Area
Table 3.9: Prevalence of Type 2 Diabetes Among First Nation Manitobans by Tribal Council Area 36
Table 3.10: 2-Year Incidence Among First Nation Children and All Other Children in Manitoba
Table 3.11: 2-Year Prevalence Among First Nation Children and All Other Children in Manitoba
Table 3.12: 5-Year Incidence Among First Nation Children in Manitoba
Table 3.13: 5-Year Prevalence Among First Nation Children in Manitoba
Table 4.1: Average Charlson Index Score Among First Nation Manitobans and All Other Manitobans
Table 5.1: Continuity of Care for First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Index Group 58
Table 5.2: Association Between COC Index Group and Specialist Visit Rates for First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes
Table 5.3: Association Between COC Index Group and Hospitalization Rates for First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes
Table 5.4: Association Between COC Index Group and Hospitalization for Ambulatory Care Sensitive Conditions for First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes
Table 6.1: Association Between COC Index Group and Having at least One Contact with an Eye Care Provider in Two Years for First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes
Table 6.2: Percent of Adult Manitobans with Type 2 Diabetes and End-Stage Renal Disease who had at least one Renal Transplant

Table 6.3: Association Between COC Index Group and Receiving a Urine ACR Screenfor First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes
Table 6.4: Association Between COC Index Group and Flu Vaccination Within One Yearfor First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes
Table 8.1: Description of the Population of Children with Type 1 and Type 2 Diabetes and Their Diabetes-Free Matches. .107
Table 8.2: Incidence of Type 2 Diabetes in Children Among First Nation Manitobans and All Other Manitobans110
Table 8.3: Prevalence of Type 2 Diabetes in Children Among First Nation Manitobans and All Other Manitobans110
Table 8.4: Most Common Causes of Hospitalization Five Years Following the Month of Diagnosis AmongManitoba Children with Type 2 Diabetes and their Diabetes-Free Matches
Table 8.5: Most Common Disease Categories in the Charlson Index Score Among Manitoba Children with Type 2 Diabetes and Their Diabetes-Free Matches
Table 8.6: Mental Health Outcomes for Children with Type 1 and Type 2 Diabetes and their Diabetes-Free Matches Mat
Table 8.7: Involvement with Child and Family Services (CFS) Among Children with Type 1 and Type 2 Diabetes and their Diabetes-Free Matches .119
Table 9.1: Distribution of Births to First Nation Manitoban Women and All Other Manitoban Womenwith Type 2 Diabetes by Age Group, 2011/12-2016/17
Table 9.2: Births to Women with Type 2 Diabetes and Births to Diabetes-Free Matches by Health Region of Residence and Income Quintile.
Table 9.3: Percent of First Nation Manitoban Women and All Other Manitoban Women with Type 2 Diabetesand their Diabetes-Free Matches with at Least One Antenatal Hospitalization
Table 9.4: Relative Risk of Antenatal Hospitalization Among First Nation Manitoban Womenand All Other Manitoban Women with Type 2 Diabetes compared to their Diabetes-Free Matches.128
Table 9.5: Distribution of Counts for Antenatal Hospitalizations Among First Nationand All Other Manitoban Women with Type 2 Diabetes and their Diabetes-Free Matches
Table 9.6: Location of Delivery Hospital Among First Nation Manitoban Womenand All Other Manitoban Women with Type 2 Diabetes and their Diabetes-Free Matches
Table 9.7: Association of Type 2 Diabetes with Neonatal Length of Stay and Length of Stay Over Benchmark (Excess LOS)
Table 9.8: Percentages of Outcomes Under Study for First Nation Manitobansand All Other Manitobans with Type 2 Diabetes and Diabetes-Free Matches
Table 10.1: Demographics in the Matched Adult Cohort
Table 10.2: Demographic Comparisons Between First Nation Adult Manitobansand All Other Adult Manitobans with Type 2 Diabetes and Their Diabetes-Free Matches
Table 10.3: Rate of Suicide Attempts Among Adult Manitobans with Type 2 Diabetes and Their Diabetes-Free Matches Before and After Diagnosis. .142
Table 10.4: Relative Rate of Suicide Attempts Among Adult Manitobans with Type 2 Diabetes and Diabetes-Free Matches Before and After Diagnosis
Table 10.5: Rate of Mood and Anxiety Disorders Among Adults with Type 2 Diabetes and Their Diabetes-Free Matches Before and After Diagnosis .143
Table 10.6: Relative Rate of Mood and Anxiety Disorders for Cases with Type 2 Diabetes versus Diabetes-Free Matches. .143
Table 10.7: Rate of Substance Use Disorder Among Adults with Type 2 Diabetes and Their Diabetes-Free Matches Before and After Diagnosis

Table 10.8: Relative Rate of Substance Use Disorder for Cases with Type 2 Diabetes versus Diabetes-Free Matches Before and After Diagnosis	144
Table 10.9: Rate of Atypical Antipsychotic Drug Use Among Adult Manitobans with Type 2 Diabetes and Their Diabetes-Free Matches Before and After Diagnosis	145
Table 10.10: Relative Rate of Atypical Antipsychotic Drug Use Among Adult Manitobans with Type 2 Diabetes Compared to their Diabetes-Free Matches Before and After Diagnosis	145

List of Figures

Figure 2.1: Cohort Flowchart: Time 2, 2013/14-2014/15
Figure 2.2: Map of Health Regions in Manitoba, 2016
Figure 2.3. Map of Tribal Council Areas in Manitoba, 2016
Figure 3.1: Incidence of Any Diabetes Among Adult Manitobans by Age Group19
Figure 3.2: Incidence of Any Diabetes Among Adult Manitobans by Urban Income Quintile
Figure 3.3: Incidence of Any Diabetes Among Adult Manitobans by Rural Income Quintile
Figure 3.4: Prevalence of Any Diabetes Among Adult Manitobans by Urban Income Quintile
Figure 3.5: Prevalence of Any Diabetes Among Adult Manitobans by Rural Income Quintile
Figure 3.6: Incidence of Any Diabetes Among Adult Manitobans by Regional Health Authority
Figure 3.7: Prevalence of Any Diabetes Among Adult Manitobans by Health Region
Figure 3.8: Incidence of Type 2 Diabetes Among First Nation Adult Manitobans and All Other Adult Manitobans by Age Group
Figure 3.9: Prevalence of Type 2 Diabetes Among First Nation Adult Manitobans and All Other Adult Manitobans by Age Group
Figure 3.10: Incidence of Type 2 Diabetes Among Manitobans by Income Quintile
Figure 3.11: Prevalence of Type 2 Diabetes Among Manitobans by Income Quintile
Figure 3.12: Incidence of Type 2 Diabetes Among First Nation Manitobans and All Other Manitobans by Health Region
Figure 3.13: Prevalence of Type 2 Diabetes Among First Nation Manitobans and All Other Manitobans by Health Region
Figure 3.14: Incidence of Type 2 Diabetes in Manitoban Children by Health Region
Figure 3.15: Prevalence of Type 2 Diabetes in Manitoba Children by Health Region
Figure 4.1: Health Region Distribution of First Nation Manitobans and All Other Manitobans with Type 2 Diabetes, 2015/16-2016/17
Figure 4.2: Sex Distribution of First Nation Manitobans and All Other Manitobans with Type 2 Diabetes, 2015/16-2016/17
Figure 4.3: Age Distribution of First Nation Manitobans and All Other Manitobans with Type 2 Diabetes, 2015/16-2016/17
Figure 4.4: Total Mortality Rate Among First Nation Manitobans and All Other Manitobans with Type 2 Diabetes by Health Region
Figure 4.5: Total Mortality Rate Among First Nation Manitobans with Type 2 Diabetes by Tribal Council Area
Figure 4.6: Premature Mortality Rate Among First Nation Manitobans and All Other Manitobans with Type 2 Diabetes by Health Region
Figure 4.7: Premature Mortality Rate Among First Nation Manitobans with Type 2 Diabetes by Tribal Council Area47
Figure 5.1: Primary Care Provider Visit Rate Among First Nation Adult Manitobansand All Other Adult Manitobans with Type 2 Diabetes by Health Region
Figure 5.2: Primary Care Provider Visit Rate Among First Nation Adult Manitobans with Type 2 Diabetes by Tribal Council Area 53
Figure 5.3: Primary Care Provider Visit Rate Among First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Age and Sex

Figure 5.4: Percent of First Nation Manitobans and All Other Manitobans with Type 2 Diabeteswith Zero Ambulatory Care Visits in One Year by Health Region
Figure 5.5: Percent of First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabeteswith Zero Ambulatory Care Visits in One Year by Age and Sex
Figure 5.6: Continuity of Care Among First Nation Adult Manitobans with Type 2 Diabetes and All Other Adult Manitobans with Type 2 Diabetes by Health Region
Figure 5.7: Continuity of Care for First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Age and Sex
Figure 5.8: Continuity of Care Among First Nation Adult Manitobans with Type 2 Diabetes by Tribal Council Area
Figure 5.9: Continuity of Care for First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Index Group .58
Figure 5.10: Specialist Visit Rate Among First Nation Adult Manitobans with Type 2 Diabetes and All Other Adult Manitobans with Type 2 Diabetes by Health Region60
Figure 5.11: Specialist Visit Rate Among First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Age and Sex
Figure 5.12: Specialist Visit Rate Among First Nation Adult Manitobans with Type 2 Diabetes by Tribal Council Area61
Figure 5.13: Inpatient Hospitalization Rate Among First Nation Manitobans with Type 2 Diabetes and All Other Manitobans with Type 2 Diabetes by Health Region63
Figure 5.14: Inpatient Hospitalization Rate Among First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Age and Sex
Figure 5.15: Inpatient Hospitalization Rate Among First Nation Manitobans with Type 2 Diabetes by Tribal Council Area
Figure 5.16: Rate of Hospitalization for Ambulatory Care Sensitive Conditions Among First Nation Manitobans with Type 2 Diabetes and All Other Manitobans with Type 2 Diabetes by Health Region
Figure 5.17: Rate of Hospitalizations for Ambulatory Care Sensitive Conditions Among First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Age and Sex
Figure 5.18: Rate of Hospitalization for Ambulatory Care Sensitive Conditions Among First Nation Manitobans with Type 2 Diabetes by Tribal Council Area
Figure 6.1: Distribution of Minimum HbA1c Values for First Nation Manitobans with Type 2 Diabetes and All Other Manitobans with Type 2 Diabetes
Figure 6.2: Distribution of Maximum HbA1c Values for First Nation Manitobans with Type 2 Diabetes and All Other Manitobans with Type 2 Diabetes
Figure 6.3: Distribution of Mean HbA1c Values for First Nation Manitobans with Type 2 Diabetes and All Other Manitobans with Type 2 Diabetes74
Figure 6.4: Annualized Percent of First Nation Adult Manitobans with Type 2 Diabetes and All Other Adult Manitobans with Type 2 Diabetes who were Treated for Retinopathy by Health Region
Figure 6.5: Percent of First Nation Manitobans and All Other Manitobans with Type 2 Diabetes who had 1+ Contacts with an Eye Care Provider in 2 Years by Health Region
Figure 6.6: Percent of First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes who had 1+ Contacts with an Eye Care Provider in 2 Years by Age and Sex
Figure 6.7: Percent of First Nation Adult Manitobans with Type 2 Diabetes and All Other Adult Manitobans with Type 2 Diabetes who had End-Stage Renal Disease by Health Region
Figure 6.8: Percent of First Nation Adult Manitobans with Type 2 Diabetes who had End-Stage Renal Disease by Tribal Council Area

Figure 6.9: Percent of First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes who had End-Stage Renal Disease by Age and Sex	1
Figure 6.10: Incident Dialysis Treatment for First Nation Adult Manitobans with Type 2 Diabetes and All Other Adult Manitobans with Type 2 Diabetes by Health Region	3
Figure 6.11: Incident Dialysis Treatment for First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Age and Sex	3
Figure 6.12: Percent of First Nation Manitobans with Type 2 Diabetes and All Other Manitobans with Type 2 Diabeteswith 1+ Urine ACR Screens in One Year by Health Region	5
Figure 6.13: Percent of First Nation Manitobans with Type 2 Diabetes with 1+ Urine ACR Screens in One Year by Tribal Council Area 85	5
Figure 6.14: Percent of First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes that had 1+ Urine ACR Screens by Age and Sex	5
Figure 6.15: Rate of Lower Limb Amputations Among First Nation Adult Manitobans with Type 2 Diabetesand All Other Adult Manitobans with Type 2 Diabetes by Health Region	3
Figure 6.16: Rate of Lower Limb Amputations Among First Nation Adult Manitobans with Type 2 Diabetes by Tribal Council Area 88	3
Figure 6.17: Rate of Lower Limb Amputations Among First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Age and Sex. 89	9
Figure 6.18: Rate of Influenza Vaccination Among First Nation Manitobans with Type 2 Diabetes and All Other Manitobans with Type 2 Diabetes by Health Region	1
Figure 6.19: Rate of Influenza Vaccination Among First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Age and Sex	1
Figure 7.2: Rate of Acute Myocardial Infarction Among First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Age and Sex	7
Figure 7.1: Rate of Acute Myocardial Infarction Among First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Health Region97	7
Figure 7.3: Prevalence of Ischemic Heart Disease Among First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Health Region	9
Figure 7.4: Prevalence of Ischemic Heart Disease Among First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Age and Sex	9
Figure 7.5: Prevalence of Heart Failure Among First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Health Region	1
Figure 7.6: Prevalence of Heart Failure Among First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Age and Sex	1
Figure 7.7: Prevalence of Hypertension Among First Nation Manitobans and All Other Manitobans with Type 2 Diabetes by Health Region	3
Figure 7.8: Prevalence of Hypertension Among First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Age and Sex	3
Figure 8.1: Annual Incidence of Type 1 and Type 2 Diabetes in Children in Manitoba	3
Figure 8.2: Incidence of Type 2 Diabetes in Manitoban Children by Health Region	3
Figure 8.3: Prevalence of Type 2 Diabetes in Manitoba Children by Health Region	9
Figure 8.4: 2-Year Incidence Rate of Type 2 Diabetes in Children Among First Nation Manitobans and All Other Manitobans	9
Figure 8.5: Relative Risks of Hospitalization Among Children with Type 2 Diabetes Compared to Diabetes-Free Matches	2

Figure 8.6: Relative Risk of Hospitalization Among Children with Type 2 Diabetes Compared to Children with Type 1 Diabetes	112
Figure 8.7: Relative Risks of Mental Health Comorbidities Among Children with Type 2 Diabetes Compared to Diabetes-Free Matches	
Figure 8.8: Relative Risk of Mental Health Comorbidities Among Children with Type 2 Diabetes Compared to Children with Type 1 Diabetes	115
Figure 8.9: Relative Risks of Mental Health Comorbidities Among Diabetes-Free Matches of Children with Type 2 Diabetes Compared to Diabetes-Free Matches of Children with Type 1 Diabetes	116
Figure 8.10: Relative Risks of Educational Attainment Among Children with Type 2 Diabetes Compared to Diabetes-Free Matches	
Figure 8.11: Relative Risk of Educational Attainment Among Children with Type 2 Diabetes Compared to Children with Type 1 Diabetes	118
Figure 8.12: Relative Risks of Educational Attainment Among Diabetes-Free Matches of Children with Type 2 Diabetes Compared to Diabetes-Free Matches of Children with Type 1 Diabetes	118
Figure 8.13: Relative Risks of Child and Family Services Involvement Among Children with Type 2 Diabetes Compared to their Diabetes-Free Matches	119
Figure 8.14: Relative Risk of Child & Family Services Involvement Among Children with Type 2 Diabetes Compared to Children with Type 1 Diabetes	120
Figure 8.15: Relative Risks of Child and Family Services Involvement Among Diabetes-free Matches of Children with Type 2 Diabetes Compared to Diabetes-Free Matches of Children with Type 1 Diabetes	120
Figure 9.1: Fertility Rate Among First Nation Manitoban Women and All Other Manitoban Women with Type 2 Diabetes	126
Figure 9.2: Fertility Rate Among First Nation Manitoban Women and All Other Manitoban Women with Type 2 Diabetes by Health Region	
Figure 9.3: Distribution of Length of Stay in Days for Infants Admitted to NICU Among Mothers with Type 2 Diabetes and their Diabetes-Free Matches	131
Figure 9.4: Distribution of Gestational Age at Birth for Infants of Mothers with Type 2 Diabetes and their Diabetes-Free Matches.	132
Figure 9.5: Relative Risks of Maternal and Infant Outcomes Among First Nation Manitoban Mothers with Type 2 Diabetes Compared to their Diabetes-Free Matches	134
Figure 9.6: Relative Risks of Maternal and Infant Outcomes Among All Other Manitoban Mothers with Type 2 Diabetes Compared to their Diabetes-Free Matches	135
Figure 9.7: Relative Risks of Maternal and Infant Outcomes Among First Nation Manitoban Mothers with Type 2 Diabetes Compared to All Other Manitoban Mothers with Type 2 Diabetes	136

Acronyms

ACR	Albumin Creatinine Ratio
ACSC	Ambulatory Care Sensitive Conditions
COC	Continuity of Care
DER-CA	Diabetes Education Resource for Children and Adolescents
ESRD	End-Stage Renal Disease
FNHSSM	First Nations Health and Social Secretariat of Manitoba
GA	Gestational Age
ICD	International Classification of Diseases
LOS	Length of Stay
LGA	Large for Gestational Age
MHSAL	Manitoba Health, Seniors and Active Living
NDSS	National Diabetes Surveillance System
NICU	Neonatal Intensive Care Unit
PHIN	Personal Health Information Number
PMR	Premature Mortality Rate
RHA	Regional Health Authority
RR	Relative Risk
SEFI	Socio-Economic Factor Index
T2DM	Type 2 Diabetes Mellitus
ТСА	Tribal Council Area
TMR	Total Mortality Rate
TRC	Truth and Reconciliation Commission

Executive **Summary**

Diabetes is a mixed group of metabolic disorders characterized by hyperglycemia (high blood sugar) resulting from impaired insulin secretion, impaired insulin action or a combination of both. Type 2 diabetes (also referred to as Type 2 Diabetes Mellitus or T2DM) results from the failure of the pancreatic beta cells to secrete sufficient insulin to keep up with the body's demands, typically in the context of insulin resistance. People living with type 2 diabetes are at risk for long-term complications of hyperglycemia, which contribute to significant morbidity and mortality.

In the past, type 2 diabetes was considered a disease of older adulthood, but over the last three decades, it has been diagnosed in younger populations, including children. In this report, we take a detailed look at the current status of type 2 diabetes in Manitoba. The information in this report will be important for planning healthcare resources that will ensure people diagnosed with type 2 diabetes receive the care they need to live their healthiest life.

A Focus on First Nation Populations

This report examines the health and healthcare use of Manitobans with type 2 diabetes. Indigenous groups, particularly First Nation people, are over-represented in this population. The author team for this report includes members of the First Nations Health and Social Secretariat of Manitoba (FNHSSM) and researchers from the Manitoba Centre for Health Policy (MCHP). We also shared the results with the Manitoba First Nations Diabetes Leadership Council during the research process; the Council provided feedback on the research and helped with interpretation of the findings.

The entire research process, including developing the indicators, selecting the outcomes and interpreting the results, was undertaken in partnership with FNHSSM. Our intent was to begin to address the Truth and Reconciliation Commission (TRC) of Canada's Call to Action #19, which calls on governments and research institutions to identify indicators of health and report on the availability of appropriate health services for Indigenous peoples [1]. Additionally, we acknowledge "*that the current state of Aboriginal health in Canada is a direct result of previous Canadian government policies, including residential schools*" [1]. In order to align our research with the TRC's calls to action, this report presents results separately for First Nation populations in Manitoba. This approach is necessary to ensure that the results are interpreted within the proper context and to support planning and appropriate allocation of resources.

What This Report Contains

Starting in Chapter 3, we present a historical look at rates of any diabetes (including type 1 diabetes, type 2 diabetes and any other non-gestational type of diabetes) in Manitoba from 1984/85 to 2016/17. Then we describe the rates of specifically type 2 diabetes over the last six fiscal years (2011/12 to 2016/17). The subsequent chapters examine health services use (Chapter 5), type 2 diabetes-related care and complications (Chapter 6) and cardiovascular health (Chapter 7) of Manitobans with type 2 diabetes from 2015/16 to 2016/17. Following this are chapters examining outcomes among Manitoban children with type 2 diabetes (Chapter 8), maternal and pregnancy-related outcomes among women with type 2 diabetes (Chapter 9), and mental health outcomes among adult Manitobans with type 2 diabetes (Chapter 10) compared to diabetesfree matches. The report concludes with a summary and recommendations (Chapter 11). Chapter 2 provides detailed information about the methods used for the analyses in Chapters 3-10.

Methods and Interpretation

We used multiple datasets from the **Manitoba Population Research Data Repository** at MCHP to identify Manitobans living with type 2 diabetes. The National Diabetes Surveillance System definition of diabetes [2], which uses hospital and physician billing data to identify all types of diabetes, was enhanced to include other datasets within the Repository, and this allowed us to specifically identify people with type 2 diabetes.

Indicators and outcomes were chosen to reflect morbidities either directly caused by type 2 diabetes or known to be closely associated with type 2 diabetes. Pregnant women and their infants and children are special population groups with specific type 2 diabetes-related complications, and they were examined both within the larger population and separately.

The screening guidelines used were the Diabetes Canada 2018 Clinical Practice Guidelines for the prevention and management of Diabetes in Canada [3].

We used the First Nations Research File to identify individuals who are Registered First Nation Manitobans. The Repository does not allow for identification of nonregistered or self-identified First Nation people, so we could only include those who were Registered First Nation people in the 'First Nation Manitobans' group. We compared Registered First Nation Manitobans to the remainder of the Manitoba population, whom we refer to as All Other Manitobans.

Many of the analyses are age- and sex-adjusted to allow for valid comparisons between these populations.

Findings

Chapter 3: Incidence and Prevalence of Any Diabetes and Type 2 Diabetes in Manitoba

Summary: Looking back to 1984 at all types of diabetes, we saw that the Manitoba incidence and prevalence of any diabetes in adults increased over time. The increase was faster in younger age groups. Looking back over the last six years (2011/12 to 2016/17), the rate of type 2 diabetes in children and adults also increased in younger age groups, and was higher among First Nation Manitobans than among All Other Manitobans, higher among people in lower income quintiles than higher income quintiles, and higher in the Northern Health Region than in other health regions in Manitoba. In the past two years (2015/16 to 2016/17), 14.7% of First Nation Manitobans and 8.4% of All Other Manitobans had type 2 diabetes. However, after adjusting for age and sex, the difference between these groups was even more dramatic: the rate of type 2 diabetes was 3.5 times higher among First Nation Manitobans than among All Other Manitobans (relative risk [RR] 3.47, 95% confidence interval [95% CI] 2.56, 4.70). First Nation Manitobans were also twice as likely as All Other Manitobans to receive a new diagnosis of type 2 diabetes.

Recommendations: The screening guidelines for type 2 diabetes in adults should be re-evaluated to make sure the guidelines account for how much younger Manitobans are being diagnosed with type 2 diabetes. We need to ensure that clinical programs for individuals with type 2 diabetes are providing appropriate and culturally safe care to all populations and especially to First Nation populations.

Results for Any Diabetes using the National Diabetes Surveillance System Definition:

The **prevalence** (or proportion) of people with any diabetes has been consistently increasing over time. From 1985/86 to 2016/17, the prevalence of any diabetes increased from 3.2% to 9.8%. It increased across all income quintiles; however, rates were higher in lower income quintiles than in higher income quintiles. The distribution of any diabetes prevalence across health regions widened over time, with rates in Northern Manitoba increasing and rates in Southern Manitoba decreasing.

The **incidence** (or rate of new diagnoses) of any diabetes was dependent on age, with higher rates as age increased and increasing rates over time. However, when we looked at rates by age group among adult Manitobans, we saw that over time incidence increased much more quickly for younger age groups than for older age groups, particularly among people under age 50. Among adult Manitobans, age at diagnosis decreased from a **mean** of 59 years in 1984 to a mean of 55 years in 2017. When age was not accounted for, there was a small increase in any diabetes incidence over time, except in the lowest rural income quintile, where rates of new diagnoses were stable. Whether this rate stability was due to under-diagnosis or a true drop in incidence is unknown.

Results for Type 2 Diabetes using the Enhanced Type 2 Diabetes Definition:

The remainder of the report used an enhanced definition to look at specifically type 2 diabetes. We examined incidence and prevalence from 2011/12 to 2016/17 in two-year **cohorts**.

The results of the age group and health region comparisons are presented in Table E.1.

Table E.1: Summary of Incidence and Prevalence Rate Comparisons for Type 2 Diabetes Comparing First Nation Manitobans to All Other Manitobans by Age Group and Health Region

	Incidence	Prevalence	Incidence	Prevalence
	First Nation Manitobans		All Other Manitobans	
By Age Group	Increasing in age<30, no change in age>30	Increasing age<30, no change age>30	No significant change in age <30 years, increasing in age>30	No change age<30, increasing age>30
By Health Region	No change over time, higher rates than All Other Manitobans, no difference between Health Regions	No change over time, higher rates than All Other Manitobans, no difference between Health Regions	No change over time, higher in North than Manitoba average	No change over time, higher in North

Chapter 4: Demographics and General Health Status of Manitobans with Type 2 Diabetes

Summary: The population of Manitobans with type 2 diabetes had a higher percentage of First Nation individuals than the general population. The First Nation population with type 2 diabetes was younger and more likely to be female than All Other Manitobans with type 2 diabetes. Thus, it was important to adjust for age and sex in further comparisons. Mortality and morbidity were high in the population of Manitobans living with type 2 diabetes, and higher among First Nation Manitobans than among All Other Manitobans.

Details: In fiscal years 2015/16 to 2016/17, there were 108,942 Manitobans age 7+ with type 2 diabetes. Among these, 16% were First Nation Manitobans, whereas only 10% of the population of Manitoba age 7+ were First Nation Manitobans. First Nation Manitobans with type 2 diabetes were more likely to be female, to be younger and to live in the Northern Health Region or Interlake-Eastern Regional Health Authority (RHA) than All Other Manitobans with type 2 diabetes.

The **total mortality rate** (TMR, death at any age) and premature mortality rate (PMR, death before age 75) were higher for Manitobans with type 2 diabetes than the general population and did not vary by health region or **Tribal Council** Area (TCA). Among Manitobans with type 2 diabetes, TMR and PMR were higher among First Nation Manitobans than among All Other Manitobans after adjusting for age and sex. As expected, TMR increased with age, and the rate of type 2 diabetes among First Nation Manitobans remained higher than among All Other Manitobans. The exception was among those more than 80 years old, where rates did not differ between First Nation Manitobans and All Other Manitobans. Neither PMR nor TMR differed between First Nation people with type 2 diabetes living on-**reserve** and off-reserve.

Chapter 5: Health Services Use among Manitobans with Type 2 Diabetes

Summary: Among Manitobans with type 2 diabetes, there were differences in use of primary care services between males and females and between First Nation Manitobans and All Other Manitobans. Males, especially young adult males, used fewer primary care services and had higher rates of ambulatory care sensitive (ACS) hospitalizations. First Nation Manitobans with type 2 diabetes used similar levels of primary care services to All Other Manitobans with type 2 diabetes, but had more hospitalizations and fewer specialist visits, suggesting that the care they received did not meet their needs. **Continuity of care** was not consistently associated with use of health services, but was higher among First Nation Manitobans living off-reserve than among those living on-reserve, and was higher among All Other Manitobans than among First Nation Manitobans.

Recommendations: Ensuring that young adults with type 2 diabetes, and especially young male adults with type 2 diabetes, are able to access appropriate primary care is critical. We recommend that the quality of care they receive be assessed and programs aiming to address inequities in care to First Nation populations be evaluated. The lack of equity in First Nation Manitobans' access to specialty care should be addressed. While healthcare is only one part of the continuum of care and services needed to improve outcomes for people living with diabetes, it is an integral part that requires immediate attention.

Details: Comparisons in this chapter were between groups of people with type 2 diabetes. It is important to note that multiple factors, including patient-related and societal factors, affect access to and use of all aspects of the healthcare system. Risk of hospitalization is influenced not only by access to quality outpatient care, but also by access to home care, foot care and wound care services. Reporting rates of diabetes, as we do in this report, is useful for assessing the quantity of care people receive, but cannot speak to quality of care they receive during any interaction. Table E2 outlines the indicators reported in this chapter.

 Table E.2: Summary of Healthcare Use Among First Nation Manitobans and All Other Manitobans with Type 2 Diabetes

 Age- and sex-adjusted rates

Indicator	First Nation	All Other			
maneutor	Manitobans	Manitobans			
Primary Care Provider Visit Rates (age 18+)	6.62	7.34			
(Per person-year)		State (St. 1) Carlierton			
Zero Ambulatory Care Visits in One Year (age 7+)	6.99%	4.05 %			
(Percent)					
Continuity of Primary Care (age 18+)	0.50	0.66			
(Index, range: 0-1)	0.59	0.00			
Specialist Visit Rates (age 18+)	1 4 9	1 02			
(Per person-year)	1.40	1.95			
Hospitalization Rates (age 7+)		0.00			
(Per 1,000 person-year)	0.44	0.23			
ACS Hospitalization Rates (age 7-74)	0.10	0.04			
(Per 1,000 person-year)	0.10	0.04			
Note: All values indicate a statistically significant difference between First Nation Manitobans and All Other					

Note: All values indicate a statistically significant difference between First Nation Manitobans and All Other Manitobans

Chapter 6: Type 2 Diabetes-Related Care and Complications

Summary: A significant proportion of Manitobans with type 2 diabetes did not receive recommended care and screening as per national diabetes guidelines. Those at highest risk of not receiving care were young adults. The First Nation population had higher rates of complications, even though the rates of receipt of recommended care were often similar between First Nation and All Other Manitoban populations, suggesting that care was inequitable and did not meet their needs. Higher continuity of care was associated with improved receipt of recommended care across all indicators.

Rates of **retinopathy** cannot be identified from the Repository; however, we can identify *treatment* for retinopathy. Treatment rates did not differ by health region, but were higher (often close to twice as high) among First Nation Manitobans with type 2 diabetes compared to All Other Manitobans with type 2 diabetes.

Rates of new and established end-stage renal disease were dramatically higher among First Nation Manitobans with type 2 diabetes than among All Other Manitobans with type 2 diabetes. There was little variation across health regions, except in Winnipeg, where rates of established end-stage renal disease were higher than the Manitoba average, most likely because individuals with end-stage renal disease relocated to Winnipeg to receive dialysis. When we looked at end-stage renal disease by TCA, we found that onreserve rates were higher than off-reserve rates. These findings are similar to those found in the MCHP report *Care of Manitobans Living with Chronic Kidney Disease* [4].

Rates of lower limb **amputations** were much higher among First Nation Manitobans than among All Other Manitobans. By region, rates in Winnipeg were higher than the Manitoba average among both First Nation Manitobans and All Other Manitobans. **Recommendations:** Alternate methods of delivering screening services should be considered, and consultation with young adults and First Nation communities for planning these services would be an important part of this. As per the Diabetes Canada guidelines [5], more multidisciplinary and evidence-supported programs to coordinate care and reduce complications are needed. Beyond providing the care recommended by national guidelines, important steps to reduce complications of diabetes include paying close attention to: health-related behaviours, the social determinants of health (e.g., access to improved opportunities for physical activity, and access to healthy and affordable foods), and the Indigenous determinants of health.

Details: Comparisons in this chapter are between groups of Manitobans with type 2 diabetes. The indicators we chose reflect recommended care from the Diabetes Canada guidelines [5] and are summarized in Table E.3. The Repository only contains results from tests conducted in public (not private) laboratories, so some geographical areas have lower capture rates for HbA1c tests (specifically Winnipeg and surrounding area, and Percy Moore Hospital in Interlake-Eastern RHA).

Table E.3: Age- and Sex-Adjusted Percent of Recommended Care Received by First Nation Manitobans and All Other Manitobans with Type 2 Diabetes

Diabetes Canada 2018 guideline recommendations for type 2 diabetes

Indiantau	Decommondation	First Nation	All Other
Indicator	Recommendation	Manitobans	Manitobans
Mean HbA1c	Less than 7%	26.64%	40.26%
Contact With an Eye Care Provider in Last Two Years	Every 1-2 years	71.60%	65.70%
Urine Albumin to Creatinine Ratio Screen	Annual	62.60%	53.10%
Influenza Vaccination	Annual	28.90%	48.00%

Chapter 7: Cardiovascular Health of Manitobans with Type 2 Diabetes

Summary: Higher rates of cardiovascular disease were seen among Manitobans with type 2 diabetes compared to the general population, as reported in previous MCHP publications. Rates of end-stage cardiovascular complications (heart failure and **myocardial infarction**) were higher among First Nation Manitobans with type 2 diabetes than among All Other Manitobans with type 2 diabetes, despite similar rates of earlier-stage diagnoses (**hypertension** and **ischemic heart disease**). **Recommendations:** Strategies to ensure early recognition and treatment of hypertension and ischemic heart disease are needed, especially in First Nation communities. Identification and management of cardiovascular conditions by the healthcare system is an essential part of their management alongside attention to health-related behaviors and the social and Indigenous determinants of health.

Details: Indicators in this chapter are summarized in Table E.4. We compare rates from the current report to previous MCHP reports, where available.

 Table E.4: Summary of Health Complications Among First Nation Manitobans and All Other Manitobans with Type 2 Diabetes

 Age- and sex-adjusted rates, per person-year unless otherwise indicated

Indicator	First Nation Manitobans w T2DM	All Other Manitobans w T2DM	Manitobans with or without T2DM (Fransoo et al., 2019)
Heart Failure (age 40+, 2016/17)	7.47%	4.99%	1.59%
Acute Myocardial Infarctions (age 40+, 2013/14-2016/17) (per 1,000)	16.15	9.33	3.24 (year 2012-2016)
Ischemic Heart Disease (age 18+, 2013/14-2016/17)	30.47%	30.47% 24.93%	8.33%
iounenne meare piscase (age 10 / 1015/ 11 2016/ 11/			(age 19+, 2012/13-2016/17)
Hypertension (age 7+ 2015/16-2016/17)	51 46%	57 77%	20.7%
(ige 1 , 2013) 10 2010/11)	5111070 5711770		(age 19+, 2016/17)

Bolded values indicate a statistically significant difference between First Nation Manitobans and All Other Manitobans

Chapter 8: Type 2 Diabetes among Children in Manitoba

This chapter examines outcomes for children with type 2 diabetes compared to children with type 1 diabetes and diabetes-free children.

Summary: The incidence and prevalence of type 2 diabetes in children in Manitoba increased both among First Nation children and among All Other Manitoban children. In 2016/17, the incidence of type 2 diabetes among First Nation children was 154.6 per 100,000 **person-years** and among All Other Manitoban children it was 6.1 per 100,000 person-years. The prevalence and incidence of type 2 diabetes among First Nation children in Manitoba are among the highest in the world. In addition, the proportion of All Other Manitoban children with type 2 diabetes has increased over time.

Manitoban children with type 2 diabetes carry a high burden of illness both before and after diagnosis of diabetes, likely reflecting the many **comorbidities** associated with obesity and insulin resistance. These children also have high rates of comorbid mental illness. It is likely that these comorbidities impact the ability of individuals and families to undertake self-managed care.

Recommendations: Developing appropriate programs to provide care, support and education to children with type 2 diabetes and their families is essential. Such programs must take into account the demographic, socioeconomic and psycho-cultural characteristics of the affected populations. In addition, medical and mental health comorbidities must be addressed. As First Nation children are disproportionally affected, First Nation communities and leaders should be involved in developing care strategies to ensure an appropriate approach to well-being that includes cultural identity and cultural values.

Chapter 9: Maternal and Neonatal Outcomes among Women with Type 2 Diabetes

This chapter examines pregnancy-related outcomes for all Manitoba women with type 2 diabetes. It then examines selected maternal and **neonatal** morbidity and resource use in a cohort of mother-baby pairs in which the mother had type 2 diabetes; these are matched to mother-baby pairs in which the mother had no diabetes.

In Manitoba, there were 2,283 infants born to women with type 2 diabetes over the six-year study period of 2011/12 to 2016/17, and about half of these were born to First Nation women. Birth rates were highest in the age 25-29 group in both First Nation and All Other Manitoban cohorts, with rates among First Nation women at 152 per 1,000 person-years and among All Other Manitobans at 101 per 1,000 person-years.

Summary: Women with type 2 diabetes had a higher rate of maternal and neonatal mortality than those without type 2 diabetes. They had higher rates of **antenatal hospitalization**, delivery outside of their home health region, neonatal intensive care unit (NICU) stays, and maternal readmission. Rates for all outcomes among First Nation women were higher than among All Other Manitoban women both with and without type 2 diabetes.

Recommendations: We recommend expansion of neonatal and antenatal care in hospitals close to rural communities where many women with type 2 diabetes live to allow for antenatal hospitalizations and care of late premature infants. Resource planning for the future should take into account that as the age at diagnosis of type 2 diabetes continues to decline, the number of infants born to women with type 2 diabetes will rise.

Chapter 10: Mental Health Outcomes among Manitobans with Type 2 Diabetes

In this chapter, rates of mental health outcomes among adults with type 2 diabetes were compared to rates in a matched group of diabetes-free individuals.

Summary: Having type 2 diabetes was associated with higher rates of mood and anxiety disorders, suicide attempts and atypical psychotic medication use. Among First Nation Manitobans, type 2 diabetes was not associated with a change in the risk of substance use disorders. Among All Other Manitobans, type 2 diabetes was associated with higher rates of substance use disorders compared to a matched group of diabetes-free individuals. For all outcomes measured, the risk was higher among First Nation Manitobans with type 2 diabetes than among All Other Manitobans with type 2 diabetes. **Recommendations:** Mental healthcare is an integral part of diabetes care, and all healthcare providers should be educated on the importance of mental healthcare in patients with type 2 diabetes. Programs to address mental health and substance use disorders should also take the effects of type 2 diabetes into account. Ongoing attention to improving culturally safe and appropriate mental healthcare for First Nation Manitobans with type 2 diabetes is important.

Details: For some indicators, there were differences in mental health outcomes before and after diagnosis of type 2 diabetes. Importantly, there were higher rates of antipsychotic medication use in the after-diagnosis period than the before-diagnosis period for all groups (antipsychotic medication use can precipitate type 2 diabetes), and there were higher rates of antipsychotic medication use in those with type 2 diabetes than in their diabetes-free matches.

Table E.5: Summary of Mental Health Indicators Among First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes Crude rate per 1,000 person-years, relative risk compared to diabetes-free matches

	First Nation Manitobans			All Other Manitobans		
Indicator	Rate	Relative Risk	95% Confidence Interval	Rate	Relative Risk	95% Confidence Interval
Suicide Attempts	3.02	1.46	1.27-1.67	0.47	1.95	1.70-2.24
Mood and Anxiety Disorders	33.60	1.17	1.13-1.20	30.01	1.17	1.15-1.18
Substance Use disorder	22.09	0.97	0.93-1.00	6.72	1.14	1.11-1.17
Atypical Antipsychotic Use	10.12	1.38	1.29-1.48	7.29	1.42	1.37-1.46

Conclusions and Recommendations

- In Manitoba, type 2 diabetes is occurring at a younger age. Screening guidelines for type 2 diabetes need to be updated.
- A significant proportion of Manitobans living with type 2 diabetes are not achieving recommended control of their glucose (HbA1c) levels. Addressing this discrepancy will require a multifaceted approach to prevent or delay disease progression to complications.
- Young adults with type 2 diabetes (especially males) do not have adequate contact with the healthcare system. Alternative strategies to ensure they have appropriate access to healthcare and consultation with communities to develop and integrate these strategies are needed to ensure young people's healthcare needs are met.
- Rates of screening for kidney disease are very low. Supplemental strategies to increase screening for kidney disease are needed. Suggestions include point-of-care testing leading to triage and disease treatment and standard care and referral pathways.
- Higher continuity of care is associated with higher receipt of recommended care among adult Manitobans. Continuity of care should be evaluated as a strategy to improve care provided to Manitobans.

- Despite equal or higher rates of primary care visits and type 2 diabetes screening tests, adult First Nation Manitobans have higher rates of death and complications than other adult Manitobans. First Nation Manitobans living with type 2 diabetes are not experiencing the desired results. Strategies should be developed in collaboration with First Nations to address the inequities in access to quality healthcare.
- Rates of type 2 diabetes are increasing in Manitoba children and the burden of illness in this population is high. There is a need for additional supports to ensure that this population and their families receive appropriate care and education.
- Pregnant women with type 2 diabetes are more likely to use more healthcare resources than those without diabetes. Perinatal healthcare planning needs to account for type 2 diabetes and ensure that First Nation women and women living outside of Winnipeg receive equitable care.
- There is a significant burden of mental health disorders among Manitobans with type 2 diabetes. Screening for and ensuring access to mental healthcare should be an integral part of diabetes care.

Chapter 1: Introduction and Background

This chapter provides information on type 2 **diabetes**, the objectives of this report, and the organization of the chapters in this report.

Type 2 Diabetes

Diabetes is a mixed group of metabolic disorders characterized by hyperglycemia resulting from impaired insulin secretion, impaired insulin action or a combination of both. Diabetes results from the progressive loss of pancreatic beta cell mass and/or function, driven by various genetic and environmental factors [6]. In 2017, Statistics Canada estimated that 7.3% of the Canadian population aged 12 and older had diabetes, of which 90-95% was type 2 diabetes [7].

Type 2 diabetes results from the failure of the beta cells to secrete sufficient insulin to keep up with the body's demands, typically in the context of insulin resistance. People living with type 2 diabetes are at risk for the long term complications of hyperglycemia, including macrovascular complications (heart disease, cerebrovascular disease) and microvascular complications (neuropathy, **retinopathy** and nephropathy). Type 2 diabetes is a significant cause of morbidity and mortality. In Canada, individuals living with diabetes are 12 times more likely to have end-stage renal disease, 20 times more likely to have a non-traumatic lower limb **amputation**, and twice as likely (across all age groups) to die than individuals without diabetes [8]. In the past, type 2 diabetes was considered a disease of older adulthood, but over the last three decades it has been diagnosed in younger populations, including within the childhood years.

Around the world, Indigenous populations of all ages have higher rates of type 2 diabetes than non-Indigenous populations [9] In 2011, Indigenous people represented 16.7% of the Manitoba population and had a growth rate 3 times higher than the non-Indigenous population [10]. As far back as 20 years ago, the **prevalence** and **incidence** of type 2 diabetes among First Nation men in Manitoba were significantly higher than among non-First Nation men (2.5 and 3 times higher, respectively). Similarly, the incidence of diabetes among First Nation women in Manitoba was 3.7 times higher and the prevalence of type 2 diabetes was 4.5 times higher than among non-First Nation women. A national pediatric surveillance study (2006-2008) demonstrated that the minimum incidence of type 2 diabetes in First Nation children in Canada was 40 times higher than in their Caucasian counterparts (23.2/100,000/year vs 0.54/100,000/year, respectively) [11]. The majority of First Nation children with type 2 diabetes reported in this surveillance study resided in central Canada (Manitoba and Northwestern Ontario) [12]. In Manitoba specifically, approximately 90% of all children with type 2 diabetes are of self-declared First Nation heritage [13].

In light of the increasing incidence and prevalence of diabetes and the associated rise in morbidity and mortality, the Ministry of Heath in Manitoba resolved that an in-depth look at type 2 diabetes and related health outcomes among the population of Manitoba was needed. It was important that this look was representative of the Manitoba population with a type 2 diabetes diagnosis. As First Nation people have higher rates of type 2 diabetes than all other Manitobans, the research team included representation from the First Nations Health and Social Secretariat of Manitoba (FNHSSM). The development of the indicators, the selected outcomes, and the interpretation of the results were done in partnership with FNHSSM as first steps to addressing the Truth and Reconciliation Commission of Canada's Call to Action #19, which calls on governments and research institutions to identify indicators of health and report on the availability of appropriate health services [1]. Additionally, our research approach acknowledges "that the current state of Aboriginal health in Canada is a direct result of previous Canadian government policies, including residential schools" [1]. As part of the research planning process, we were called upon to present results separately for First Nation individuals, which is necessary to allow proper interpretation and to support planning and appropriate allocation of resources. First Nation researchers were involved in all stages of the research and are included as authors on this report. Results were also discussed with the Manitoba First Nations Diabetes Leadership Council and their input was incorporated into the report findings and conclusions.

Objectives of This Report

Type 2 diabetes is a complex disease but its risk factors, diagnosis, management and complications are welldescribed in a robust body of published literature. This report aims to provide a high-level analysis on the impact of type 2 diabetes in Manitoba, but does not delve into complex analyses of individual aspects of diabetes.

Objective 1: Describe the characteristics of the population of Manitobans living with any diabetes (type 1, type 2 and any other non-gestational type of diabetes) and the characteristics of Manitobans living with type 2 diabetes over time. This information is presented in Chapter 3 (Incidence and Prevalence of Diabetes) and Chapter 4 (Demographics and General Health Status of Manitobans with Type 2 Diabetes).

Objective 2: Examine the care provided to Manitobans living with type 2 diabetes, and compare that care with recommended screening and care guidelines from Diabetes Canada. This information is presented in Chapter 5 (Health Services Use), Chapter 6 (Type 2 Diabetes-Related Care and Complications) and Chapter 7 (Cardiovascular Health in Manitobans with Type 2 Diabetes). **Objective 3:** Examine the impact of type 2 diabetes in special populations in Manitoba. This objective uses matched **cohorts** (people with type 2 diabetes are matched to people without diabetes). See Chapter 8 (Type 2 Diabetes in Children in Manitoba), Chapter 9 (Maternal and **Neonatal** Outcomes in Type 2 Diabetes) and Chapter 10 (Mental Health Outcomes in Type 2 Diabetes).

Organization of the Chapters

Each chapter begins with a brief introduction to the topic and the chapter objectives, followed by individual sections for each indicator related to that topic. The individual sections begin with a definition of the indicator in plain language. Detailed definitions, including data sources, data years, diagnoses and drug codes, are provided in Appendix 2 in the online supplement (http://mchp-appserv. cpe.umanitoba.ca/deliverablesList.html). Following the definition are key findings about the indicator, which are then presented in graphs and/or tables. The majority of our findings are presented by **health region** or Regional Health Authority (RHA), age and sex, and some indicators are also available by **Tribal Council Area*** (TCA).

Additional results are available in Appendix 1 online.

*Terms in boldface are defined in the Glossary at the end of this report.

Chapter 2: Methods and Interpretation

This chapter describes the methods used for this report, including the data used, the development of cohorts, and the presentation of results. Considerations for the interpretation of the findings are also discussed.

Data Used in this Report

The data used for this report are housed at the Manitoba Centre for Health Policy (MCHP), which maintains the **Manitoba Population Research Data Repository** ("the Repository"). Most of the data in the Repository are derived from **administrative records** – data that were collected as part of the administration of health and social services in Manitoba. Data are sent to MCHP from Manitoba Health, Seniors and Active Living (MHSAL) only after identifying information (names and addresses) have been removed and **Personal Health Identification Numbers** (PHINs) are scrambled. The scrambled PHINs are attached to every person-level record in the datasets. This allows us to link individuals across the datasets used in the study while protecting the privacy of individual Manitobans.

The following datasets were used in this report:

- <u>First Nations Research File</u>: This file was used with the permission of the First Nations Health and Social Secretariat of Manitoba (FNHSSM). The transfer of the file to the Repository is based on a bilateral agreement between FNHSSM and Indigenous and Northern Affairs Canada (INAC), and a trilateral agreement between FNHSSM, MHSAL and the University of Manitoba (on behalf of MCHP). The file is maintained by INAC (federal government) and represents a record of individuals who are **Registered** (also known as "**Status**") First Nation individuals. MCHP's access to the file is approved by the Health Information Research Governance Committee of FNHSSM. This report uses the First Nations Research File to identify and include Registered First Nation Manitobans and First Nation Communities in this report.
- <u>Manitoba Health Insurance Registry</u>: These data provide demographic and health insurance coverage information on all residents of Manitoba who are registered to receive health benefits.
- <u>Hospital Abstracts</u>: Health data maintained by MHSAL consisting of hospital forms or computerized records of demographic and clinical information (e.g., sex, postal code, diagnoses and intervention codes), completed at discharge from hospital.

- <u>Medical Services</u>: Health data maintained by MHSAL, consisting of claims for physician visits in offices, hospitals and outpatient departments; **fee-for-service** information for diagnostic tests performed in offices and hospitals; payments for on-call agreements that are not attributed to individual patients; as well as information about physicians' specialties.
- <u>Vital Statistics Mortality Registry</u>: A record of all deaths in Manitoba that includes cause of death.
- <u>Diagnostic Services of Manitoba (now part of</u> <u>Shared Health Manitoba)</u>: Database containing all hospital-based chemistry laboratory data, including tests for HbA1c (glucose) levels and urine albumin-to-creatinine ratio.
- <u>Child and Family Services Application and Intake</u>: This dataset holds records of families that accessed services (supportive and protective) provided by Child and Family Services. It also records children who were taken into care by Child and Family Services.
- <u>Enrollment</u>, <u>Marks and Assessments</u>: This dataset was used to create the education indicators (e.g., high school graduation).
- Manitoba Diabetes Education Resource for Children and Adolescents (DER-CA): This dataset includes data from a program offering specialty services to children and youth under age 18 with type 1 or type 2 diabetes (http://www.wrha.mb.ca/healthinfo/a-z/ diabetes/directory-diabetes-education-resources-forchildren-and-adolescents.php).
- <u>Manitoba Immunization Monitoring System</u>: This file provides data on immunizations Manitobans have received.
- <u>Manitoba Tuberculosis Registry</u>: The Manitoba Tuberculosis Registry contains information on persons suspected of, diagnosed with, and treated for tuberculosis in Manitoba.
- <u>Canada Census</u>: Public use census data from Statistics Canada were used to assign each individual to an income quintile based on the average household income of their dissemination area. We linked the dissemination areas to postal codes via Canada Post's Postal Code Conversion File and used the postal codes to assign an average household income to each individual in our study. The population is then ordered from lowest to highest income and divided into five equal sections (income quintiles); this is done separately for urban and rural Manitoba.

• <u>Drug Program Information Network</u>: All medications dispensed from a community-based pharmacy in Manitoba are included in this file. Each record includes details about the drug dispensed, including the person for whom the prescription was written, the type of drug and how much of the drug was dispensed.

Additional information about Repository data that were used in this report is available on MCHP's website: http:// umanitoba.ca/faculties/health_sciences/medicine/units/ chs/departmental_units/mchp/resources/repository/ descriptions.html.

Identifying the Cohort of Manitobans with Type 2 Diabetes

There are multiple ways to identify people with chronic conditions such as diabetes using the administrative data contained in the Repository. We first identified all Manitobans with a valid PHIN, and then narrowed the cohort to people with type 2 diabetes, as follows:

For a historical look at diabetes in Manitoba we used the National Diabetes Surveillance System (NDSS) definition of diabetes, which includes type 1, type 2 and any other type of non-pregnancy-related diabetes and does not attempt to discriminate by subtype [2]. The NDSS definition classifies an individual as having diabetes if they have at least one hospitalization or two physician visits with an ICD-9-CM/ICD-10-CA code for diabetes within a two-year period. It excludes codes within 120 days before and 90 days after delivery of a newborn (to exclude codes related to gestational diabetes) [14]. Gestational diabetes is not captured in outpatient claims as it requires more than the first 3 digits of an ICD-9-CM code [ICD-9-CM gestational diabetes code: 648.8]; however, the ICD-9-CM physician billing codes are only captured to 3 digits in the Repository. The ICD-9-CM/ICD-10-CA codes used in hospitalization separation abstracts do allow for differentiation by diabetes type; however, it has been the experience of the researchers involved in this report that diabetes types are often misclassified due to physician error when compared against clinical databases. Thus, we are not relying on the ICD-9-CM/ICD-10-CA codes to distinguish type 1 from type 2 diabetes.

We also developed an 'enhanced type 2 diabetes' definition by building on the NDSS definition and using additional information available in the Repository. This definition aims for a high specificity (i.e., we would rather miss a few cases of type 2 diabetes than misclassify other types of diabetes as type 2). It is difficult to uniquely identify individuals with type 2 diabetes from a cohort of people with any type of diabetes. Creating the enhanced definition required us to look for unique treatments that all individuals with type 2 diabetes receive and remove any individuals receiving treatments that were definitely for other types of diabetes [15,16], as follows:

Start by identifying individuals with any diabetes:

- Had 1 or more hospitalizations with a diagnosis of diabetes mellitus, ICD-9-CM diagnosis code 250; ICD-10-CA codes E10-E14, or
- Had 2 or more physician visits with a diagnosis of diabetes mellitus, ICD-9-CM diagnosis code 250, or
- Had 1 or more prescriptions for drugs used in diabetes, e.g., insulin, blood glucose lowering drugs (ATC code A10 excluding metformin), or
- Had 1 or more prescriptions for metformin with at least one physician visit for diabetes, or
- Had 1 or more glycohemoglobin (HbA1c) tests with a result ≥ 6.5% [17], or
- Were identified as having type 2 diabetes in the Diabetes Education Resource for Children and Adolescents (DER-CA).

Note: To prevent classifying gestational diabetes as type 2, all diagnoses, prescriptions and HbA1c tests for pregnant women occurring from 120 days before delivery to 90 days after delivery were excluded from the above algorithm.

Then exclude those likely to have non-type 2 diabetes (those who met any of the following criteria):

- Had 1 prescription for metformin (ATC code A10BA) without a diagnosis for diabetes from a hospitalization or physician visit (suggests metformin was prescribed for an indication other than diabetes), or
- Ever had 1 or more prescriptions for an insulin pump infusion set (Manitoba Product Identification Numbers: 00905739, 00908300, 00992968, 00992976, 00992984, 00992991), which is only used in type 1 diabetes, or
- Ever had 1 or more diagnoses for cystic fibrosis from a hospitalization or physician visit (ICD-9-CM diagnosis code 277.0; ICD-10-CA code E84 [diabetes most likely secondary to cystic fibrosis]), or
- Age at first diabetes diagnosis was less than 7 years old (as type 2 diabetes is extremely rare under the age of 7) [18], or
- Were identified as having any type of diabetes other than type 2 in the Diabetes Education Resource for Children and Adolescents (DER-CA), e.g., type 1, medication induced.

To be included in the type 2 diabetes cohort, individuals needed to meet the diagnostic definition uniquely in each study time period. If an individual was diagnosed with type 2 diabetes in the 1st time period but not in 2nd time period, they were not included in the type 2 diabetes cohort in the 2nd time period. For estimates of incidence, individuals had to have had their first ever healthcare contact for diabetes (diagnosis or treatment) in that time period to be counted as a new case for that time period. See Figure 2.1 for the numbers identified at each step.

Figure 2.1: Cohort Flowchart: Time 2, 2013/14-2014/15



Number of Records For:
Findings from the Use of the Enhanced Definition for Type 2 Diabetes

Our enhanced type 2 diabetes definition augments the NDSS definition by allowing individuals into the cohort on the basis of their HbA1c data and medication prescriptions, not only on the basis of ICD codes. This approach is expected to better capture individuals who would have been missed if we had relied strictly on physician billing. For example, we might have missed individuals living on reserve who receive care from nurses who do not bill or shadow bill for their services.

Data on HbA1c levels collected in Diagnostic Services Manitoba labs and Dynacare labs are included in the data. The percentage of individuals identified solely through the Diagnostic Services Manitoba lab data decreased overtime and ranged from 6% in the first time period (2011/12 to 2012/13) to 5.3% in the last time period (2015/16 to 2016/17). Samples collected and processed in private labs are not included. Thus, there are gaps in the HbA1c data where individuals accessed private labs, notably in Winnipeg and surrounding regions and around Percy Moore Hospital in the Interlake-Eastern RHA. Any testing done at point-of-care, except for testing done in the DER-CA clinics, is also not captured in the data, including outreach services of the Diabetes Integration Project or the **FINISHED Project** for Health-Care Providers and Stakeholders [19].

Our enhanced type 2 diabetes definition also refines the NDSS definition by attempting to limit the cohort to those with type 2 diabetes by excluding individuals likely to have another type of diabetes. While the enhanced definition has not been validated, the team felt it was important to exclude as many individuals with type 1 diabetes as possible, as the two types of diabetes have different demographics and a different natural history [17].

Up to 10% of the diabetes cohort initially was only identified through prescription dispensation data. However, in discussion with clinical advisors, a decision was made to exclude individuals with only a metformin dispensation and no ICD diabetes code, as these individuals may have been prescribed metformin for other indications, the scope of which continues to grow [20]. After this modification to the definition, only about 2% of the cases of diabetes per time period were identified solely through prescription dispensations.

Identification of Type 2 Diabetes in Children in this Report

In Manitoba, most diabetes diagnoses in children are given by paediatric endocrinologists; these diagnoses are captured in the DER-CA database. This allows precise differentiation between types of diabetes, and most importantly it allows the differentiation of type 1 from type 2 diabetes. Type 1 diabetes is more commonly diagnosed in children, although type 2 is increasingly common. Some children, and especially older teenagers age 16+, may not be seen by a paediatric team and thus their type 2 diabetes may not be captured in the DER-CA data.

When we used the enhanced type 2 diabetes definition to identify type 2 diabetes in children, it produced incidence rates that were unrealistically high. It is expected from previous work that the DER-CA database under-captures type 2 diabetes in children by about 15%, but the enhanced definition identified approximately twice as many new diagnoses as expected. While this phenomenon requires further investigation, for the current report, when results for children are reported separately from results for adults, only children diagnosed as having diabetes in the DER-CA dataset are included, and those data are used to assign their diabetes type. Where the report presents data for the entire population (adults and children together), the enhanced type 2 definition was used. This results in a very small number of children (less than 30 children, 0.03% of the cohort) who most likely do not have type 2 diabetes being included.

Groupings for the Analyses

Presentation of Results Comparing First Nation Manitobans to All Other Manitobans

Type 2 diabetes is known to have higher incidence rates, impacts, and complications among First Nation Manitobans. Thus, it is important to report diabetes indicators separately for this population. Registered First Nation people represent 9.5% of the population of Manitoba age 7+, but they make up 15.6% of Manitobans living with diabetes. First Nation people are over-represented both within the type 2 diabetes cohort and in the adverse outcomes of diabetes. Social determinants of health such as poverty, lower educational achievement, and unstable housing are known to be associated with diabetes outcomes and disproportionately affect First Nation individuals [21,22]we employ Bacchi's (1999. Additionally, the outcomes we report on here may be influenced by the Indigenous determinants of health, which includes cultural continuity, physical and social environments, self-determination, connectivity to land and reconciliation, history of health issues, and racism and marginalization [24].

Given this context, we have chosen to present our results for Registered First Nation Manitobans separately from results for All Other Manitobans. Registered First Nation individuals were identified, with permissions, from the 2016 Indian Registry System File (referred to here as the First Nations Research File). It is a limitation of the data that only people registered under the Indian Act are included as First Nation Manitobans; all others are included in the All Other Manitobans group. A direct comparison of how many people self-identify as First Nation but are not identified in the First Nations Research File is not currently available. However, among people diagnosed with type 2 diabetes as children (and captured in the DER-CA database), 92% who selfidentified as First Nation were classified as such using the First Nations Research File, and 98% of children identified in the First Nations Research File self-identified as First Nation, thus demonstrating that the First Nations Research File captures the vast majority of self-identifying First Nation children with type 2 diabetes.

Geography

It is often useful to present health-related data by the **health region** in which individuals reside or in which they received care. We have allocated Manitobans to a health region by home address. If a health service was provided in Winnipeg to someone who resides in the North, this service is assigned to the Northern Health Region. We used this approach because provincial health resources are allocated to the regions based on the population living in that health region. Presenting the data by health region also provides an indication of how geographically remote the populations living within them are.

When looking at type 2 diabetes in Manitoba, First Nation individuals are over-represented, and this impacts our interpretation of the findings. The results from this report should be used in conjunction with the recently released reports The 2019 RHA Indicators Atlas and The Health Status of and Access to Healthcare by Registered First Nation Peoples in Manitoba [23,24]. Similar methodologies have been used in the current report as in these other two. As such, findings should be examined together so that we can build on what we have previously learned. One of the unexpected key findings when the health of First Nation Manitobans was examined is that the health of many Northern First Nation communities was better than those in the south. This finding underscores the complexity of health and health service use in Manitoba First Nations; it emphasizes the importance of considering all factors associated with health, not just health services, including the social and Indigenous determinants of health, when comparing between regions. It is therefore instructive to look at the comparisons between health regions. This may also provide clues to differences in clinical practice among physicians working in different regions. The regional analysis also provides some understanding of the relative resources, such as hospital beds, in each region.

Note that Churchill is included in the Winnipeg Regional Health Authority (WRHA) despite being geographically distinct from Winnipeg.

Residence information for Registered First Nation people comes from the First Nation Research File, and is current to the time of data abstraction (2016). Residence information for All Other Manitobans comes from the Manitoba Health Registry, which relies on individuals to report address changes to MHSAL and thus may not reflect individuals' most current address.

When comparing across health regions, results are often age- and sex-adjusted to allow for valid comparisons. It is also important to note that for some areas with low numbers of residents, differences between First Nation populations and All Other Manitoban populations may look large but are not **statistically significant** due to small sample size.

Figure 2.2: Map of Health Regions in Manitoba, 2016



For selected indicators identified in discussions within the research team (including representation from FNHSSM), findings are shown separately for First Nation Manitobans living on-reserve and off-reserve, and by Tribal Council Area (TCA). Individuals living "on-reserve" are individuals residing either on their home reserve or another reserve; all are counted in their home reserve. The seven **Tribal Councils** as well as groupings of independent First Nation communities (Independent-North and Independent-South) and Non-Affiliated communities were included (see Table 2.1) as TCAs.¹ These groupings are key to understanding use of healthcare services among First Nations because

of the strong relationships between communities and the TCAs with which they affiliate. These groupings allow comparisons between health status and service use of First Nation individuals living on-reserve across TCAs. First Nation Manitobans face significant challenges based on the fragmentation of the funding and delivery systems between the federal and provincial governments, between RHAs and TCAs, and amongst the communities themselves. This fragmentation severely limits development of strategic initiatives needed to address some of the challenges described in this report.

Note: Sioux Valley First Nation chose not to grant permission for access to their data and so were excluded from all analyses.

Table 2.1: Organization of First Nation Communities into Tribal Council Areas in This Report

Tribal Council Areas in This Report	First Nation Communities			
Official Tribal Councils				
	Birdtail Sioux Dakota Nation			
Dakata Ojihway Tribal Council	Long Plain First Nation			
	Roseau River Anishinabe First Nation			
(DOTC)	Swan Lake First Nation			
	Waywayseecappo First Nation			
	Dauphin River First Nation			
	Kinonjeoshtegon First Nation			
Interlake Reserves Tribal Council	Lake Manitoba Treaty 2 First Nation			
(IRTC)	Little Saskatchewan First Nation			
	Peguis First Nation			
	Pinaymootang First Nation			
	Garden Hill First Nation			
Island Lake Tribal Council	Red Sucker Lake First Nation			
(ILTC)	St. Theresa Point First Nation			
	Wasagamack First Nation			
	Barren Lands First Nation			
	Bunibonibee Cree Nation			
Keewatin Tribal Council (KTC)	Fox Lake Cree Nation			
	Gods Lake First Nation			
	Manto Sipi Cree Nation			
	Northlands Denesuline First Nation			
	Sayisi Dene First Nation			
	Shamattawa First Nation			
	Tataskweyak Cree Nation			
	War Lake First Nation			
	York Factory First Nation			
	Black River First Nation			
	Bloodvein First Nation			
Southeast Resource Development	Brokenhead Ojibway Nation			
Council	Hollow Water First Nation			
(SERDC)	Little Grand Rapids First Nation			
	Pauingassi First Nation			
	Poplar River First Nation			
	Chemawawin Cree Nation			
	Mathias Colomb First Nation			
Swampy Cree Tribal Council	Mathias Colomb Cree Nation			
(SCTC)	Masskabiker Gree Nation			
	Sanatawayak Gree Nation			
	Mushwi Sinibk Eirst Nation			
	Ebb and Elow First Nation			
	Camblers First Nation			
	Kaosaakaawanin Oiibway Eirst Nation			
West Region Tribal Council	Dipe Creek First Nation			
(WRTC)	Polling River First Nation			
	Skowpan First Nation			
	Tootinaowaziihaang Traat Basang			
	Tootinaowaziibeeng Treat Reserve			

Table 2.1: Continued

Tribal Council Areas	First Nation Communities		
Other Groupings			
	Nisichawayasihk Cree Nation		
Independent-North	Norway House Cree Nation		
	Opaskwayak Cree Nation		
	O-Pipon-Na-Piwin Cree Nation		
	Pimicikamak Cree Nation		
	Berens River First Nation		
	Buffalo Point First Nation		
	Dakota Tipi First Nation		
Indopendent South	Fisher River Cree Nation		
independent-south	Lake St. Martin First Nation		
	O-Chi-Chak-Ko-Sipi First Nation		
	Sagkeeng First Nation		
	Sandy Bay First Nation		
Non-Affiliated	Canupawakpa Dakota Nation		
Non-Anniated	Dakota Plains Wahpeton Nation		

Figure 2.3. Map of Tribal Council Areas in Manitoba, 2016



Presentation of Results

Chapters 3-7

The order of RHAs and TCAs that appear in the graphs and tables in this report is based on the level of population health status of each RHA or TCA, as measured by the premature mortality rate (PMR; death before age 75). Each graph shows either the TCAs or RHAs in order of increasing overall PMR. The areas with the lowest PMR are considered to have the highest health status.

In analysing data by RHA, we made two comparisons. First, we compared First Nation Manitobans with type 2 diabetes to All Other Manitobans with type 2 diabetes within each RHA. Second, we compared each cohort in an RHA to its cohort average (e.g., First Nation Manitobans with type 2 diabetes in Southern Health-Santé Sud vs the Manitoba average for First Nation Manitobans with type 2 diabetes).

In analysing data by TCA, we again made two comparisons. First, we compared First Nation Manitobans living on- and off-reserve within a TCA. Second, we compared First Nation Manitobans living on- and off-reserve to a benchmark group. The benchmark group was the group that performed the best on the measurement in question (e.g., they had the lowest hospitalization rates, or the highest immunization rates). For example, if Dakota Ojibway Tribal Council's onreserve population had the highest immunization rate, all other on-reserve groups were compared to DOTC for this measure.

If a difference is "statistically significant" or "statistically different", then this difference was large enough that we are confident it is not just due to chance. Statistical significance describes how much confidence to put in the results. When you see a large difference that is *not* statistically significant, it is telling you that this rate is probably not different from the comparison rate and that it could fluctuate greatly from year to year. This could be due to the finding being based on small numbers (either a small number of events or a small population). A finding based on small numbers could change from year to year and may be higher, similar or lower than the comparison the next time it is measured. All of the graphs show whether results are statistically significant using numbers or symbols next to each RHA or TCA label. These are explained in the footnotes below each graph.

When an "s" appears on a graph or next to an RHA or TCA name, this indicates that we cannot report the finding because it is based on a very small number of individuals or events (less than six), putting the individuals in that group at risk for being identified. In this case, we "suppress" this finding (referred to as **suppressed data**).

For some outcomes, we report **relative risk (RR)**. The RR shows how one population compares to another population. If a rate of an event is 10 events/person-year in one group, and 5 events/person-year in another, then the

RR = 10/5 = 2. Graphs and figures in some chapters show RR with 95% **confidence intervals** (95% CI). Confidence intervals show the range of values which are statistically probable. For RR, the difference between the two groups is significant if the confidence interval does not cross 1.0. For example, if RR = 0.81 (95% CI 0.67-0.89), the RR and the 95% CI fall below 1.0, so the risk of the outcome for people with type 2 diabetes is significantly lower than for the comparison group. In another example, RR = 1.23 (95% CI 0.75-1.36) – here, the risk of the outcome is greater for people with type 2 diabetes is higher than for the comparison group (RR is greater than 1.0) but the difference between the groups is not significant, because the confidence interval crosses 1.0.

Chapters 8-10

In Chapters 8-10, people with type 2 diabetes are matched to people without any diabetes, and comparisons between the two groups are shown. For Chapters 7 and 8, results are compared between First Nation Adult Manitobans and All Other Adult Manitobans. In Chapter 8, we also report outcomes for children with type 2 diabetes compared to children with type 1 diabetes. These results cannot be **stratified** by First Nation Manitobans vs All Other Manitobans as the group of All Other Manitoban Children with type 2 diabetes is too small.

Rates and Adjustments

Most graphs in this report present **adjusted rates**, whereas the tables in Appendix 1 in the online supplement show counts and the **crude rates** that the adjusted rates are based on. The type of rate presented in any given table or figure is reported in the figure/table title or sub-title. A rate refers to the number of events or individuals with a characteristic that is of interest during a given period per number of individuals or events observed in this period. Many health-related events can happen to a given person more than once. For example, the physician visit rate shows how often individuals visit a physician each year (that is, number of visits per individual in a year). Where an indicator covers a period longer than one year, the rate is annualized, that is, calculated as an average rate per year.

The rates in most graphs by health region and by TCA have been statistically adjusted to account for the age and sex compositions of the different populations we are comparing. This adjustment allows for fair comparisons among areas with different population characteristics. Adjusted rates show what that area's rate would have been if the area's population had the same age and sex composition as the Manitoba population. For example, adjusted rates are almost always higher than crude rates for individuals living in the Northern Health Region, because this region has a relatively young population, but the population tends to be less healthy so they use many health services more often than expected for their age. Adjusted rates do not tell you how many actual people or events are reported for that indicator. If an area has a very different age and sex composition compared to Manitoba, the adjusted rate may give you an overestimate or underestimate of the actual number of people or events reported. This is why we report the counts and crude rates in Appendix 1 online. Adjusted rates are however essential for comparisons between populations in the proper context.

The age and sex distribution of the First Nation Manitobans cohort is different from that of All Other Manitobans; there are more women and more young people in the First Nation Manitobans cohort. To accurately compare First Nation Manitobans to All Other Manitobans, we adjusted the crude rates for the First Nation Manitobans to represent what they would be if there were more men and more older adults. We also adjusted the crude rates for the All Other Manitobans group to represent more women and more young people. This type of adjustment can lead to higher rates of undesirable outcomes for the First Nation group and lower rates for the All Other Manitobans group. In some cases, the adjustment can result in a dramatic disparity between groups. This is why we also show crude rates (or RR) for many of the indicators.

We report some indicators without adjustment, either because events are relatively rare and so adjustment is not possible, or because the rates are presented by sex and so adjustment by sex does not make sense. This is indicated in the title of the figure.

All data management, programming, and analyses were performed on MCHP's secure servers, using SAS® software (Version 9.4).

Study Years

We used data from different years for some outcomes. and this is noted in the pertinent graph or table. Years are usually fiscal years. For Chapter 3, we examined rates of any diabetes from 1984/85 to 2016/17, which was the most current data available for this report. For most indicators in Chapters 4-7, we examined rates of type 2 diabetes over six years and averaging two years together, so we report rates for fiscal years 2011/12-2012/13, 2013/14-2014/15 and 2015/16-2016/17. Type 2 diabetes in children is identified using the DER-CA data only and rates are presented for calendar years 2009-2018. For indicators where the condition they describe is permanent once it occurs (e.g., end-stage renal disease), we identified the cohort in years 2013/14-2014/15; however, we examined data back to 1979 to look for the outcome. In Chapters 8-10, we use matched cohorts and the time periods for these are identified at the start of each chapter.

Interpretation of the Findings

When reviewing the results presented in this report, it is important to consider the underlying context that contributes to these findings. The contexts of each community, each region and each council area are critical to understanding the current reality described by the findings in this report and to exploring potential solutions. Equitable access to quality healthcare is important for all people with diabetes, but many factors outside of the healthcare system impact disease onset and progression. Poverty, language barriers, food insecurity and difficulty accessing exercise facilities all impact outcomes. Low socioeconomic status, however it is measured, is associated with poorer outcomes for all people with type 2 diabetes [25]. Access to allied healthcare, such as dentistry, foot care, physiotherapy, occupational therapy and registered dieticians, may be impacted by people's ability to pay for these services, by geography and by waiting lists.

Many of Manitoba's First Nations are disproportionality affected by the above issues, but are also impacted by the Indigenous determinants of health. These include ongoing systemic racism in accessing various systems and services, multi-generational trauma due to historical and current government policies and practices including exposure to residential schools and loss of family structures and traditional languages, lack of access to traditional lands and foods, poor access to clean water, and the absence of quality housing. The data we have used in this report do not capture many of these factors, and also do not capture indicators of the strengths and resilience inherent within First Nation communities, which are working to mitigate these issues.

Chapter 3: Incidence and Prevalence of Any Diabetes and Type 2 Diabetes in Manitoba

This chapter presents an overview of the incidence and prevalence of any diabetes and of type 2 diabetes in Manitoba.

Objectives:

- Examine the trends in incidence and prevalence for any diabetes (type 1, type 2 and any other non-gestational diabetes) in Manitoba, historically to present day
- Examine the trends in incidence and prevalence of type 2 diabetes in Manitoba in a recent cohort
- Examine associations between type 2 diabetes and income quintile, age, and health region among First Nation Manitobans and All Other Manitobans

Historical Rates of Any Diabetes (Based on the NDSS Definition) in Manitoba

The National Diabetes Surveillance System (NDSS) definition of diabetes is a standard definition used extensively in administrative data research [2]. Its strengths include its reliance on exclusively physician and hospital claims data, and the extensive body of comparative literature available. However, this definition has some drawbacks. It is only validated for use in adults, it identifies any type of non-gestational diabetes and misses populations where patients don't see physicians as often or where physicians do not submit billing codes. For most of this report, we use an enhanced definition to identify people with type 2 diabetes specifically (see Chapter 2). However, to allow for comparisons with other findings and to allow more historical comparisons, we first present diabetes incidence and prevalence using the NDSS definition. NDSS Definition of Any Diabetes:

Individuals were considered to have any diabetes (type 1, type 2, and any other non-gestational diabetes) if they met one or more of the following conditions:

- 1 or more hospitalizations with a diagnosis of diabetes mellitus, ICD-9-CM diagnosis code 250; ICD-10-CA codes E10-E14, or
- 2 or more physician visits with a diagnosis of diabetes mellitus, ICD-9-CM diagnosis code 250.

Note: To prevent classifying gestational diabetes as type 1 or type 2, all diagnoses for pregnant women identified between 120 days before delivery to 90 days after were excluded from the above definition

Incidence and Prevalence of Any Diabetes among Adult Manitobans by Age Group

Key Findings (Figure 3.1; Tables 3.1-3.2):

- Incidence pattern differed by age group
 - Incidence increased over time in all age groups less than 80 years
 - Rate of increase was higher in younger groups (younger than age 50)
 - Incidence also increased in older groups but at a lower rate than in younger groups
- Prevalence increased over time in all age groups

Figure 3.1: Incidence of Any Diabetes Among Adult Manitobans by Age Group

Crude rate per 1,000 person-years at risk using NDSS definition of diabetes, age 18+, 1985/86-1986/87 to 2015/16-2016/17



* Indicates a statistically significant increase in incidence over time for that age group (p<.05)

Table 3.1: Prevalence of Any Diabetes Among Adult Manitobans by Age Group

Crude percent using NDSS definition of diabetes, age 18+Age groups 18-24 to 55-59

Fiscal Year	Age Group							
	18-24*	25-29*	30-34*	35-39*	40-44*	45-49*	50-54*	55-59*
1985/86-1986/87	0.35	0.51	0.73	1.20	1.90	2.86	4.11	5.35
1987/88-1988/89	0.39	0.51	0.75	1.24	2.08	2.98	4.56	6.00
1989/90-1990/91	0.36	0.55	0.77	1.26	2.20	3.06	4.58	6.14
1991/92-1992/93	0.38	0.60	0.78	1.27	2.32	3.48	4.95	6.68
1993/94-1994/95	0.38	0.66	0.88	1.41	2.35	3.70	5.03	7.16
1995/96-1996/97	0.39	0.71	1.04	1.47	2.34	3.89	5.50	7.59
1997/98-1998/99	0.48	0.77	1.22	1.66	2.53	4.21	6.16	8.05
1999/00-2000/01	0.48	0.89	1.29	1.93	2.79	4.56	6.96	9.10
2001/02-2002/03	0.54	0.93	1.55	2.18	3.20	4.88	7.59	10.28
2003/04-2004/05	0.57	0.97	1.66	2.44	3.53	5.15	7.83	11.15
2005/06-2006/07	0.62	1.02	1.72	2.70	3.90	5.49	8.02	11.67
2007/08-2008/09	0.62	1.09	1.76	2.82	4.11	5.84	8.32	11.62
2009/10-2010/11	0.64	1.16	1.92	3.17	4.52	6.30	8.76	12.06
2011/12-2012/13	0.71	1.24	2.11	3.35	5.15	6.98	9.53	12.96
2013/14-2014/15	0.74	1.31	2.30	3.62	5.62	7.92	10.16	13.72
2015/16-2016/17	0.86	1.33	2.31	3.91	6.11	8.54	10.88	13.87

* Indicates a statistically significant increase in prevalence over time for that age group (p<.05)

Table 3.1	Continued
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Age groups 60-64 to 90+

Fiscal Year							
	60-64*	65-69*	70-74*	75-79*	80-84*	85-89*	90+*
1985/86-1986/87	6.81	8.01	9.08	10.26	10.17	9.07	6.96
1987/88-1988/89	7.39	8.51	9.69	10.46	10.66	9.09	7.64
1989/90-1990/91	7.61	9.09	10.02	10.41	10.76	9.66	6.93
1991/92-1992/93	8.27	9.73	10.49	10.65	10.87	9.67	6.71
1993/94-1994/95	8.74	10.37	10.77	10.93	10.91	9.59	7.13
1995/96-1996/97	9.59	10.68	11.68	11.40	10.95	10.01	7.47
1997/98-1998/99	10.60	11.88	12.71	12.47	11.52	10.31	6.91
1999/00-2000/01	11.58	13.46	14.03	13.96	12.87	11.04	8.70
2001/02-2002/03	12.53	14.74	15.46	15.57	13.99	12.13	9.18
2003/04-2004/05	13.64	15.92	16.66	16.84	15.26	12.47	10.48
2005/06-2006/07	14.81	17.01	18.41	17.93	16.62	14.16	10.78
2007/08-2008/09	15.52	17.41	18.89	19.01	17.79	14.78	11.42
2009/10-2010/11	15.79	18.61	19.75	20.33	19.02	15.92	12.55
2011/12-2012/13	16.65	19.98	21.81	22.13	20.66	18.20	12.81
2013/14-2014/15	17.54	21.15	23.41	24.28	22.67	20.26	13.74
2015/16-2016/17	17.66	21.58	23.99	24.72	23.47	20.91	15.05

 * Indicates a statistically significant increase in prevalence over time for that age group (p<.05)

Due to the faster rate of increase in diabetes incidence in younger vs older groups, we calculated the **mean**/median age at diabetes diagnosis in adults over time. Mean age at diagnosis was 59 in the earliest cohort, and 55 in the most recent cohort (Table 3.2). This tells us that either the

disease was present earlier in the more recent cohort, or improved screening and testing led to identification of disease earlier in its course. Note that the size of the cohort grew as the diabetes incidence and the size of the Manitoba population increased.

Table 3.2: Mean/Median Age for Incident Diabetes (Any Type) Among Adult Manitobans by Fiscal Year NDSS definition of diabetes, age 18+, 1985/86-1986/87 to 2015/16-2016/17

Fiscal Year	Count	Mean Age	Median Age
1985/86-1986/87	5,768	59	61
1987/88-1988/89	5,811	59	60
1989/90-1990/91	5,542	59	60
1991/92-1992/93	5,953	58	59
1993/94-1994/95	6,069	58	59
1995/96-1996/97	6,086	58	58
1997/98-1998/99	7,038	57	58
1999/00-2000/01	7,935	58	58
2001/02-2002/03	8,728	57	57
2003/04-2004/05	8,978	58	57
2005/06-2006/07	9,302	57	57
2007/08-2008/09	8,655	57	56
2009/10-2010/11	9,106	56	56
2011/12-2012/13	10,412	56	56
2013/14-2014/15	10,939	56	56
2015/16-2016/17	10,765	55	55

Incidence and Prevalence of Any Diabetes among Adult Manitobans by Income Quintile

Key Findings (Figures 3.2-3.5):

- Incidence
 - Higher incidence in lower income quintiles
 - Incidence increased over time in all quintiles
 except rural Q1

- Prevalence
 - · Higher prevalence in lower income quintiles
 - Prevalence increased over time in all income quintiles





* indicates a statistically significant increase over time for that income guintile (p<.05) + indicates a statistically significant difference between the lowest and highest income quintile for that fiscal year (p<.05)

Figure 3.3: Incidence of Any Diabetes Among Adult Manitobans by Rural Income Quintile Crude rate per 1,000 person-years at risk using NDSS definition of diabetes, age 18+, 1985/86-1986/87 - 2015/16-2016/17



* indicates a statistically significant increase over time for that income quintile (p<.05)

+ indicates a statistically significant difference between the lowest and highest income quintile for that fiscal year (p<.05)

Chapter 3: Incidence and Prevalence of Any Diabetes and Type 2 Diabetes in Manitoba

Crude rate per 1,000 people using NDSS definition of diabetes, age 18+, 1985/86-1986/87 to 2015/16-2016/17



* indicates a statistically significant increase over time for that income quintile (p<.05)

+ indicates a statistically significant difference between the lowest and highest income quintile for that fiscal year (p<.05)

Figure 3.5: Prevalence of Any Diabetes Among Adult Manitobans by Rural Income Quintile Crude rate per 1,000 people using NDSS definition of diabetes, age 18+, 1985/86-1986/87 to 2015/16-2016/17



+ indicates a statistically significant difference between the lowest and highest income quintile for that fiscal year (p<.05)

Incidence and Prevalence of Any Diabetes among Adult Manitobans by Health Region

Key Findings (Figures 3.6-3.7):

- Incidence increased over time in all health regions
- Prevalence increased over time in all health regions

The crude incidence and prevalence of any diabetes by age and health region are available in Appendix 1 online.

Figure 3.6: Incidence of Any Diabetes Among Adult Manitobans by Health Region

Crude rate per 1,000 person-years at risk using NDSS definition of diabetes, age 18+, 1985/86-1986/87 - 2015/16-2016/17



* Indicates a statistically significant increase in incidence over time for this region (p<.05)

Figure 3.7: Prevalence of Any Diabetes Among Adult Manitobans by Health Region

Crude rate per 1,000 people using NDSS definition of diabetes, age 18+, 1985/86-1986/87 to 2015/16-2016/17



 \ast Indicates a statistically significant increase in prevalence over time for this region (p<.05)

Incidence and Prevalence of Type 2 Diabetes in Manitoba

For the remainder of this chapter and the report, we present the results using the enhanced definition for type 2 diabetes, in which we incorporated laboratory information, hospital and physician codes, and prescription drug data (see Chapter 2) to identify people with type 2 diabetes specifically. These results are presented for the last six years in two-year periods. Results are presented separately for First Nation Manitobans and All Other Manitobans.

Enhanced Definition of Type 2 Diabetes:

Individuals were considered to have type 2 diabetes if they met one or more of the following conditions:

- 1 or more hospitalizations with a diagnosis of diabetes mellitus, ICD-9-CM diagnosis code 250, ICD-10-CA codes E10-E14, or
- 2 or more physician visits with a diagnosis of diabetes mellitus, ICD-9-CM diagnosis code 250, or
- 1 or more prescriptions for drugs used in diabetes, e.g., insulin, blood glucose lowering drugs, ATC code A10, or
- 1 or more glycohemoglobin (HbA1c) tests with a result ≥ 6.5%, or
- Identified as having type 2 diabetes in the Diabetes Education Resource for Children and Adolescents (DER-CA),

and did not meet any of the following conditions:

- 1 prescription for metformin (ATC code A10BA) without a diagnosis for diabetes from a hospitalization or physician visit, or
- Ever had 1 or more prescriptions for an infusion set (Manitoba Product Identification Numbers: 00905739, 00908300, 00992968, 00992976, 00992984, 00992991), or

- Ever had 1 or more diagnoses for cystic fibrosis from a hospitalization or physician visit, ICD-9-CM diagnosis code 277.0; ICD-10-CA code E84, or
- Age at first diabetes diagnosis was less than 7 years, or
- Identified as any type of diabetes in the DER-CA other than type 2, e.g., type 1, medication induced.

Note: To prevent classifying gestational diabetes as type 2, all diagnoses, prescriptions and HbA1c tests for pregnant women identified between 120 days before delivery to 90 days after were excluded from the above algorithm.

Incidence and Prevalence of Type 2 Diabetes among Adult Manitobans by Age Group

Key Findings (Figures 3.8-3.9; Table 3.3):

Incidence

- Among younger groups, incidence of type 2 diabetes was higher for First Nation Manitobans than for All Other Manitobans
- Among older groups, incidence was similar between First Nation Manitobans and All Other Manitobans
- No significant changes over time within each age group
- Prevalence
 - Among younger groups, prevalence of type 2 diabetes was higher for First Nation Manitobans than for All Other Manitobans
 - Prevalence was similar among older groups



Figure 3.8: Incidence of Type 2 Diabetes Among First Nation Adult Manitobans and All Other Adult Manitobans by Age Group Crude annualized rate per 1,000 person-years at risk, age 18-84, 2011/12-2012/13 to 2015/16-2016/17

Figure 3.9: Prevalence of Type 2 Diabetes Among First Nation Adult Manitobans and All Other Adult Manitobans by Age Group Crude percent, age 18-84, 2011/12-2012/13 to 2015/16-2016/17



Because we did not see any differences over time when Manitobans were grouped into five-year age groups and because we wanted to build on the results seen for any diabetes (Figure 3.1), we used regression models to examine the relationship between First Nation identity, age and time. We observed a significant interaction between these variables. Among First Nation individuals age 30 and under, the diagnosis rate increased over time, while for those over age 30, it decreased. Among All Other Manitobans age 30 and under, the rate was stable, while for those over age 30, it increased. The lack of a significant change in diagnosis rate among All Other Manitobans under age 30 may however be due to relatively low diagnosis rates (small numbers) overall in this group.

Table 3.3: Relative Rate of Incident Type 2 Diabetes in 2015/16-2016/17 compared to 2011/12-2012/13 Age- and sex-adjusted rate per person-year at risk, age 7+

Comparison Group	Rate Ratio	95% CI	p-value
First Nation Manitobans			
≤ 30 Years Old	1.21	1.10-1.32	<.0001
> 30 Years Old	0.84	0.77-0.91	<.0001
All Other Manitobans			
≤ 30 Years Old	1.05	0.96-1.15	0.2473
> 30 Years Old	1.10	1.02-1.19	0.0142

Incidence and Prevalence of Type 2 Diabetes among Manitobans by Income Quintile

Key Findings (Figures 3.10-3.11):

- Incidence
 - There were no significant differences, only trends (p<0.10)
 - In lower rural income quintiles, incidence tended to decrease over time
 - · Less distinct pattern for urban income quintiles

Prevalence

- There were no significant differences, only trends (p<0.10)
- Prevalence tended to increase over time for all income quintiles

Figure 3.10: Incidence of Type 2 Diabetes Among Manitobans by Income Quintile Crude rate per 1,000 person-years at risk, age 7+, 2011/12-2012/13 to 2015/16-2016/17



Figure 3.11: Prevalence of Type 2 Diabetes Among Manitobans by Income Quintile Crude percent, age 7+, 2011/12-2012/13 to 2015/16-2016/17



Incidence and Prevalence of Type 2 Diabetes among Manitobans by Health Region

First Nation individuals with type 2 diabetes were more likely to be younger and female compared to All Other Manitobans with type 2 diabetes. Due to this difference, calculating age- and sex-adjusted rates by RHA results in adjusted rates that are much higher than crude rates for First Nation individuals and can lead to misinterpretation and confusion. Thus, crude rates are presented alongside age- and sex-adjusted relative risks. It is important to note that when comparing risk between First Nation Manitobans and All Other Manitobans, the adjusted rates should be used.

Key Findings (Figures 3.12-3.13):

- In the most recent time period (2015/16 to 2016/17), the crude incidence among First Nation Manitobans was 7.6 per 1,000 person-years and among All Other Manitobans it was 5.7 per 1,000 person years
- Incidence:
 - Did not change over time
 - Was higher among First Nation Manitobans compared to All Other Manitobans in all health regions

- Did not vary between health regions among First Nation Manitobans
- Was higher among All Other Manitobans in the Northern Health Region compared to the Manitoba average in the last two time periods (2013/14 to 2014/15 and 2015/16 to 2016/17)
- In the most recent time period (2015/16 to 2016/17), the crude prevalence of type 2 diabetes for First Nation Manitobans was 14.7% and for All Other Manitobans it was 8.4%
- Prevalence:
 - Did not change over time
 - Was higher among First Nation Manitobans compared to All Other Manitobans in all health regions
 - Did not vary by health region among First Nation Manitobans

As noted earlier in this chapter, we need to account for age when examining incidence because incidence rates vary by age. Figure 3.12: Incidence of Type 2 Diabetes Among First Nation Manitobans and All Other Manitobans by Health Region Crude rate per 1,000 person-years at risk, age 7+, 2011/12-2012/13 to 2015/16-2016/17



Figure 3.13: Prevalence of Type 2 Diabetes Among First Nation Manitobans and All Other Manitobans by Health Region Crude percent, age 7+, 2011/12-2012/13 to 2015/16-2016/17

nern th- Sud	First Nation Manitobans									
South Heal Santé	All Other Manitobans							2011/1	2-2012/13	
iipeg IA	First Nation Manitobans							2015/1	6-2016/17	
Winn RF	All Other Manitobans									
irie ntain alth	First Nation Manitobans									
Pra Moui Hea	All Other Manitobans									
lake- :ern HA	First Nation Manitobans									
Interl East RH	All Other Manitobans					-				
hern alth jion	First Nation Manitobans									
Nort Hea Reg	All Other Manitobans									
toba	First Nation Manitobans									
Mani	All Other Manitobans									
	0	% 2%	4%	6%	8%	10%	12%	14%	16%	18%

Key Findings for Adjusted Rates by Health Region (Tables 3.4-3.5)

 Adjusted prevalence rates did not vary by health region for First Nation Manitobans or All Other Manitobans

- · Adjusted incidence:
 - Did not vary by health region among First Nation Manitobans
 - Was higher in the Northern Health Region among All Other Manitobans than in other regions
- Table 3.4: Relative Risk of Incident Type 2 Diabetes for Health Region Compared to Manitoba Average Among First Nation Manitobans

 and All Other Manitobans

Age- and sex-adjusted relative risks, age 7+, 2015/16-2016/17

	First Nation	Manitobans	All Other Manitobans		
Regional Health Authority	Relative Risk	95% Confidence Interval	Relative Risk	95% Confidence Interval	
RHA (REF = Manitoba)					
Southern Health-Santé Sud	1.13	0.82-1.56	0.84	0.65-1.09	
Winnipeg RHA	1.03	0.77-1.38	1.01	0.78-1.30	
Prairie Mountain Health	1.05	0.77-1.43	1.09	0.84-1.42	
Interlake-Eastern RHA	0.96	0.72-1.28	1.00	0.77-1.30	
Northern Health Region	1.10	0.83-1.44	1.33	1.01-1.76	

 Table 3.5: Relative Risk of Prevalent Type 2 Diabetes for Health Region Compared to Manitoba Average Among First Nation Manitobans

 and All Other Manitobans

Age- and sex-adjusted relative risks, age 7+, 2015/16-2016/17

	First Nation	Manitobans	All Other Manitobans			
Regional Health Authority	Relative Risk	95% Confidence Interval	Relative Risk	95% Confidence Interval		
RHA (REF = Manitoba)						
Southern Health-Santé Sud	1.03	0.75-1.40	0.81	0.60-1.10		
Winnipeg RHA	0.80	0.59-1.08	1.02	0.75-1.38		
Prairie Mountain Health	1.06	0.78-1.44	1.11	0.82-1.50		
Interlake-Eastern RHA	1.02	0.75-1.38	0.96	0.71-1.30		
Northern Health Region	1.12	0.83-1.52	1.24	0.91-1.68		

Key Findings for Adjusted Rates comparing First Nation Manitobans to All Other Manitobans by Health Region (Tables 3.6-3.7)

- Incidence
 - Incidence rates among First Nation Manitobans were almost twice the rates among All Other Manitobans
 - We saw a different degree of risk in different health regions; however, all incidence rates among First Nation Manitobans were higher than among All Other Manitobans

- Prevalence
 - Prevalence rates among First Nation Manitobans were 3.5 times higher than among All Other Manitobans
 - We saw a different degree of risk in different health regions; however, all incidence rates among First Nation Manitobans were higher than among All Other Manitobans

 Table 3.6: Relative Risk of Incident Type 2 Diabetes for First Nation Manitobans Compared to All Other Manitobans

 Age- and sex-adjusted relative risks, age 7+, 2015/16-2016/17

Regional Health Authority	Relative Risk	95% Confidence Interval
RHA (REF = All Other Manitobans)		
Southern Health-Santé Sud	2.64	1.91-3.64
Winnipeg RHA	2.01	1.51-2.68
Prairie Mountain Health	1.89	1.39-2.57
Interlake-Eastern RHA	1.88	1.41-2.52
Northern Health Region	1.61	1.20-2.17
Manitoba	1.97	1.51-2.56

Bold indicates a statistically significant difference

Table 3.7: Relative Risk of Prevalent Type 2 Diabetes for First Nation Manitobans Compared to All Other Manitobans Age- and sex-adjusted relative risks, age 7+, 2015/16-2016/17

Regional Health Authority	Relative Risk	95% Confidence Interval	
RHA (REF = All Other Manitobans)			
Southern Health-Santé Sud	4.40	3.22-6.01	
Winnipeg RHA	2.71	1.99-3.68	
Prairie Mountain Health	3.32	2.44-4.51	
Interlake-Eastern RHA	3.67	2.70-4.98	
Northern Health Region	3.14	2.31-4.27	
Manitoba	3.47	2.56-4.70	

Bold indicates a statistically significant difference

Crude Rates of Type 2 Diabetes by Tribal Council Area

Results shown by Tribal Council Area are presented as crude rates only due to relatively small numbers.

 Table 3.8: Incidence of Type 2 Diabetes Among First Nation Manitobans by Tribal Council Area

 Crude rate per 1,000 person-years, age 7+, 2011/12-2012/13 to 2015/16-2016/17

Tribal Council Area	2011/12-2012/13		2013/14-2014/15		2015/16-2016/17	
	On-Reserve	Off-Reserve	On-Reserve	Off-Reserve	On-Reserve	Off-Reserve
Interlake Reserves (IRTC)	8.99	7.39	9.50	8.35	7.46	8.44
West Region (WRTC)	8.19	9.27	7.15	10.37	8.08	7.59
Independent-North	8.76	8.19	8.24	7.93	7.39	7.92
Swampy Cree (SCTC)	8.13	7.45	7.16	8.27	7.28	7.83
Keewatin (KTC)	9.07	7.59	7.75	6.12	6.72	6.86
Independent-South	8.17	7.08	6.38	7.07	6.40	7.38
Dakota Ojibway TC (DOTC)	6.92	6.75	7.91	7.00	7.84	7.25
Southeast (SERDC)	7.65	7.44	7.49	8.25	8.04	7.61
Island Lake (ILTC)	12.16	11.62	10.81	8.18	10.65	10.16
Non-affiliated	13.83	S	8.70	14.03	S	S
All First Nations	8.85	7.71	8.05	7.89	7.63	7.69

s indicates suppression due to small numbers

Table 3.9: Prevalence of Type 2 Diabetes Among First Nation Manitobans by Tribal Council Area Crude percent, age 7+, 2011/12-2012/13 to 2015/16-2016/17

Tribal Council Area	2011/12-2012/13		2013/14-2014/15		2015/16-2016/17	
	On-Reserve	Off-Reserve	On-Reserve	Off-Reserve	On-Reserve	Off-Reserve
Interlake Reserves (IRTC)	15.19%	11.10%	16.52%	12.30%	16.06%	12.99%
West Region (WRTC)	14.50%	12.72%	15.82%	14.39%	16.09%	14.97%
Independent-North	13.93%	11.71%	14.56%	13.01%	14.72%	13.95%
Swampy Cree (SCTC)	12.86%	11.47%	13.53%	12.48%	13.53%	13.34%
Keewatin (KTC)	12.74%	10.51%	13.24%	11.09%	13.50%	12.25%
Independent-South	14.49%	12.17%	14.68%	12.84%	14.72%	13.41%
Dakota Ojibway TC (DOTC)	12.72%	9.06%	13.49%	9.72%	13.60%	10.23%
Southeast (SERDC)	15.63%	11.74%	15.69%	12.51%	15.76%	12.77%
Island Lake (ILTC)	21.15%	21.66%	21.78%	22.06%	22.09%	21.72%
Non-affiliated	24.63%	10.43%	26.32%	13.30%	24.77%	14.10%
All First Nations	14.88%	11.62%	15.51%	12.61%	15.60%	13.31%

Crude Rates of Type 2 Diabetes among Children Only

When we tried to use the enhanced definition of type 2 diabetes among children under age 18, it resulted in incidence and prevalence rates that were so high that they were unrealistic, especially for All Other Manitobans where the true rates of type 2 diabetes are low. Thus, we instead calculated type 2 diabetes rates for children using DER-CA data only. It is known that the DER-CA data slightly under-capture type 2 diabetes in children and adolescents, possibly up to 15% of cases [26], especially among older teens age 16-17, as they are not universally referred to paediatric endocrinology for assessment and would then not be captured in DER-CA. In order to supplement the DER-CA dataset and gain as much information from it as we could, we extended the time period back to 2009.

Key Findings (Tables 3.10-3.13; Figures 3.14-3.15):

- Incidence of type 2 diabetes increased over time
 among Manitoba children
- Prevalence of type 2 diabetes increased over time
 among Manitoba children
- Both incidence and prevalence rates were higher in the Northern Health Region

The majority of children living with type 2 diabetes in Manitoba are registered First Nation individuals (82.4% in 2017/18), and due to the small numbers of All Other Manitoban children with type 2 diabetes, we present rates for information only (small numbers do not allow statistical testing).

Table 3.10: 2-Year Incidence of Type 2 Diabetes Among First Nation Children and All Other Children in Manitoba Crude rate per 100,000 person-years at risk, age 7-17, 2009-2010 to 2017-2018

Time	First Nation Manitobans	All Other Manitobans
2009-2010	110.48	4.93
2011-2012	140.49	4.94
2013-2014	168.95	7.44
2015-2016	162.59	9.07
2017-2018	154.59	6.13

Table 3.11: 2-Year Prevalence of Type 2 Diabetes Among First Nation Children and All Other Children in Manitoba Crude rate per 100,000 children, age 7-17, 2009-2010 to 2017-2018

Time	First Nation Manitobans	All Other Manitobans		
2009-2010	478.04	27.60		
2011-2012	615.63	25.55		
2013-2014	778.45	28.99		
2015-2016	813.78	33.93		
2017-2018	821.72	36.91		

Incidence and prevalence of type 2 diabetes among First Nation children by Tribal Council Area are presented for information only (the small numbers do not allow for statistical testing).

Table 3.12: 5-Year Incidence of Type 2 Diabetes Among First Nation Children in ManitobaCrude rate per 100,000 person-years at risk, age 7-17, 2009-2013 and 2014-2018

Tribal Council Area	2009	-2013	2014-2018		
	On-Reserve	Off-Reserve	On-Reserve	Off-Reserve	
Interlake Reserves (IRTC)	120.97	S	105.70	S	
West Region (WRTC)	121.81	S	S	S	
Independent-North	120.85	S	132.56	89.85	
Swampy Cree (SCTC)	95.42	S	189.47	148.74	
Keewatin (KTC)	94.38	157.18	214.17	138.29	
Independent-South	83.47	84.71	109.44	S	
Dakota Ojibway TC (DOTC)	116.45	S	138.74	S	
Southeast (SERDC)	151.50	S	196.30	S	
Island Lake (ILTC)	536.22	S	514.12	S	
Non-affiliated	0.00	S	S	S	

Table 3.13: 5-Year Prevalence of Type 2 Diabetes Among First Nation Children in Manitoba Crude rate per 100,000 children, age 7-17, 2009-2013 and 2014-2018

Tribal Council Area	2009	-2013	2014-2018		
	On-Reserve	Off-Reserve	On-Reserve	Off-Reserve	
Interlake Reserves (IRTC)	733.33	S	588.24	S	
West Region (WRTC)	531.44	S	513.70	S	
Independent-North	600.67	S	790.43	582.15	
Swampy Cree (SCTC)	522.47	816.80	1,018.43	760.04	
Keewatin (KTC)	411.02	774.53	1,256.47	601.37	
Independent-South	465.27	429.41	638.98	423.28	
Dakota Ojibway TC (DOTC)	651.23	S	606.88	S	
Southeast (SERDC)	727.71	S	1,369.86	S	
Island Lake (ILTC)	3,240.00	S	3,419.40	S	
Non-affiliated	S	S	S	S	

Figure 3.14: Incidence of Type 2 Diabetes in Manitoban Children by Health Region

Crude rate per 100,000 person-years at risk, age 7-17, 2009-2010 to 2017-2018, using DER-CA data only



Figure 3.15: Prevalence of Type 2 Diabetes in Manitoba Children by Health Region Crude rate per 100,000 children, age 7-17, 2009-2010 to 2017-2018, using DER-CA data only



Further detail about children living with type 2 diabetes in Manitoba can be found in Chapter 8.

Chapter Summary and Recommendations

In Manitoba, people living with type 2 diabetes are getting younger, and more children and young adults are being diagnosed with type 2 diabetes. Our results suggest that further study of type 2 diabetes rates, including modelling the effects of age, time and First Nation identity in a larger cohort, is necessary to better understand the complex and evolving pattern of this disease.

Overall Summary and Recommendations

Guidelines on screening and risk factors for type 2 diabetes should be re-examined to ensure that they account for the increasing incidence of type 2 diabetes in children, youth and younger adults. Clear screening guidelines addressing the younger population should be developed. Programs aimed at primary prevention, such as food security programming, family supports, physical activity promotion and mental health promotion, are now becoming more important than ever [5,27].

The earlier diagnosis also results in higher prevalence of diabetes in younger age groups and a longer burden of illness. Thus, appropriate and early management as per current evidence and ensuring access to complication screening and treatment for all at-risk Manitobans is necessary to reduce morbidity in the long term. This type of screening has been demonstrated to be cost effective in Manitoba by the FINISHED project [19].

Summary and Recommendations for First Nation Manitobans with Type 2 Diabetes

This report confirms that First Nation populations have higher rates of type 2 diabetes and are diagnosed at a younger age than other Manitobans, as has previously been reported in the literature [11]. Whether the perceived drop in incidence in older age groups is an actual reduction in type 2 diabetes or just a reflection of diagnosis at an earlier age requires further study. This study demonstrated that First Nation individuals have 3.5 times the risk of being diagnosed with type 2 diabetes when compared to other Manitobans. As well, the Northern Health Region, which is home to a high proportion of First Nation individuals, has dramatically higher rates of type 2 diabetes compared to other health regions. These findings underline the importance of developing, funding and implementing culturally appropriate public health interventions to reduce the number of new diabetes cases and to maintain optimal health in those currently living with type 2 diabetes.

Chapter 4: Demographics and General Health Status of Manitobans with Type 2 Diabetes

This chapter presents an overview of the demographics and general health status of Manitobans with type 2 diabetes.

Objectives:

- Present the demographics (age, sex and region of residence) of the most recent cohort of people living with type 2 diabetes (2015/16 to 2016/17)
- Present mortality statistics and general health-related morbidity in this cohort
- Present recent comparative measures from the general population in Manitoba taken from
 - the RHA Indicators Atlas published by MCHP in 2019
 - the 2019 MCHP report titled 'Health Status of and Access to Healthcare by Registered First Nation Peoples in Manitoba'

All results are presented for the cohort of people living with type 2 diabetes in the last two fiscal years (2015/16 to 2016/17), with comparisons between First Nation Manitobans and All Other Manitobans where applicable.

Geographical Distribution

Key Findings (Figure 4.1):

- The majority of First Nation individuals with type 2 diabetes lived in the Northern Health Region and Interlake-Eastern RHA
- The majority of All Other Manitobans with type 2 diabetes lived in Winnipeg
- Comparison to the general Manitoba population: the geographical distribution of people with type 2 diabetes was similar to the general Manitoba population [24]

Figure 4.1: Health Region Distribution of First Nation Manitobans and All Other Manitobans with Type 2 Diabetes, 2015/16-2016/17



Age and Sex Distribution

Key Findings (Figures 4.2-4.3):

- At the time of this study, there were 108,942 individuals age 7+ living with type 2 diabetes in Manitoba
 - Exact numbers varied between the cohort years as the prevalence increased over time
 - First Nation Manitobans represented 16% of the total type 2 diabetes cohort but only made up 10% of all Manitoba residents
- Rates of type 2 diabetes were higher among female First Nation Manitobans than male; this is the reverse of what was seen among All Other Manitobans

- There was a significant difference in the age distribution between First Nation Manitobans with type 2 diabetes and All Other Manitobans with type 2 diabetes
 - First Nation Manitobans were younger their group included more children and young adults and fewer older adults

Comparison to the general Manitoba population: the age distribution of people with type 2 diabetes was similar to the general Manitoba population [24].





Figure 4.3: Age Distribution of First Nation Manitobans and All Other Manitobans with Type 2 Diabetes, 2015/16-2016/17



Total Mortality Rate

Total mortality rate (TMR) is defined as the rate of death from all causes. It is an indication of the overall health of the population, where lower TMR indicates higher health.

It is important to note that age- and sex-adjusted measures are presented in the following TMR and premature mortality rate (PMR) graphs to allow for valid comparisons between populations that have different age and sex compositions. As mortality increases with age, and Manitoba First Nation populations are not only younger than All Other Manitobans but also tend to die at a younger age on average, the adjusted TMR is quite a bit higher than the crude TMR. This is because adjustment shows what the rate would be if the First Nation population was as old as All Other Manitobans. As an example, the crude TMR among First Nation Manitobans was 25.31 per 1,000 person-years (vs adjusted TMR 70.1 per 1,000 person-years) and the crude TMR among All Other Manitobans was 35.25 per 1,000 personyears (vs adjusted TMR 39.78 per 1,000 person-years).

Key Findings (Figures 4.4-4.5):

- TMR was almost twice as high among First Nation Manitobans compared to All Other Manitobans
- There were no significant differences in TMR among health regions
- There were no significant differences in TMR among Tribal Council Areas (TCAs)
- Lack of differences may be due to small sample sizes
- Comparison to the general population in Manitoba:
 - In the general population of Manitoba, TMR was higher in the Northern Health Region vs other regions [23], but we did not see differences among regions in this report
 - In the First Nation Peoples Health Status report, TMR among First Nation individuals was almost twice what it was for All Other Manitobans [24], similar to what we found in this report
Figure 4.4: Total Mortality Rate Among First Nation Manitobans and All Other Manitobans with Type 2 Diabetes by Health Region Age- and sex-adjusted rate per 1,000 person-years, age 7+, 2013/14-2016/17



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Figure 4.5: Total Mortality Rate Among First Nation Manitobans with Type 2 Diabetes by Tribal Council Area Age- and sex-adjusted annual rate per 1,000 person-years, age 7+, 2013/14-2016/17



s - suppression due to small numbers

Premature Mortality Rate

The premature mortality rate (PMR) is defined as the rate of death from all causes between the ages of 7-74 years. It is an excellent overall measure of population health, where a lower PMR indicates better population health.

As with TMR, it is important to note that age- and sexadjusted measures are presented in the PMR graphs to allow for valid comparisons between populations which have different age and sex compositions. As mortality increases with age, and First Nation populations in Manitoba are not only younger than All Other Manitobans, but also tend to die at a younger age on average, the adjusted PMR among First Nation Manitobans is quite a bit higher than the crude rate. This is because adjustment shows what the rate would be if the First Nation population was as old as All Other Manitobans. For comparison, the crude PMR among First Nation Manitobans was 20.37 per 1,000 person-years (vs adjusted PMR 37.19 per 1,000 person-years) and crude PMR among the All Other Manitobans was 16.5 per 1,000 person-years (vs adjusted PMR 19.35 per 1,000 person-years). As expected, we also saw a pattern of increased PMR with age and male sex (Appendix 1 in the online supplement).

Key Findings (Figures 4.6-4.7):

- PMR was almost twice as high among First Nation Manitobans compared to All Other Manitobans
- There were no significant differences among health regions
- There were no significant differences among Tribal Council Areas (TCAs)
- May be due to small sample sizes
- Comparison to the general population in Manitoba:
 - There was a slight gradient from north to south, which we did not observe in this report [24]
 - In the First Nation Peoples Health Status report, PMR was significantly higher in the Northern Health Region [24], but we did not detect differences between regions in this report



Figure 4.6: Premature Mortality Rate Among First Nation Manitobans and All Other Manitobans with Type 2 Diabetes by Health Region Age- and sex-adjusted annual rate per 1,000 person-years, age 7-74, 2013/14-2016/17

> indicates area's All Others rate was statistically different from Manitoba's All Others rate (p<0.01) а

indicates data suppressed due to small numbers S





s - suppression due to small numbers

General Disease Burden – Charlson Comorbidity Index

The Charlson Comorbidity Index is a measure of how ill people are. Higher scores indicate a greater degree of illness. The Charlson Comorbidity Index is based on the International Classification of Diseases (ICD) diagnosis codes found in administrative data, such as hospital abstracts data. We used diagnoses from physician visits and hospital abstracts one year prior to the cohort years to construct the index (e.g., we used diagnoses from the 2014/15 fiscal year for the 2015/16-2016/17 cohort). Each comorbidity category has an associated weight from 1 to 6 based on the adjusted risk of mortality or resource use. The sum of all the weights is the comorbidity score for a patient. A score of zero indicates that no comorbidities were found. The higher the score, the more likely the predicted outcome will result in mortality or higher health resource use. The diabetes-free weighted score is presented here.

The scores are presented so the reader has an idea of the general health of the people living with type 2 diabetes in Manitoba, in addition to the detailed information on type 2 diabetes and related complications throughout this report. Due to the difference in age distribution between First Nation Manitobans and All Other Manitobans, results are **stratified** by age.

Weighted Mean Charlson Comorbidity Index by Age

Key Findings (Table 4.1):

- No difference in overall burden of illness in the younger groups
- In the older age groups, the burden of illness was higher among First Nation Manitobans compared to All Other Manitobans

We can look at the individual diagnosis groups that make up the Charlson Index to get an idea of which conditions contribute to the disease burden in the population. Some conditions were more predominant among First Nation Manitobans, and others more common among All Other Manitobans. For details, please see Appendix 1 online (Figures 1.3-1.4 and Tables 1.8-1.10). For further analysis of the direct complications of type 2 diabetes, such as endstage renal disease and vascular/cardiac complications, see Chapters 6 and 7.

 Table 4.1: Average Charlson Index Score Among First Nation Manitobans and All Other Manitobans

 Diabetes-free weighted score, age 7+, 2015/16-2016/17

Age Group	First Nation Manitobans	All Other Manitobans	Average Score Difference (95% CI)
7-29	0.20	0.18	0.02 (-0.06-0.11)
30-49	0.33	0.27	0.06 (0.02-0.09)
50+	0.72	0.65	0.07 (0.04-0.09)

Bold values indicate statistically significant differences (p<.05)

Chapter Summary

This chapter summarizes the general characteristics and general health status of Manitobans living with type 2 diabetes. It underlines the importance of age and sex adjustment in analyses going forward, especially when comparing results between First Nation Manitobans and All Other Manitobans, as the First Nation cohort is younger, more likely to be female and has a higher burden of illness. This is due to earlier age of diagnosis as well as higher mortality and premature mortality among First Nation individuals. We observed fewer differences in health status among different health regions than in previous reports examining the general Manitoba population. When First Nation people with type 2 diabetes are compared across health regions their health status is similar, and the same occurs for All Other Manitobans. Specifically, we did not detect higher mortality in the Northern Health Region. It is possible that this is because when looking at the general population, First Nation people, who have a higher mortality rate due to type 2 diabetes and the impact of social and indigenous determinants of health, make up a higher percentage of the Northern Health Region population than other regions. Our results here are stratified into First Nation Manitobans and All Other Manitobans, so that effect is not seen. Additionally, many individuals with type 2 diabetes move permanently to Winnipeg to access services, especially from more rural/remote regions like the Northern Health Region. This decreases morbidity in the North and increases it in Winnipeg.

Chapter 5: Health Services Use among Manitobans with Type 2 Diabetes

This chapter focuses on the continuum of health services use by Manitobans living with type 2 diabetes. Characterizing this use is important to identify differences in service use across the population and to highlight areas for further study. Call to Action #19 from the Truth and Reconciliation Commission of Canada [1] addresses the need for appropriate access to health services for First Nation individuals, and provides impetus for the analyses in this chapter. Each indicator provides a slightly different perspective, as both inpatient health service use (hospitalizations and ambulatory care sensitive hospitalizations) and outpatient/ambulatory health service use are reported.

It is important to note that both patient-related and societal factors affect access to and use of all aspects of the healthcare system. Risk of hospitalization is influenced not only by access to quality outpatient care, but also access to other services such as home care, foot care and wound care services. Additionally, the social determinants of health (e.g., socioeconomic status and living conditions) affect the likelihood of health service use for the entire population. Among First Nation individuals, health service use is additionally impacted by the Indigenous determinants of health, including racism, marginalization, and lack of language support. Please keep in mind that rates of health service use reported here only assess quantity of care, and cannot speak to quality of care received at any interaction.

Objectives:

- Examine rates of outpatient (ambulatory) visit rates (primary care provider visits and specialist visits)
- Examine rates of hospitalization (general hospitalization and hospitalization for Ambulatory Care Sensitive Conditions (ACSC))
- Assess the association between continuity of care and rates of health service use
- Assess differences in health service use by age, sex, health region, TCA and among First Nation Manitobans with type 2 diabetes and All Other Manitobans with type 2 diabetes

Results are presented based on where the patient lives, not necessarily where they were hospitalized or where they accessed care. For example, a resident of the Northern Health Region who is hospitalized in Winnipeg is counted under the Northern Health Region.

Primary Care Provider Ambulatory Visit Rates

This section reports rates of ambulatory visits to primary care providers (family physicians and nurse practitioners). For context, the ambulatory visit rate for all Manitobans (not just those with type 2 diabetes) is 4.63 visits per person in 2016/17 [23]. Rates in the general population are known to differ from rates among First Nation Manitobans and All Other Manitobans; in 2016/17, the ambulatory visit rate among First Nation Manitobans was 2.88 visits per person, and the rate among All Other Manitobans was 3.47 visits per resident [24].

It is important to consider that differences in rates are affected by both patient illness and access to care. Lower rates may reflect poorer access despite higher patient illness, and conversely, higher rates may reflect better access despite less illness. The social determinants of health and the Indigenous determinants of health also affect access to care. Ambulatory visit rates are lower in areas of Manitoba where individuals receive primary care at nursing stations (primarily in the North), as nursing station visits are not captured in Repository. Ambulatory visit rates are also known to be under-captured by about 30% in areas where physicians are salaried and do not bill directly for services they provide. In addition to presenting ambulatory visit rates, we also present the percentage of people with no visits recorded within one year, as this may indicate poor access to primary care providers.

Care for type 2 diabetes is provided differently based on patients' age. In general, paediatric patients receive type 2 diabetes care from paediatric endocrinologists (specialists); however, their primary care needs outside of type 2 diabetes are met by paediatricians or family physicians/ nurse practitioners. Adults and young people between ages 16 and 19 typically receive type 2 diabetes care from primary care providers (family physicians and nurse practitioners). Thus, the results in this section apply mainly to adults, not children.

Key Findings (Figures 5.1-5.5):

- Overall rates of ambulatory visits were 6.6 visits per person-year for First Nation Adult Manitobans with type 2 diabetes and 7.3 visits per person-year for All Other Adult Manitobans with type 2 diabetes
- By health region:
 - Visits rates were higher in Winnipeg for First Nation Manitobans with type 2 diabetes vs All Other Manitobans with type 2 diabetes, but similar in all other regions

- Rates for both groups were higher than the Manitoba average in Prairie Mountain Health
 - Additionally, in Winnipeg, First Nation Manitobans (but not All Other Manitobans) had higher visit rates than the Manitoba average
- There was no gradient in ambulatory visit rates from lowest to highest PMR
- Rates for both First Nation Manitobans and All Other Manitobans with type 2 diabetes were lower than the Manitoba average (for those with type 2 diabetes) in the Northern Health Region
- First Nation Manitobans were almost twice (7% vs 4%) as likely to have no **ambulatory visits** in a year than All Other Manitobans
- For both groups, the likelihood of having no visits in a year was higher in the Northern Health Region than the Manitoba average, but the groups were not different from each other
- By TCA:
 - Dakota Ojibway Tribal Council had the highest ambulatory visit rates on- and off-reserve
 - Off-reserve visit rates were higher than onreserve visits rates in almost all TCAs
 - The Manitoba rate overall was lower onreserve (RR 0.76, 95% CI 0.66-0.88)
 - On-reserve visit rates for Swampy Cree Tribal Council, Keewatin Tribal Council, Southeast Resource Development Council, and Island Lake Tribal Council were significantly lower than the TCA with the highest visit rate
 - Few significant differences were seen among TCA off-reserve visit rates
 - Only Independent-North and Keewatin Tribal Council had on-reserve visit rates that were significantly lower than the TCA with the highest visit rate
- By age and sex:
 - Ambulatory visit rates increased with age in all groups
 - Visit rates among female Manitobans were higher than among male Manitobans
 - Overall, male Manitobans were more likely to have no visits than female Manitobans

Figure 5.1: Primary Care Provider Visit Rate Among First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Health Region

Age- and sex-adjusted rate per person-year, age 18+, 2013/14-2016/17



a indicates area's All Others rate was statistically different from Manitoba's All Other Manitobans rate (p<0.01)

s indicates data suppressed due to small numbers

Figure 5.2: Primary Care Provider Visit Rate Among First Nation Adult Manitobans with Type 2 Diabetes by Tribal Council Area Age- and sex-adjusted rate per person-year, age 18+, 2013/14-2016/17



+ - The difference between this area's rate and the highest First Nations On-Reserve rate (Dakota Ojibway (DOTC)) was statistically significant (p<0.01).

+ - The difference between this area's rate and the highest First Nations Off-Reserve rate (Dakota Ojibway (DOTC)) was statistically significant (p<0.01).

§ - The difference between this area's First Nations On-Reserve and Off-Reserve rate was statistically significant (p<0.01).

Figure 5.3: Primary Care Provider Visit Rate Among First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Age and Sex

Crude rate per person-year, age 18+, 2013/14-2016/17



Percent of Manitobans with Zero Ambulatory Care Visits in One Year

Figure 5.4: Percent of First Nation Manitobans and All Other Manitobans with Type 2 Diabetes with Zero Ambulatory Care Visits in One Year by Health Region

Age- and sex-adjusted percent, age 7+, 2016/17



f indicates area's First Nation rate was statistically different from Manitoba's First Nation rate (p <0.01)

a indicates area's All Others rate was statistically different from Manitoba's All Other Manitobans rate (p < 0.01)

s indicates data suppressed due to small numbers

Figure 5.5: Percent of First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes with Zero Ambulatory Care Visits in One Year by Age and Sex

Crude percent, age 18+, 2016/17



Continuity of Care

There is evidence to suggest that having a regular healthcare provider results in better preventative care for type 2 diabetes [28]. Continuity of care can be measured in different ways. Here we report the **Continuity of Care Index**, which has a scale from 0 to 1 with higher numbers reflecting better continuity, i.e., a higher percentage of visits to the same provider. In calculating continuity of care, we included only Manitoba residents age 18+ who had at least three visits to a primary care provider in three years. We limited the cohort to adults because diabetes care differs by age group (children in Manitoba typically receive diabetes care from paediatric specialists).

Key Findings (Figures 5.6-5.8):

- The Continuity of Care Index for First Nation Manitobans was 0.59 and for All Other Manitobans it was 0.66
- By health region:
 - There were very few differences in continuity of care among health regions
 - In all health regions except the Northern Health Region, continuity of care was lower among First Nation Manitobans than among All Other Manitobans
 - In the Northern Health Region, continuity of care among All Other Manitobans was lower than the Manitoba average for All Other Manitobans

- Continuity of care among First Nation Manitobans living in Interlake-Eastern RHA was lower than the Manitoba average for First Nation Manitobans
- By TCA:
 - Continuity of care on-reserve was lower overall than continuity of care off-reserve (RR 0.88, 95% CI 0.79-0.97)
 - People living on-reserve in Independent-North had the highest continuity of care of any other TCA (Independent-North was a bit of an outlier)
 - All other First Nation communities, except those in Keewatin Tribal Council had significantly lower continuity of care compared to Independent-North
 - Among people living off-reserve, the highest continuity of care was in Swampy Cree Tribal Council, and Independent-North, Keewatin Tribal Council, Dakota Ojibway Tribal Council, and Island Lake Tribal Council had significantly lower continuity of care
- By age and sex:
 - Continuity of care increased with age
 - Continuity of care was higher for males than for females among First Nation Manitobans and among All Other Manitobans

Figure 5.6: Continuity of Care Among First Nation Adult Manitobans with Type 2 Diabetes and All Other Adult Manitobans with Type 2 Diabetes by Health Region

Age- and sex-adjusted Continuity of Care Index, age 18+, 2014/15-2016/17







Figure 5.8: Continuity of Care Among First Nation Adult Manitobans with Type 2 Diabetes by Tribal Council Area Age- and sex-adjusted Continuity of Care Index, age 18+, 2014/15-2016/17



+ - The difference between this area's rate and the highest First Nation On-Reserve rate (Independent North) was statistically significant (p<0.01).

+ - The difference between this area's rate and the highest First Nation Off-Reserve rate (Swampy Cree (SCTC)) was statistically significant (p<0.01).

§ - The difference between this area's First Nation On-Reserve and Off-Reserve rate was statistically significant (p<0.01).

Distribution of Continuity of Care Index Values

Figure 5.9 shows the distribution of Continuity of Care Index values for First Nation Manitobans and All Other Manitobans. This graph demonstrates why the mean Continuity of Care Index values are lower for First Nation Manitobans. First Nation Manitobans are over-represented in the lower value groups and under-represented in the higher value groups when compared to All Other Manitobans. In order to assess whether there was a relationship between continuity of care and care received by the population with type 2 diabetes, we divided First Nation Manitobans with type 2 diabetes and All Other Manitobans with type 2 diabetes into six groups based on their Continuity of Care Index (Table 5.1). We then tested the association between continuity of care and selected indicators of health service use and screening.

Figure 5.9: Continuity of Care for First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Index Group Crude percent in each index group (excluding people with fewer than 3 visits in 3 years), age 18+, 2014/15-2016/17



Table 5.1: Continuity of Care for First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Index Group Crude number and percent in each index group, age 18+, 2014/15-2016/17

COC Index Group	First Nation Manitobans		All Other Manitobans	
	Number	Percent	Number	Percent
1 (0-0.24)	3,371	21.99%	6,088	7.31%
2 (0.25-0.49)	4,646	30.31%	20,246	24.30%
3 (0.50-0.74)	2,631	17.16%	20,597	24.72%
4 (0.75-0.99)	1,654	10.79%	17,149	20.58%
5 COC Index of 1	1,809	11.80%	15,593	18.71%
N/A*	1,219	7.95%	3,654	4.39%
Total	15,330	100.00%	83,327	100.00%

N/A = fewer than 3 visits and therefore excluded from the COC index

Specialist Visit Rates

Specialist visits include visits to all types of physician specialists, such as endocrinologists, surgeons and cardiologists. In this analysis, paediatricians are also considered specialists. In interpreting these results, it is important to realize that these are visit rates, not referral rates. The data do not capture information on cases where a patient was not referred, did not attend the appointment, or did not need to see a specialist. In Manitoba, seeing a specialist usually requires a referral from a primary care provider; however, the Diabetes Integration Project (see Chapter 6 for description) can refer patients directly to a specialist, bypassing the primary care provider. Most specialists practice in Winnipeg, although some specialists provide outreach visits to some communities outside of Winnipeg. As demonstrated in the 2019 report on First Nation Health Status. First Nation Manitobans have lower rates of specialist visits than other Manitobans (RR 0.88, 95% CI 0.79-0.97) despite having higher morbidity [24].

Key Findings (Figures 5.10-5.12):

- Specialist visit rates were 1.5 visits per person-year among First Nation Manitobans compared to 1.9 visits per person-year among All Other Manitobans
- By health region:
 - Specialist visit rates were 20% lower among First Nation Manitobans than among All Other Manitobans
 - Only in the Northern Health Region were specialist visit rates higher among First Nation Manitobans than among All Other Manitobans
 - In Southern Health-Santé Sud, All Other Manitobans had significantly lower specialist visit rates than the Manitoba average
 - The specialist visit rates among First Nation Manitobans were higher in the Winnipeg Regional Health Authority compared to the Manitoba average

- The specialist visit rates among All Other Manitobans were lower in the Northern Health Region compared to the Manitoba average
- Both First Nation Manitobans and All Other Manitobans had lower visit rates in Prairie Mountain compared to the Manitoba average

By TCA:

- Overall, there was no difference between specialist visit rates between people living onreserve and people living off-reserve (RR 0.95, 95% CI 0.78 -1.16)
 - Where we did observe a difference between people living on- and offreserve, specialist visit rates were higher among those living off-reserve
- The highest specialist visit rates were in Island Lake Tribal Council (both on- and off-reserve); the rates for all other TCAs were significantly lower
- By age and sex:
 - We observed higher specialist visit rates for females among First Nation Manitobans and All Other Manitobans during the child-bearing years
 - Specialist visit rates were higher among females than among males in both groups until age 60-69
 - Among First Nation Manitobans, males and females age 60-69 had similar visit rates
 - Among All Other Manitobans, males age 60-69 had a higher rate of visits than females age 60-69



Figure 5.10: Specialist Visit Rate Among First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Health Region Age- and sex-adjusted rate per person-year, age 18+, 2013/14-2016/17

a indicates area's All Others rate was statistically different from Manitoba's All Other Manitobans rate (p<0.01)

s indicates data suppressed due to small numbers

Figure 5.11: Specialist Visit Rate Among First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Age and Sex Crude rate per person-year, age 18+, 2013/14-2016/17







+ - The difference between this area's rate and the highest First Nation On-Reserve rate (Island Lake (ILTC)) was statistically significant (p<0.01).

+ - The difference between this area's rate and the highest First Nation Off-Reserve rate (Island Lake (ILTC)) was statistically significant (p<0.01).

§ - The difference between this area's First Nation On-Reserve and Off-Reserve rate was statistically significant (p<0.01).

Association between Continuity of Care and Specialist Visits

Index value for those with fewer than 3 primary care provider visits in 3 years – among this group, there were no differences in specialist visit rates.

Continuity of care was not associated with rates of specialist visits for First Nation Manitobans or for All Other Manitobans. We could not calculate a Continuity of Care

 Table 5.2: Association Between COC Index Group and Specialist Visit Rates for First Nation Adult Manitobans and All Other Adult

 Manitobans with Type 2 Diabetes

 Age 18-59, 2013/14 - 2016/17

COC Index Group	First Nation Manitobans		All Other Manitobans	
	Relative Risk	95% Confidence Interval	Relative Risk	95% Confidence Interval
2 (0.25-0.49)	1.15	0.81-1.62	1,12	0.78-1.61
3 (0.50-0.74)	1.26	0.89-1.80	1.17	0.81-1.68
4 (0.75-0.99)	0.95	0.64-1.39	1.00	0.67-1.48
5 COC Index of 1	1.38	0.96-1.99	1.45	0.99-2.13
N/A*	0.89	0.62-1.28	0.85	0.58-1.23

* N/A = fewer than 3 visits and therefore excluded from the COC index

Hospitalizations Overall

Presented here are the overall hospitalization rates for people with type 2 diabetes. For context, the age- and sex-adjusted hospitalization rate for the general Manitoba population in 2016/17 was 78.44 hospitalizations per 1,000 people [23]. A recent study reports the adjusted overall hospitalization rate among registered First Nation Manitobans as 139.07 hospitalizations per 1,000 individuals and among All Other Manitobans as 56.7 hospitalizations per 1,000 individuals [24]. Hospitalizations for childbirth were excluded. The most common reasons for hospitalization were diabetes and cardiovascular disease (Appendix 1 in the online supplement).

Key Findings (Figures 5.13-5.15):

- The hospitalization rate among First Nation Manitobans with type 2 diabetes was 438.5 hospitalizations per 1,000 person-years compared to 225.6 hospitalizations per 1,000 person-years among All Other Manitobans with type 2 diabetes
- By health region:
 - Across Manitoba, the hospitalization rate was approximately double among First Nation Manitobans vs All Other Manitobans (Manitoba average RR 1.94, 95% CI 1.60-2.37)
 - There were no significant differences between health regions and within groups except for a higher hospitalization rate among First Nation Manitobans in Prairie Mountain Health (compared to the Manitoba average)

- By TCA:
 - We saw little difference in hospitalization rates between people living on-reserve vs off-reserve, and they were not significantly different overall
 - When we did observe differences, rates were higher for on-reserve populations
 - Southeast (Southeast Resource Development Council) had the lowest rates among all TCAs both on- and off-reserve
 - West Region Tribal Council on-reserve populations had significantly higher rates than Southeast
 - Independent-South, Dakota Ojibway Tribal Council and Island Lake Tribal Council offreserve populations had significantly higher rates than Southeast
- By age and sex:
 - Hospitalization rates were higher in older age groups
 - Hospitalization rates were similar between sexes

Southern Health-Santé Sud (*) First Nation Manitobans w T2DM All Other Manitobans w T2DM MB First Nation Manitobans w T2DM Winnipeg RHA (*) - MB All Other Manitobans w T2DM Health Regions Prairie Mountain Health (*,f) Interlake-Eastern RHA (*) Northern Health Region (*) Manitoba (*) 0 200 400 600 800 1,000 1,200 indicates area's First Nation rate was statistically different from All Other Manitobans rate (p<0.05)

Figure 5.13: Inpatient Hospitalization Rate Among First Nation Manitobans and All Other Manitobans with Type 2 Diabetes by Health Region Age- and sex-adjusted rate per 1,000 person-years, age 7+, 2013/14-2016/17, excludes hospitalizations for childbirth

> indicates area's First Nation rate was statistically different from Manitoba's First Nation rate (p<0.01) f

indicates area's All Others rate was statistically different from Manitoba's All Other Manitobans rate (p<0.01) а

indicates data suppressed due to small numbers S

Figure 5.14: Inpatient Hospitalization Rate Among First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Age and Sex

Crude average annual rate per 1,000 person-years, age 18+, 2013/14-2016/17, excludes hospitalizations for childbirth





Figure 5.15: Inpatient Hospitalization Rate Among First Nation Manitobans with Type 2 Diabetes by Tribal Council Area Age- and sex-adjusted average annual rate per 1,000 person-years, age 7+, 2013/14-2016/17, excludes hospitalizations for childbirth

+ - The difference between this area's rate and the lowest First Nation On-Reserve rate (Southeast (SERDC)) was statistically significant (p<0.01).

+ - The difference between this area's rate and the lowest First Nation Off-Reserve rate (Southeast (SERDC)) was statistically significant (p<0.01).

§ - The difference between this area's First Nation On-Reserve and Off-Reserve rate was statistically significant (p<0.01).

Association between Continuity of Care and Hospitalizations

Continuity of care was not associated with hospitalizations except for those with a Continuity of Care Index = 1 (very high continuity of care). Hospitalization rates for this group were lower among both First Nation Manitobans and All Other Manitobans. There was no gradient across continuity of care groups. We could not calculate a Continuity of Care Index value for those with fewer than 3 primary care provider visits in 3 years –this group also had lower hospitalization rates.

Table 5.3: Association Between COC Index Group and Hospitalization Rates for First Nation Adult Manitobans and All Other AdultManitobans with Type 2 Diabetes

Per 1,000 person-years, age 18+, 2013/14 - 2016/17

COC Index Group	First Nation Manitobans		All Other Manitobans	
	Relative Risk	95% Confidence Interval	Relative Risk	95% Confidence Interval
2 (0.25-0.49)	1.03	0.84-1.25	0.96	0.77-1.20
3 (0.50-0.74)	1.11	0.90-1.36	1.08	0.86-1.37
4 (0.75-0.99)	1.09	0.88-1.36	1.12	0.88-1.44
5 COC Index of 1	0.46	0.37-0.58	0.41	0.32-0.54
N/A*	0.75	0.59-0.94	0.69	0.54-0.89

* N/A = fewer than 3 visits and therefore excluded from the COC index

Hospitalizations for Ambulatory Care Sensitive Conditions

While not all hospitalizations are avoidable, it is increasingly recognized that many are. Ambulatory Care Sensitive Conditions (ACSCs) are a set of 28 medical conditions/ diagnoses "for which timely and effective outpatient care can help to reduce the risk of hospitalization by either preventing the onset of an illness or condition, controlling an acute episodic illness or condition, or managing a chronic disease or condition" [29]. Since this definition was developed and used in research, it has also become apparent that effective outpatient physician care is only one of several factors that can influence hospitalizations for ACSCs - others include allied healthcare, such as foot care and home care, and the social determinants of health (e.g., poverty, access to clean water and quality housing) [30,31]. These may be the primary drivers of differences in risk of hospitalizations in some populations.

Definition: Please see Appendix 2 online for the list of ambulatory care sensitive conditions.

Key Findings (Figures 5.16-5.18):

- The overall ambulatory care sensitive (ACS) hospitalization rate for First Nation Manitobans was 100.2 hospitalizations per 1,000 person-years compared to 37.4 hospitalizations per 1,000 personyears among All Other Manitobans
- By health region:
 - Across all health regions, ACS hospitalization rates were approximately 2.5x higher among First Nation Manitobans than among All Other Manitobans
 - Among All Other Manitobans, rates were higher than the Manitoba average in Prairie Mountain Health and lower than the Manitoba average in Winnipeg
 - Among First Nation Manitobans, rates were higher than the Manitoba average in Prairie Mountain Health

By TCA:

- There was no difference overall in ACS hospitalization rates between people living onreserve and off-reserve
- Of all the TCAs, Southeast (Southeast Resource Development Council) had the lowest ACS hospitalization rates both on- and off-reserve
- Most TCAs had similar rates to Southeast Resource Development Council
- Dakota Ojibway Tribal Council's rates were higher both on- and off-reserve
- West Region Tribal Council and Island Lake Tribal Council had different patterns than the other TCAs and large variation in rates both on- and off-reserve
- By age and sex:
 - ACS hospitalization rates were higher in older groups
 - ACS hospitalization rates were similar between sexes within each group

Figure 5.16: Rate of Hospitalization for Ambulatory Care Sensitive Conditions Among First Nation Manitobans and All Other Manitobans with Type 2 Diabetes by Health Region

Age- and sex-adjusted rates per 1,000 person-years, age 7-74, 2013/14-2016/17



a indicates area's All Others rate was statistically different from Manitoba's All Other Manitobans rate (p<0.01)

s indicates data suppressed due to small numbers

Figure 5.17: Rate of Hospitalizations for Ambulatory Care Sensitive Conditions Among First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Age and Sex

Crude average annual rate per 1,000 person-years, age 18-79, 2013/14-2016/17



Note: Missing values indicate suppressed due to small values.

Figure 5.18: Rate of Hospitalization for Ambulatory Care Sensitive Conditions Among First Nation Manitobans with Type 2 Diabetes by Tribal Council Area

Age- and sex-adjusted rate per 1,000 person-years, age 7-74, 2013/14-2016/17



+ - The difference between this area's rate and the lowest First Nation On-Reserve rate (Southeast (SERDC)) was statistically significant (p<0.01).

+ - The difference between this area's rate and the lowest First Nation Off-Reserve rate (Southeast (SERDC)) was statistically significant (p<0.01).

§ - The difference between this area's First Nation On-Reserve and Off-Reserve rate was statistically significant (p<0.01).

Association between Continuity of Care and Ambulatory Care Sensitive Hospitalizations

Only the group with a Continuity of Care Index value = 1 had a significant association between ACS hospitalization and continuity of care (associated with lower hospitalization rates for both First Nation Manitobans and All Other Manitobans). There was no gradient. We could not calculate a Continuity of Care Index value for those with fewer than three primary care provider visits in three years – among this group, First Nation Manitobans also had lower ACS hospitalization rates, but All Other Manitobans did not.

 Table 5.4: Association Between COC Index Group and Hospitalization for Ambulatory Care Sensitive Conditions for First Nation Adult

 Manitobans and All Other Adult Manitobans with Type 2 Diabetes

 Age 18-74, 2013/14 - 2016/17

COC Index Group	First Nation Manitobans		All Other Manitobans	
	Relative Risk	95% Confidence Interval	Relative Risk	95% Confidence Interval
2 (0.25-0.49)	1.06	0.73-1.52	0.81	0.54-1.21
3 (0.50-0.74)	1.57	1.07-2.30	1.26	0.83-1.91
4 (0.75-0.99)	1.49	0.97-2.29	1.38	0.87-2.20
5 COC Index of 1	0.31	0.19-0.51	0.25	0.15-0.43
N/A*	0.55	0.34-0.87	0.66	0.40-1.09

* N/A = fewer than 3 visits and therefore excluded from the COC index

Chapter Summary and Recommendations

The health services use outcomes in this chapter describe the continuum of medical care provided to Manitobans living with type 2 diabetes. Due to the nature of the Repository data, we can look at rates of service use but do not have information on *why* people did or did not access a particular health service. There is also no way of knowing what the "right" or "appropriate" rates would be. However, some of the patterns we observed are concerning. These findings point to areas for improvement.

Overall Results and Recommendations

As demonstrated in Chapter 4, Manitobans living with type 2 diabetes did not differ in premature mortality rate or total mortality rate across health regions. Thus, we might also expect them to have relatively similar needs for healthcare services in different regions. We did however observe some differences in health services use by health region, mostly in outpatient services. Rates of both specialist and primary care visits in Winnipeg were higher than in other regions, most likely reflecting the availability of practitioners in the urban centre of the province. This theory is supported by data showing higher visit rates in non-urban areas where programs to increase access to care have been implemented, such as for First Nation populations in the North and in Island Lake Tribal Council. Prairie Mountain Health has high rates of both ambulatory visits and hospitalizations, but low rates of specialist visits, as has been seen previously in the general Manitoba population [23]. The North has lower primary care provider visit rates among both First Nation Manitobans with type 2 diabetes and All Other Manitobans with type 2 diabetes. This suggests that the care First Nation Manitobans receive at nursing stations does not entirely account for the low visit rates in the North, nor does lack of shadow billing, as the percent of the cohort with zero visits in a year is only slightly higher for All Other Manitobans and not higher than the Manitoba average for First Nation Manitobans. Very little difference in continuity of care was seen across health regions. Areas where primary care provider visit rates are higher or lower do not have different continuity of care, except in the North where All Other Manitobans tend to have lower continuity of care. These findings identify areas where the quantity and consistency of access to primary care could be improved.

Primary care includes a wide range of diagnostic and preventative advice and counselling services. While often provided by family doctors and nurse practitioners, it may also be provided by nurses, midwives, dietitians, pharmacists, mental health professionals, therapists and other health professionals [32]. Care for diabetes may also include self management education, as outlined in Appendix 3 online. For many people, especially those living in First Nation communities, care is provided by nurses at nursing stations. Although the Repository contains information on visits to family doctors, nurse practitioners and specialists, it does not capture the entire breadth of primary care provided by other health professionals.

We detected very few differences in ambulatory care sensitive hospitalizations across the health regions; this is expected, as other indicators of overall population health (total mortality, premature mortality) likewise are similar across regions. In our report, the exception was Prairie Mountain Health, where both rates of general hospitalizations and ambulatory care sensitive hospitalizations were higher despite similar TMR and PMR.

There are concerning differences in health services use between males and females. In this report, males had poorer health overall (higher TMR and PMR) compared to females, but had fewer physician visits than females, especially in the early adult years, and were more likely than females to have not seen a physician at all in a one-year span. However, those that did seek out care had higher continuity of care than females. Males were generally also less likely to see a specialist than females, except for older males in the All Other Manitobans group, who saw more specialists than females. **These findings support the development of programs to remove barriers to male attendance at primary care visits.**

There was no consistent association between continuity of care and specialist visits, general hospitalizations or ambulatory care sensitive hospitalizations. This suggests that a confounding factor other than primary care continuity is driving health services use in the population. However, both a high Continuity of Care Index value of 1 and no score (due to a very low rate of visits) were associated with health services use – this suggests that a factor common to both those groups may be playing a role.

Summary and Recommendations for First Nation Manitobans with Type 2 Diabetes

Chapter 4 demonstrated that First Nation Manitobans with type 2 diabetes had higher PMR (higher morbidity and mortality) than All Other Manitobans with type 2 diabetes across all health regions. This is further supported by the findings in Chapter 5, which shows that First Nation Manitobans with type 2 diabetes had higher rates of hospitalizations and ambulatory care sensitive hospitalizations. However, First Nation Manitobans with type 2 diabetes had equal primary care visit rates compared to All Other Manitobans with type 2 diabetes (except in Winnipeg), lower specialist visit rates and lower continuity of care. When we compared First Nation Manitobans with type 2 diabetes living on- and off-reserve, we saw that in most TCAs those living on-reserve received similar or fewer services and had a slightly higher burden of illness (measured by hospitalizations and ambulatory care sensitive hospitalizations in a setting of similar TMR and PMR) than those living off-reserve. For some outcomes, there was little variation between those living on-reserve and off-reserve. This suggests that the care First Nation Manitobans with type 2 diabetes are receiving is inadequate for their needs; this phenomenon is not confined to on-reserve populations.

This chapter is meant to be a starting point for examining diabetes care among First Nation populations. We can only report quantity and consistency of care, and cannot identify factors outside of the healthcare system that may be impacting outcomes. However, all Manitobans should have access to adequate and equitable healthcare. Additional information about interactions with the healthcare system as well as survey data on First Nation individuals' health and well-being can be found in the report 'The Health Status of and Access to Healthcare by Registered First Nation Peoples in Manitoba' [24].

We saw the highest rates of visits to specialists in Island Lake Tribal Council, most likely due to the Ongomiizwin Program [33], again **supporting the positive role of targeted programs.** In the Island Lake Tribal Council, we also observed lower on-reserve ambulatory care sensitive hospitalizations. It is important to note that while Island Lake Tribal Council's services are contracted though the WRHA, geographically Island Lake Tribal Council is in the Northern Health Region, and thus their service use is captured under the Northern Health Region in this report.

During discussions of this chapter's findings with representatives from First Nation communities, there was concern that the findings suggest that the care provided to First Nation individuals with type 2 diabetes was different than the care provided to All Other Manitobans with type 2 diabetes. Care could be impacted by racism, language and communication issues, and limited capacity to address multiple morbidities within a single physician/ nurse practitioner encounter. There is growing evidence that primary care is not the only type of care that prevents ambulatory care sensitive hospitalizations: Indigenous people receiving care from Indigenous-run programs and providers have better outcomes [34]. Strategies to increase the availability of Indigenous healthcare providers are essential. Multiple other factors, including the social determinants of health and Indigenous determinants of health, which differentially affect First Nation Manitobans and All Other Manitobans, likely also play a role. We observed few differences between on- and off-reserve ambulatory care sensitive hospitalizations, thus, the factors driving the difference between First Nation Manitobans and All Other Manitobans are not related to differences in living on- vs off-reserve.

Chapter 6: Type 2 Diabetes-Related Care and Complications

Adult Manitobans with type 2 diabetes receive diabetes care from their primary care providers (family physicians and nurse practitioners) with referral to specialists as needed. Children with type 2 diabetes under 17 receive diabetes care from paediatric endocrinologists at the Diabetes Education Resource for Children and Adolescents (DER-CA) in Winnipeg. In some areas of Manitoba, especially rural/remote areas and First Nation communities, diabetes care is provided by nurses at community health centres or nursing stations. Diabetes-related care is one part of the continuum of interventions to reduce complications and improve outcomes in those with type 2 diabetes in conjunction with diet, exercise and diabetes-related education.

Objectives:

- Examine rates of guideline-recommended diabetes-related care provided to Manitobans with type 2 diabetes
- Examine rates and prevalence of diabetes-related complications among Manitobans with type 2 diabetes
- Assess associations between continuity of care and recommended care received
- Assess differences by age, sex, health region, Tribal Council Area and among First Nation Manitobans with type 2 diabetes compared to All Other Manitobans with type 2 diabetes

The Continuity of Care Index ranges from 0-1, with higher scores indicating better continuity of care (also see Chapter 5). The association between continuity of care and the outcomes in this chapter was tested by dividing Manitobans with type 2 diabetes into six groups based on their Continuity of Care Index scores, as seen in Table 5.1. Five groups reflect different degrees of continuity of care as measured by the index from 0-1, and the N/A category comprises Manitobans who made less than three visits to primary care providers in three years and could not be assigned a Continuity of Care Index score. Using group 1 as the reference group (reflecting very low continuity of care), we determined whether Manitobans in groups 2 to 5 and the N/A group were more likely or less likely than Manitobans in group 1 to receive diabetes care that met the Diabetes Canada guidelines.

HbA1c Levels (Glucose Control)

Blood levels of HbA1c reflect a person's average glucose control over the last 3 months. This test is used not only to monitor a person's degree of glucose control, but also in diagnosis of new cases of type 2 diabetes. A person receives a diagnosis of type 2 diabetes when their HbA1c levels are 6.5% or higher. For most individuals diagnosed with type 2 diabetes, the aim is to achieve and maintain glycemic control (HbA1c levels of 7% or lower). Higher HbA1c levels are associated with higher rates of complications related to type 2 diabetes.

Multiple factors within the healthcare system, the community and the individual affect how close to the guidelines people with type 2 diabetes can keep their HbA1c levels. For most individuals with type 2 diabetes, HbA1c should be measured every 3 months to ensure that glycemic goals are being met or maintained. Once glycemic targets have been met, testing should be done at least once every 6 months [5].

Methods

The figures in this section are histograms showing the distribution of HbA1c levels among First Nation Manitobans with type 2 diabetes and All Other Manitobans with type 2 diabetes. We present the minimum, maximum and average HbA1c levels for these two groups. These data are intended to show a picture of glucose control (diabetes management) among Manitobans with type 2 diabetes.

We used information from Manitobans for whom at least one HbA1c test was recorded in the laboratory data. HbA1c tests within the first 6 months of a type 2 diabetes diagnosis were excluded. The Repository contains laboratory data from the public laboratory system in Manitoba, but not the private outpatient laboratory system. Therefore, data capture from some geographical areas is less complete than from others, and these areas include Winnipeg and surrounding area and Percy Moore Hospital in Interlake-Eastern RHA. Some Manitobans may also travel outside their area of residence to have bloodwork done. HbA1c tests done as point-of-care tests are also not captured in the Repository. Point-of-care testing has been done as part of the Diabetes Integration Project (DIP) and the FINISHED project². However, high HbA1c results from these point-of-care tests would prompt a referral to a physician and we would then possibly be able to capture follow-up testing results if this testing occurred in a public laboratory. Thus, the results in this section only reflect the tests we could access in the Repository and are not truly population-based.

For information on the geographical distribution of people for whom we have no recorded HbA1c in the Repository, see Appendix 1 in the online supplement. This reflects both those people who did not have an HbA1c test and those who had a test in a private lab.

Because we did not have complete capture of HbA1c test results, we did not examine rates of HbA1c testing as an indicator, but instead present the results we have for HbA1c levels.

Key Findings (Figures 6.1-6.3):

- Note that the dashed line in these figures represents the goal of 7%
- In all graphs (minimum, maximum and average HbA1c), there was a wide distribution of HBA1c levels
- In all graphs, First Nation Manitobans with type 2 diabetes made up a larger proportion of the population with high HbA1c levels than All Other Manitobans with type 2 diabetes
 - The discrepancy between these two groups
 was largest when examining maximum HbA1c
 levels
- Average HbA1c levels were higher than recommended (higher than 7%) among 73.36% of First Nation Manitobans with type 2 diabetes and 59.74% of All Other Manitobans with type 2 diabetes

² The FINISHED project is a 3-year project providing mobile kidney disease screening in First Nation communities in West Region and Island Lake Tribal Council areas. The FINISHED project (First Nation Community Based Screening to Improve Kidney Health And Prevent Dialysis) did point-of-care HbA1c testing in 14 communities. For more information, please visit: http://www.kidneyhealth.ca/ wp/about-us/projects/finished-project/finishedcomm/





Figure 6.2: Distribution of Maximum HbA1c Values for First Nation Manitobans and All Other Manitobans with Type 2 Diabetes 2013/14-2016/17





Figure 6.3: Distribution of Mean HbA1c Values for First Nation Manitobans and All Other Manitobans with Type 2 Diabetes 2013/14-2016/17

Treatment and Screening for Diabetic Retinopathy

Diabetic retinopathy is a complication of diabetes caused by damage to the blood vessels of the retina. It can lead to blindness if left untreated. Progression of retinopathy can be slowed via glucose control, lipid lowering and blood pressure control. Receiving treatment is associated with being screened prior to blindness.

Although the Repository does not reliably capture diagnosis of blindness and diabetic retinopathy, it does capture treatment – thus, this report presents the percent of Manitobans with type 2 diabetes who were treated for diabetic retinopathy. Among our cohort of adult Manitobans with type 2 diabetes, 8.4% of First Nation Manitobans and 5.2% of All Other Manitobans were treated for retinopathy.

Treatment for Diabetic Retinopathy

Key Findings (Figure 6.4):

 Almost twice as many First Nation Manitobans with type 2 diabetes received retinopathy treatment as All Other Manitobans with type 2 diabetes (1.9% vs 1.0%)

- By health region:
 - Across all of Manitoba, the percent of Manitobans with type 2 diabetes who received retinopathy treatment did not vary by health region
 - In all regions, there was an upwards trend or a significantly higher percentage of First Nation Manitobans with type 2 diabetes who received retinopathy treatment compared to All Other Manitobans with type 2 diabetes
 - There was no gradient across health regions by PMR
- By age and sex:
 - There were no significant differences in retinopathy treatment by age or sex among First Nation Manitobans with type 2 diabetes or All Other Manitobans with type 2 diabetes
 - This lack of differences may be due to relatively small numbers for this indicator (Figure 1.7 of Appendix 1 online)

Figure 6.4: Annualized Percent of First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes who were Treated for Retinopathy by Health Region

Age- and sex-adjusted percent, people with 1+ retinopathy treatments, age 18+, 2015/16-2016/17



* indicates area's First Nation rate was statistically different from All Other Manitobans rate (p<0.05)

f indicates area's First Nation rate was statistically different from Manitoba's First Nation rate (p<0.01)

a indicates area's All Others rate was statistically different from Manitoba's All Other Manitobans rate (p<0.01)

s indicates data suppressed due to small numbers

Screening for Diabetic Retinopathy (Contact with an Eye Care Provider)

Retinal exams are standard care for people with type 2 diabetes. The Diabetes Canada guidelines recommend that people with type 2 diabetes have these exams done every 1-2 years to screen for retinopathy. This requires a full dilated eye exam by an **ophthalmologist** or optometrist or (for mobile screening programs) a retinal photograph. Established retinal screening programs exist in various communities across Manitoba³.

Data Limitations

The costs of retinopathy screening services are fully covered by Manitoba Health and so all screens should be captured in the Repository. However, due to the limited information in physician billing codes, we only know when someone made a visit to an optometrist or ophthalmologist and not exactly what type of care was provided in that visit. For example, a Repository record of an optometrist visit for a full dilated eye screening exam would look the same as a record of a visit to prescribe eye glasses.

Methods

The retinopathy screening indicator is either an ophthalmologist or optometrist visit billing code, or a store and forward billing code. The store and forward billing code is what the ophthalmologist reading the retinal images from a mobile screening program submits to Manitoba Health as a claim for services.

Key Findings (Figures 6.5-6.6):

• Among all Manitobans with type 2 diabetes, 71.6% of First Nation Manitobans and 65.7% of All Other Manitobans received retinopathy screening care that met the Diabetes Canada guidelines

- By health region:
 - The percent of Manitobans with type 2 diabetes who had at least one contact for eye care was similar across most health regions
 - The percent of All Other Manitobans who received eye care was higher in the North than the Manitoba average
 - Within each health region, the percent of Manitobans with type 2 diabetes who had at least one contact for eye care was similar between First Nation Manitobans and All Other Manitobans
 - The only exception was Interlake-Eastern RHA, where a higher percentage of First Nation Manitobans received eye care than All Other Manitobans
- By age and sex:
 - The percent of Manitobans with type 2 diabetes who had at least one contact for eye care was higher among older groups than among younger groups
 - Among males age 18-29, only 43.0% of First Nation Manitobans with type 2 diabetes and 39.8% of All Other Manitobans with type 2 diabetes received eye care
 - The percent of Manitobans with type 2 diabetes who had at least one contact for eye care was higher among females than among males in both the First Nation Manitobans and the All Other Manitobans groups

³ For more information, visit http://umanitoba.ca/faculties/health_sciences/ indigenous/institute/healthservices/diabetic_retinal_screening.html

Figure 6.5: Percent of First Nation Manitobans and All Other Manitobans with Type 2 Diabetes who had 1+ Contacts with an Eye Care Provider in 2 Years by Health Region

Age- and sex-adjusted percent, age 7+, 2015/16-2016/17



a indicates area's All Others rate was statistically different from Manitoba's All Other Manitobans rate (p<0.01)

s indicates data suppressed due to small numbers

Figure 6.6: Percent of First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes who had 1+ Contacts with an Eye Care Provider in 2 Years by Age and Sex Crude percent, age 18+, 2015/16-2016/17



Association between Continuity of Care and Retinopathy Screening

Higher continuity of care (quintiles 3 and 4) was associated with retinopathy screening for both First Nation Manitobans

with type 2 diabetes and All Other Manitobans with type 2 diabetes. Those without enough visits to a primary care provider for us to calculate a Continuity of Care Index were less likely to receive retinopathy screening than those in other continuity of care quintiles.

Table 6.1: Association Between COC Index Group and Having at least One Contact with an Eye Care Provider in Two Years for First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes

COC Index Group	First Nation Manitobans		All Other Manitobans	
	Relative Risk	95% Confidence Interval	Relative Risk	95% Confidence Interval
2 (0.25-0.49)	1.10	0.99-1.22	1.10	0.98-1.24
3 (0.50-0.74)	1.12	1.01-1.25	1.13	1.01-1.28
4 (0.75-0.99)	1.20	1.06-1.34	1.22	1.08-1.38
5 COC Index of 1	1.01	0.90-1.14	1.09	0.96-1.25
N/A*	0.74	0.63-0.87	0.76	0.63-0.90

* N/A = fewer than 3 visits and therefore excluded from the COC index

End-Stage Renal Disease and Screening for Albuminuria

We have chosen to focus on end-stage renal disease (ESRD; dialysis or renal transplant) rather than examining chronic kidney disease (which develops before and progresses to ESRD) due to recent information on chronic kidney disease being available in the MCHP report 'Care of Manitobans Living with Chronic Kidney Disease' [4]. The chronic kidney disease report demonstrated an ESRD rate (all causes) of 1.45 cases per 1,000 adults in Manitoba, with higher rates in the North and remote regions.

Progression from early chronic kidney disease to ESRD in individuals with type 2 diabetes can be slowed via glucose management, control of **hypertension** and screening for albuminuria (and subsequent treatment with an ACE inhibitor/ARB medication). Testing the albumin-to-creatinine ratio in the urine (urine ACR) every year is recommended among individuals with type 2 diabetes. The management of ESRD includes dialysis or renal transplant. Most newly diagnosed ESRD will initially be managed with dialysis.

We did not find any records in the Repository of children in Manitoba developing ESRD from type 2 diabetes, thus this indicator was measured among adults aged 18+ only.

Key Findings (Figures 6.7-6.9):

 Among all adult Manitobans with type 2 diabetes, 4.8% of First Nation Manitobans and 1.2% of All Other Manitobans had ESRD

- By health region:
 - There were no major differences between health regions
 - The percent of All Other Manitobans with type 2 diabetes and ESRD was higher in Winnipeg and lower in Interlake-Eastern RHA than the Manitoba average
 - In all health regions, more First Nation Manitobans with type 2 diabetes than All Other Manitobans with type 2 diabetes had ESRD
- By TCA:
 - Numbers for these analyses are relatively low
 - The percent of First Nation Manitobans with type 2 diabetes and ESRD living on-reserve was higher than the percent living off-reserve in Interlake Reserves Tribal Council and overall
 - The percent of First Nation Manitobans with type 2 diabetes and ESRD was higher in Interlake Reserves Tribal Council, Island Lakes Tribal Council, West Region Tribal Council and Southeast Resource Development Council than the benchmark lowest percent
- By age and sex:
 - The percent of Manitobans with type 2 diabetes and ESRD was not significantly higher for males than for females among First Nation Manitobans and All Other Manitobans
 - The percent of Manitobans with type 2 diabetes and ESRD was higher in older age groups among First Nation Manitobans but was similar across age groups for All Other Manitobans

Figure 6.7: Percent of First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes who had End-Stage Renal Disease by Health Region

Age- and sex-adjusted percent, age 18+, 1979-2017



s indicates area's All Others rate was statistically different from Manitob

Figure 6.8: Percent of First Nation Adult Manitobans with Type 2 Diabetes who had End-Stage Renal Disease by Tribal Council Area Age- and sex-adjusted percent, age 18+, 1979-2017



+ - The difference between this area's rate and the lowest First Nations On-Reserve rate (Swampy Cree (SCTC)) was statistically significant (p<0.01).

§ - The difference between this area's First Nations On-Reserve and Off-Reserve rate was statistically significant (p<0.01).

s indicates suppression due to small numbers
Figure 6.9: Percent of First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes who had End-Stage Renal Disease by Age and Sex

Crude Percent, age 18+, 1979-2017



Note: Missing values indicate suppressed due to small values.

Table 6.2: Percent of Adult Manitobans with Type 2 Diabetes and End-Stage Renal Disease who had at least one Renal Transplant Crude percent, age 18+, all indications for transplant included, data available 1979-2017

Cohort	Male	Female
First Nation Manitobans with T2DM	13.08%	9.34%
All Other Manitobans with T2DM	26.48%	21.93%

We noted an important discrepancy between First Nation Manitobans with type 2 diabetes and ESRD and All Other Manitobans with type 2 diabetes and ESRD: First Nation Manitobans were less likely to have a kidney transplant than All Other Manitobans (Table 6.2).

Incidence of End-Stage Renal Disease

This indicator examines the incidence of ESRD, or the percent of adult Manitobans with type 2 diabetes who developed new onset ESRD. To measure incidence, we examined Manitobans with type 2 diabetes who had started dialysis, but had no previous history of dialysis and had not had a kidney transplant.

Key Findings (Figures 6.10-6.11):

- In a two-year period (2015/16-2016/17), 1.1% of First Nation Manitobans with type 2 diabetes and 0.3% of All Other Manitobans with type 2 diabetes developed ESRD
- By health region:
 - There were no significant differences in incidence of ESRD by health region, most likely due to small numbers
 - Among First Nation Manitobans with type 2 diabetes, the percent of people who started dialysis in Winnipeg was lower than the percent who had established cases of ESRD

- In all health regions, the incidence of ESRD was higher among First Nation Manitobans with type 2 diabetes than among All Other Manitobans with type 2 diabetes
- By TCA:
 - Due to low numbers, we present crude results only (see Appendix 1 online)
- By age and sex:
 - ESRD incidence was not significantly higher among males than among females for First Nation Manitobans with type 2 diabetes and All Other Manitobans with type 2 diabetes
 - ESRD incidence was higher in older age groups among female First Nation Manitobans with type 2 diabetes, but was similar among males
 - There was no association between age and ESRD incidence among All Other Manitobans with type 2 diabetes



Figure 6.10: Incident Dialysis Treatment for First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Health Region Age- and sex-adjusted percent, age 18+, 2015/16-2016/17, excludes people with kidney transplant and previous dialysis

Figure 6.11: Incident Dialysis Treatment for First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes

by Age and Sex

Crude percent, age 18+, 2015/16-2016/17, excludes people with kidney transplant and previous dialysis



Note: Missing values are suppressed due to small values.

Screening for Urine Albumin-to-Creatinine Ratio (Urine ACR)

Urine ACR screening can be done by either sending a urine sample to a laboratory or at point-of-care. Outreach programs such as the Diabetes Integration Project (DIP) or the FINISHED project conduct point-of-care urine ACR screens, and these are not captured in the Repository. However, all urine ACR screens that are processed in public laboratories are included in our analyses. Thus, areas receiving outreach programs have higher rates than are captured in our data.⁴ Individuals with diagnosed ESRD were excluded from these analyses.

Key Findings (Figures 6.12-6.14):

- Among all Manitobans with type 2 diabetes, 62.6% of First Nation Manitobans and 53.1% of All Other Manitobans had a urine ACR screen in 2015/16
- By health region:
 - In all health regions, the percent of Manitobans with type 2 diabetes who had a urine ACR screen was well below the rates recommended by Diabetes Canada
 - The percent of Manitobans with type 2 diabetes who had a urine ACR screen was higher in the North than the Manitoba average

- The percent of First Nation Manitobans with type 2 diabetes who had a urine ACR screen was higher than for All Other Manitobans with type 2 diabetes
- The percent of All Other Manitobans with type 2 diabetes who had a urine ACR screen was lower in Prairie Mountain Health and higher in Southern Health-Santé Sud than the Manitoba average
- By TCA:
 - For most TCAs, the percent of First Nation Manitobans with type 2 diabetes who had a urine ACR screen was similar on-reserve and off-reserve
 - The percent of First Nation Manitobans with type 2 diabetes who had a urine ACR screen was lower than the benchmark (Keewatin Tribal Council) for all reserves except SERDC and Island Lakes Tribal Council
- By age and sex:
 - The percent of Manitobans with type 2 diabetes who had a urine ACR screen was higher in older groups than younger groups
 - There were no consistent differences by sex among First Nation Manitobans with type 2 diabetes and All Other Manitobans with type 2 diabetes

⁴ DIP has three teams that deliver services across Manitoba in First Nations communities: Winnipeg, Dauphin, and Thompson. These teams travel to Hollow Water, Sandy Bay, Swan Lake, Long Plain, Peguis, Pine Creek, Skownan, Ebb & Flow, Ochichakkosippi, Rolling River, Keeseekoowenin, Gambler, Tootinaowaziibeeng, Nelson House, Chemawawin, Split Lake, God's River, God's Lake, and Oxford House.

Figure 6.12: Percent of First Nation Manitobans and All Other Manitobans with Type 2 Diabetes with 1+ Urine ACR Screens in One Year by Health Region

Age- and sex-adjusted percent, age 7+, 2015/16



f indicates area's First Nation rate was statistically different from Manitoba's First Nation rate (p<0.01)

a indicates area's All Others rate was statistically different from Manitoba's All Other Manitobans rate (p<0.01)

s indicates data suppressed due to small numbers

Figure 6.13: Percent of First Nation Manitobans with Type 2 Diabetes with 1+ Urine ACR Screens in One Year by Tribal Council Area Age- and sex-adjusted percent, age 7+, 2015/16



t - The difference between this area's rate and the highest First Nations On-Reserve rate (Keewatin (KTC)) was statistically significant (p<0.01).

§ - The difference between this area's First Nations On-Reserve and Off-Reserve rate was statistically significant (p<0.01).



Crude percent, age 18+, 2015/16



Due to the low rates of urine ACR screening overall, we conducted a stratified analysis examining only Manitobans with type 2 diabetes who were not already prescribed an ACE inhibitor/ARB medication. In this group, screening rates were lower than for the cohort overall. The rates for Manitobans with type 2 diabetes prescribed an ACE inhibitor/ARB medication were higher than for the overall type 2 diabetes cohort (Appendix 1 online, Figures 1.9-1.10).

Association between Continuity of Care and Urine ACR Screening

Higher continuity of care (quintile 2 to 4) was associated with higher likelihood of urine ACR screening among both First Nation Manitobans with type 2 diabetes and All Other Manitobans with type 2 diabetes. Those in the All Other Manitobans group without enough primary care provider visits for us to be able to calculate a Continuity of Care Index (less than three visits in three years) were less likely to receive ACR screening.

Table 6.3: Association Between COC Index Group and Receiving a Urine ACR Screen for First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes

	First Natio	n Manitobans	All Other Manitobans	
COC Index Group	Relative Risk	95% Confidence Interval	Relative Risk	95% Confidence Interval
2 (0.25-0.49)	1.21	1.09-1.35	1.31	1.16-1.48
3 (0.50-0.74)	1.21	1.08-1.36	1.31	1.15-1.48
4 (0.75-0.99)	1.49	1.32-1.68	1.61	1.41-1.83
5 COC Index of 1	1.21	1.07-1.37	1.32	1.15-1.51
N/A*	0.85	0.71-1.01	0.75	0.61-0.91

* N/A = fewer than 3 visits and therefore excluded from the COC index

Lower Limb Amputations

Type 2 diabetes is a risk factor for peripheral vascular (small blood vessel) disease, which limits blood circulation to the lower limbs and interferes with wound healing, and neuropathy (nerve damage), which reduces the sensation of pain and can lead to undiscovered injury and infection and contribute to necrosis in the feet. Both of these complications are more likely in the setting of suboptimal glucose control. Among people with type 2 diabetes, meticulous foot care is important to prevent ulcerations from progressing to the point of amputation. In our study cohort, 7.5% of First Nation Manitobans with type 2 diabetes and 1.8% of All Other Manitobans with type 2 diabetes had ever had a lower limb amputation.

Key Findings (Figures 6.15-6.17):

- Among Manitobans with type 2 diabetes, 10.9 per 1,000 First Nation Manitobans and 2.3 per 1,000 All Other Manitobans had a lower limb amputation from 2011/12 to 2016/17
- By health region:
 - Due to low numbers, we observed significantly higher rates of lower limb amputations in Prairie Mountain Health only. Rates were higher there among both First Nation Manitobans with type 2 diabetes and All Other Manitobans with type 2 diabetes
 - Across all regions, First Nation Manitobans with type 2 diabetes had consistently higher rates of lower limb amputations than All Other Manitobans with type 2 diabetes

- By TCA:
 - There was no consistent pattern of lower limb amputations among First Nation Manitobans living on- vs off-reserve
 - West Region Tribal Council, Island Lakes Tribal Council, Independent-South and Dakota Ojibway Tribal Council had higher rates of lower limb amputations than the benchmark TCA (Keewatin Tribal Council)
 - There was little variation in off-reserve rates among TCAs, except for Dakota Ojibway Tribal Council where rates were significantly higher than the benchmark
 - There was little variation between rates onand off- reserve except for West Region Tribal Council where on-reserve rates were much higher
- By age and sex:
 - Lower limb amputation rates among females were lower than among males
 - Rates were higher in older age groups among First Nation Manitobans with type 2 diabetes, but not among All Other Manitobans with type 2 diabetes

For rates of amputations above the ankle vs below the ankle, please see Appendix 1 online. Patterns are similar to the overall rates but are affected by small numbers.



Age- and sex-adjusted rate per 1,000 person-years, age 18+, 2011/12-2016/17



Figure 6.16: Rate of Lower Limb Amputations Among First Nation Adult Manitobans with Type 2 Diabetes by Tribal Council Area Age- and sex-adjusted rate per 1,000 person-years, age 18+, 2011/12-2016/17



+ - The difference between this area's rate and the lowest First Nations On-Reserve rate (Keewatin (KTC)) was statistically significant (p<0.01).

+ - The difference between this area's rate and the lowest First Nations Off-Reserve rate (Interlake Reserves (IRTC)) was statistically significant (p<0.01).

§ - The difference between this area's First Nations On-Reserve and Off-Reserve rate was statistically significant (p<0.01).

s indicates suppression due to small numbers

Figure 6.17: Rate of Lower Limb Amputations Among First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Age and Sex

Crude rate per 1,000 person-years, age 18+, 2011/12-2016/17



Note: Missing values indicate suppressed due to small values.

Influenza Vaccination

An annual flu vaccination for individuals aged 6 months and older has been recommended in Manitoba since the 2010/11 flu season. However, the flu vaccine was recommended yearly for high risk groups (including those with type 2 diabetes) well before 2010/11.

Key Findings (Figures 6.18-6.19):

- Among Manitobans with type 2 diabetes, 37.4% of First Nation Manitobans and 46.7% of All Other Manitobans received the flu vaccine in 2016/17
- By health region:
 - In Southern Health-Santé Sud, a smaller percentage of First Nation Manitobans with type 2 diabetes received the flu vaccination than All Other Manitobans with type 2 diabetes
 - In Winnipeg, a higher percentage of First Nation Manitobans with type 2 diabetes received the flu vaccination than All Other Manitobans with type 2 diabetes
 - Overall, a smaller percentage First Nation Manitobans with type 2 diabetes received the flu vaccination than All Other Manitobans with type 2 diabetes

- By age and sex:
 - There was a trend towards a higher percent of females vs males receiving the flu vaccine among First Nation Manitobans with type 2 diabetes and All Other Manitobans with type 2 diabetes
 - The percent of Manitobans with type 2 diabetes who received the flu vaccine increased with age group but remained well below the goal among First Nation Manitobans and All Other Manitobans
 - There was a growing discrepancy between the percent of First Nation Manitobans with type 2 diabetes who received the flu vaccine and All Other Manitobans with type 2 diabetes who received the flu vaccine as age increased

Figure 6.18: Rate of Influenza Vaccination Among First Nation Manitobans and All Other Manitobans with Type 2 Diabetes by Health Region Age- and sex-adjusted percent, age 7+, 2015/16



a indicates area's All Others rate was statistically different from Manitoba's All Other Manitobans rate (p < 0.01)

s indicates data suppressed due to small numbers

Figure 6.19: Rate of Influenza Vaccination Among First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Age and Sex

Crude percent, age 18+, 2015/16



Association between Continuity of Care and Influenza Vaccination

Among First Nation Manitobans with type 2 diabetes, higher continuity of care (quintiles 2 to 4) was associated with influenza vaccination. Among All Other Manitobans with type 2 diabetes, there was an association only among those in quintiles 3 and 4. Those without enough visits to a primary care provider for us to calculate a Continuity of Care Index were less likely to be vaccinated than those in other continuity of care quintiles.

Table 6.4: Association Between COC Index Group and Flu Vaccination Within One Year for First Nation Adult Manitobans and All OtherAdult Manitobans with Type 2 Diabetes

Age 18+, 2013/14 - 2014/15

	First Nation	n Manitobans	All Other Manitobans	
COC Index Group	Relative Risk	95% Confidence Interval	Relative Risk	95% Confidence Interval
2 (0.25-0.49)	1.23	1.07-1.41	1.15	0.99-1.33
3 (0.50-0.74)	1.25	1.08-1.44	1.18	1.01-1.37
4 (0.75-0.99)	1.48	1.27-1.72	1.40	1.19-1.64
5 COC Index of 1	1.03	0.87-1.20	0.99	0.84-1.17
N/A*	0.68	0.54-0.85	0.55	0.42-0.70

* N/A = fewer than 3 visits and therefore excluded from the COC index

Chapter Summary and Recommendations

This chapter presents data on whether Manitobans living with type 2 diabetes receive the standard of care recommended by national guidelines, and the rates of diabetes-related complications. These results show that the percent of Manitobans receiving diabetes care that meets the recommended guidelines in Manitoba is low and the percent of Manitobans experiencing complications is high. The current system of delivery for these services is not meeting the needs of the population.

Overall Results and Recommendations

The results for HbA1c levels demonstrate that a significant proportion of Manitobans with type 2 diabetes do not achieve the recommended targets for glucose control. Even small improvements for each individual would slow the progression of disease. At the population level, these small improvements would result in better overall population health. Achieving reductions in HbA1c levels depends on multiple factors; medical management of diabetes with insulin or diabetes-specific medication is only one aspect. Two particularly important barriers to address would be ensuring that people with type 2 diabetes have access to supervised exercise programs and nutritional counselling [5]. Consistent and continuous primary care was associated with higher rates of receiving the recommended diabetes care. Alternative or community-based methods of delivering primary care and screening services could be a consideration for some groups with low physician visit rates, such as young adults, and especially male young adults. These methods could be informed by strategies used by the Partners in Inner City Integrated Prenatal Care (PIIPC) program, which is a collaborative effort involving community consultation, street outreach, facilitated access, and a social marketing initiative that has successfully improved prenatal care in Winnipeg [35].

For the indicators 'at least one contact with an eye care provider' and 'urine ACR screening', there was little variation between health regions and low rates overall across the province. The percent of people receiving recommended care for these indicators in the Northern Health Region was slightly higher than in other regions, and the percent was often similar or higher among First Nation Manitobans with type 2 diabetes when compared to All Other Manitobans with type 2 diabetes. This differs from the patterns of care seen for other indicators and is likely reflective of targeted programs in certain parts of the North. However, we did not see a reduction in outcomes such as ESRD in Northern Manitoba. This suggests that access to care is only the first step. The better rates of treatment for retinopathy we observed could be due to either greater disease or greater screening, resulting in treatment before blindness.

These results demonstrate that targeted programs can increase the number of people receiving services; however, these targeted services should be expanded outside of the North as screening rates are low across the rest of the province. Specific populations of concern include men (all ages) and young adults (both male and female), as their rates of screening are particularly low. Consideration could be given to a centralized screening program with mobile outreach, such as those for cancer. ESRD is a high-cost complication. Dialysis costs a median of \$101,947 per individual per year, notwithstanding the human costs, and even modest reductions would be massively cost saving.

Where trends suggest that rates of diabetes-related complications are higher in Winnipeg, as we observed for ESRD and lower limb amputations, this may be due to relocation of those with more severe type 2 diabetes in order to access services, as dialysis is not uniformly available across the province. This is supported by the trend towards a lower percent of people initiating dialysis in the setting of higher rates of established ESRD rates in Winnipeg.

Universal flu vaccination rates are not adequate among the high risk population of Manitobans with type 2 diabetes. Centralized and outreach programs as well as ongoing public education about the importance of the flu vaccine should be considered. A higher percentage of people being vaccinated in Winnipeg vs other regions suggests that strategies there should be assessed for their applicability to other regions.

Summary and Recommendations for First Nation Manitobans with Type 2 Diabetes

This chapter identifies equal or better receipt of type 2 diabetes-related screening services in the North vs other regions and in First Nation communities vs off-reserve populations. This demonstrates that despite the barriers faced by the First Nation populations in accessing care, the barriers are not the only reason for poor outcomes. Higher rates of diabetes-related complications and higher HbA1c levels were also seen among First Nation Manitobans vs All Other Manitobans. This again underlines the importance of addressing the multifactorial risks among First Nation Manitobans, including the social and Indigenous determinants of health. The higher percentage of First Nation Manitobans receiving retinopathy treatment and being diagnosed with ESRD in older age suggests that either diabetes is progressing despite screening and management, or that type 2 diabetes is being diagnosed at an increasingly later stage when end-stage complications are already present, a pattern not seen among All Other Manitobans with type 2 diabetes.

The large discrepancy in lower limb amputations between First Nation Manitobans with type 2 diabetes and All Other Manitobans with type 2 diabetes underlines the importance of providing resources to address foot care needs and to help people manage their type 2 diabetes to reduce the progression of neuropathy/vasculopathy.

There were some significant differences in the outcomes in this chapter among TCAs (despite small numbers), and this information is available for individual communities to use in assessing service delivery or for advocating for supports and funding if needs have already been identified.

Chapter 7: Cardiovascular Health of Manitobans with Type 2 Diabetes

This chapter examines the rates of cardiovascular (heart and large blood vessel) diseases for which type 2 diabetes is a risk factor among Manitobans with type 2 diabetes. The risk of cardiovascular disease can be reduced through management of glucose levels and through optimizing health-related behaviours such as diet, exercise, smoking and alcohol use. Diabetes Canada also provides guidelines on using certain medications to reduce cardiovascular disease risk in eligible individuals [5].

Objectives:

- Examine rates of cardiovascular complications, including heart failure, acute myocardial infarction (heart attack), ischemic heart disease (angina) and hypertension (high blood pressure) among Manitobans with type 2 diabetes
- Assess differences by age, sex, health region and between First Nation Manitobans with type 2 diabetes and All Other Manitobans with type 2 diabetes

Acute Myocardial Infarction (Heart Attack)

Critical narrowing and blockage of the blood vessels supplying the heart muscle can lead to an acute myocardial infarction (AMI). The rate of AMI for the general Manitoba population is 3.24 AMIs per 1,000 person-years among Manitobans age 40 and older [23]. We report rates among Manitobans age 40 and older because AMIs are rare among younger people.

Key Findings (Figures 7.1-7.2):

- Among all Manitobans with type 2 diabetes, AMI rates were 16.1 per 1,000 person-years for First Nation Manitobans and 9.3 per 1,000 person-years for All Other Manitobans
- By health region:
 - We saw few differences in AMI rates between health regions and the rate for Manitoba overall
 - AMI rates among First Nation Manitobans with type 2 diabetes were higher in Southern Health-Santé Sud than other regions
 - AMI rates among All Other Manitobans with type 2 diabetes were higher in Interlake-Eastern RHA than other regions

- AMI rates were mostly higher among First Nation Manitobans with type 2 diabetes than among All Other Manitobans with type 2 diabetes
 - The exception was Interlake-Eastern RHA and the Northern Health Region, where rates were similar between groups
- By age and sex:
 - AMI rates increased minimally with age
 - Rates for males were generally higher than for females among First Nation Manitobans with type 2 diabetes and among All Other Manitobans with type 2 diabetes

Figure 7.1: Rate of Acute Myocardial Infarction Among First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Health Region

Age- and sex-adjusted rate per 1,000 person-years, age 40+, 2013/14-2016/17



s indicates data suppressed due to small numbers

Figure 7.2: Rate of Acute Myocardial Infarction Among First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Age and Sex

Crude rate per 1,000 person-years, age 40+, 2013/14-2016/17



Note: Missing values indicate suppressed due to small values.

Ischemic Heart Disease

Ischemic heart disease (IHD), also called angina, is caused by narrowing and partial blockage of the blood vessels supplying blood to the heart. It often causes pain with exertion, and may precede the development of an AMI. In the general Manitoba population, 8.3% of people are diagnosed with IHD [23]. We measured this indicator among Manitobans with type 2 diabetes who were age 18 and older.

Key Findings (Figures 7.3-7.4):

- Among all Manitobans with type 2 diabetes, 30.5% of First Nation Manitobans and 24.9% of All Other Manitobans had IHD
- By health region:
 - We saw few differences in the prevalence of IHD in individual health region vs Manitoba overall
 - In the Northern Health Region, the prevalence of IHD was lower than the Manitoba average for First Nation Manitobans with type 2 diabetes and All Other Manitobans with type 2 diabetes

- In Southern Health-Santé Sud, IHD prevalence was lower among All Other Manitobans with type 2 diabetes than the Manitoba average for this group
- In Prairie Mountain Health, the prevalence was higher among First Nation Manitobans with type 2 diabetes than the Manitoba average for this group
- Across all health regions, First Nation Manitobans with type 2 diabetes had a higher IHD prevalence than All Other Manitobans with type 2 diabetes
- By age and sex:
 - IHD prevalence increased with age among First Nation Manitobans with type 2 diabetes and All Other Manitobans with type 2 diabetes
 - The prevalence among males was higher than among females for both groups

Figure 7.3: Prevalence of Ischemic Heart Disease Among First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Health Region

Age- and sex-adjusted percent, age 18+, 2013/14-2016/17



indicates area's First Nations rate was statistically different from Manitoba's First Nations rate (p<0.01) f indicates area's All Others rate was statistically different from Manitoba's All Other Manitobans rate (p<0.01) а

indicates data suppressed due to small numbers s

Figure 7.4: Prevalence of Ischemic Heart Disease Among First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Age and Sex

Crude percent, age 18+, 2013/14-2016/17



Note: Missing values indicate suppressed due to small values.

Heart Failure

Heart failure occurs when the heart muscle is damaged and unable to pump blood efficiently, often leading to fluid backing up into the lungs. Heart failure can be caused by many different conditions, including acute myocardial infarction and hypertension. In the general Manitoba population, 1.59% of people are diagnosed with heart failure [23]. In this report, we examine the prevalence of heart failure among Manitobans with type 2 diabetes who are age 40 and older; heart failure is uncommon in younger age groups.

Key Findings (Figures 7.5-7.6):

 Among all Manitobans with type 2 diabetes, 7.5% of First Nation Manitobans and 5.0% of All Other Manitobans had heart failure

- By health region:
 - Most health regions had a prevalence of heart failure similar to the overall Manitoba rate
 - Only All Other Manitobans with type 2 diabetes in Interlake-Eastern RHA had a higher prevalence
 - Across all health regions, heart failure prevalence was higher among First Nation Manitobans with type 2 diabetes than among All Other Manitobans with type 2 diabetes
- By age and sex:
 - Heart failure prevalence increased minimally with age
 - Males in the First Nation Manitobans with type 2 diabetes group and the All Other Manitobans with type 2 diabetes group had a higher prevalence of heart failure than females

Figure 7.5: Prevalence of Heart Failure Among First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Health Region

Age- and sex-adjusted percent, age 40+, 2016/17



s indicates data suppressed due to small numbers

Figure 7.6: Prevalence of Heart Failure Among First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Age and Sex

Crude percent, age 40+, 2016/17



Hypertension (High Blood Pressure)

In the general Manitoba population, the proportion of people age 19+ who are diagnosed with hypertension is 20.7% [23]. We measured this indicator among Manitobans with type 2 diabetes who were age 7 and older, as hypertension is sometimes diagnosed in children.

Key Findings (Figures 7.7-7.8):

- Among Manitobans with type 2 diabetes, 51.5% of First Nation Manitobans and 57.8% of All Other Manitobans had hypertension
- By health region:
 - First Nation Manitobans with type 2 diabetes living in Winnipeg and Prairie Mountain Health had a higher prevalence of hypertension than the Manitoba average for this group
 - All Other Manitobans with type 2 diabetes living in the Northern Health Region had a lower prevalence of hypertension than the Manitoba average for this group

- Prevalence of hypertension was similar between First Nation Manitobans with type 2 diabetes and All Other Manitobans with type 2 diabetes – except that All Other Manitobans had a higher prevalence in Manitoba overall and in Interlake-Eastern RHA
- By age and sex:
 - Hypertension was more prevalent in older age groups
 - After age 40, the prevalence of hypertension was higher among All Other Manitobans with type 2 diabetes than among First Nation Manitobans with type 2 diabetes
 - There were minimal sex differences within the First Nation Manitobans with type 2 diabetes group and the All Other Manitobans with type 2 diabetes group



Figure 7.7: Prevalence of Hypertension Among First Nation Manitobans and All Other Manitobans with Type 2 Diabetes by Health Region Age- and sex-adjusted percent, age 7+, 2015/16-2016/17

> indicates area's First Nations rate was statistically different from Manitoba's First Nations rate (p<0.01) indicates area's All Others rate was statistically different from Manitoba's All Other Manitobans rate (p<0.01)

а indicates data suppressed due to small numbers s

Figure 7.8: Prevalence of Hypertension Among First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes by Age and Sex

Crude percent, age 18+, 2015/16-2016/17



Chapter Summary and Recommendations

The results in this chapter demonstrate that cardiovascular disease is more prevalent among Manitobans with type 2 diabetes than in the general population. There was little variation by health region. Cardiovascular disease prevalence increased with age. Many of the public health interventions recommended to control to type 2 diabetes itself, such as exercise, diet and reduction in smoking/ alcohol use are also important to prevent these chronic conditions.

Overall Results and Recommendations

We saw very little variation between different health regions. This is consistent with findings in Chapter 4, which looked at mortality and morbidity among Manitobans with type 2 diabetes, and stands in contrast to a recent MCHP report which examined these cardiovascular disease indicators in the general population [23]. In the general population, cardiovascular disease is more prevalent in the North. It is likely that this discrepancy is due to the higher percentage of people with type 2 diabetes in the general population of the North, and thus we see higher rates of morbidity/mortality. Our results also likely reflect relocation of individuals with more severe type 2 diabetes from rural/remote areas to urban centres to access care. as was indicated to us by our Advisory Group and by representatives from First Nation communities. It is also possible that some of the lower cardiovascular disease prevalence we see in the North is due to non-capture of physician visits and care in nursing stations (among First Nation Manitobans only); however this same lack of capture of diagnoses in the Repository would also have existed during analyses for the MCHP report on the general population. Studies on the numbers of patients having to relocate and strategies to provide care closer to home are needed.

Where we saw differences by health region, it was for AMI rates, with higher rates among First Nation Manitobans in Southern Health-Santé Sud and among All Other Manitobans in Interlake-Eastern RHA. There was no difference or only a small difference between heath regions when we examined AMI risk factors (prevalence of IHD and hypertension). It is possible this reflects lack of recognition and management of these conditions prior to a more severe event; this possibility merits further assessment.

Summary and Recommendations for First Nation Manitobans with Type 2 Diabetes

Overall, we saw a lesser discrepancy in cardiovascular health between First Nation Manitobans with type 2 diabetes and All Other Manitobans with type 2 diabetes than we did when looking at other indicators in this report. For the more severe chronic heart conditions (AMI and heart failure), First Nation Manitobans tended to have higher rates and prevalence.

The somewhat lesser discrepancies between First Nation Manitobans and All Other Manitoban in early cardiovascular disease indicators, such as hypertension and IHD, is concerning. It is possible that the lack of discrepancy between groups is due to non-recognition and thus non-treatment prior to disease progression. Through consultation with communities, we should further investigate the reasons for low rates of diagnosis of these conditions.

The origin of the cardiovascular diseases examined in this report is multi-factorial, but the risk of being diagnosed with these conditions can be reduced through attention to health-related behaviours, glucose management, and the social and Indigenous determinants of health. To develop strategies to reduce the onset of these conditions, consultation, partnership and adequate funding and resources for First Nation communities are needed.

Chapter 8: Type 2 Diabetes in Children in Manitoba

Childhood-onset type 2 diabetes, defined as onset at less than 18 years of age, is increasing around the world [36]. First described more than three decades ago, childhood-onset type 2 diabetes now represents over 50% of all newly diagnosed diabetes in children in some populations, though there is significant regional variation. Indigenous children appear to bear the greatest risk, with the highest reported prevalence among the Pima Indians of Southwest United States and First Nation children in central Canada (Manitoba) [11,37].

In Canada, a minimum incidence of 1.54 cases per 100,000 children was described a decade ago, with significant regional variation [11]. At that time, the incidence in Manitoba was the highest in the country at 12.28 cases per 100,000 children. By 2012, this rate had climbed to 26 cases per 100,000 children in the general childhood population in Manitoba. The majority of children in Manitoba with type 2 diabetes are of self-declared First Nation heritage [13,37]. The pathophysiology of childhood-onset type 2 diabetes resembles that of adult onset type 2 diabetes; both feature insulin resistance and non-autoimmune beta cell failure as key components. However, there are additional unique aspects to childhood-onset type 2 diabetes, including more rapid beta cell failure and earlier and more aggressive onset of microvascular complications [38,39]. While strategies for prevention and treatment are urgently needed, treatment options are currently limited by lack of evidence.

Understanding the epidemiology of type 2 diabetes in children and the relationships between childhood-onset type 2 diabetes and mental health, illness and hospitalizations, interaction with the child welfare system, and educational outcomes will help inform potential strategies to prevent and best support the population of children and youth in Manitoba living with type 2 diabetes.

Objectives:

- To describe the incidence and prevalence of type 2 diabetes in children in Manitoba
- To determine hospitalization rates and reasons for hospitalization in children with type 2 diabetes in Manitoba
- To describe the rates of diabetic ketoacidosis (DKA), an acute complication of diabetes, at diagnosis and following diagnosis in children with type 2 diabetes in Manitoba
- To determine the rate of mood and anxiety disorders, completed suicides and attempted suicides, substance use, and use of atypical antipsychotics in children with type 2 diabetes in Manitoba
- To describe the educational attainment among youth with type 2 diabetes in Manitoba
- To explore the involvement of children with type 2 diabetes with Child and Family Services

Methods

The Diabetes Education Resource for Children and Adolescents (DER-CA), located in the Winnipeg Children's Hospital, is the sole tertiary care centre providing specialty services to children and youth under age 18 and diagnosed with diabetes in Manitoba, Nunavut and Northwestern Ontario. The clinic staff is an integrated, co-located interprofessional team that includes paediatric endocrinologists, advanced diabetes educators (nurses and dietitions), a social worker, psychologists and administrative staff. The DER-CA maintains a clinical database that contains demographic information on patients and their families, including information on the mother's diabetes status at time of pregnancy, clinical information such as height, weight, blood pressure, diabetes type, complications of diabetes and laboratory data such as HbA1c results. The Diabetes Canada criteria for the diagnosis of diabetes are used within DER-CA [17]. Assignment of diabetes type (1 or 2) was made by experienced pediatric endocrinologists based on clinical criteria and the presence (type 1) or absence (type 2) of diabetes-associated auto-antibodies in accordance with the Diabetes Canada Clinical Practice Guidelines [40].

From the DER-CA database, we initially identified 1,260 children with type 1 diabetes and 725 children with type 2 diabetes (see Figure 8.1). We limited the cohort to children born in Manitoba, continually residing in Manitoba since birth and diagnosed with diabetes between January 1, 2000 and December 31, 2015, resulting in 788 children with type 1 diabetes and 537 children with type 2 diabetes. These children were matched 1:3 with diabetes-free children on First Nation identity or All Other Manitoban identity, year of birth, sex, and region of residence as of the date they were diagnosed. The diabetes-free matches were also limited to those born in Manitoba and had to have lived in Manitoba continually from birth to the date their matched case was diagnosed. Of the 788 children with type 1 diabetes, we found three matches for 708, two matches for 51, one match for 19, and no matches for 10. For the 537 children with type 2 diabetes, we found three matches for 476, two matches for 39, one match for 13, and 9 could not be matched. Children without a match were excluded. For characteristics of the matched cohorts, see Table 8.1.

The remainder of this chapter examines different outcomes by comparing children with type 2 diabetes to their diabetes-free matches, children with type 1 diabetes to their diabetes-free matches, and children with type 2 diabetes to children with type 1 diabetes. Relative risks and 95% confidence intervals are presented for the indicators examined in this chapter. The relative risks were not adjusted for age or sex because the children with diabetes were matched to children without diabetes by birth year, sex, ethnicity and region of residence. The relative risks were estimated using Poisson regression in a generalized linear model with a log link function and an offset of the logarithm of the person-years per time period. Covariates included cohort (diabetes case or match), time period and the interaction of cohort and time. Generalized estimating equations were used to account for repeated measures over time for the children.

For definitions of the outcomes in this chapter, please see Appendix 2 in the online supplement.

Results

Key Findings (cohort characteristics, Table 8.1):

 Compared to children with type 1 diabetes, children with type 2 diabetes were older at diagnosis (mean age 12.9 vs mean age 9.3), more likely to be female, more likely to live in a rural setting and more likely to have lower socioeconomic status

Key Findings (type 2 diabetes versus type 1 diabetes incidence over the last 20 years, Figure 8.1):

In a historical look at incident cases of type 1 and type 2 diabetes in Manitoba children using only the DER-CA data:

- Incidence of type 2 diabetes increased 7-fold (from 5 cases per 100,000 children to approximately 35 cases per 100,000 children)
- More recently, the number of newly diagnosed children with type 2 diabetes exceeded that of type 1 diabetes

Key Findings (incidence and prevalence of type 2 diabetes in children in Manitoba, Figures 8.1-8.4; Tables 8.2-8.3):

- Incidence of type 2 diabetes among children in Manitoba has increased more than 50% over the last decade (from 22.8 cases per 100,000 children to 35.7 cases per 100,000 children)
- Incidence of type 2 diabetes among First Nation children in Manitoba was 154 cases per 100,000 children and trended upwards. This incidence is currently among the highest in the world for this age group [41–43]. Both incidence and prevalence of type 2 diabetes were highest in the Northern Health Region and increasing most rapidly.
- Rates were higher in the Northern Health Region due to the high prevalence of First Nation populations living there

	Diabetes Type			
Indicator	Туре 1	Diabetes-Free Match (Type 1)	Type 2	Diabetes-Free Match (Type 2)
Count	778	2245	528	1519
Age at Diagnosis* (years) (95% CI)	9.29 (8.99-9.60)	9.26 (9.08-9.44)	12.95 (12.75-13.14)	12.95 (12.84-13.07)
Female (%)	43.7	43.7	62.88	62.08
First Nation Identity (%)	6.56	5.84	82.95	83.02
Non-First Nation Identity (%)	93.44	94.16	17.05	16.98
Rural (%)	44.22	42.63	80.87	81.63
Urban (%)	55.53	57.15	17.42	16.92
SEFI Score (95% CI)	-0.14 (-0.200.08)	-0.13 (-0.170.09)	1.63 (1.52-1.73)	1.58 (1.51-1.64)

Table 8.1: Description of the Population of Children with Type 1 and Type 2 Diabetes and their Diabetes-Free Matches

* Mean age at diagnosis of case

SEFI = Socio-Economic Factor Index

Figure 8.1: Annual Incidence of Type 1 and Type 2 Diabetes in Children in Manitoba

Crude rate per 100,000 person-years at risk, using DER-CA data only, age 0-17 and 7-17, 1994/95-2016/17



Note: Missing values indicate suppressed due to small values.

Figure 8.2: Incidence of Type 2 Diabetes in Manitoban Children by Health Region

Crude rate per 100,000 person-years at risk, using DER-CA data only, age 7-17, 2009-2010 to 2017-2018



Figure 8.3: Prevalence of Type 2 Diabetes in Manitoba Children by Health Region

Crude rate per 100,000 children, using DER-CA data only, age 7-17, 2009-2010 to 2017-2018



Figure 8.4: 2-Year Incidence Rate of Type 2 Diabetes in Children Among First Nation Manitobans and All Other Manitobans Crude rate per 100,000 person-years at risk, using DER-CA data only, age 7-17, 2009/10-2017/18



 Table 8.2: Incidence of Type 2 Diabetes in Children Among First Nation Manitobans and All Other Manitobans

 Crude rates and 95% confidence intervals per 100,000 person-years at risk for children age 7-17

Time Period	Incidence (Rates and 95% Confidence Intervals)			
	First Nation Manitobans All Other Manitobans			
2009-2010	110.48 (86.48-141.15)	4.93 (2.92-8.33)		
2011-2012	140.49 (113.00-174.68) 4.94 (2.93-8.34)			
2013-2014	168.95 (138.60-205.94) 7.44 (4.85-11.41)			
2015-2016	162.59 (133.38-198.18) 9.07 (6.18-13.32)			
2017-2018	154.59 (126.56-188.82)	6.13 (3.86-9.73)		

Table 8.3: Prevalence of Type 2 Diabetes in Children Among First Nation Manitobans and All Other ManitobansCrude rates and 95% confidence intervals per 100,000 person-years at risk for children age 7-17

Time Period	Prevalence (Rates and 95% Confidence Intervals)			
	First Nation Manitobans All Other Manitobans			
2009-2010	478.04 (406.24-562.54)	27.60 (20.32-37.48)		
2011-2012	615.63 (533.22-710.78) 25.55 (18.59-35.11)			
2013-2014	778.45 (685.39-884.15) 28.99 (21.50-39.09)			
2015-2016	813.78 (720.13-919.61)	33.93 (25.79-44.65)		
2017-2018	821.72 (728.83-926.43)	36.91 (28.47-47.86)		

Hospitalizations and Medical Comorbidities in Children with Type 2 Diabetes

We compared the risk of hospitalization before and after diabetes diagnosis and with and without diabetic ketoacidosis (DKA) among children with type 2 diabetes vs their diabetes-free matches or children with type 1 diabetes. DKA is serious condition that occurs in people with diabetes when there is not enough insulin to use the body's glucose stores; fat is used instead, which results in a buildup of ketones and leads to acidosis. DKA can be the presenting symptom of diabetes, or can occur after diabetes is diagnosed.

We also examined comorbidities using the Charlson Comorbidity Index and looked at the most common reasons for hospitalization among children with type 2 diabetes.

Key Findings (Figures 8.5-8.6; Tables 8.4-8.5):

- Children who developed type 2 diabetes were more likely than both their diabetes-free matches (RR 2.83, 95% CI 1.78, 4.53) and children who developed type 1 diabetes (RR 10.08, 95% CI 4.46, 22.75) to be admitted to hospital in the year prior to diagnosis of diabetes. This may reflect the multiple comorbidities in children who develop type 2 related to insulin resistance (e.g., obesity, hypertension, dyslipidemia).
- Children with type 2 diabetes were more likely to be admitted to hospital in the first year post-diagnosis compared to children with type 1 diabetes, both with DKA (RR 3.53, 95% CI 1.96, 6.35) and without DKA (RR 3.77, 95% CI 2.053, 6.91).

- Children with type 2 diabetes were more likely than their diabetes-free matches to be admitted to hospital in the first year post-diagnosis (RR 3.19, 95% CI 2.08, 4.89) and in the first five years post-diagnosis (RR 2.43, 95% CI 1.4, 4.25). This significant difference remained even when we excluded children with DKA (RR 3.12, 95% CI 2.03, 4.78 in the first year post-diagnosis and RR 2.26, 95% CI 1.30, 3.95 in the first five years postdiagnosis).
- Children with type 2 diabetes had a higher rate of comorbidity than their diabetes-free matches, as indicated by a higher Charlson index. This result likely reflects other morbidities associated with insulin resistance among children with type 2 diabetes.
- In Manitoba, there was a relatively low proportion of children who had DKA when they were diagnosed with type 2 diabetes (5.7%). This compares favourably with other reports where approximately 10% of youth with type 2 diabetes presented with DKA [11,44]. This low proportion may reflect increased awareness of type 2 diabetes in Manitoba, since this province has a long history of childhood onset type 2 diabetes and a relatively high prevalence compared to other jurisdictions in Canada and the US.
- Mental illness and injuries & poisonings were the most common reasons for hospital admission among children with type 2 diabetes. This was not different from their diabetes-free matches.

Figure 8.5: Relative Risk of Hospitalization Among Children with Type 2 Diabetes Compared to their Diabetes-Free Matches





Figure 8.6: Relative Risk of Hospitalization Among Children with Type 2 Diabetes Compared to Children with Type 1 Diabetes



* DKA = Diabetic ketoacidosis

 Table 8.4: Most Common Causes of Hospitalization Five Years Following the Month of Diagnosis Among Manitoba Children with

 Type 2 Diabetes and their Diabetes-Free Matches

Percent of hospitalizations per group, age 7-17

Diabetes Type	Most Common Cause of Hospitalization			
	Including DKA*	Excluding DKA*		
Type 2 Diabetes				
	Mental Illness (25.42%)	Mental Illness (26.43%)		
Diagnosed	Injury and Poisoning (13.67%)	Injury and Poisoning (14.21%)		
	III-Defined Conditions (10.07%)	III-Defined Conditions (10.47%)		
Dishotos Free	Mental Illness (21.83%)	Mental Illness (21.83%)		
Diabetes-Free Motobos	Pregnancy and Brith (21.83%)	Pregnancy and Brith (21.83%)		
Watches	Injury and Poisoning (18.13%)	Injury and Poisoning (18.13%)		
Type 1 Diabetes				
	Endocrine and Metabolic (61.99%)	Endocrine and Metabolic (30.63%)		
Diagnosed	Respiratory (6.16%)	Respiratory (11.25%)		
	III-Defined Conditions (5.82%)	III-Defined Conditions (10.63%)		
	Respiratory (21.13%)	Respiratory (21.13%)		
Matchas	Digestive (18.31%)	Digestive (18.31%)		
Watches	Injury and Poisoning (18.31%)	Injury and Poisoning (18.31%)		

*DKA = Diabetic ketoacidosis

Diabetic Ketoacidosis (DKA) at Diagnosis of Diabetes

The proportion of children with type 2 diabetes who had DKA when they were diagnosed was 5.7%. The proportion of children with type 1 diabetes who had DKA when they were diagnosed was 31.5% (RR 5.54, 95% CI: 3.79, 8.1).

Charlson Comorbidity Index (Diabetes-free)

The Charlson index is based on a list of 17 conditions identified from diagnoses in hospital and physician data. Each condition is assigned a weight from 1 to 6. The index score is the sum of the weights for all identified conditions [45]. A Charlson index score of 0 indicates no comorbid conditions, while higher scores indicate a greater level of comorbidity. The Diabetes-Free Charlson Index excludes the two conditions containing diagnoses of diabetes (diabetes without complications, diabetes with complications) and so it is based on a list of 15 conditions. Note that the findings below should be interpreted with caution as there has been some literature suggesting the Charlson Index is not a good predictor of comorbidities in children (with cancer) [46]. The mean weighted Diabetes-Free Charlson Index score among children with type 2 diabetes (Charlson index score 0.23, 95% CI 0.17, 0.29) was significantly higher than among their diabetes-free matches (0.0764, 95% CI 0.06, 0.09). The mean weighted Diabetes-Free Charlson Index score among children with type 1 diabetes was slightly higher than among their diabetes-free matches, but the difference was not statistically significant. The mean weighted Diabetes-Free Charlson Index score among children with type 2 diabetes (0.2273, 95% CI 0.1688, 0.2858) was significantly higher than among those with type 1 diabetes (0.1195, 95% CI 0.0946, 0.1445). Three disease categories account for these differences: children with type 2 diabetes had significantly more pulmonary disease and severe and mild renal disease than their matches (Table 8.5).

Table 8.5: Most Common Disease Categories in the Charlson Index Score Among Manitoba Children with Type 2 Diabetes and their Diabetes-Free Matches

Disease Category	Type 2 Diabetes (%)	Diabetes-Free Matches (%)	p-value
Chronic Pulmonary Disease	8.71	4.74	0.0007
Renal Disease	2.65	0.72	0.0005
Mild Liver Disease	1.33	S	<.0001

Mental Health

Key Findings (Table 8.6; Figures 8.7-8.9):

- Children and youth with type 2 diabetes were more likely than both their diabetes-free matches and children with type 1 diabetes to have had a mood or anxiety disorder and to have completed or attempted suicide
- Children with type 2 diabetes were not more likely than their diabetes-free matches to have had concerns with substance abuse

 Table 8.6: Mental Health Outcomes for Children with Type 1 and Type 2 Diabetes and their Diabetes-Free Matches

 Crude rates per 1,000 person-years, before and after the diagnosis date

	Type 1 Diabetes		Type 2 Diabetes		
Outcomes	Diagnosed	Diabetes-Free Matches	Diagnosed	Diabetes-Free Matches	
Mood and Anxiety Disorders (ages 6-18)					
Cohort Counts	753	2,166	528	1,519	
Rate Before (95% CI)	8.13 (5.54-11.94)	4.58 (3.38-6.19)	12.88 (9.74-17.05)	5.31 (4.10-6.87)	
Rate After (95% CI)	25.75 (21.35-31.07)	13.45 (11.54-15.68)	59.32 (49.60-70.94)	34.40 (29.94-39.53)	
Substance Use Disorder (ages	12-18)				
Cohort Counts	663	1,901	522	1,501	
Rate Before (95% CI)	0	S	10.46 (5.63-19.44)	8.24 (5.48-12.40)	
Rate After (95% CI)	5.71 (3.44-9.47)	3.19 (2.14-4.76)	15.78 (10.96-22.70)	14.17 (11.28-17.80)	
Suicide and Suicide Attempts	(ages 12-18)				
Cohort Counts	663	1,901	522	1,501	
Rate Before (95% CI)	0	S	10.46 (5.63-19.44)	3.23 (1.68-6.20)	
Rate After (95% CI)	S	S	13.60 (9.19-20.13)	6.13 (4.33-8.67)	
Use of Atypical Anti-Psychotic Medication (ages 6-18)					
Cohort Counts	753	2,166	528	1,519	
Rate Before (95% CI)	3.58 (2.03-6.30)	2.80 (1.92-4.09)	6.86 (4.70-10.00)	2.47 (1.71-3.58)	
Rate After (95% CI)	5.91 (3.99-8.74)	4.02 (3.04-5.32)	24.71 (18.73-32.61)	14.17 (11.42-17.60)	

"s" indicates data suppressed due to small numbers

Figure 8.7: Relative Risks of Mental Health Comorbidities Among Children with Type 2 Diabetes Compared to their Diabetes-Free Matches



Note: relative risks for substance abuse before diagnosis is suppressed due to small numbers in diabetes-free matches.

Figure 8.8: Relative Risk of Mental Health Comorbidities Among Children with Type 2 Diabetes Compared to Children with Type 1 Diabetes



Note: relative risks are not shown for substance abuse before diagnosis or for suicide and suicide attempts before and after diagnosis due to small numbers in the type 1 population

Figure 8.9: Relative Risks of Mental Health Comorbidities Among Diabetes-Free Matches of Children with Type 2 Diabetes Compared to their Diabetes-Free Matches of Children with Type 1 Diabetes



Note: relative risks are not shown for substance abuse before diagnosis, as well as suicide and suicide attempts before and after diagnosis due to small numbers.
Educational Attainment among Children with Type 2 Diabetes

Key Findings (Figures 8.10-8.12):

- Children with type 2 diabetes were less likely than their diabetes-free matches to attain the required Grade 9 credits within a standard time frame. However, the proportion of children with type 2 diabetes who graduated from high school was no different from that of their diabetes-free matches.
- Both children with type 2 diabetes and their diabetes-free matches were less likely to attain the required grade 9 credits within a standard timeframe compared to children with type 1 diabetes or their diabetes-free matches. Similarly, the proportion of children with type 2 diabetes and their matches who graduated from high school was significantly lower than the proportion of children with type 1 diabetes or their matches who graduated from high school. These differences may reflect variations in the sociodemographic characteristics of the populations with type 2 and 1 diabetes but are unlikely to be related to the disease itself.

Figure 8.10: Relative Risks of Educational Attainment Among Children with Type 2 Diabetes Compared to their Diabetes-Free Matches



Figure 8.11: Relative Risk of Educational Attainment Among Children with Type 2 Diabetes Compared to Children with Type 1 Diabetes



Figure 8.12: Relative Risks of Educational Attainment Among Diabetes-Free Matches of Children with Type 2 Diabetes Compared to their Diabetes-Free Matches of Children with Type 1 Diabetes



Involvement with Child and Family Services (CFS)

Key Findings (Table 8.7; Figures 8.13-8.15):

- A high proportion of children and youth with type 2 diabetes were involved with CFS at least once and a high proportion had been in care for at least one day. However, there were no significant differences in CFS involvement or being taken into care between children and youth with type 2 diabetes and their diabetes-free matches. Thus, having a chronic illness such as type 2 diabetes does not appear to be significantly associated with contact with CFS.
- A higher proportion of children and youth with type 2 diabetes and their diabetes-free matches were involved with CFS than children and youth with type 1 diabetes and their diabetes-free matches. This suggests that there are systemic factors unrelated to diabetes that affect the groups differently.

Table 8.7: Involvement with Child and Family Services (CFS) Among Children with Type 1 and Type 2 Diabetes and their Diabetes-FreeMatches

Crude rate per child, age 0-18

	Type 1 I	Diabetes	Type 2 Diabetes		
Outcomes	utcomes Diagnosed Diabe		Diagnosed	Diabetes-Free Matches	
	(n=778)	(n=2,245)	(n=528)	(n=1,519)	
Children in Care (%)	5.53 (4.10-7.45)	4.68 (3.86-5.66)	25.38 (21.43-30.06)	23.70 (21.37-26.28)	
Children with Any Involvement with CFS (%)	20.82 (17.85-24.29)	20.89 (19.08-22.87)	50.95 (45.21-57.41)	49.77 (46.35-53.45)	

Figure 8.13: Relative Risks of Child and Family Services Involvement Among Children with Type 2 Diabetes Compared to their Diabetes-Free Matches



Figure 8.14: Relative Risk of Child & Family Services Involvement Among Children with Type 2 Diabetes Compared to Children with Type 1 Diabetes



Figure 8.15: Relative Risks of Child and Family Services Involvement Among Diabetes-free Matches of Children with Type 2 Diabetes Compared to Diabetes-Free Matches of Children with Type 1 Diabetes



Summary and Conclusions

- The incidence and prevalence of type 2 diabetes in children in Manitoba is increasing among First Nation children and among All Other Manitoban children. In addition, the proportion of All Other Manitoban children with type 2 diabetes is increasing.
- First Nation children are disproportionally affected by type 2 diabetes. They have among the highest prevalence and incidence of type 2 diabetes in the world.
- Children with type 2 diabetes carry a high burden of illness both before and after diagnosis of diabetes, and this likely reflects the many comorbidities associated with diabetes, including obesity and insulin resistance.
- Many children and youth with type 2 diabetes have comorbid mental illness. It is likely that this comorbidity impacts the individuals' and families' ability to undertake self-managed care.

 Many children with type 2 diabetes are involved with Child and Family Services and many are not excelling in high school, although these observations do not differ from their diabetes-free matches. This suggests that there may be systemic factors influencing the lives of this population and creating barriers to success, including low socioeconomic status, food insecurity, and among First Nation Manitobans, lingering effects of the residential school system and ongoing systemic racism.

Policy Recommendations

There should be more attention on developing appropriate programs to provide care, support and education to children with type 2 diabetes and their families. In many instances, type 2 diabetes is intergenerational and multiple generations are affected. Support programs must take into account the demographic, socioeconomic and psychocultural characteristics of the population affected. As First Nation children are disproportionally affected by type 2 diabetes, First Nation communities and leaders must be involved in the process to ensure an appropriate approach to well-being that includes cultural identity and cultural values – requisites to well-being that are as important as economic security [47].

Chapter 9: Maternal and Neonatal Outcomes for Women with Type 2 Diabetes

As demonstrated in Chapter 3, the incidence of type 2 diabetes among younger people in Manitoba is increasing, and thus we are seeing more women with pre-existing type 2 diabetes becoming pregnant and having children. The risks to women with type 2 diabetes in pregnancy and the risks to their infants are well established. They include a higher need for operative delivery, a higher risk of having a large-for-gestational-age infant, a higher risk of birth injuries to both mother and infant, increased rates of premature births and higher need for Newborn Intensive Care Unit (NICU) stays, higher risk of poor feeding by infants, higher risk of respiratory distress, and higher risk of hypoglycemia in the infant [48,49]. Women who have type 2 diabetes are also likely to have high-risk medical conditions like hypertension and poorer socio-demographic indices (more likely to live in poverty, lower levels of educational achievement, and lower likelihood of high school completion). They are also more likely to identify as First Nation, both because First Nation women have higher birth rates than other Manitoba women and because of the higher incidence of type 2 diabetes among First Nation populations [50]. In this chapter the focus is on maternal and neonatal health outcomes among women with type 2 diabetes and their infants.

Objectives:

- Examine the distribution of births and perinatal outcomes among Manitoba women with type 2 diabetes
 - Compare to Manitoba women without diabetes
 - Compare First Nation women and All Other Manitoban women with type 2 diabetes
- Compare health services use outcomes of mother-baby pairs with type 2 diabetes to diabetes-free mother-baby pairs
 - Compare First Nation women and All Other Manitoban women with type 2 diabetes

Methods

In order to assess health services use outcomes among pregnant women with type 2 diabetes, we first report pregnancy outcomes among all pregnant women with type 2 diabetes in Manitoba. We then present a more detailed assessment of outcomes by comparing these women to diabetes-free matches. Women with type 2 diabetes who were age 14-40 and had at least one live birth during the study period (2011/12 to 2016/17) were matched 1:3 on maternal age, First Nation identity vs All Other Manitobans, RHA zone at delivery, and on whether they gave birth to a single child vs. multiples (twins, triplets, etc.) to a mother-baby pair with no identified diabetes (type 1, type 2 or gestational diabetes). If women in the type 2 diabetes group had more than one eligible live birth during the study period, one birth was chosen at random for matching.

We undertook several different comparisons to identify areas of increased risk and health services use among women with type 2 diabetes. We did not adjust for confounding factors as we were interested in determining the impact of type 2 diabetes in pregnancy and after birth on the healthcare system – thus it was less important whether the outcomes occurred as a result of the diabetes or the confounders.

Detailed definitions of the outcomes reported in this chapter can be found in Appendix 2 in the online supplement.

Pregnancy Outcomes among Manitoba Women with Type 2 Diabetes

Births to Women with Type 2 Diabetes

During the study period (2011/12 to 2016/17), there were 2,283 live infants born to women with type 2 diabetes. There were no births to women younger than age 14; very few births occurred in women after age 40. Thus, we restricted our analyses to women age 14-40 at delivery.

In the last fiscal year of the study period (2016/17), 44.7% of women with type 2 diabetes who had a live birth were First Nation women; among these, 27.9% (n=674) lived off-reserve and 72.1% (n=1,743) lived on-reserve. The All Other Manitobans group comprised 2,990 women. The proportion of births was higher among First Nation women with type 2 diabetes than among All Other Manitoban women with type 2 diabetes. First Nation infants made up 55.8% of the infant cohort.

Key Finding (Table 9.1):

• First Nation women with type 2 diabetes were more likely to have a baby at a younger age compared to All Other Manitoban women with type 2 diabetes

First Nation Manitobans All Other Manitobans w T2DM w T2DM Age Group Count Percent Count Percent 14-19 10 66 5.4% 1.0% 20-24 215 17.7% 55 5.7% 25-29 345 28.3% 197 20.5% 30-34 349 28.7% 382 39.7% 35-40 243 20.0% 319 33.1% **Total 14-40** 1,218 100.0% 963 100.0%

Table 9.1: Distribution of Births to First Nation Manitoban Women and All Other Manitoban Women with Type 2 Diabetes by Age Group, 2011/12-2016/17

Fertility Rates

The fertility rate of a population is the number of live births per 1,000 women. When it is broken down into age ranges (as reported here), it is described as age-specific fertility rate. A recent report from MHCP showed that the age-specific fertility rate for Manitoba women age 15-45 was 55.49 births per 1,000 women [23].

Key Findings (Figures 9.1-9.2):

- Among all Manitoban women with type 2 diabetes, fertility rates were highest in the middle age ranges (age 20-30)
- Among First Nation women with type 2 diabetes, fertility rates were higher at lower age groups than among All Other Manitobans (First Nation women had their children when they were younger)

- Fertility rates declined rapidly after age 40 (not shown)
- Fertility rates were higher among First Nation women with type 2 diabetes (118 births per 1,000 person-years) than among All Other Manitoban women with type 2 diabetes (86 births per 1,000 person-years)
- In all health regions except Southern Health-Santé Sud and Prairie Mountain Health, fertility rates were higher among First Nation women with type 2 diabetes than among All Other Manitoban women with type 2 diabetes



Figure 9.1: Fertility Rate Among First Nation Manitoban Women and All Other Manitoban Women with Type 2 Diabetes Crude rate per 1,000 person-years, women age 14-40, 2011/12-2016/17

Figure 9.2: Fertility Rate Among First Nation Manitoban Women and All Other Manitoban Women with Type 2 Diabetes by Health Region Age-adjusted rate per 1,000 person-years, women age 14-40, 2011/12-20161/7



indicates area's First Nations rate was statistically different from Manitoba's First Nations rate (p<0.01) f indicates area's All Others rate was statistically different from Manitoba's All Other Manitobans rate (p<0.01) а

indicates data suppressed due to small numbers s

Perinatal Mortality

Diabetes is a known risk factor for perinatal mortality. The proportion of age 14-40 Manitoban women with type 2 diabetes who had a **stillbirth** was 2.6% among First Nation women and 1.2% among All Other Manitoban women. The proportion of women with type 2 diabetes whose infants were either stillborn or died within six days of birth was 3.9% among First Nation women and 1.6% among All Other Manitoban women. In the general population of Manitoba, 0.8% of First Nation women experienced a stillbirth compared to 0.6% of All Other Manitoban women [51].

Comparing Women with Type 2 Diabetes to Diabetes-Free Matches

Starting with a cohort of 1,521 live births to women with type 2 diabetes (after randomly choosing one birth per woman), we matched 89.3% of the cohort to three controls, 5.2% to two controls, and 4.5% to one control. 15 births (1%) could not be matched and were excluded from these analyses. The unmatched births were all in the 31-40 maternal age group, and tended to be to First Nation women, live in the Northern Health Region, and be single births (not multiples).

 Table 9.2: Births to Women with Type 2 Diabetes and Births to Diabetes-Free Matches by Health Region of Residence and Income Quintile

 Age 14-40, 2011/12-2016/17

Variable	Births to Women w N=1,506	vith Type 2 Diabetes (25.93%)	Births to Type 2 Diabetes-Free Matches N=4,301 (74.07%)		
	First Nation	All Other	First Nation	All Other	
Health Region	Manitobans	Manitobans	Manitobans	Manitobans	
Southern Health-Santé Sud	35 (4.29%)	57 (8.26%)	125 (5.6%)	171 (8.27%)	
Winnipeg RHA	201 (24.63%)	440 (63.77%)	653 (29.24%)	1,320 (63.83%)	
Prairie Mountain Health	91 (11.15%)	140 (20.29%)	242 (10.84%)	420 (20.31%)	
Interlake-Eastern RHA	116 (14.22%)) 33 (4.78%) 274 (12.27%)		97 (4.69%)	
Northern Health Region	373 (45.71%)	20 (2.9%)	20 (2.9%) 939 (42.05%)		
Income Quintile				1. 19	
Rural 1 (Lowest)	372 (45.59%)	41 (5.94%)	976 (43.71%)	58 (2.80%)	
Rural 2	198 (24.26%)	29 (4.20%)	562 (25.17%)	118 (5.71%)	
Rural 3	23 (2.82%)	48 (6.96%)	62 (2.78%)	120 (5.80%)	
Rural 4	95 (11.64%)	27 (3.91%)	253 (11.33%)	105 (5.08%)	
Rural 5 (Highest)	14 (1.72%)	28 (4.06%)	38 (1.70%)	120 (5.80%)	
Urban 1 (Lowest)	59 (7.23%)	153 (22.17%)	168 (7.52%)	258 (12.48%)	
Urban 2	19 (2.33%)	115 (16.67%)	92 (4.12%)	314 (15.18%)	
Urban 3	21 (2.57%)	101 (14.64%)	40 (1.79%)	303 (14.65%)	
Urban 4	12 (1.47%)	85 (12.32%)	23 (1.03%)	338 (16.34%)	
Urban 5 (Highest)	S	59 (8.55%)	16 (0.72%)	331 (16.01%)	
Manitoba	816 (54.18%)	690 (45.82%)	2,233 (51.92%)	2,068 (48.08%)	

s indicates suppression due to small numbers

Note: 'Income not found' is not included in the table, therefore percent may not add to 100%

Antenatal Hospitalizations

Key Findings (Tables 9.3-9.5):

- Women with type 2 diabetes had a higher risk of being hospitalized before birth than their diabetes-free matches
 - The most common reasons for hospitalization included diabetes management, preterm labour/hemorrhage, and management of renal disease
- Among both First Nation women and All Other Manitoban women, those with type 2 diabetes had a risk of **antenatal hospitalization** almost triple that of their diabetes-free matches
- Among First Nation women with and without type diabetes, the risk of antenatal hospitalization was higher than among All Other Manitoban women
- Similar patterns were seen for risk of multiple antenatal hospitalizations for the comparisons undertaken

Table 9.3: Percent of First Nation Manitoban Women and All Other Manitoban Women with Type 2 Diabetes and their Diabetes-FreeMatches with at Least One Antenatal Hospitalization

Case/Match	Group	Crude Rate
Type 2 Diabetes Cases	First Nation Manitobans	35.66%
Type 2 Diabetes Cases	All Other Manitobans	12.61%
Diabatas Free Matches	First Nation Manitobans	12.14%
Diabetes-riee Matches	All Other Manitobans	4.64%

Table 9.4: Relative Risk of Antenatal Hospitalization Among First Nation Manitoban Women and All Other Manitoban Women with Type 2 Diabetes compared to their Diabetes-Free Matches

Comparison Groups	Relative Risk	95% Confidence Interval
First Nation Manitobans: Type 2 Diabetes Cases vs Diabetes-Free Matches	2.94	2.54-3.40
All Other Manitobans: Type 2 Diabetes Cases vs Diabetes-Free Matches	2.72	2.06-3.58
Type 2 Diabetes cases: First Nation Manitobans vs All Other Manitobans	2.83	2.28-3.51
Diabetes-Free Matches: First Nation Manitobans vs All Other Manitobans	2.61	2.09-3.27

Table 9.5: Distribution of Counts for Antenatal Hospitalizations Among First Nation and All Other Manitoban Women with Type 2 Diabetes and their Diabetes-Free Matches

Case/Match	Group	Number of Antenatal Hospitalizations			
		0	1	2+	
Type 2 Diabetes Cases	First Nation Manitobans	525 (64.3 %)	157 (19.2 %)	134 (16.4 %)	
	All Other Manitobans	603 (87.4 %)	67 (9.7 %)	20 (2.9 %)	
Diabetes-Free Matches	First Nation Manitobans	1962 (87.9 %)	219 (9.8 %)	52 (2.3 %)	
	All Other Manitobans	1972 (95.4 %)	96 (4.6%)*		

* Cells have been combined due to suppressed numbers

Travel for Delivery

Key Findings (Table 9.6):

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- First Nation women with type 2 diabetes were more likely to have to travel outside of their home health region to give birth than their diabetes-free matches
 - We only saw a small difference in births outside the home health region between All Other Manitoban women and their diabetesfree matches
- Among Manitoban women without diabetes, First Nation women had a higher chance of having to travel outside of their home health region to give birth than All Other Manitoban women

 Table 9.6:
 Location of Delivery Hospital Among First Nation Manitoban Women and All Other Manitoban Women with Type 2 Diabetes and their Diabetes-Free Matches

Comparison Group	Home RHA	Other RHA	Winnipeg
Comparison Group	Hospital	Hospital	Hospital
First Nation Manitobans With Type 2 Diabetes	45.59%	29.48%	
All Other Manitobans With Type 2 Diabetes	86.23%	6.31%	
First Nation Manitobans Diabetes-Free Matches	65.20%	1.75%	33.05%
All Other Manitobans Diabetes-Free Matches	89.85%	1.06%	9.09%

Areas are comined where needed to avoid suppressed values

Delivery-Related Outcomes for Manitoban Women with Type 2 Diabetes and their Infants

Key Findings (Table 9.7; Figure 9.3):

- The mean post-delivery length of stay in hospital for women with type 2 diabetes was 3.67 days (95% CI 3.58-3.76); for women without diabetes it was 2.96 days (95% CI 2.93-2.99)
- The mean length of stay in hospital for newborn infants born to women with type 2 diabetes was almost double that of infants born to women without diabetes (8.3 days versus 4.2 days, t = -9.74, p < 0.0001)
- Infants born to women with type 2 diabetes had a nearly 4 times higher risk of being admitted to the NICU compared to infants born to women without type 2 diabetes (RR 3.71, 95% CI 3.27, 4.21)
- Infants born to women with type 2 diabetes were over-represented in the 6-10 day NICU stay group

Comparing Postnatal Hospital Length of Stay to Benchmark (Table 9.7):

When examining postnatal hospital stays, a benchmark approach is often used. In this case, we calculated the benchmark for postnatal hospital stays using data from the Canadian Institute for Health Information (CIHI). According to CIHI, the average length of stay for infants in a Manitoba hospital is 3.3 days [52]. We calculated excess hospital days for infants exposed to type 2 diabetes in pregnancy and not exposed to diabetes in pregnancy, and stratified these results by whether the infant was admitted to the NICU or not. Infants born after being exposed to maternal type 2 diabetes used just over 4 times the excess hospital days than infants not exposed to maternal type 2 diabetes.

	Length of Stay (Days)		Excess Len (Da	gth of Stay ays)	Difference in Length of Stay	
Stay Location	Mothers with Type 2 Diabetes	Diabetes- Free Matches	Mothers with Type 2 Diabetes	Diabetes- Free Matches	(Days) Mothers with Type 2 Diabetes vs Diabetes-Free Matches	
Overall Length of Stay	8.29	4.23	5.13	1.07	4.06	
Length of Stay in NICU	18.94	18.37	15.77	15.20	0.57	
Length of Stay Not in NICU	3.68	2.97	0.52	-0.19	0.71	

Table 9.7: Association of Type 2 Diabetes with Neonatal Length of Stay and Length of Stay Over Benchmark (Excess LOS)

Figure 9.3: Distribution of Length of Stay in Days for Infants Admitted to NICU Among Mothers with Type 2 Diabetes and their Diabetes-Free Matches 2011/12-2016/17



Neonatal and Maternal Outcomes

Outcomes in this section were chosen to reflect those known to be closely related to maternal type 2 diabetes. Prenatal care, an important healthcare service outcome, is included here as well.

The percent of people meeting each outcome is shown in Table 9.8. Following that, we present three figures per outcome showing the relative risk of the outcome for First Nation women with type 2 diabetes vs their diabetes-free matches, All Other Manitoban women with type 2 diabetes vs their diabetes-free matches, and First Nation women with type 2 diabetes vs All Other Manitoban women with type 2 diabetes. The relative risks are also presented in tables in Appendix 1 online.

Gestational Age at Birth

Key Findings (Figure 9.4):

- In Manitoba, 75% of babies born to mothers with type 2 diabetes were born between 34-38 weeks gestation
- Premature births were significantly more common among women with type 2 diabetes, especially late premature births (34-36 weeks)
- A slightly higher percent of premature births occurred among First Nation women with type 2 diabetes compared to All Other Manitoban women with type 2 diabetes

Figure 9.4: Distribution of Gestational Age at Birth for Infants of Mothers with Type 2 Diabetes and their Diabetes-Free Matches Percent of live births, 2011/12-2016/17



Other Maternal and Neonatal Outcomes

Most of the outcomes in this section are considered adverse outcomes; only having an appropriate-sizefor-gestational-age (AGA) infant and the prenatal care indices are considered desirable outcomes. Hospital re-admission and labour induction rates also function as markers of health resource use. Induction of labour and premature births are linked together for women with type 2 diabetes, as delivery is often indicated for large fetal size or avoidance of stillbirth risks at late gestation [53].

Key Findings (Table 9.8; Figures 9.5-9.7);

- Women with type 2 diabetes and their infants were generally at increased risk for adverse outcomes and had a lower likelihood of desired outcomes
- We saw similar patterns among First Nation mother baby-pairs with type 2 diabetes and All Other Manitoban mother-baby pairs with type 2 diabetes, except:
 - Prenatal care indices were better among First Nation women with type 2 diabetes compared to their diabetes-free matches, and there was no difference between All Other Manitoban women with type 2 diabetes and their diabetesfree matches

- Maternal type 2 diabetes was associated with a lower risk of small-for-gestational-age (SGA) infants among First Nation women with type 2 diabetes but not among All Other Manitobans with type 2 diabetes
- First Nation women with type 2 diabetes had poorer outcomes than All Other Manitoban women with type 2 diabetes for prenatal care, labour induction, neonatal hospital re-admissions, NICU admissions and congenital anomalies
 - First Nation women type 2 diabetes were also less likely to have an AGA or SGA infant and more likely to have a large-for-gestational-age (LGA) infant than All Other Manitoban women with type 2 diabetes.

We added an interaction term to the models to examine whether type 2 diabetes affected the risk of outcomes differently in First Nation women compared to All Other Manitoban women. For most outcomes, the interaction was not significant, suggesting that type 2 diabetes in pregnancy posed the same risk to women in both groups. However, for caesarean section, prenatal care indices, and NICU admission, the effect of diabetes was different between groups, suggesting type 2 diabetes conferred a differential risk for First Nation women vs All Other Manitoban women.

Table 9.8: Percentages of Outcomes Under Study for First Nation Manitobans and All Other Manitobans with Type 2 Diabetes and their Diabetes-Free Matches

	First Nation	Manitobans	All Other Manitobans		
Outcomes	With T2DM (n=816)	Without T2DM (n=2,233)	With T2DM (n=690)	Without T2DM (n=2,068)	
Prenatal Care				ár.	
First Trimester Initiation	76.1%	63.3%	89.1%	86.6%	
Appropriate	89.7%	71.3%	98.0%	95.7%	
Maternal Outcomes					
Caesarean	40.0%	17.1%	45.1%	25.5%	
Operative Vaginal Delivery	6.0%	4.3%	7.0%	7.7%	
Induction	55.4%	28.1%	45.4%	21.7%	
Mortality/Morbidity	0.9%	1.0%	1.6%	1.4%	
Maternal Readmission	5.0%	2.2%	4.5%	1.4%	
Neonatal Outcomes					
Appropriate for Gestational Age	49.0%	75.2%	66.1%	80.4%	
Large for Gestational Age	47.4%	16.3%	26.5%	11.0%	
Small for Gestational Age	3.4%	8.4%	7.4%	8.7%	
Neonatal Readmission	5.5%	3.4%	2.6%	2.9%	
NICU Admission	33.1%	8.4%	26.8%	7.8%	
Congenital Anomalies	8.6%	2.4%	4.3%	1.6%	
Birth Trauma	2.0%	0.3%	2.0%	0.4%	

Note: Maternal readmission cohort was smaller at 807, 687, 2,230, and 2,065 respectively

Figure 9.5: Relative Risks of Maternal and Infant Outcomes Among First Nation Manitoban Mothers with Type 2 Diabetes Compared to their Diabetes-Free Matches



Figure 9.6: Relative Risks of Maternal and Infant Outcomes Among All Other Manitoban Mothers with Type 2 Diabetes Compared to their Diabetes-Free Matches



Figure 9.7: Relative Risks of Maternal and Infant Outcomes Among First Nation Manitoban Mothers with Type 2 Diabetes Compared to All Other Manitoban Mothers with Type 2 Diabetes



Overall Summary and Recommendations

The findings in this chapter demonstrate the higher morbidity and healthcare needs that women with type 2 diabetes and their newborns experience throughout pregnancy and the postnatal period. Women with type 2 diabetes in pregnancy often have multiple risk factors both medical (e.g., pre-gestational hypertension) and sociodemographic (e.g., poverty). The First Nation women in this study are also impacted by the Indigenous determinants of health, including the need to relocate to another health region to give birth, the expenses associated with that move, and potentially other determinants like food insecurity and systemic racism.

Coordinated preconception and early prenatal care can reduce pregnancy and birth complications in women with type 2 diabetes, as can attention to the social and Indigenous determinants of health [54,55]. Management of type 2 diabetes in pregnancy is important: adequate control of blood glucose can reduce the incidence of LGA infants and the need for induction at late preterm gestation, both of which contribute significantly to morbidity in our cohort. Many in the cohort did not have early and adequate prenatal care, and this is more pronounced among First Nation women. Pregnancy is a time during which many women access the healthcare system. It is an opportunity to connect women with medical supports, social services, and financial benefits to optimize outcomes. Practitioners who provide prenatal care to women with type 2 diabetes should be aware of the services available to their patients. 'Get your benefits!' is a Manitoba-based booklet and website with information helpful to primary care providers (https://www.gov.mb.ca/health/primarycare/providers/ getyourbenefits.html) and their patients. In areas with high rates of type 2 diabetes in young women of child-bearing age, culturally appropriate prenatal care programs should be available.

Women with type 2 diabetes are almost 3 times as likely to be hospitalized before delivery compared to women without diabetes. Many of these women have multiple admissions. Unfortunately, hospital admission may occur at a distance from the home community and interfere with the ability to work and/or care for other children and family. Manitoba currently has an antenatal home care program (https://www. wrha.mb.ca/prog/antenatal/index.php), providing services to women within the WRHA who need monitoring for hypertension, premature rupture of membranes, or preterm labour. Expansion of the existing antenatal home care program outside of the WRHA and broadening its abilities to provide home-based monitoring for common complications of diabetes in pregnancy could reduce hospitalizations. After delivery, women with type 2 diabetes in our study continued to have increased healthcare needs with double the rate of maternal readmission after delivery. Exploration of the reasons for this difference is important.

Infants exposed to type 2 diabetes in-utero had significantly higher healthcare needs than those not exposed to diabetes; on average, they required a four-day longer stay at birth, or a five-day longer stay than the Manitoba benchmark. The higher length of stay was evident whether they were admitted to a NICU or not, and they were almost four times as likely to need a NICU admission. This length of stay is typical among infants born late preterm [56]. Many of the NICU admissions in infants born to women with diabetes are due to the common complications of late prematurity, such as hypoglycemia (requiring an IV infusion) and feeding issues (requiring gavage tube feeding) [48,56]. Management of these issues does not require a neonatologist or an intensive care unit, and can be managed on regular postpartum newborn wards if proper nursing training and ratios are maintained, as occurs currently in the Health Sciences Centre and St. Boniface Hospital in Winnipeg. Currently, Winnipeg, Thompson and Brandon are the only centres in Manitoba that can reliably provide this level of care. Exploration of the barriers to providing this care in other hospitals could substantially decrease the number of infants requiring separation from their mothers and admission to a NICU. NICU admission is associated with increased rates of postpartum depression [57], and postnatal separation of infants from their mothers decreases breastfeeding initiation rates [58].

Summary and Recommendations for First Nation Manitobans with Type 2 Diabetes

In addition to the discussion above, there are additional considerations for First Nation women with type 2 diabetes in pregnancy. While rates of adequate and early prenatal care are higher for those with type 2 diabetes, they still remain low overall. Specific programs to provide culturally appropriate and safe prenatal care should be available in all communities. Consultation with First Nation groups on barriers to accessing prenatal care and barriers to achieving control of diabetes in pregnancy should be undertaken. Critically, stable funding to address these issues should be available. Programs such as the Restoring the Sacred Bond Initiative (https://www.restoringthesacredbond.ca/ site/indigenous-doula-initiative) serve as an example. Interactions with Child and Family Services both pre- and postnatally and concerns about child apprehension impact accessibility to healthcare for many women. Travel for delivery was more common among First Nation women than among All Other Manitobans, and even higher for those with type 2 diabetes, and this can impact the ability of women to work and care for other family members. First Nation women also experienced higher rates of antenatal and postnatal admission to hospital. Expansion of both in-hospital and outpatient maternal and neonatal care in secondary care hospitals such as Boundary Trails (Winkler/ Morden), The Pas and Thompson would allow for more family-centered care and free up intensive care beds in Winnipeg where space is at capacity.

Chapter 10: Mental Health Outcomes among Manitobans with Type 2 Diabetes

While mental health disorders are not always considered a complication of type 2 diabetes, it is now well established that mental health issues are more common in people with diabetes than in people without diabetes [5]. Medications used to treat mental health disorders, specifically a class of medications called atypical antipsychotics, can also contribute to the development of diabetes. In this chapter, we examine mental health-related outcomes among Manitobans with type 2 diabetes and compare them with a matched group of diabetes-free individuals. We assess how common mental disorders are and examine whether having type 2 diabetes increases the risk of mental health problems. This knowledge is important to ensure that people with type 2 diabetes receive the care and resources they need to address mental health concerns.

Objectives:

- Examine mental health outcomes among Manitobans with type 2 diabetes:
 - · Completed suicides and attempted suicides
 - Mood and anxiety disorders
 - Substance use disorders
 - Atypical antipsychotic drug use
- Examine whether mental health outcomes differ between Manitobans with type 2 diabetes and their diabetes-free matches
- Examine whether patterns in mental health outcomes differ between First Nation Manitobans with type 2 diabetes and All Other Manitobans with type 2 diabetes

Methods

We matched 131,148 Manitobans with type 2 diabetes 1:1 with individuals who were diabetes-free on First Nation identity vs All Other Manitoban identity, year of birth, sex, and region of residence (on the date of diabetes diagnosis). There were 5,062 Manitobans with type 2 diabetes for whom we could not find a match. Unmatched individuals tended to be First Nation people, female and older (on average) than those for whom we did find a match. For characteristics of the cohort of Manitobans with type 2 diabetes and their diabetes-free matches, see Table 10.1, in which we present the relative risks of the characteristics with 95% confidence intervals. The relative risks were estimated using Poisson regression in a generalized linear model with a log link function and an offset of the logarithm of the person-years per time period. Covariates included cohort (type 2 diabetes case or match), time period and the interaction of cohort and time. Generalized estimating equations were used to account for repeated measures over time.

Cohort Characteristics

Key Findings (Tables 10.1-10.2):

- Manitobans with type 2 diabetes had a higher diabetes-free Charlson Comorbidity Index score than their diabetes-free matches
 - Further detail on the Charlson Index is available in Appendix 2 online
- Manitobans with type 2 diabetes were more likely to have lower socioeconomic status and to be slightly older than their diabetes-free matches among both First Nation Manitobans and All Other Manitobans

Table 10.1: Demographics in the Matched Adult Cohort

Indicators	Type 2 Diabetes Cohort	Diabetes-Free Match
Mean Age (SD)	59.28 (15.36)	58.23 (15.70)
First Nation Identity (%)	11.45	11.45
Sex (% Male)	53.46	53.46
Rural Income Quintile (%)		
Q1	9.02	8.33
Q2	9.35	9.41
Q3	8.08	7.94
Q4	7.19	7.28
Q5	5.89	6.59
Urban Income Quintile (%)		
Q1	13.77	11.44
Q2	12.90	11.97
Q3	12.07	11.95
Q4	11.06	11.98
Q5	9.33	11.96

Table 10.2: Demographic Comparisons Between First Nation Adult Manitobans and All Other Adult Manitobans with Type 2 Diabetes and their Diabetes-Free Matches

Age 18+, 2011/12-2016/17

	Type 2 Diabetes Cohort		Diabetes-Free Matches		
Variable	Mean	95% Confidence Interval	Mean	95% Confidence Interval	p-value
First Nation Manitobans					
Age at Diagnosis	44.36	44.15-44.57	43.34	43.13-43.56	<.0001
Socio-Economic Factor Index	1.56	1.55-1.58	1.50	1.48-1.52	<.0001
Charlson Comorbidity Score*	0.30	0.29-0.32	0.17	0.16-0.17	<.0001
Weighted Charlson Comorbidity Score*	0.40	0.38-0.41	0.22	0.22 0.21-0.23	
All Other Manitobans					
Age at Diagnosis	61.20	61.12-61.29	60.16	60.07-60.24	<.0001
Socio-Economic Factor Index	-0.09	-0.090.08	-0.18	-0.190.18	<.0001
Charlson Comorbidity Score*	0.40	0.40-0.41	0.25	0.24-0.25	<.0001
Weighted Charlson Comorbidity Score*	0.54	0.53-0.54	0.33	0.33-0.34	<.0001

* Charlson Comorbidity Score excludes diabetes-related scores

See Appendix 2 online for details of the Charlson Comorbidity Index scores.

Completed Suicides and Attempted Suicides

There is a growing body of evidence that mental health is poorer among people with type 2 diabetes, and this includes higher rates of suicides and suicide attempts [59]. Rates of completed suicides and attempted suicides are also independently higher among First Nation Manitobans than among All Other Manitobans [60]. Among Manitobans with type 2 diabetes, the age- and sex-adjusted rate of completed suicides for First Nation individuals was 30.9 deaths per 100,000 person-years, and for All Other Manitobans it was 14.4 deaths per 100,000 person-years. When we examined suicide rates among the diabetes-free matches, they were quite a bit lower than expected. We suspect that more sophisticated modeling than we could feasibly do for this report would be required to take into account the differential rates of death by suicide over time. Reported below are attempted suicide rates only.

Key Findings (Tables 10.3-10.4):

- The rate of attempted suicides was higher among First Nation Manitobans with type 2 diabetes than among All Other Manitobans with type 2 diabetes, both before and after diagnosis of diabetes
- The relative risk of a suicide attempt was higher among both First Nation Manitobans with type 2 diabetes and All Other Manitobans with type 2 diabetes compared to their respective diabetes-free matches, both before and after diagnosis of diabetes
- Among First Nation Manitobans with type 2 diabetes (but not All Other Manitobans with type 2 diabetes), the rate of attempted suicides declined after diagnosis
- Among the diabetes-free matches for both First Nation Manitobans with type 2 diabetes and All Other Manitobans with type 2 diabetes, there was no change in the rate of attempted suicides after diagnosis of diabetes

 Table 10.3: Rate of Suicide Attempts Among Adult Manitobans with Type 2 Diabetes and Their Diabetes-Free Matches Before and After Diagnosis

Crude rate per 1,000 person-years

First Nations Identity	Cases with Ty Diagi	Cases with Type 2 Diabetes Diagnosis		Diabetes-Free Matches	
	Before	After	Before	After	
First Nation Manitobans	4.22	3.02	3.66	2.08	
All Other Manitobans	0.46	0.47	0.28	0.24	

Table 10.4: Relative Rate of Suicide Attempts Among Adult Manitobans with Type 2 Diabetes and Diabetes-Free Matches Before and After Diagnosis

	First Nation	Manitobans	All Other Manitobans		
Comparison Groups	Relative Rate	95% Confidence Interval	Relative Rate	95% Confidence Interval	
Cases with Type 2 Diabetes vs. Diabetes- Free Matches After Diagnosis	1.46	1.27-1.67	1.95	1.70-2.24	
Cases with Type 2 Diabetes vs. Diabetes- Free Matches Before Diagnosis	1.16	1.06-1.27	1.65	1.49-1.84	
Cases with Type 2 Diabetes After Diagnosis vs. Before Diagnosis	0.70	0.63-0.77	1.02	0.92-1.13	
Diabetes-Free Matches After Diagnosis vs. Before Diagnosis	0.55	0.49-0.63	0.86	0.75-0.99	

Mood and/or Anxiety Disorders

Mood and/or anxiety disorders are defined using a previously developed algorithm which uses hospitalizations, physician visits and dispensed medications to assign a diagnosis. See Appendix 2 online for details. It is important to note that the Repository contains information on diagnosed mood/anxiety disorders only, thus only capturing mood/anxiety disorders among people who present to a physician and/or have a prescription for medication used to treat mood/anxiety disorders. Where we saw changes in the rate of mental health disorders after a type 2 diabetes diagnosis, it is possible that this merely reflects greater contact with the healthcare system and not a true change in rate of mental disorders.

Key Findings (Table 10.5-10.6):

- The rate of mood/anxiety disorders was slightly higher among First Nation Manitobans with type 2 diabetes compared to All Other Manitobans with type 2 diabetes, both before and after diagnosis of diabetes
- Among both First Nation Manitobans with type 2 diabetes and All Other Manitobans with type 2 diabetes, there was a slightly higher risk of mood/ anxiety disorders before and after diagnosis of diabetes, compared to their respective diabetes-free matches
- Among First Nation Manitobans with type 2 diabetes, the risk of being diagnosed with a mood/ anxiety disorder increased after diagnosis, but among All Other Manitobans with type 2 diabetes it declined

Table 10.5: Rate of Mood and Anxiety Disorders Among Adults with Type 2 Diabetes and Their Diabetes-Free Matches Before and After Diagnosis

Crude rate per 1,000 person-years

First Nations Status	With Type 2 Diabetes Diagnosis		Diabetes-Free Matches	
	Before	After	Before	After
First Nation Manitobans	32.37	33.60	30.55	28.74
All Other Manitobans	30.61	30.01	26.19	25.68

Table 10.6: Relative Rate of Mood and Anxiety Disorders for Cases with Type 2 Diabetes versus Diabetes-Free Matches

Comparison Groups	First Nation Manitobans		All Other Manitobans	
	Relative Rate	95% Confidence Interval	Relative Rate	95% Confidence Interval
Type 2 Diabetes Cases vs. Diabetes-Free Matches After Diagnosis	1.17	1.13-1.20	1.17	1.15-1.18
Type 2 Diabetes Cases vs. Diabetes-Free Matches Before Diagnosis	1.06	1.03-1.10	1.17	1.15-1.18
Type 2 Diabetes Cases After Diagnosis vs. Before Diagnosis	1.03	1.00-1.06	0.98	0.97-0.99
Diabetes-Free Matches After Diagnosis vs. Before Diagnosis	0.94	0.91-0.97	0.98	0.97-0.99

Substance Use Disorders

While many definitions of substance use disorders exist in practice, they are captured here when coded as a diagnosis at a healthcare provider visit or hospitalization. See technical appendix for details.

Key Findings (Tables 10.7-10.8):

- The rate of substance use disorders was almost 4 times higher among First Nation Manitobans with type 2 diabetes compared to All Other Manitobans with type 2 diabetes
- The rate of substance use disorders among First Nation Manitobans with type 2 diabetes was not different than among their diabetes-free matches, but the rate of substance use disorders increased in both groups after diagnosis of diabetes
- The rate of substance use disorders among All Other Manitobans with type 2 diabetes was higher than among their diabetes-free matches both before and after diabetes diagnosis, and the rate increased in both groups after diagnosis of diabetes

Table 10.7: Rate of Substance Use Disorder Among Adults with Type 2 Diabetes and Their Diabetes-Free Matches Before and After Diagnosis

Crude rate per 1,000 person-years

First Nations Status	With Type 2 Diabetes Diagnosis		Diebetes-free Matches	
	Before	After	Before	After
First Nation Manitobans	21.02	22.09	21.52	22.76
All Other Manitobans	6.62	6.72	5.42	5.89

Table 10.8: Relative Rate of Substance Use Disorder for Cases with Type 2 Diabetes versus Diabetes-Free Matches Before and After Diagnosis

Comparison Groups	First Nation Manitobans		All Other Manitobans	
	Relative Rate	95% Confidence Interval	Relative Rate	95% Confidence Interval
Type 2 Diabetes Cases vs. Diabetes-free Matches After Diagnosis	0.97	0.93-1.00	1.14	1.11-1.17
Type 2 Diabetes Cases vs. Diabetes-free Matches After Before Diagnosis	0.97	0.94-1.01	1.21	1.18-1.24
Type 2 Diabetes Cases After Diagnosis vs. Before Diagnosis	1.06	1.03-1.10	1.04	1.02-1.07
Diabetes-free Matches After Diagnosis vs. Before Diagnosis	1.07	1.04-1.11	1.11	1.08-1.14

Atypical Antipsychotic Drug Use

Use of atypical antipsychotic medications, such as olanzapine, is associated with type 2 diabetes because they contribute to weight gain and lower glycemic control [5]. However, the reasons for taking these medications are also associated with type 2 diabetes.

Key Findings (Tables 10.9-10.10):

- First Nation Manitobans with type 2 diabetes had higher rates of atypical antipsychotic drug use than All Other Manitobans with type 2 diabetes
- For both First Nation Manitobans with type 2 diabetes and All Other Manitobans with type 2 diabetes, rates of atypical antipsychotic drug use were higher than among their diabetes-free matches, both before and after diagnosis of diabetes
- Use of atypical antipsychotic drugs increased after diabetes diagnosis among Manitobans with type 2 diabetes and among the diabetes-free matches

Table 10.9: Rate of Atypical Antipsychotic Drug Use Among Adult Manitobans with Type 2 Diabetes and Their Diabetes-Free MatchesBefore and After Diagnosis

Crude rate per 1,000 person-years

First Nation Identity	With Type 2 Diabetes Diagnosis		Diabetes-Free Matches	
	Before	After	Before	After
First Nation Manitobans	3.02	10.12	2.27	7.20
All Other Manitobans	2.03	7.29	1.29	4.97

Table 10.10: Relative Rate of Atypical Antipsychotic Drug Use Among Adult Manitobans with Type 2 Diabetes Compared to their Diabetes-Free Matches Before and After Diagnosis

	First Nation Manitobans		All Other Manitobans	
Comparison Groups	Relative Rate	95% Confidence Interval	Relative Rate	95% Confidence Interval
Type 2 Diabetes Cases vs. Diabetes-Free Matches After Diagnosis	1.38	1.29-1.48	1.42	1.37-1.46
Type 2 Diabetes Cases vs. Diabetes-Free Matches Before Diagnosis	1.33	1.16-1.52	1.55	1.46-1.65
Type 2 Diabetes Cases After Diagnosis vs. Before Diagnosis	4.02	3.69-4.39	4.73	4.55-4.91
Diabetes-Free Matches After Diagnosis vs. Before Diagnosis	3.89	3.50-4.32	5.19	4.95-5.43

Chapter Summary and Recommendations

The findings in this chapter confirm the previously reported mental health comorbidities experienced by Manitobans living with type 2 diabetes [5]. Type 2 diabetes itself often increases the risk of mental health disorders, and while we did not explore them here, other risk factors for mental health disorders, such as low socioeconomic status, are also often prevalent in those with type 2 diabetes (Chapter 4).

Overall Summary and Recommendations

The findings in this chapter underline the importance of multi-disciplinary care for individuals with type 2 diabetes. Clinicians must be aware of the increased risk for mental health disorders in these patients. A substantial proportion of Manitobans with type 2 diabetes have a mood/anxiety disorder and/or a substance use disorder, which can complicate the management of their type 2 diabetes - it may affect the care they receive from their healthcare providers as well as their ability to undertake self-management of their diabetes. Programs that help people access care and manage their type 2 diabetes should screen for mental health and substance use disorders. In facilities that provide care to patients for substance use and mental health disorders, there needs to be a focus on helping patients manage the day-to-day aspects of type 2 diabetes. Patient contacts with mental health and substance use support programs may also be an opportunity to screen for diabetes and ensure patients are referred to programs to manage their diabetes in a timely manner.

Summary and Recommendations for First Nation Manitobans with Type 2 Diabetes

As has been extensively documented in previous reports, First Nation individuals are burdened with higher rates of mental health disorders, substance use disorders, and suicide attempts/completed suicides than other Manitobans [24]. This is to a large extent the result of the social determinants of health and ongoing trauma from colonization, the residential school system, and systemic racism. Programs and supports to provide care to people living with type 2 diabetes and comorbid mental health disorders should be designed to be culturally appropriate, community driven, safe and sensitive to the needs of the population they are serving.

Chapter 11: Conclusions and Recommendations

This report provides an overview of the current health status and health services use of Manitobans living with type 2 diabetes. We first examined the historical incidence and prevalence of diabetes over time (from 1985 to present day). We then looked at the care provided to Manitobans with type 2 diabetes and the diabetes-related complications they experienced. We also determined patterns of health and health services use in specific sub-populations of Manitobans with type 2 diabetes, including Registered First Nation peoples, pregnant women and children.

Our summary of the findings and major conclusions and recommendations follow in this chapter. Most of our recommendations are drawn from the Clinical Practice Guidelines for the Prevention and Management of Diabetes in Canada by the Diabetes Canada Clinical Practice Guideline Expert Committee (2018) [5].

Overall Prevalence and Incidence of Type 2 Diabetes

The prevalence of type 2 diabetes in Manitoba is increasing. Currently, there are more than 100,000 people in the province living with type 2 diabetes. The incidence of type 2 diabetes in Manitoba is also increasing by as much as 3% per year, depending on the age group.

Type 2 Diabetes is Occurring at a Younger Age

Type 2 diabetes is being diagnosed in younger and younger Manitobans over time, and thus the paediatric population with type 2 diabetes is growing. Historically, children and youth with type 2 diabetes were almost exclusively from First Nation communities [13,37], but this report demonstrates that rates of new cases of type 2 diabetes in youth and young adults who are not First Nation Manitobans are increasing. Current screening guidelines for adults recommend that screening for type 2 diabetes start at age 40, or if certain risk factors are present, screening should start earlier and occur every 3 years [5]. In light of our findings in this report, these screening guidelines should be re-evaluated and the recommendation for an "earlier screening start" in the presence of risk factors be more clearly defined. The increasing incidence of type 2 diabetes among women of child-bearing age also reinforces the need for early screening (i.e., at first prenatal visit) among women at risk.

Achieving Recommended HbA1c Levels (Glucose Control)

A significant proportion of Manitobans living with type 2 diabetes are not achieving the recommended targets for glucose control. This report shows that 73.4% of First Nation Manitobans with type 2 diabetes and 59.7% of All Other Manitobans with type 2 diabetes do not achieve the goal of HbA1c levels \leq 7%. Addressing this discrepancy will require a multifaceted approach:

- Evidence-supported methods, including the use of a chronic care model of management, are required to help people achieve these goals [5]. The chronic care model of management would be implemented in the primary care setting, where the majority of adult Manitobans with type 2 diabetes receive their diabetes care.
- Telehealth has also been demonstrated to be an effective tool to deliver care to people with diabetes who live in rural/remote regions [5].
- Barriers to accessing allied healthcare providers, such as dieticians, physiotherapists, occupational therapists, social workers and foot care providers need to be identified and addressed.

- Primary care providers should be supported in building capacity in their clinics to provide multi-disciplinary care. Appropriate physician billing tariffs should be created to allow physicians to spend the time they need with each patient.
- Tools from outside of the healthcare system to improve glucose control include increasing physical activity, appropriate dietary strategies, and access to mental health services. This will require cooperation between government departments and various sectors other than health.
- Ongoing education for Manitobans with type 2 diabetes about how to self-manage their diabetes is important, and healthcare providers should be aware of what education resources and services are available in their patients' regions5.
- Please also see the Helpful Hints Box below.

HELPFUL HINTS BOX: ORGANIZATION OF CARE

Recognize: Consider diabetes risk factors for all of your patients and screen appropriately for diabetes.

Register: Develop a registry for all of your patients with diabetes.

Resource: Support self-management through the use of Inter-professional teams which could include the primary care provider, diabetes educator, dietitian, nurse, pharmacist and other specialists.

Relay: Facilitate information sharing between the person with diabetes and the team for coordinated care and timely management changes.

Recall: Develop a system to remind your patients and caregivers of timely review and reassessment.

(From S24 of Diabetes Guidelines) [5]

⁵ For more information, see Appendix 3 in the online supplement and https://www.gov.mb.ca/health/hst

Contacts with the Healthcare System

This report found that young adults with type 2 diabetes, and especially males, do not have adequate contact with the healthcare system. Paediatric care for type 2 diabetes in Manitoba is provided via a centralized specialty clinic. When youth transition to adult care, typically at age 18, their diabetes care is then typically managed by their primary care provider. They may therefore also transition from receiving care from a paediatrician to a different primary care provider (family physician/nurse practitioner). This report shows that young adults with type 2 diabetes have lower rates of physician visits than older adults with type 2 diabetes, and male young adults with type 2 diabetes have lower rates than female young adults with type 2 diabetes: in fact, 10-25% of young adults with type 2 diabetes had no physician visits at all in 2016/17. These low primary care provider visit rates are associated with low rates of receiving recommended screening and high rates of hospitalization. First Nation young adults with type 2 diabetes also had lower rates of primary care provider contacts than All Other Manitoban young adults with type 2 diabetes. Alternative strategies are needed to ensure the healthcare needs of these populations are met, including consultation with First Nation communities and specifically with First Nation young adults.

Screening for Chronic Kidney Disease

People with type 2 diabetes should have a urine albuminto-creatinine ratio (ACR) screening test once a year to screen for early signs of kidney disease. If kidney disease is confirmed, they should be treated with an ACE inhibitor and/or ARB medication to reduce the progression of their kidney disease to end-stage renal disease (ESRD) and to reduce the accompanying need for dialysis and eventual kidney transplant. Dialysis and management of ESRD, also termed kidney failure, are expensive and have a huge impact on patients and their families. In this report, we saw that urine ACR screening among young adults with type 2 diabetes was especially low (as few as 40% of young adult males had been screened). Urine ACR screening stands out as an indicator where First Nation Manitobans with type 2 diabetes had higher rates than All Other Manitobans with type 2 diabetes. This may be because of targeted programs to increase screening in regions where many First Nation people live; however, screening rates overall were lower than desirable. Proven strategies to increase urine ACR screening, such as those used in the FINISHED project [19], should be continued and expanded.

Continuity of Care is Associated with Higher Receipt of Recommended Care

Having a consistent primary care provider was associated with higher rates of screening tests and fewer hospitalizations among adult Manitobans with type 2 diabetes. We saw that a higher Continuity of Care Index score was associated with receipt of recommended screening tests (e.g., urine ACR screening and more frequent contacts with an optometrist/ophthalmologist) and with lower rates of both general and ambulatory care sensitive hospitalizations. Continuity of care was lower among the First Nation Manitobans with type 2 diabetes than among All Other Manitobans with type 2 diabetes, except in the North. Continuity of care was also lower among the First Nation Manitobans with type 2 diabetes living on-reserve than off-reserve. Improving continuity of care should be a focus for improving screening rates and reducing hospitalizations among Manitobans with type 2 diabetes.

First Nation Manitobans with Type 2 Diabetes have Higher Mortality and Higher Rates of Diabetes-Related Complications

First Nation Manitobans with type 2 diabetes had higher rates of death and diabetes-related complications than All Other Manitobans with type 2 diabetes. We saw a pattern across health indicators and outcomes: rates of cardiovascular complications, end-stage kidney disease, mortality and lower limb amputations were all higher among First Nation Manitobans with type 2 diabetes. However, rates of screening tests and primary care provider visits were similar, and (in some regions) even higher among First Nation Manitobans with type 2 diabetes. Because some key early stage cardiovascular disease indicators (such as hypertension and ischemic heart disease) were lower among First Nation Manitobans than end-stage indicators (like acute myocardial infarction and heart failure), there is concern that these conditions are not being diagnosed soon enough to prevent progression to serious disease. These findings support the understanding that access to care is only the first step in achieving equitable outcomes among all Manitobans. Within the healthcare system, there needs to be attention on ensuring consistent care for First Nation individuals (as some of the above-mentioned indicators improved with greater continuity of care). Diabetes care is also provided through allied healthcare providers, such as nurses, dieticians, social workers, occupational therapists and physiotherapists, and foot care providers - access to these resources must also be ensured. The impacts of the social and Indigenous determinants of health can also be important barriers to First Nation people receiving appropriate care; consultation with our Advisory Group and with representatives from First Nation communities in Manitoba revealed that ongoing discrimination within the healthcare system is a major factor in the quality of care First Nation people receive. This feedback is supported by published research [34] as is the training of healthcare providers to facilitate culturally safe care [61].

More Children in Manitoba have Type 2 Diabetes

Type 2 diabetes in children (< 18 years of age) is increasing in Manitoba. First Nation children are disproportionally affected by this trend. Children with type 2 diabetes carry a high burden of illness both before and after diagnosis of diabetes, and this likely reflects the many comorbidities associated with diabetes, including obesity and insulin resistance. In addition, many children with type 2 diabetes suffer from mental illness, which can impact their ability to engage in positive self-care and self-management as regards their diabetes. Programs that provide support, care and education to children with type 2 diabetes and their families and are specific to the psycho-cultural environment of those affected, need to be developed and implemented.

Pregnant Women with Type 2 Diabetes use More Health Services than those Without Diabetes

Use of antenatal and postnatal health services was higher for Manitoba women with type 2 diabetes and their infants than women without diabetes. Women with type 2 diabetes had a rate of antenatal hospitalization almost 3 times that of their diabetes-free matches. Compared to their diabetes-free peers, women with type 2 diabetes had infants that were almost 4 times more likely to require NICU admission and their length of stay in hospital was twice as long. Women with type 2 diabetes also had a higher risk of delivering outside of their home health region. First Nation women are known to face higher risks of these complications than All Other Manitoban women: that risk is even higher among First Nation women with type 2 diabetes. First Nation women with type 2 diabetes are more likely than All Other Manitoban women with type 2 diabetes to live in areas without basic perinatal care and to be hospitalized away from home. As the Manitoba birth rate and the incidence of type 2 diabetes in young people continue to rise, these issues will grow. The current perinatal system is at capacity and expansion of facilities to provide care for Manitoba families closer to home is urgently needed. Perinatal healthcare planning needs to account for the rising rate of type 2 diabetes and find solutions for the First Nation women and women living outside of Winnipeg who are traveling great distances at great cost to give birth. Continuation and expansion of programs such as the Restoring the Sacred Bond Initiative is recommended.

Mental Health Disorders are Common among Manitobans with Type 2 Diabetes

Among Manitobans with type 2 diabetes, there was a higher risk of suicide attempts and a higher risk of mood/ anxiety disorders compared to their diabetes-free matches. Among All Other Manitobans with type 2 diabetes (but not First Nation Manitobans with type 2 diabetes), substance use disorders were also more common than among their diabetes-free matches; rates of substance use disorders are already high in among First Nation Manitobans, even among those without diabetes. Use of atypical antipsychotic medications was higher among Manitobans with type 2 diabetes both before and after their diabetes was diagnosed, compared to their diabetes-free matches. Routine screening for mental health disorders among Manitobans with type 2 diabetes is essential; mental healthcare is an integral part of diabetes care.

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Glossary

Adjusted rate

Adjusted rates are crude rate values that are statistically adjusted to control for different age and sex distributions among groups (e.g.: across health regions, community areas, income quintiles, community areas, or Resource Utilization Bands (RUBs)) to ensure that the rates for all groups (and over time) can be fairly compared. The adjusted values are those that the group would have had if their age and sex distribution was the same as for a standard population, which is usually the Manitoba population. Statistical models are used to calculate these rates, and to compare a given group's rate and the provincial rate, as well as to compare rates over time within the group. Also called Rate Adjustment, Rate Standardization or Standardized Rates.

Administrative records (data)

Data generated through the routine administration of programs. While not originally intended for research, administrative data can be a rich source of information. The Manitoba Population Research data Repository, housed at MCHP, holds administrative data from a variety of government department administrative datasets, such as healthcare, education, social/families, and others.

Albumin-Creatinine Ratio (ACR)

The **Albumin-Creatinine Ratio (ACR)** is used to measure the results of a lab test for proteinuria related to chronic kidney disease (CKD). Using the Diagnostic Services Manitoba (DSM) - Chemistry Data, ACR is defined as the ratio of Urine Albumin (test code 1384; mg/mmol) to Urine Creatinine (test code 0232; mg/mmol). ACR greater than or equal to 3 mg/ mmol is considered abnormal.

Ambulatory Visits

Ambulatory visits include almost all contacts with physicians (General Practitioner (GP)/Family Practitioner (FP), Nurse Practitioners and specialists); this includes office visits, walk-in clinics, home visits, personal care home (PCH)/nursing home visits and visits to outpatient departments. The type of service provided is defined by a tariff code.

Amputation

The removal of the lower by amputation, in combination with a diagnosis of diabetes. The amputation is considered major if above the ankle, and minor if at or below the ankle.

Antenatal Hospitalization

An admission to hospital for physical or psychological conditions resulting from, or aggravated by, pregnancy which does not lead to delivery. It is an indicator of maternal morbidity.

Charlson Comorbidity Index

The Charlson Comorbidity Index is a method of categorizing comorbidities of patients based on the International Classification of Diseases (ICD) diagnosis codes found in administrative data, such as hospital abstracts data. Each comorbidity category has an associated weight (from 1 to 6), based on the adjusted risk of mortality or resource use, and the sum of all the weights results in a single comorbidity score for a patient. A score of zero indicates that no comorbidities were found. The higher the score, the more likely the predicted outcome will result in mortality or higher resource use.

Cohort

A group of subjects under examination in a study, who share at least one common characteristic (e.g.: age, health status).

Comorbid/comorbidity

A comorbidity is simply defined as a pre-existing medical condition of a patient, or the presence of one or more medical conditions known to increase risk of death, that exist in addition to the most significant condition (usually recorded as the "most responsible diagnosis" on hospital discharge abstracts) that causes a patient's stay in the hospital. The number of comorbid conditions can be used to provide an indication of the health status (and risk of death) of patients. In other words, comorbidity is an indicator of the differential utilization of hospital care.

Confidence Interval

The Confidence Interval is an interval, calculated from data, which contains a population parameter, such as the population median or mean, with specified probability. For example, a 95% confidence interval (written as "95% CI") would have a 95% probability of containing the true population value.

Congestive Heart Failure

A chronic disease that is often called congestive cardiac failure (CCF) or heart failure. CHF is characterized by the inability of the heart to pump a sufficient amount of blood throughout the body, or by requiring elevated filling pressures in order to pump effectively. CHF is an abnormal cardiac condition that reflects impaired cardiac pumping and blood flow. The pooling of blood leads to congestion in body tissue.

Continuity of Care

The Continuity of Care Index (COCI) is an indicator that weighs both the frequency of ambulatory visits to primary care provider (mdbloc=11, 200) and the dispersion of ambulatory visits between family physicians and nurse practitioners. The possible index values range from just greater than zero (where visits are made to different providers) to one (all visits made to the same provider).

Crude rate

The number of events or people with a given condition or procedure, divided by the number of people living in an area/ region; often expressed as a rate per 1,000 residents (for less frequent events). Crude rates are helpful in figuring out the burden of disease, and/or number of residents with that condition or procedure. This is in contrast to adjusted rates, which statistically adjust the crude rates, to arrive at an estimate of what an area's rate might have been if the local population's age and sex distribution was the same as that for the entire province. The crude rate could potentially be affected by the age and sex distribution of an area; hence most rates are adjusted to allow for fair comparisons between areas.

Diabetes

A chronic condition in which the pancreas no longer produces enough insulin (Type I Diabetes) or when cells stop responding to the insulin that is produced (Type II Diabetes), so that glucose in the blood cannot be absorbed into the cells of the body. The most common endocrine disorder, Diabetes Mellitus affects many organs and body functions, especially those involved in metabolism, and can cause serious health complications including **renal failure**, heart disease, stroke, and blindness. Symptoms include frequent urination, fatigue, excessive thirst, and hunger. Also called insulin-dependent diabetes, Type I diabetes begins most commonly in childhood or adolescence and is controlled by regular insulin injections. The more common form of diabetes, Type II, can usually be controlled with diet and oral medication. Another form of diabetes called gestational diabetes can develop during pregnancy and generally resolves after the baby is delivered.

Diabetic Ketoacidosis

Diabetic Ketoacidosis (DKA) is a build up of ketones in the blood stream. Low levels of insulin in the blood stream (common for those with type 1 diabetes) prevents the body's cells from using blood sugar (glucose). Glucose is a source of energy for the body. As the cells are not getting the energy they need, they begin to break down (metabolise) body fat. This reaction produces ketones. When ketones build up in the blood stream they acidify the blood which decreases the pH balance. This upset in the pH balance prevents many of the body's chemical reactions from taking place.

Fee-for-service

A method of payment whereby physicians bill for each service rendered, according to a pre-arranged schedule of fees and services. Physicians who are paid on a fee-for-service basis file a claim for each service rendered and are responsible for their operating costs. Other physicians are compensated under an alternate payment plan.

FINISHED project

The FINISHED project is a 3-year project providing mobile kidney disease screening in First Nation communities in West Region and Island Lake Tribal Council areas. The FINISHED project (First Nation Community Based Screening To Improve Kidney Health And Prevent Dialysis) did point-of-care HbA1c testing in 14 communities. For more information, please visit: http://www.kidneyhealth.ca/wp/about-us/projects/finished-project/finishedcomm/.

Health Region

Regional governance structure set up by the provincial government to be responsible for the delivery and administration of provincially funded health services in a specific geographical area.

Hypertension

Primary hypertension is often referred to as high blood pressure. The "tension" in hypertension describes the vascular tone of the smooth muscles in the artery and arteriole walls. Hypertension is a major health problem, especially because it often has no symptoms. If left untreated, hypertension can lead to heart attack (acute myocardial infarction (AMI)), stroke, enlarged heart, or kidney damage.

Incidence

Incidence is the number of new cases of a specific disease/condition/event over a specified time period. The incidence rate counts new cases in the numerator; individuals with a history of the disease/condition/event are not included. The denominator for incidence rates is the population at risk. Even though individuals who have already developed the condition should be eliminated from the denominator, incidence rates are often expressed based on the average population rather than the population at risk. In the case of chronic conditions, where most people appear to be at risk, the distinction between populations at risk and the whole population appears to be less critical.

Inpatient Hospitalization

These are hospitalizations during which patients are formally admitted to the hospital for diagnostic, medical, or surgical treatment and typically stay for one or more days. Multiple admissions of the same person are counted as separate events. Out-of-province hospitalizations for Manitoba residents are also included.

Ischemic Heart Disease

A condition in which the blood flow (and thus oxygen) is restricted to a part of the body. Cardiac ischemia is the name for lack of blood flow and oxygen to the heart muscle. Thus, the term 'ischemic heart disease' refers to heart problems caused by narrowed heart arteries. When arteries are narrowed, less blood and oxygen reaches the heart muscle. This is also called coronary artery disease and coronary heart disease. It can ultimately lead to heart attack.

Manitoba Population Research Data Repository (Repository)

The Manitoba Population Research Data Repository is a comprehensive collection of administrative, registry, survey and other data primarily comprised of residents of Manitoba. This repository is housed at the Manitoba Centre for Health Policy (MCHP). It was developed to describe and explain patterns of healthcare and profiles of health and illness, facilitating inter-sectoral research in areas such as healthcare, education, social services and justice. The administrative health data, for example, hold records for virtually all contacts with the provincial healthcare system, the Manitoba Health Services Insurance Plan (including physicians, hospitals, personal care homes, home care, and pharmaceutical prescriptions) of all registered individuals. MCHP acts as a trustee or steward of the information in the Repository for agencies such as Manitoba Health.

Mean

Mean is another word for average. It is the value which comes a close as possible to all other values in a data set. The average income of Manitobans is a number which is as close as can be to the income of all Manitobans.

Myocardial Infarction

Also known as a heart attack, a myocardial infarction occurs when the heart muscle (the myocardium) experiences sudden (acute) deprivation of circulating blood. The interruption of blood is usually caused by narrowing of the coronary arteries leading to a blood clot. The clogging frequently is initiated by cholesterol piling up on the inner wall of the blood vessels that distribute blood to the heart muscle.

Neonatal

Defined as age from birth to 28 days.

Ophthalmologist

A physician with specialized training who diagnoses and treats disorders of the eye. An ophthalmologist is qualified to prescribe medication, prescribe and adjust eyeglasses and contact lenses and is qualified to perform laser treatment and surgery.

Person-years

A measurement of observation time per person and is often used as the denominator in incidence rates when, for varying periods, individuals are at risk of developing a disease, using a health service, or dying. Instead of using the number of people at the start of the observation period as the denominator, one can determine for each person the actual time at risk, from the beginning of the study period until the disease is detected, the person is lost to follow-up (i.e., moves out-of-province or dies), or the end of the study period. If a study period is one year and a person is disease free for the entire period then they will have a person-year value of one; while if another person develops a disease six months after the start of the study, they will have a person-year value of 0.5 (Young, 1998).

Personal Health Identification Number

A unique nine-digit numeric identifier assigned by Manitoba Health to every person registered for health insurance in Manitoba, and to non-residents who are treated in Manitoba at facilities which submit claims electronically. At MCHP, the PHIN is either a scrambled (encrypted) version of the Manitoba Health PHIN or an alphanumeric identifier assigned by MCHP to individuals who do not have scrambled numeric PHINs.

Prevalence

The term prevalence refers to the proportion of the population that "has"** a given disease at a given time. The measure of a condition in a population at a given point in time is referred to as point prevalence. A second type is called period prevalence. Over a period of time, such as five years, this measures the number of individuals with a particular condition in the population during that time period. Period prevalence is the most common measure of prevalence used in MCHP studies. Prevalence data provide an indication of the extent of a condition and may have implications for the provision of services needed in a community. Both measures of prevalence are proportions - as such, they do not describe changes over time and should not be described as rates.

Primipara

"A woman who has had one birth at more than 20 weeks' gestation, regardless of whether the infant is born alive or dead." (Olds SB et al., 2004).

P-value

A **p-value** is the probability that the results obtained from a statistical test are due to chance (with no actual effect). A p-value must be less than the alpha value in order for statistical significance to be claimed. If the p-value is greater than alpha, statistical significant cannot be claimed.

Registered (Status) First Nation Individual

A first Nation individual with the legal status of a person who is registered as an "indian" under the Indian Act (1876) and therefore receiving entitlements of sharing reserve land, voting rights, and Band membership and residency. Also called "Status First Nation Individual".

Relative Risk

A relative risk is the ratio of two risks. A risk is determined by the number of people who have a condition of interest, divided by the total population. A risk may be calculated for a region of interest, and then compared to a larger region (e.g., Winnipeg RHA compared to all of Manitoba).

Renal failure

Renal failure is the loss of the kidneys ability to remove wastes, concentrate urine, and maintain electrolytes levels in the blood. At MCHP, our definition of renal failure includes both acute and chronic renal failure. Renal disease associated with some other conditions, along with renal failure due to trauma, pregnancy and labour have typically not been included in our definition.

Repository

See Manitoba Population Research Data Repository

Reserve

A tract of land, the legal title to which is held by the Crown, set apart for the use and benefit of an Indian band. Some "bands" (Indian Act terminology) have more than one reserve. Many First Nations now prefer the term "First Nation community" or "First Nations" and no longer use "reserve".

Retinopathy

Individuals with diabetes are at a greater risk of damage to the retina than the general population. In the later stages of diabetes, individuals may develop diabetic retinopathy (non-inflammatory damage to the retina), which causes the swelling of blood vessels in the retina and leaking of fluid or the abnormal growth of new blood vessels on the surface of the retina. Diabetic retinopathy can develop without symptoms and, when left untreated, may cause loss of vision or blindness, so regular eye examinations for diabetics help to diagnose retinopathy early and slow its progression.

Shadow billing

Claims (billings) submitted to the provincial government by physicians on alternate payment plans (APP) for services they provide. Unlike physician claims submitted by fee-for-service physicians for payment, these claims are for administrative purposes only (i.e.: as a record of services provided). Also known as "Evaluation Claims" and "Dummy Claims".

Statistically significant or statistically different

A term used when the probability that an observed significant result would have occurred by chance is very small (usually 5% or less). Statistically significant results are often reported along with p-values, which express the level of certainty that the statistical significance is not due to chance.

Stillbirth

Death of a baby before delivery. Also referred to as Stillborn or fetal death. In Heaman et al. (2012), a stillbirth was identified as a fetal death with a gestation of 20 weeks or greater or a birth weight of at least 500 grams.

Stratified

To stratify a variable (such as age) is to split it into separate groups. These groups will be analysed separately rather than as a whole. Instead of analysing 1 group of 100 participants, one may analyse 5 groups of 20 participants. For example, all members within a group will have roughly the same age, and as such comparison between the groups can be made.

Suppressed data

At MCHP, data are suppressed (not revealed or published) when the number of persons or events involved is five or less in order to avoid potential identification of individuals in an area. Data are not suppressed when the actual event count is zero. This process of suppressing data is conducted to protect the privacy of the population.

Tribal Council

"For the purpose of accessing Tribal Council Program funding, a Tribal Council is a grouping of bands, (bands as defined by the Indian Act), with common interests who voluntarily join together to provide advisory and/or program services to member bands" (Indigenous and Northern Affairs Canada, 2019). They "must be legally incorporated and accountable to their member bands [usually at least 5] through representation of each band in decision making and review of service delivery" (Indigenous and Northern Affairs Canada, 2019). TCs provide information, expertise and/or assistance to the Chief, Councils and the communities relating to "band government, financial management, community planning, technical services and economic development" (Indigenous and Northern Affairs Canada, 2019).

Tribal Council Area

Tribal Council Areas are groupings of First Nation communities affiliated with the seven official Tribal Councils (TCs), as well as Independent and Non-Affiliated First Nation communities. The official TCs include: Dakota Ojibway TC, Interlake Reserves TC, Island Lake TC, Keewatin TC, Southeast Resource Development Council, Swampy Cree TC, and West Region TC.

Total Mortality Rate

The number of deaths per 1,000 area residents, per year. This measures the rate of death from all causes and is an indication of the overall health of the population, similar to what is measured by life expectancy.





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