HEALTH CARE UTILIZATION DIFFERENCES BETWEEN FIRST NATIONS AND THE GENERAL POPULATION WITH INFLAMMATORY BOWEL DISEASE IN SASKATCHEWAN

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By

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ABSTRACT

Background: Indigenous patients with inflammatory bowel disease (IBD) have expressed concerns about barriers to access IBD care. The limited evidence of IBD among Indigenous people highlights the need for studies evaluating access to IBD care in this population. **Aim:** This study aimed to compare health care utilization between First Nations and the general population diagnosed with IBD in Saskatchewan. **Methods:** A population-based retrospective cohort study was conducted using administrative health databases of Saskatchewan from 1998 to 2017 fiscal years. As a patient-oriented research initiative, outcomes of interest were chosen in collaboration with Indigenous patients and family advocates (Indigenous individuals living with IBD and family members of an Indigenous person with the disease). A validated algorithm requiring multiple health care contacts was applied to identify incident IBD cases. The self-declared First Nations status variable was used to divide IBD cases between First Nations and the general population. A 1:5 age and sex matching was applied. Cox-proportional models were used to estimate hazard ratios (HRs) and 95% confidence intervals (95%CI). **Results:** A matched cohort with 696 IBD incident cases was created (First Nations=116, general population=580). Comparing health care utilization of First Nations and individuals from the general population with IBD, there were no statistically significant differences in outpatient gastroenterology visits (First Nations=81.0%, general population=83.6%; HR=1.13, 95% CI: 0.90-1.41), colonoscopies (First Nations=91.4%, general population=86.9%; HR=1.14, 95% CI: 0.92-1.41), and surgeries for IBD (First Nations =31.0%, general population=33.5%; HR=1.14, 95% CI: 0.80-1.64). In contrast, adjusting by rural or urban residence at the date of diagnosis and diagnostic type, differences between the groups were observed for any IBD medication claim (First Nations=79.3%, general population=89.3%; HR=0.52, 95% CI: 0.41-0.65), 5-ASA claims (First Nations=75.9%, general population=81.4%; HR=0.56, 95% CI: 0.45-0.71), and IBD-specific (First Nations=54.3%, general population=49.3%; HR=1.33, 95% CI: 1.01-1.75) and IBD-related hospitalizations (First Nations=63.8%, general population=52.8%; HR=1.55, 95% CI: 1.20-2.01). **Conclusions:** This study identified that First Nations had a higher risk of having an IBD-specific and IBD-related hospitalization compared to individuals IBD from the general population. Additionally, it was found an inverse association between First Nations status and having prescription medication claims for IBD in Saskatchewan. These associations could reflect a barrier to access IBD medications, contributing to a higher risk for IBD-specific or -related hospitalizations in the First Nations group. Multiple confounding variables were considered when evaluating these associations, but it was not possible to control by disease severity. Further studies should continue evaluating access to IBD care, medication use, hospitalization rates, and disease severity among First Nations living with IBD.

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DEDICATION

To my parents, Eva and Ribamar, for prioritizing my education despite all the challenges we experienced in life.

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5 amino salicylic acid (5-ASA)
95% confidence interval (95%CI)
Canadian Classification of Diagnostic, Therapeutic, and Surgical Procedures (CCP)
Canadian Classification of Health Interventions (CCI)
Canadian Digestive Diseases Week™ (CDDW™)
Charlson's Comorbidity index (CCI)
Corticosteroid dependency (CsDep)
Crohn's disease (CD)
Drug Identification Number (DIN)
First Nations and Inuit Health Branch (FNIHB)
First Nations and Métis Health Services (FNMHS)
First Nations Northern Inter-Tribal Health Authority (NITHA)
Hazard ratios (HRs)
Immune modulator (IM)
Indigenous Australians (IA)
Indigenous patients and family advocates (IPFAs)
Inflammatory bowel disease (IBD)
International Classification of Diseases (ICD)
Non-Insured Health Benefits (NIHB)
Northern Inter-Tribal Health Authority (NITHA)
Saskatchewan Health Quality Council (HQC)
Socioeconomic status (SES)
Standard deviation (SD)
Ulcerative colitis (UC)
United States of America (USA)

Health care utilization differences between First Nations and the general population with Inflammatory Bowel Disease in Saskatchewan

1. BACKGROUND

Canada has an estimated population of 1,673,785 Aboriginal people (4.9% of the Canadian population), comprising Inuit, Metis, and First Nations.[1] First Nation people, who are the majority among the Aboriginal people subgroups, are a growing population, reaching in 2016 a total of 977,230 people.[1] This population group has 634 distinguishable First Nation communities. First Nations who have been registered as an "Indian" under the Indian Act have the Indigenous "status."[2] First Nations people comprise those with and without the Indigenous "status."[3] Only those with Indigenous "status" are registered under the Indian Act and therefore have rights assured by the government.[3] First Nations received this status because they were recognized under the Crown as separate nations.[3] Métis comprise those who have a mix of First Nations and European descent, whereas Inuit People are the Indigenous people who live in the 53 northern areas in Canada and are not part of the Indian Act.[3,4]

1.1 Impact of colonization on Indigenous People health and wellbeing

Oppression and racism are current problems faced by Indigenous people worldwide.[5] Oppression is often understood as an issue regarding freedom. The oppressed population lacks freedom as people are subject to unjust treatment and control by the oppressors.[6] According to Clarie Grant,[6] racism, a manifestation of oppression, is defined as prejudice or discrimination based on someone's race. Racism categorizes society into groups that are ranked according to power and privilege.[7] Ashley Doane maintains that those who do not rank well in this division are stigmatized, stereotyped, and suffer prejudice. Individuals may be considered racist even if they come from an oppressed group.[7]

Indigenous people have suffered prejudice because of the colonization process.[5,8] In Canada, prejudice and discrimination were both strongly manifested during colonization at the institutional and interpersonal levels, jeopardizing Indigenous traditions, language, and health.[8] The settlers were not only able to take the land but also implemented colonialist ideologies that gave privileges to European people and culture; as a result, Indigenous people were greatly disadvantaged compared to other societal groups due to oppression and racism.[8]

Due to the consequences of colonialism, unfortunately, Indigenous peoples continue to experience inequitably health outcomes than the general Canadian population, even nowadays.[8] Indigenous people are more likely to live in poor neighborhoods, drop out of school, be unemployed, and experience violence.[8] Indigenous people in Canada have higher poverty rates and lower life expectancy.[8] These outcomes experienced by Indigenous people are considered health inequities because they are unfair, avoidable differences rooted in systematic racism and

oppression.[8–12] If these poorer health outcomes were due to genetics or lack of resources, they would be considered health inequalities instead.[9–12] The pathway to poor health experienced by Indigenous people is also marked by trauma as they have experienced political disempowerment, loss of collective identity, and genocide.[8]

Settlement and colonization severely impacted the health and wellbeing of Indigenous people in Canada.[13] First, there were disease impacts due to virgin soil epidemics as the Europeans imported many diseases (e.g. smallpox, measles, and tuberculosis) causing great morbidity and mortality in the Indigenous population.[13] Second, Indigenous people were exploited in the fur trade that paved the way for settlement.[13] Further, the Indian Act (1879) was created alienate the cultural identity of Indigenous peoples and assimilate them into Canadian society.[13] When children were forcibly taken from their communities to attend residential school from the 1880s to the 1990s,[14] their families experienced intense grief and feeling of helplessness within Indigenous communities.[15] Indigenous children experienced structural racism as they learned in residential schools that their culture was "less than" the culture from the mainstream society.[16] Based on policies and institutional practices, residential schools tragically tried to assimilate Indigenous children into the settler's culture.[15] Many children in these schools were physically and psychologically abused and never had the chance to see their families again. According to estimates, at least 3,000 Indigenous children died within the walls of residential schools.[17] Scholars often refer to this schooling process as a "cultural genocide."[17] Indigenous children in British Columbia also experienced violence through a policy called 60s scoop.[13] Starting in 1960s, the government removed Indigenous children from home to adoption or foster care if the government considered that these children belonged to "dysfunctional families."[13] Therefore, these are examples of how Indigenous people experienced an erosion of traditional social roles and violence throughout Canadian history.[13] Although Indigenous people in Canada have experienced many tragedies due to the colonization process, they are still a growing population in the country, which speaks to the strength and resilience of First Nations, Metis, and Inuit people.[13,18]

1.2 Barriers to access healthcare for Indigenous People in Canada

The United Nations Declaration on the rights of Indigenous peoples stresses the right of Indigenous people to live freely and in a non-discriminatory environment.[19]According to the C169 - Indigenous and Tribal Peoples Convention of Indigenous,[20] the government of Canada has the responsibility to fully support Indigenous people in their endeavours, grow in their own identity, and enjoy economic and social development. Although Indigenous communities are developing, they are still experiencing many barriers such as racism and oppression erected by the colonizers.[5]

Some of these barriers can be observed in health care.[21-22] The common health care barriers for Indigenous people include consequences of colonization,[8] stereotypical perceptions about Indigenous people,[23] communication patterns related to health information,[24-25] language barriers,[26] and limited access to appropriate transportation to health care facilities.[27] All these

barriers attest to the systemic racism[28] embedded into the Canadian health care system and are likely responsible for the health disparities observed in the Indigenous population.[29]

Besides, there is a long way to achieve culturally appropriate care for Indigenous people.[13] Douglas (2020)[13] describes cultural safety as the highest form of intercultural care.[13] In cultural safety health care approaches, health care professionals should practice cultural humility and be aware that improving their knowledge and practices to better assists Indigenous people is a lifelong commitment.[13] Culturally safe health care professionals should seek and foster relationships with Indigenous people in order to build the mutual commitments of respect and trust.[13]

A Canadian study about the health care experiences of Indigenous people living with adult-onset diabetes found that Indigenous people are exposed to culturally unsafe care from the health providers.[25] In this study, participants also reported that their dissatisfaction with health care was related to specific health policies that permeate and cause discrimination in health care systems.[25] These findings highlight the need to not only improve access to care for Indigenous people, but also to assure that they are receiving culturally safe care.[25]

The government of Canada has led some initiatives aiming to reduce the undesirable health and socioeconomic conditions experienced by Indigenous people as a result of colonization.[30,31] For instance, Royal Commission on Aboriginal Peoples (1991) highlighted the need for policies aiming to improve the future of Indigenous people, reconcile the relationship between settlers and Aboriginal people, and gather strength.[30] Furthermore, in 2015, the Truth and Reconciliation Commission published a report highlighting the need to address the damage caused by the Canada's residential school system.[31] This report was created to call on the Canadian government, institutions and societal groups to take action on the 94 calls necessary to promote reconciliation.[31] Under the Truth and Reconciliation Commission,[31(p. 02)] the Call to Action Nº, 18 in the heading "Legacy" says:

> We call upon the federal, provincial, territorial, and Aboriginal governments to acknowledge that the current state of Aboriginal health in Canada is a direct result of previous Canadian government policies, including residential schools, and to recognize and implement the health-care rights of Aboriginal people as identified in international law, constitutional law, and under the Treaties.

In 2019, the Assembly of First Nations assessed the completion of the Calls to Action by categories, demonstrating that "Health (18-24)" has achieved moderate progress.[32] Therefore, health care research examining and comparing access to health services is needed to understand complex problems and implement effective health care interventions to improve the health of Indigenous people.

Accessing health services across Canada in rural, remote, and northern communities, is more challenging for Indigenous people.[29] Because of the population size in these types of communities, they are often not seen as priority for recruiting and retaining medical personnel.[29,33,34] A study explored the distribution of family physician and nurse practitioner services by geographic area in Alberta and Saskatchewan.[35] In these prairie provinces, the study identified inequities in the distribution of primary care, with greater disparities in more rural and remote regions.[35] Shah and colleagues (2017) conducted a geospatial analysis to analyze accessibility to family physicians and physiotherapist services in Saskatchewan.[36] The authors found that the most vulnerable population groups (e.g., aboriginal people, older adults, and low-income families) seemed to have a lower access to physiotherapists services compared to family physicians, especially in in rural and remote communities.[36] Rural, remote, and northern Indigenous communities often rely on health care professionals who do not live in the area and

come sporadically and briefly to follow up with patients.[29,33,34] This lack of health care services in rural and remote locations in Saskatchewan might result in the scarcity of medical supplies such as medication and equipment.[35,36]

For First Nations expecting to receive on-reserve health care, it can be frustrating to wait until receiving medical assistance.[29,33,34]Additionally, First Nations may experience other barriers such as lack or refusal of coverage by the Non-Insured Health Benefits (NIHB).[29] Some First Nations may also not be aware of all the benefits covered by the NIHB.[29] NIHB offers additionally health care coverage for First Nations and Inuit clients on the following medical needs: vision care, dental care, mental health counselling, medical supplies and equipment, prescription and over-the-counter medications, medical transportation to access medically required health services not available on reserve or within their community.[37]

Indigenous people often access health care when they are experiencing more severe, complex health care challenges.[38] This late health care access can happen due to delays in diagnosis and lack of follow-up, leading Indigenous people to experience worse health outcomes.[38] Indigenous people then tend to leave their rural communities to seek in urban centers better health care access.[33,39] By coming to urban centers for extended periods and leaving family and support network, Indigenous people may also face additional issues such as stress, anxiety, loneliness, and financial hardships.[33,39] These additional problems can worsen and delay recovery of the health condition of Indigenous people.

Since 1960's, the federal government has stated that providing health services for First Nations in Canada is not an Indigenous or treaty right; instead, it is a humanitarian matter.[29] As Indigenous communities are entitled to manage and control their health programs themselves, the federal government promoted the Health Transfer Policy in 1989.[40] This decentralization was accelerated due to federal budgetary cutbacks.[13] Douglas (2020)[13] comments on this removal of federal responsibility to provide health care for First Nations. The author notes that "the effect on these peoples is that responsibility is now largely limited to arms-length funding and health promotion."[13(p.94)] Indeed, health prevention, health promotion, homecare, and infectious disease control in First Nations and Inuit communities is provided and funded by the First Nations and Inuit Health Branch (FNIHB) of Indigenous Services Canada.[37]

First Nations and Inuit communities self-govern their health programs and establish their own Indigenous Health authorities.[29,40] The health care responsibilities of Indigenous Health authorities can emerge in three levels. Level 1: focuses on health serviced located in the community and for the community.[29,40] Level 2: includes zones, multi-community bands, and Tribal Councils.[29,40] Level 3: provides medical health officer services, communicable disease prevention and management, disease surveillance, health status evaluation, immunization and nursing support, and advisory services to 2nd level services.[41]

The Western province of Saskatchewan has done considerable progress in promoting culturally based health care. In 2001, Saskatchewan started providing 3rd level services through the First Nations Northern Inter-Tribal Health Authority (NITHA) for northern communities.[42] NITHA is the only First Nations Organization providing 3rd level services in Canada.[42] This health authority has four partner organizations that teamed up in 1998: Prince Albert Grand Council, Meadow Lake Tribal Council, Peter Ballantyne Cree Nation, and Lac La Ronge Indian Band.[43] NITHA currently including 33 First Nation communities, serving 47% (55,000) of on reserve population.[43]

In Saskatchewan, the First Nations and Métis Health Service (FNMHS) works to improve access to culturally safe health care for Indigenous people through patient navigation.[44] In brief, patient navigation programs help Indigenous patients to understand the role of health care

systems (including community and hospital linkages), establish their spiritual connection, and support patients in discharge planning.[44,45] These interventions have the potential to improve health care access among Indigenous people.[44] For example, evidence suggests that patient navigation improves adherence to cancer screening[46,47] and reduces treatment delays[48,49] in Indigenous populations with cancer.[44]

Despite the increase in the availability and appropriateness of health services, First Nations may also experience barriers in accessing health care if they do not have a Registered Indians status. Approximately, 25% of the First Nation population in Canada do not have Registered Indians status.[1] In Saskatchewan, 8.6% of First Nations people did not have a registered Indian status in 2011.[50] First Nations need to be registered under the Indian Act and obtain the status Indian to receive health care benefits from NIHB.[51] In their health card applications, First Nations may or may indicate their Indian status; this information is voluntary and not verified.[52,53]

Health care disparities in Canada among Indigenous people is a problem that has been studied before. For instance, peritoneal dialysis among Indigenous people is much lower than in the general Canadian population, despite Indigenous people having higher rates of chronic kidney diseases.[54] However, little is known about access to care for inflammatory bowel disease (IBD) among Indigenous people in Canada, raising the hypothesis that this population may be underutilizing certain health care services and, therefore, experiencing delays in diagnosis and access to appropriate treatments.

1.3 Inflammatory bowel disease

Inflammatory bowel disease, including Crohn's disease (CD) and ulcerative colitis (UC), is a chronic, idiopathic, and incurable disorder, causing inflammation of the gastrointestinal tract.[55] CD can affect any part of the digestive system, whereas UC affects only the large bowel.[56] Patients with IBD present with common clinical symptoms such as diarrhea, abdominal pain, weight loss, and rectal bleeding.[56]

Scientists are still not able to explain in detail the causes of IBD.[57] However, the disease seems to be influenced by an interaction of several factors such as immune system defects, gut bacteria activity, genetics, and environmental factors. Over 200 genetic risk loci are known to be associated with IBD.[58] Changes in the integrity of the intestinal tissue also seem to influence the onset of the disease. For example, increased intestinal permeability intensifies the inflammatory response due to increases in neutrophils, macrophages, and lymphocytes.[58] Additionally, disturbances in the integrity of the epithelium and the immune system disrupt the balance in the intestinal flora, leading to inflammation.[58] Environmental factors such as unhealthy diets and antibiotic intake may cause relapses of IBD.[57] There seems to be an association between smoking and CD, whereas smoking cessation increases the risk of developing UC.[58] A literature review indicates that the relationship between socioeconomic status (SES) and IBD onset is still unclear, as studies that evaluate both variables present conflicting results.[59] What is understood, however, is that patients with low SES living with IBD have increased risks of hospitalization, intensive care unit admission, mortality, use of corticosteroids, narcotics, and psychotropic medication.[59,60] Therefore, IBD needs further research to uncover the etiology of the disease.[59] Also, healthcare outcomes for those with low SES and living with IBD need to be highly considered.[60]

Patients with IBD may experience difficulties in finishing work tasks.[61] In social life, these patients may be discouraged due to issues such as searching for accessible toilets,

developing friendships, and feeling confidence about their own bodies.[62] IBD is also often related to anxiety, depression,[63] and reduced quality of life.[64] Due to the unpredictable disease course, patients with IBD may be surprised by flares, low energy, need for surgery, and undesirable side effects from medication.[62] Due to its nature and required treatments, IBD can have a severe impact on the patient's quality of life.[65] Along with the potential medications side effects, the disease symptoms could affect the family, work, and social life of patients living with IBD.[65,66]

In IBD pharmacological treatment, medication aims to achieve remission, prevent flares, and reduce the risk for colorectal cancer and surgeries.[56] The main medications for IBD can be divided into three groups:[56,67] 1) anti-inflammatory drugs such as 5 amino salicylic acid (5-ASA), including sulfasalazine, mesalazine, olsalazine, and balsalazide; 2) immune modulators (IMs) such as azathioprine, methotrexate, and cyclosporine; 3) biological therapies (e.g. infliximab, adalimumab, and golimumab);[56,68] and corticosteroids (e.g. hydrocortisone, prednisone, and dexamethasone).[69]

Surgery may be a health intervention for patients with IBD.[70] During an IBD patient's lifetime, about 20% of UC patients will need surgery, whereas around 80% of CD patients will require surgery.[70] UC patients who need surgery may undergo total proctocolectomy and ileoanal pouch anastomosis. These procedures have promising prognosis and result in good quality of life for UC patients.[70] However, for patients with CD, surgery does not result in cure.[70] Traditional indications for surgery include cancer, complications such as structuring or penetrating disease, or medically refractory disease.[71,72]

Europe and North America have the highest prevalence of IBD in the world.[73] In Norway, UC affects 505 per 100,000 people.[73] In Germany, CD affects 322 per 100,000 people. In the United States of America (USA), there are 286 cases of IBD per 100,000 people.[73] During last three decades, the incidence of IBD has been rising in developing countries across South America, Africa, and Asia.[73] Researchers have suggested that this global increase in IBD rates is related to Western diets and lifestyle, which cause changes in the intestinal microbiome and contribute to make an individual more susceptible to develop IBD.[74]

Canada has one of the highest prevalence and incidence rates of IBD in the world.[75,76] Currently, 0.7% of Canadians live with IBD.[77] By 2030, researchers estimate that 1% of the Canadian population will have IBD.[77] The incidence of IBD in Canada varies across provinces. For example, British Columbia, from 1998 to 2000, had an IBD incidence of 18.7 per 10,000 people.[66] On the other hand, Nova Scotia had an alarming incidence of IBD from 1996 to 2009, reaching 51.8 per 10,000 people.[66] Canada, together with the Western world, is in the compounding prevalence epidemiological stage of IBD.[78] Canada firstly experienced the emergence stage (1750-1950), which is the first epidemiological stage of IBD evolution, marked by sporadic cases of IBD.[78] The acceleration of incidence stage came next (1950-200).[78] This stage is characterized by an alarming increase in the IBD incidence, whereas the IBD prevalence is low.[78] The third stage is the compounding prevalence stage (2000-current), which is noticeable by stable or low incidence rates as prevalence continues increasing because of previous decades of low mortality and high incidence.[78] The future stage is the prevalence equilibrium.[78] This stage may start in 2050 as prevalence decreases due to stable incidence and more older adults living with IBD present higher mortality.[78]

1.4 IBD among Indigenous people

Some evidence of IBD among Indigenous people is available. A study in Manitoba found that incidence rates of IBD were 5 times higher in the general population than observed among Indigenous people.[79] An Australian study demonstrated that IBD is prevalent in Australia but rare in Indigenous Australians (IA), stating that the prevalence of IBD among IA was 5 per 100,000 people among IA, whereas in the general population the prevalence was 186 per 100,000 population.[80] Another Australian study found that the rate of IBD in the Indigenous pediatric population is about eight times lower than that of non-Indigenous pediatric people.[81]

However, more information about the epidemiology of IBD among Indigenous people is needed.[79,81-84] One can claim that this disease among Indigenous people has been overlooked, which may lead to the misconception that Indigenous people cannot develop IBD. This issue might mask the real burden of the disease in this specific group and may lead to misdiagnosing Indigenous people who suffer from this illness.[82] IBD among Indigenous people has been an overlooked issue globally with limited epidemiological data of IBD among Indigenous people.[79,81,83,84]

IBD is an important disease to be considered among Indigenous People, especially because of their dietary changes observed historically in Canada. Due to the anti-fur campaigns between the 1980s and 1990s, Canada's fur trade industry collapsed. Douglas (2000) notes:[13(p.97)]

> "Animals were hunted and trapped, they were eaten and their furs were sold, and the income generated from these endeavours was used to support this lifestyle. When the fur industry collapsed, so did the fur trade and the economic support for traditional harvesting. As a consequence, the levels of social assistance have increased markedly, and diets have shifted from consumption of traditional foods to consumption of unhealthy and expensive market foods from the stores."

Therefore, traditional food has been replaced by Western/unhealthy food in Indigenous people's diet.[13] This dietary shift may be a contributing factor for IBD onset in the Indigenous population in Canada.[85]

Researchers have recently partnered with Indigenous community members in order to estimate the epidemiology of IBD among First Nations in the province of Saskatchewan[86–88], a province that has an estimated Indigenous population of 175,020 (16.3% of its total population)[89] and roughly 65.5% (114,570) are First Nations people.[89] Saskatchewan is a Western Canadian province with a population of approximately 1,098,352 people.[90] In a recent patient-oriented research initiative, researchers observed that the prevalence of IBD among First Nations had and an annual increase of 4.2% from 1999 to 2016.[87,88] In 2016, the prevalence of IBD among First Nations in Saskatchewan was 142 per 100,000 population.[87,88] On the other hand, incidence rates for IBD among First Nations remained stable over time.[87,88] Although, the prevalence and incidence rates of IBD in the general population of Saskatchewan are still higher than those observed among First Nations.[77,91] Furthermore, in Saskatchewan, 50.5% of First Nations live on-reserve.[92] People with IBD in rural areas may not receive gastroenterologist care as often as those living with IBD in urban areas.[93] This issue may also impact the health of Indigenous people living with IBD.[27,93] Restricted access to IBD care may result in poor health outcomes among Indigenous people. In fact, adverse disease outcomes tend to increase due to the lack of health care utilization.[94-95]

1.5 Rationale of the study

Indigenous patients and family advocates (IPFAs – Indigenous individuals living with IBD or family members of an Indigenous person with the disease) have manifested concerns about the access to IBD care. Some of these concerns are described in the video entitled "Storytelling: amplifying the voices of Indigenous people in the search for IBD care."[96] For exmaple, Colten, An Indigenous person from Muskoday First Nation, expressed his dissatisfaction in seeking health care to treat his health condition in its early onset. Specifically, as he stated "I wasn't being listened to, nor I was being taken seriously."[96] Also, Rhonda, an Indigenous Woman from James Smith Cree Nation, shared that she had to convince health professionals that Indigenous people can also develop IBD and explain which medication, tests, and treatments that she needed.[96] Consequently, studying health care utilization differences between First Nations and the general population with IBD is relevant considering the lack of research and the need for improvements in health systems to assist people. The increasing prevalence of IBD in Canada and around the world,[73,77] the burden of the disease to patients[97] and health care systems,[77,98] and the barriers experienced by Indigenous people to access health care[29,96] highlight the need of this study. Additionally, Saskatchewan is the first province that is studying IBD among First Nations people across Canada.[86–88] The results of studies in this area could foster the development of policies that, when applied with cultural safe health interventions, can avoid negative health care outcomes for First Nations people living with IBD.

2. OBJECTIVES OF THE STUDY

This study aimed to compare health care utilization (i.e. outpatient gastroenterologist visits, colonoscopies, IBD medication claims, and IBD-specific and -related hospitalizations, and surgeries for IBD) between First Nations and individuals from the general population diagnosed with IBD in Saskatchewan from 1998 to 2017 fiscal years. The specific research objectives were to:

- Compare outpatient visits with a gastroenterologist between First Nations and individuals from the general population diagnosed with IBD.
  Hypothesis: First Nations with the diagnosis of IBD are less likely to have outpatient gastroenterologist visits than the general population.
- Contrast the access to a colonoscopy between First Nations and the general population with the diagnosis of IBD.
  Hypothesis: First Nations with the diagnosis of IBD are less likely to access a colonoscopy than the general population.
- Compare prescription medication claims for IBD between First Nations and the general population after the date of diagnosis with IBD.
  Hypothesis: First Nations diagnosed with IBD have a lower risk of having an IBD medication claims compared to the general population.
- Identify differences between First Nations and the general population in the risk of IBD-specific and -related hospitalizations and surgery for IBD.
  Hypothesis: First Nations diagnosed with IBD have a higher risk of having a surgery for IBD or hospitalization (IBD-specific and -related) compared to the general population.

3. METHODS

3.1 Study design

A population-based retrospective cohort study was conducted using administrative health databases of Saskatchewan. Following a patient-oriented research approach, the outcomes of interest for this study were chosen in collaboration with IPFAs who have been involved in the project since its conception. Colten Brass is a member from the Muskoday First Nation, Saskatchewan, and an IPFA engaged in my research as an active member of my Advisory Committee, contributing to each stage of the project, from the study design to the result interpretation and knowledge sharing phases. Furthermore, this project has been reporting to the Saskatchewan research team leading the initiative entitled *"Understanding and advocating for miyo-māhcihowin among Indigenous Peoples living with IBD."* [86–88]

3.2 Data source

Administrative health data from the Saskatchewan Ministry of Health (between April 1st, 1998, and March 31st, 2018) was used to compare health care utilization between First Nations and the general population with IBD diagnosis. Data was extracted and analyzed at the Saskatchewan Health Quality Council (HQC). Four administrative databases were used in this study, including the Person Health Registration System, hospital discharge abstracts, physician claims, and prescription medication claims.

The number of studies using health administrative databases in Canada has increased over time.[99] Health information systems in Canada are of the highest calibre in the world regarding data quality, providing an information-rich environment for researchers.[100] As health administrative databases become popular in Canadian research, IBD researchers have also provided evidence that these data sources are reliable for population-level studies on health care utilization.[77,88,101–104]

3.3 Case definition

The algorithm developed and validated Bernstein et al[102,105] in Manitoba was used to identify IBD cases in administrative health data according to the frequency of health care contacts and using the International Classification of Diseases (ICD) codes. To identify CD cases, the following codes were used: ICD-10-CA: K50 and ICD-9: 555. For UC case ascertainment, it was used: ICD-10-CA: K51 and ICD-9: 556. This case definition was used in this study given the similarities between Manitoba and Saskatchewan as provinces: both are located in Western Canada and have similar population composition regarding Indigenous and non-Indigenous People.[106,107] According to Bernstein et al[102,105] an IBD case includes those who: 1) Had five or more separate health care contacts with the diagnosis of IBD within 2 years of health care coverage, or 2) Had three or more health care contacts with the diagnosis of IBD

when having less than 2 years of health care coverage. The cases were classified by disease type according to the most prevalent diagnosis in health care contacts.[103,104]

Bernstein and colleague's case definition[102,105] has good results for binary classification tests. For CD, this definition found sensitivity between 88.9% and 89.2% and specificity between 89.8% and 91.2%. On the other hand, for UC, sensitivity ranged from 87.7% to 74.4%, and the specificity was between 91.3% and 93.7%.

All individuals 18 years and older covered by the Saskatchewan Ministry of Health and meeting the IBD case definition were included in this study. Only incident IBD cases were included in the study which were distinguished from prevalent ones by using an eight-year washout period. Individuals with eight years of continuous health care coverage were followed before the date of the first eligible diagnosis which was considered the date of diagnosis. To be classified as in incident IBD case, the case should not have any health care contact with the diagnosis of CD or UC eight years before the date of diagnosis. This eight-year interval was chosen based on previous IBD epidemiological studies using administrative health data.[103,108]

The self-declared First Nations status variable in the Person Health Registration System was used to classify individuals with IBD diagnosis in two groups, those with First Nation status and those from in general population.[109] Previous studies using Saskatchewan administrative databases have already used such a method to include First Nation people.[87,88,110,111]

3.4 Health care outcomes

The outcomes of interest in this study were:

1) Outpatient gastroenterologist visit: using the physician claims database, outpatient health care contacts with a physician specialized in gastroenterology were identified after the date of diagnosis. To identify visits to a gastroenterologist, the variable "specialty of claiming physician" was be used; i.e. the code: "DD" Internal Medicine-Gastroenterology. The time to an outpatient gastroenterologist visit from first eligible diagnosis date to date of this outcome was measured as well.
2) Access to a colonoscopy: Using the hospital discharge abstract database, colonoscopies were identified after the date of diagnosis. Colonoscopies were identified using the Canadian Classification of Diagnostic, Therapeutic, and Surgical Procedures (CCP) and the Canadian Classification of Health Interventions (CCI) codes, see Appendix A. Also, the time from the date of diagnosis to the date of the first colonoscopy was measured.
3) Prescription medication claims for IBD: Using the medication claim database, prescriptions claims for IBD were identified. The time from the date of diagnosis to any prescription medication claim for IBD was measured as well. The medications for IBD included biologic (i.e. infliximab, adalimumab, golimumab, certolizumab, vedolizumab, and ustekinumab), IM (i.e. azathioprine, mercaptopurine, methotrexate), and 5-ASA (i.e. sulfasalazine and olsalazine sodium) prescription claims (Appendix B). The prescription drugs database was searched using the corresponding Drug Identification Number (DIN) of these medications. Prescription medication claims for IBD were also evaluated for each IBD medication groups, i.e. biologic, IM, and 5-ASA. Corticosteroids were not included given that they are used for more diseases and not just for IBD treatment.
4) IBD-specific hospitalizations: Using the hospital discharge abstract database, hospitalizations in which the most responsible diagnosis was CD or UC were identified (Appendix C), excluding one-day hospitalizations (these events are related to ambulatory

procedures such as endoscopies). Also, the time from the date of diagnosis to the date of the first IBD-specific hospitalization was measured.

5) IBD-related hospitalizations: IBD-related hospitalizations are those related to IBD diagnoses, symptomatology, and signs.[93] The hospital discharge abstract database was used to identify codes for IBD-related hospitalizations and include only those that lasted for two days or longer (Appendix C). Although this code list has not been formally validated, researchers have used this list of codes given its consistency with hospitalization and surgical findings.[93,112] The time difference between the date of diagnosis to the first IBD-related hospitalization was measured.
6) Surgeries for IBD: The hospital discharge abstract database was used to identify surgeries for IBD. These procedures were searched in the database based in CCP and CCI codes (Appendix D).[93,87] Time from the first eligible diagnosis of IBD to the first surgery for the disease was measured.

3.5 Statistical analysis

First Nation and the general population groups were matched by 1:5 age and sex matching, using a 5-year range.[114] Unconditional and multivariable Cox proportional regression models were used to identify differences in outpatient gastroenterologist visits, access to colonoscopy, medication claims, IBD-specific and -related hospitalization, and surgeries for IBD. Censored observations were the ones that did not present the health care outcomes during the time of follow-up. A failure included observations that present the health care outcomes during the time of follow-up. Time was measured in years from first eligible diagnosis and terminated by either failure or censoring. Hazard ratios (HRs) and corresponding 95% confidence intervals (95%CI) were reported.

Models were adjusted by rural or urban status and diagnostic type. In addition, a stratified analysis was completed by type of disease, i.e. UC and CD. IBD cases with a residential postal code at the date of diagnosis within a Census Metropolitan Areas or Census Agglomeration of 15,000 or more inhabitants were labelled as having urban status.[103,115] This definition for urban and rural residence has been used in previous IBD studies using health administrative databases in Saskatchewan.[103,104] Income quintile and region of residence (i.e. Regina/Saskatoon and surrounding areas, Northern, and Southern Saskatchewan) at the date of IBD diagnosis were tested as confounding variables in the adjusted models, as well as Charlson's Comorbidity index (CCI), health care utilization, and corticosteroid dependency (CsDep) 12 months before the IBD date of diagnosis. Comorbidity was assessed using ICD codes.[116] Because past-health care utilization could have influenced future-health care utilization among IBD cases, a set of variables measured one year before the date of diagnosis (i.e., number of visits to a general practitioner, outpatient visits with specialists [specifically to a rheumatologist, ophthalmologist, surgeon, or gastroenterologist], and medication claims for IBD), as well as CsDep, were evaluated as potential confounding variables, see Appendix I. CsDep was defined as having two or more prescriptions of oral corticosteroids within six months. This definition was based on Munkholm et al[117] definition of corticosteroid dependency and previously used in a population-based study using administrative health databases.[104]

A stratified analysis was completed to evaluate the role of being diagnosed before or after biologic medications were available for IBD. April 1, 2008, was the selected date for the pre- and post-biologic era analysis given that in Saskatchewan: 1) biologics were first available in 2001,[118]

few years were needed to make biologics widely available, and that the first biologic claim by a First Nation with the diagnosis of IBD happened in the 2008 fiscal year. Consequently, the final models were run in the pre- (before the 2008 fiscal year) and post-biologic eras (from 2008 to 2017 fiscal years) based on each individual's date of diagnosis.

As a sensitivity analysis, two different case definitions of IBD were used to evaluate changes in the identified associations. A description of the IBD case definitions used in this study can be found in Table 3.1.

Table 3.1 - Description of IBD case definitions used in this study

Authors/year	Validation place	Case definition	Use
Bernstein et al[105]	Manitoba	Within 2 years of health care coverage: - Had five or more separate health care contacts with the diagnosis of IBD In less than 2 years: - Had three or more health care contacts with the diagnosis of IBD Binary classification scores: - Sensitivity, 74.4–89.2%; and specificity, 89.8–93.7%	Main analysis
Rezaie et al[119]	Alberta	Within a two-year period: - Individuals who experienced at least two hospitalizations or had four physician claims with a diagnosis of IBD Binary classification scores: - Specificity, 99.8%; sensitivity, 83.4%	Sensitivity analysis, matched cohort #2
Benchmiol et al [108]	Ontario	Within 4 years: - At least five physician contacts or two hospitalizations with the diagnosis of IBD Binary classification scores: - Sensitivity, 76.8%; specificity, 96.2%	Sensitivity analysis, matched cohort #3

Two additional IBD incident cohorts were created using the case definitions of Rezaie et al[119] and Benchmiol et al.[108] After applying the matching procedure[114] used in the main cohort, adjusted HRs were calculated for each study outcome in the different cohorts. The controlling variables used for the sensitivity analysis were diagnostic type and residence location.

The IPFAs collaborating in this project received updates during the analysis and interpretation of study results and were invited to provide feedback and input.

All models considered alpha set at 0.05 to produce statistically significant results. Data analyses was conducted using SAS 9.2 (SAS Institute, Cary, NC) at a secured area of the HQC.

3.6 Ethics

Anonymized data provided by the Ministry of Health was accessed at the HQC. Only aggregated results were transferred. This project received approval from the Behavioural

Research Ethics Board of the Board of the University of Saskatchewan, Application ID #977 (Appendix E).

4. RESULTS

4.1 Main analysis

From the 5173 incident cases in the Saskatchewan IBD cohort, 5057 were from the general population, and 116 were First Nations (Appendix F, Table F.1). A matched cohort with 696 incident cases was created, 580 IBD cases from the general population and 116 from the First Nation group.

In the matched cohort, both the general population and First Nation group had similar means for age at diagnosis and sex distributions, attesting that the groups were matched using these two variables (Table 4.1). Most of the individuals from the general population belonged to the 4th income quintile (24.9%), and most of the First Nations were from the lowest income quintile (36.1%). The population groups had similar residence location frequencies, having urban status in 67% and 57.8% of the general population and First Nations, respectively. Regarding the diagnostic type, the proportion of individuals with CD and UC was similar in the general population group. On the other hand, there were more individuals with UC (63.8%) in the First Nations group. The follow-up periods of individuals in the matched cohort ranged from 0.24 to 19.00 years, with a median of 10.90 (interquartile range=9.78) and a mean of 10.74 (SD=5.51). Approximately 95% of individuals in the matched cohort had 2 years of follow-up after the IBD diagnosis date.

Table 4.1 - Sample characteristics, matched cohort

		Group	
	Matched cohort [n=696]	**General population [n= 580]**	**First Nations [n= 116]**
Age at diagnosis of IBD, mean [SD], years	41.44 [14.8]	41.48 [14.7]	41.21 [15.1]
Age groups, No. [%]			
≤30	157 [22.6]	130 [22.4]	27 [23.3]
31-49	346 [49.7]	287 [49.5]	59 [50.9]
≥50	193 [27.7]	163 [28.1]	30 [25.9]
Sex, n[%]			
Female	414 [59.5]	345 [59.5]	69 [59.5]
Male	282 [40.5]	235 [40.5]	47 [40.5]
Income quintiles,* No. [%]			
1 (Lowest)	101 [15.4]	62 [11.3]	39 [36.1]
2	150 [22.8]	130 [22.6]	20 [18.5]
3	130 [19.8]	113 [20.6]	17 [15.7]
4	156 [23.7]	137 [24.9]	19 [17.6]
5 (Highest)	121 [18.4]	108 [19.6]	13 [12.0]
Residence, ** **No. [%]**			
Rural	239 [34.6]	190 [33.0]	49 [42.2]
Urban	452 [65.4]	385 [67.0]	67 [57.8]
Region of residence,* **No. [%]**			
Regina, Saskatoon, and surrounding	353 [50.8]	305 [52.7]	48 [41.4]
Northern Saskatchewan	146 [21.0]	97 [16.8]	49 [42.2]
Southern Saskatchewan	196 [28.2]	177 [30.6]	19 [16.4]
Diagnostic type, No. [%]			
Crohn's Disease	342 [49.1]	300 [51.7]	42 [36.2]
Ulcerative Colitis	354[50.9]	280 [48.3]	74 [63.8]
Date of IBD diagnosis, No. [%]			
Before April 1, 2008	435 [62.5]	377 [65.0]	58 [50.0]
On or after April 1, 2008	261 [37.5]	203 [35.0]	58 [50.0]
Length of follow-up, mean [SD], years	10.74 [5.51]	11.13 [5.44]	8.78 [5.43]

IBD: inflammatory bowel disease, SD: standard deviation

* Data of income quintile not available for all subjects [missing values = 38]. ** Data of rural or urban residence not available for all subjects [missing values = 5]. *** Data of region of residence not available for all subjects [missing values = 1].

Overall, the First Nations and general population groups had similar frequencies for each of the study outcomes. However, variations in prescription medication claims and IBD-specific and IBD related hospitalizations were observed between these two groups (Table 4.2).

Table 4.2 - Study outcomes, matched cohort

	Matched cohort [n=696]	**General population [n=580]**	**First Nations [n=116]**
Outpatient gastroenterologist visit, No. [%]			
No	117 [16.8]	95 [16.4]	22 [19.0]
Yes	579 [83.2]	485 [83.6]	94 [81.0]
Access to a colonoscopy, No. [%]			
No	86 [12.4]	76 [13.1]	10 [8.6]
yes	610 [87.6]	504 [86.9]	106 [91.4]
Prescription claim for IBD, No. [%]			
No	86 [12.3]	62 [10.7]	24 [20.7]
Yes	610 [87.6]	518 [89.3]	92 [79.3]
Prescription claim of a Biologic, No. [%]			
No	536 [77.0]	435 [75.0]	101 [87.1]
Yes	160 [23.0]	145 [25.0]	15 [12.9]
Prescription claim of an IM, No. [%]			
No	432 [62.1]	348 [60.0]	84 [72.4]
Yes	264 [37.9]	232 [40.0]	32 [27.6]
Prescription claim of a 5-ASA, No. [%]			
No	136 [19.5]	108 [18.6]	28 [24.1]
Yes	560 [80.5]	472 [81.4]	88 [75.9]
IBD-specific hospitalization, No. [%]			
No	347 [49.9]	294 [50.7]	53 [45.7]
Yes	349 [50.1]	286 [49.3]	63 [54.3]
IBD-related hospitalization, No. [%]			
No	316 [45.4]	274 [47.2]	42 [36.2]
Yes	380 [54.6]	306 [52.8]	74 [63.8]
Surgeries for IBD, No. [%]			
No	466 [67.0]	386 [66.6]	80 [69.0]
Yes	230 [33.1]	194 [33.5]	36 [31.0]

IBD: inflammatory bowel disease, IM: immune modulator, 5-ASA: 5-aminosalicylic acid, SD: standard deviation.
The mean length of follow-up for each study outcomes can be found in the Appendix, Table F.2.

The unconditional models revealed differences between First Nations and the general population in having a prescription medication claim for IBD, biologic, and 5-ASA and differences in accessing a colonoscopy and having an IBD-related hospitalization (Table 4.3). According to the crude HRs, First Nations have a 42% lower risk of accessing an IBD medication than the general population (HR=0.58, 95% CI 0.47-0.73). By medication groups, the HRs for First Nations were 0.58 (95% CI: 0.34-0.99) and 0.68 (95% CI: 0.54-0.85), respectively, for biologic and 5-ASA therapies. In other words, First Nations had lower prescription medication claims for biologic and 5-ASA compared to the general population. Additionally, First Nations have a 25% higher risk of having a colonoscopy (HR=1.25, 95% CI: 1.01-1.54) and a 45% higher risk of having an IBD-related hospitalization (HR=1.45, 95% CI: 1.12-1.87) after the date of diagnosis than the general population. Appendix H presents the bivariate analysis results to explore the relationships between each of the study outcomes and age at diagnosis, sex, income quintile, diagnosis type, urban residence status, and region of residence.

Table 4.3 - Measures of association between First Nation status (reference general population) and each of the study outcomes

	Full-group analysis (n=696)		Stratified analysis			
			Crohn's Disease (n=342)		Ulcerative Colitis (n=354)	
Outcomes	Unadjusted HR (95%CI)	Adjusted HR (95%CI)*	Unadjusted HR (95%CI)	Adjusted HR (95%CI)**	Unadjusted HR (95%CI)	Adjusted HR (95%CI)***
Outpatient gastroenterologist visit	1.10 (0.88-1.37)	1.13 (0.90-1.41)	0.95 (0.65-1.39)	0.99 (0.67-1.45)	1.22 (0.92-1.61)	1.20 (0.91-1.59)
Access to a colonoscopy	**1.25 (1.01-1.54)**	1.14 (0.92-1.41)	1.19 (0.83-1.72)	1.20 (0.83-1.73)	1.11 (0.86-1.45)	1.11 (0.85-1.44)
Prescription claim for IBD	**0.58 (0.47-0.73)**	**0.52 (0.41-0.65)**	**0.53 (0.35-0.78)**	**0.51 (0.34-0.76)**	**0.52 (0.39-0.68)**	**0.51 (0.39-0.68)**
Prescription claim of a Biologic	**0.58 (0.34-0.99)**	0.65 (0.38-1.11)	0.67 (0.33-1.38)	0.67 (0.32-1.37)	0.61 (0.28-1.35)	0.62 (0.28-1.36)
Prescription claim of an IM	0.70 (0.48-1.01)	0.79 (0.55-1.15)	0.68 (0.40-1.15)	0.69 (0.40-1.17)	0.93 (0.55-1.57)	0.93 (0.55-1.58)
Prescription claim of a 5-ASA	**0.68 (0.54-0.85)**	**0.56 (0.45-0.71)**	**0.60 (0.39-0.92)**	**0.56 (0.36-0.86)**	**0.54 (0.41-0.72)**	**0.54 (0.41-0.72)**
IBD-specific hospitalization	1.24 (0.94-1.63)	**1.33 (1.01-1.75)**	**1.55 (1.04-2.30)**	1.50 (1.00-2.23)	1.18 (0.80-1.72)	1.17 (0.80-1.71)
IBD-related hospitalization	**1.45 (1.12-1.87)**	**1.55 (1.20-2.01)**	**1.74 (1.19-2.54)**	**1.68 (1.14-2.46)**	1.42 (1.00-2.01)	1.41 (1.00-2.00)
Surgeries for IBD	1.13 (0.79-1.62)	1.14 (0.80-1.64)	0.95 (0.52-1.72)	0.93 (0.51-1.70)	1.32 (0.84-2.07)	1.30 (0.83-2.05)

HR: hazard ratio, 95%CI: 95% confidence interval

* Models adjusted by rural or urban status, and diagnostic type (n=691).

** Crohn's Disease group, models adjusted by rural or urban status (n=339).

*** Ulcerative colitis group, models adjusted by rural or urban status (n=352).

In the adjusted analyses by rural or urban residence at the date of diagnosis and diagnostic type, statistically significant differences between the groups were observed for IBD medication, 5-ASA claims, IBD-specific hospitalization, and IBD-related hospitalization (Table 4.3). First Nations had a 48% lower risk to have an IBD medication claims (HR=0.52, 95%CI: 0.41-0.65) and 44% lower risk to have a 5-ASA medication claim (HR=0.56, 95%CI: 0.45-0.71) compared to the general population. Additionally, First Nations had a 33% higher risk of having an IBD-specific hospitalization (HR=1.33, 95%CI: 1.01-1.75) and a 55% higher risk of having an IBD-related hospitalization (HR=1.55, 95%CI: 1.20-2.01).

Charlson's comorbidity index and CsDep on year before the date of diagnosis, as well as neighbourhood income quintile and region of residence at the date of diagnosis were evaluated as confounding variables; however, the adjusted model estimates showed small variations compared to the estimates observed in the crude models (<10% change). Also, none of past-health care utilization variables changed the HR estimates, and therefore they were not included in the final models. Age and sex were not included in the adjusted models because they did not change higher than 10% in the estimates (Appendix I, Tables I.1 and I.2). In fact, the matching process already considered age and sex to balance population groups between First Nations and the general population. Income quintile was also evaluated a confounding variable but not included in the main adjusted model because it did not cause a variation in the estimates higher than 10%, except for IBD-related hospitalizations, in which this change in risk estimates was 10.8% (Appendix I, Table I.3). Specifically, the HR for IBD-related hospitalizations adjusted by rural or urban residence at diagnosis, diagnosis type, and income quintile was 1.38 (95%CI: 1.04-1.82) in the matched cohort; this HR was 1.55 (95%CI 1.20-2.01) when controlling only by rural or urban residence and diagnosis type.

In the stratified analysis by disease type, First Nations had a lower risk of having a medication claim for IBD (HR for CD=0.51, 95%CI: 0.34-0.76; HR for UC=0.51, 95%CI: 0.39-0.68) and a 5-ASA claims (HR for CD=0.56, 95%CI: 0.36-0.86; HR for UC=0.54, 95%CI: 0.41-0.72) than individual with IBD from the general population. Also, differences were observed for IBD-related hospitalizations (HR=1.68, 95% CI: 1.14-2.46) in the CD group.

In the pre-biologic era analysis (Table 4.4), First Nations had a 68% (HR=0.32, 95%CI: 0.23-0.45) and a 67% (HR=0.33, 95%CI: 0.24-0.47) lower risk of having a prescription claim for IBD and 5-ASA, respectively. Likewise, by type of disease, these lower risk estimates were also observed for having a medication claim for IBD (HR for CD=0.36, 95%CI: 0.19-0.69; HR for UC=0.29, 95%CI: 0.19-0.43) and a 5-ASA medication claims (HR for CD=0.38, 95%CI: 0.19-0.75; HR for UC=0.30, 95% CI: 0.20-0.44).

Table 4.4 - Measures of association between First Nation status (reference general population) and each of the study outcomes in the pre-biologic

	Pre-biologic full-group analysis (n=435)		Pre-biologic stratified analysis			
			Crohn's Disease (n=206)		Ulcerative Colitis (n=229)	
Outcomes	Unadjusted HR (95%CI)	Adjusted HR (95%CI)*	Unadjusted HR (95%CI)	Adjusted HR (95%CI)**	Unadjusted HR (95%CI)	Adjusted HR (95%CI)***
Outpatient gastroenterologist visit	0.97 (0.70-1.34)	0.99 (0.71-1.37)	0.84 (0.47-1.52)	0.89 (0.49-1.63)	1.05 (0.71-1.55)	1.03 (0.69-1.52)
Access to a colonoscopy	1.12 (0.83-1.49)	1.00 (0.75-1.34)	0.96 (0.57-1.64)	0.97 (0.57-1.66)	1.01 (0.71-1.44)	1.00 (0.70-1.42)
Prescription claim for IBD	**0.38 (0.27-0.53)**	**0.32 (0.23-0.45)**	**0.37 (0.19-0.70)**	**0.36 (0.19-0.69)**	**0.29 (0.19-0.43)**	**0.29 (0.19-0.43)**
Prescription claim of a Biologic	-	-	-	-	-	-
Prescription claim of an IM	**0.56 (0.32-0.99)**	0.62 (0.35-1.09)	0.44 (0.18-1.09)	0.44 (0.18-1.08)	0.85 (0.40-1.80)	0.85 (0.40-1.81)
Prescription claim of a 5-ASA	**0.42 (0.30-0.58)**	**0.33 (0.24-0.47)**	**0.40 (0.20-0.78)**	**0.38 (0.19-0.75)**	**0.30 (0.20-0.44)**	**0.30 (0.20-0.44)**
IBD-specific hospitalization	1.09 (0.74-1.59)	1.17 (0.80-1.71)	1.26 (0.71-2.24)	1.18 (0.66-2.10)	1.11 (0.67-1.85)	1.11 (0.67-1.85)
IBD-related hospitalization	1.30 (0.92-1.85)	1.40 (0.98-2.00)	1.51 (0.88-2.59)	1.43 (0.83-2.46)	1.33 (0.83-2.12)	1.33 (0.84-2.12)
Surgeries for IBD	0.83 (0.50-1.37)	0.84 (0.51-1.39)	0.85 (0.37-1.95)	0.85 (0.37-1.97)	0.83 (0.44-1.57)	0.83 (0.44-1.56)

HR: hazard ratio, 95%CI: 95% confidence interval
*Models adjusted by rural or urban status and diagnostic type(n=432).
** Crohn's Disease group, models adjusted by rural or urban status (n=204).
*** Ulcerative colitis group, models adjusted by rural or urban status (n=228).

In the post-biologic, there were statistically significant differences in the risk of having an IBD-specific hospitalization (HR=1.55, 95%CI: 1.03-2.35) and IBD-related hospitalization (HR=1.76, 95%CI: 1.19-2.60) for First Nations compared to the general population. Also, First Nations with CD also had a higher risk of IBD-specific hospitalization (HR=1.99, 95%CI: 1.12-3.25) and IBD-related hospitalization (HR=2.14, 95%CI: 1.22-3.74) than individuals with CD from the general population. In the UC group, the risk of First Nations having surgery for IBD was 2.66 higher than that of the general population (HR=2.66, 95%CI: 1.27-5.55), see Table 4.5.

Table 4.5 - Measures of association between First Nation status (reference general population) and each of the study outcomes in post-biologic

Outcomes	Post-biologic full-group analysis (n=261)		Post-biologic stratified analysis			
			Crohn's Disease (n=136)		Ulcerative Colitis (n=125)	
	Unadjusted HR (95%CI)	Adjusted HR (95%CI)*	Unadjusted HR (95%CI)	Adjusted HR (95%CI)**	Unadjusted HR (95%CI)	Adjusted HR (95%CI)***
Outpatient gastroenterologist visit	1.02 (0.75-1.38)	1.04 (0.76-1.41)	0.79 (0.48-1.30)	0.80 (0.49-1.33)	1.29 (0.86-1.95)	1.29 (0.85-1.94)
Access to a colonoscopy	**1.37 (1.01-1.88)**	1.27 (0.93-1.75)	1.39 (0.83-2.33)	1.40 (0.83-2.36)	1.24 (0.83-1.84)	1.22 (0.82-1.83)
Prescription claim for IBD	0.99 (0.73-1.35)	0.94 (0.69-1.28)	0.69 (0.41-1.15)	0.64 (0.38-1.09)	1.17 (0.78-1.74)	1.16 (0.78-1.73)
Prescription claim of a Biologic	**0.49 (0.24-0.97)**	0.51 (0.25-1.02)	0.52 (0.19-1.44)	0.50 (0.18-1.41)	0.47 (0.18-1.21)	0.46 (0.18-1.19)
Prescription claim of an IM	0.70 (0.43-1.14)	0.81 (0.49-1.34)	0.79 (0.41-1.54)	0.84 (0.43-1.65)	0.78 (0.37-1.65)	0.77 (0.36-1.62)
Prescription claim of a 5-ASA	**1.22 (0.88-1.69)**	1.08 (0.78-1.50)	0.90 (0.51-1.60)	0.80 (0.45-1.44)	1.28 (0.86-1.91)	1.27 (0.85-1.90)
IBD-specific hospitalization	1.43 (0.96-2.15)	**1.55 (1.03-2.35)**	**1.94 (1.10-3.40)**	**1.99 (1.12-3.52)**	1.21 (0.67-2.18)	1.20 (0.66-2.15)
IBD-related hospitalization	**1.64 (1.12-2.40)**	**1.76 (1.19-2.60)**	**2.08 (1.20-3.60)**	**2.14 (1.22-3.74)**	1.48 (0.86-2.54)	1.46 (0.85-2.51)
Surgeries for IBD	1.56 (0.92-2.64)	1.51 (0.89-2.57)	0.95 (0.40-2.27)	0.87 (0.36-2.09)	**2.77 (1.33-5.77)**	**2.66 (1.27-5.55)**

HR: hazard ratio, 95%CI: 95% confidence interval
*Models adjusted by rural or urban status and diagnostic type(n=259).
** Crohn's Disease group, models adjusted by rural or urban status (n=135).
*** Ulcerative colitis group, models adjusted by rural or urban status (n=124).

4.2 Sensitivity analysis

The sensitivity analysis with the matched cohort using Rezaie et al[119] case definition (matched cohort #2) included 990 IBD incident cases whose 165 belonged to the First Nation group, and 825 were from the general population (Appendix J, Table J.1). This cohort has similar sample characteristics compared to those in the main analysis. The HRs from matched cohort #2 demonstrated similar strengths and directions of associations compared to those in the main analysis (Appendix J, Table J.3). For instance, for prescription claim for IBD, the unadjusted and adjusted HRs were 0.74 (95%CI: 0.61-0.90) and 0.68 (95% CI 0.56-0.83), respectively. Unlike the results from the full-group main adjusted analysis, IBD-specific hospitalization (HR=1.28, 95% CI: 0.99-1.67) was not statistically significant in the full-group adjusted analysis in the matched cohort #2.

The sensitivity analysis with the matched cohort using Benchimol et al[108] case definition (matched cohort #3) obtained 708 IBD incident cases, with 118 from the First Nation group and 590 from the general population (Appendix K, Table K.1). Regarding the sample characteristics, the matched cohort #3 is more similar to the main analysis than the matched cohort #2. The percentages across the study outcomes are consistent with those in the main analysis (Appendix K, Table K.2). The analysis using this case definition also attested to the robustness of the study findings, showing multiple similarities in HRs (see Appendix K, Table K.3). The HRs for prescription medication claims for any IBD medication and a 5-ASA provided very similar associations both in the full-group and stratified analysis. Some discrepancies between the cohort #3 and the main analysis were identified; for example, there were no statistically significant differences in the risk of IBD-specific hospitalization between the groups (HR=1.30, 95%CI: 0.98-1.75).

5. DISCUSSION

This is the first study in the literature comparing health care utilization between First Nations and individuals from the general population diagnosed with IBD. In the context of health care utilization, First Nations had a higher risk of having an IBD-specific and IBD-related hospitalization than the general population. Additionally, lower risk estimates were observed in prescription claims for any IBD medication and 5-ASA for First Nations.

Poorer hospitalizations outcomes have been observed when comparing First Nations with the general population.[120–122] For example, a Saskatchewan retrospective medical chart audit found negative health disparities in the use of acute care services between First Nations and the general population.[120] By analyzing data from two urban hospitals from 2012 to 2014, this study found that First Nations were hospitalized for almost three days longer than the general population.[120] These delays to be discharged were in part due to lack of transportation, bed availability, and community/family contact.[120] Another study in Manitoba analyzed health care outcomes between First Nations and non-First Nations patients undergoing angiography using administrative data, chart audits, and angiography images from 2008 to 2012.[121] The results revealed higher hospital admission rates due to acute myocardial infarction and congestive heart failure among First Nations.[121] In Alberta, First Nations with chronic kidney disease were found to have double likelihood to be hospitalized for ambulatory care sensitive conditions compared to non-First Nations.[122] Therefore, the identified higher risk of IBD-related and IBD-specific hospitalizations for First Nations in this study are in agreement with the evidence of increased hospitalization risks for First Nations with other chronic conditions.

Approximately 22% of IBD patients will require hospitalization within two years after the date of IBD diagnosis.[123,124] King et al[125] maintain that hospitalizations for IBD are decreasing in Western countries and increasing in developing nations, following the epidemiology of IBD worldwide. Several factors, such as extensive disease, female gender, need for medication, including steroids and anti-TNFs, can be associated with the first UC-related hospitalization.[126] Factors such as non-inflammatory disease behaviour at diagnosis and perianal disease can be predictors for the first CD-related hospitalization.[127]

According to the study results, First Nations had lower IBD prescription claims compared to the general population. First Nations may experience difficulties in accessing IBD medications. A study in Ontario used health administrative data from 1996 and 2015 to analyze prescriptions for cardioprotective medications in people living with diabetes, specifically between First Nations and other people in Ontario.[128] This study found that prescriptions for cardioprotective medications increased substantially among First Nations; however, First Nations consistently had lower medication claims compared to other people.[128] In another study, First Nations with ischemic heart disease were less likely to have intermediate (40-79%) and high (≥80%) medication possession ratios for statins compared to the non-First Nations group.[129] Lower rates of medications when comparing First Nations with the general population were also reported for tobacco cessation in British Columbia.[130] In the management of type 2 diabetes, low

prescription rates for angiotensin-converting enzyme inhibitors and Angiotensin II receptor blockers were reported among First Nations in Quebec.[131]

The discrepancies in having IBD prescription claims highlighted in this study contribute to the hypothesis that First Nations experience barriers in accessing health care (i.e., access to medication) earlier in the disease onset. Also, it could be hypothesized that First Nations lack access to IBD medication claims; therefore, higher risks of IBD-specific and -related hospitalizations could reflect suboptimal disease management among First Nations. If the lower IBD prescription medication claims is not being confounded by disease severity, there is a potential inequitable access to IBD medication for First Nations. These results call for a change in the context of the social determinants of health, the inequities that exist within the health care system and "who" has (and "who" has not) access to a more streamlined, optimal, health care.[13,29]

A potential explanation for First Nations not having prescription medication claims for IBD involves systematic challenges that are embedded in racist protocols and processes in health care. For example, when trying to access IBD medication, First Nations may have faced lack of coverage by the NIHB, lack of understanding about the NIHB coverage and claim process, or simply NIHB rejection of coverage.[132]

The use of IBD medication is important for IBD management since the disease may present with an unpredictable disease course marked by periods of remission and relapse.[133] Taking IBD medication has been associated with a better disease course with lower risk of relapses, hospitalizations, surgery, or colorectal cancer.[133,134] To maintain treatment, patients living with IBD may need to take daily oral doses of several medications such as sulfasalazine, mesalazine, azathioprine, methotrexate, and corticosteroids.[133] Additionally, patients may also need to carry the extra burden of taking medication through rectal injections, suppositories, or parenteral administration.[133]

An important aspect of IBD medication that can influence its access is the understanding of its use.[135] Patients living with IBD may struggle to understand the purpose of their medication and its side effects.[135] These issues may also be common among First Nations. To address this issue, intervention studies on health literacy for Indigenous people in Canada, Australia, and New Zealand have proved effective in improving medication knowledge and self-management.[136,137] Such interventions can be developed with patients and health care providers, with focus groups and interactive tools such as electronic tablet application, medication cards, and booklets.[136,137]

The post-biologic era highlighted further disparities between First Nations and the general population with the diagnosis of IBD. In comparison to individuals from the general population, an increased risk of IBD-related and IBD-specific hospitalizations and a higher risk of surgeries for IBD among First Nations were observed in the post-biologic era. These results may indicate that First Nations may not have the same access to biologic therapies as the general population for reasons that may be linked to systematic racism in the health care system. Indeed, the percentage of First Nation patients with a prescription medication claim of a biologic (12.9%) is roughly half of that of the general population (24.9%). Other studies have analyzed biologic exposure, highlighting the role of biologics in reducing length of hospitalization[138] and surgery for IBD.[139] However, biologics can be a heavy financial burden for health care systems and users[140] and biologic benefits in decreasing hospitalization, surgeries, and their IBD-related costs may be limited to CD patients.[140] Additionally, results related to the biological eras should be interpreted with caution because they may too be influenced by improvements in IBD diagnosis, guidelines, medical practices over time.[141]

Other interesting findings are the frequency of First Nations diagnosed with IBD belonging to the lowest income quintile (36.1%) and living in urban centers (57.8%). More

precarious socioeconomic conditions are associated with unmet health care needs.[60,142] In this study, the models were controlled by rural and urban status since there is evidence demonstrating differences in health services use for IBD between rural and urban patients.[93] Benchimol et al[93] found that rural dwellers had less IBD-specific gastroenterologist visits and received specialized care from gastroenterologists less often compared to urban patients. In Saskatchewan, 42.7% of First Nations live off-reserve.[50] A systematic review and meta-analysis showed that living in urban centers can contribute to developing IBD.[143] With the deflate of the fur trade industry a few decades ago, the traditional harvesting and hunting collapsed.[13] This phenomenon led First Nations to experience high levels of socioeconomic assistance and changes in their diet, shifting from traditional to unhealthy and western food.[13] This cultural and socioeconomic insecurity may be contributing factor to IBD onset among First Nations.[85]

For Indigenous people, regardless of living in urban or rural areas, IBD care should not only be available but provided in culturally appropriate ways, considering the Indigenous people's history of racism and oppression.[29,144] Despite the Royal Commission on Aboriginal Peoples and the Truth and Reconciliation Commission that aimed to improve the health of Indigenous people, there is still a long way to go in order to promote cultural safety in health care.[145–147] This lack of cultural safety may explain some health care inequities observed in this study.[148] Finally, patient navigation could also help First Nations to obtain early access to health care services and contribute to reduce health care disparities.[149,150]

5.1 Limitations

This study has some limitations related to misclassification bias, data source, and study design. Misclassification bias can be a potential issue when using health administrative data to study chronic diseases such as IBD.[103,151] Mistakes can be originated from data entry or changes in diagnostic codes.[151] Additionally, this limitation has an extra challenge when working with specific groups (e.g. older adults, individuals in a rural location, and First Nations) due to their different health care utilization patterns and access. A validated case definition that required multiple health care contacts with the diagnosis of IBD diagnosis was applied to address this potential issue.[105] Also, a sensitivity analysis was performed using another two validated case definitions for IBD[108,119] to attest to the robustness of the study findings. Moreover, First Nations status may be inaccurate as it is only possible to account for those self-declared being First Nation in the administrative health databases used in this study. Furthermore, health care contacts in reserve are not included in these databases.

Another limitation comes from the challenges with creating the context within which Indigenous health data are collected and managed in western system of care. Indigenous-specific health information in health systems may be compromised due to factors such as misclassification errors and non-response bias, leading to an underestimation of Indigenous health issues.[152] The limitations regarding data source include the fact that the administrative health database does not inform health outcomes such as patient satisfaction, quality of life, disease management, and access to care. Another limitation emerging from the data source is information on disease severity. Patients living with IBD can be in remission, mild, moderate, and severe state of their disease.[101] Because the administrative databases do not inform disease severity; this variable may confound healthcare utilization results.[104] One could cogitate using propensity score methods,[153] considering health care utilization variables a year before the date of diagnosis as a proxy to measure severity of IBD in this study.[101,104] However, propensity score

methods using proxy variables to address the confounding effect of disease severity would be inadequate since First Nations status is not a type of exposure. Regarding the limitations of study design, there may be a risk of bias due to residual confounders since this is an observational study.

Finally, there were challenges and barriers to ensuring that this study would be grounded in an Indigenous worldview and assure decolonization and culturally safe practices. To address this limitation, I always prioritized the Indigenous partners' voice and aimed to improve my cultural humility through university courses and reflections. Firstly, I needed to decolonize myself and recognize my privileges as an international student in Canada despite having Indigenous ancestry from Brazil. Another limitation of this patient-oriented research initiative was not overtasking the patient-family advisors with too many research-related duties. To overcome this limitation, I attempted to send material for review in a flexible timeline and manifested availability and attention in case of questions.

6. KNOWLEDGE TRANSLATION

Knowledge translation in Indigenous ways of knowing has been defined as "sharing what we know about living a good life."[154] Some knowledge translation practices in Indigenous contexts have been acknowledged for incorporating the principles of two-eyed seeing: The Knaw Chi Ge Win service centre and the Nations Maternal and Child Centre in the Grand River reserve.[155] In these projects from Ontario, the knowledge translation has utilized the two-eyes seeing perspective in order to promote decolonization and culturally safe practices.[155] Two-Eyed Seeing means "To see from one eye with the strengths of Indigenous ways of knowing, and to see from the other eye with the strengths of Western ways of knowing, and to use both of these eyes together."[156(p. 335)] Abonyi and Jeffery[157] shared their experiences in applying knowledge translation practices in their project that aimed to develop a community health tool kit with Indigenous health organizations from Saskatchewan. In their experience, they found that activities should be short and pertinent." Abonyi and Jeffery also reported that visual activities were more likely to be successful.[157] These practices highlight the relevance of following Indigenous ways of knowing in the knowledge translation practices by receiving input from the community partners.

The knowledge translation[158] part of this project has been developed in collaboration with IPFAs. I aimed to promote community engagement throughout the project and empower Indigenous people with the study findings. The IPFAs involved in "*Understanding and advocating for miyo-māhcihowin among Indigenous Peoples living with IBD*" collaborative project suggested that one way to promote knowledge translation is by building relationships with the communities in the first place. Therefore, I have visited two reserves in order to develop trust and learn more about Indigenous ways of knowing with real-life experiences. Furthermore, a patient advisor and I co-presented the study proposal in an Epidemiology symposium. Also, one patient advisor and I will attend the Canadian Digestive Diseases Week™ (CDDW™) in March 2021 to present this study. My goal is to continue our knowledge translation activities (e.g., educational videos, scientific manuscripts, conference and online presentations, etc.) with the IPFAs of the research team as coauthors and co-presenters.

7. THE ORIGINALITY AND IMPACT OF THE RESEARCH

To the best of my knowledge, this is the first study that explores health care utilization among First Nations with IBD in Saskatchewan and Canada. The study is original and based on the need for studies evaluating health care utilization differences between First Nations and the general population with IBD. This need has been highlighted in a recent report on IBD in Canada.[159] Furthermore, IPFAs engaged in the study stated the need for having this kind of evidence to promote health care changes and improvements. This study was initiated based on needs and concerns about IBD care manifested by First Nations themselves, following a patient-oriented research approach. The IPFAs were continuously engaged in the research process and their opinions and perspectives have had heavy weight on the decision making towards the research process. To obtain such level of collaboration with First Nations, I first needed to establish relationships and build trust with them. This collaboration with First Nations has challenged my westernized views of conducting research and allowed me to understand better Indigenous ways of knowing and healing. For example, I needed to decolonize myself and understand that there are ways forward in advocating for the health of First Nations in Canada so that my study results would have application in the light of systematic racism and oppression. With this in mind, I hope to keep collaborating with Indigenous people as an ally in advocating for better health care access for IBD throughout my journey as a researcher. This responsibility goes beyond this study, it is about demonstrating concern over Indigenous issues, appreciation towards their causes, and promoting reconciliation and healing. Throughout the research process, promoting reconciliation and healing was an ongoing process demonstrated through appreciation and learning about Indigenous culture and prioritizing the perspectives and the recommendations of the IPFAs.

This study is important to raise awareness about IBD among Indigenous people, promoting further studies across provinces in Canada. The study results could have implications for future research and policymaking to advocate for Indigenous people's appropriate care and wellness with IBD. Finally, the study findings might help formulate health care interventions to reduce health care inequities between First Nations and non-Aboriginal people living with IBD in Saskatchewan and other Canadian provinces. For example, the evidence presented in this study could guide decision makers and health care providers designing strategies for closer follow-up with First Nations living with IBD to help them better navigate the health care system (e.g., access medications through NIHB). Additionally, there could be more training on cultural safety and cultural humility to promote awareness about Indigenous culture, traditional medicine, and decolonization in the health care system.

8. CONCLUSIONS

This study identified that First Nations have a higher risk of having an IBD-specific and related hospitalization compared to the general population. Additionally, an inverse association between First Nations status and having prescription medication claims for IBD and 5-ASA in Saskatchewan was found. When evaluating these associations, multiple confounding variables were considered, but it was not possible to control by disease severity. Thus, these associations might reflect a barrier to access IBD medications, contributing to a higher risk for IBD-specific or -related hospitalizations in the First Nations group. In the pre-biologic analysis, statistically significant differences were observed for any IBD medication and 5-ASA. An increased risk of BD-specific and -related hospitalizations and surgeries for First Nations was observed in the post-biologic era.

These results speak to more action in the light of the Truth and Reconciliation Calls, anti-racist practices in the health care system, and proper addressing of the root causes of the health care inequities for First Nations living with IBD. Further studies should continue evaluating access to IBD care (including navigation and cultural safety in health care systems), medication use, and disease severity among First Nations living with IBD.

9. REFERENCES

1. Statistics Canada. Aboriginal peoples in Canada: key results from the 2016 Census [Internet]. 2016. Available from: https://www150.statcan.gc.ca/n1/daily-quotidien/171025/dq171025a-eng.htm

2. Wilmot S. Cultural rights and First Nations health care in Canada. Health Hum Rights [Internet]. 2018 Jun;20(1):283–93. Available from: http://www.ncbi.nlm.nih.gov/pubmed/30008570

3. Bird EK-R. Health, education, language, dialect, and culture in First Nations, Inuit, and Métis communities in Canada: an overview. Can J Speech-Language Pathol Audiol. 2011;35(2):110–24.

4. Crey K, Hanson E. Indian status [Internet]. 2009. Available from: https://indigenousfoundations.arts.ubc.ca/indian_status/

5. Paradies Y. Colonisation, racism and indigenous health. J Popul Res [Internet]. 2016 Mar 18;33(1):83–96. Available from: http://link.springer.com/10.1007/s12546-016-9159-y

6. Grant C. Freedom and oppression. Polit Philos Econ. 2013;12(4):413–25.

7. Doane A. What is racism? racial discourse and racial politics. Crit Sociol. 2006;32(2/3):255–74.

8. Morrison TG, Morrison MA, Borsa T. A legacy of derogation: prejudice toward Aboriginal Persons in Canada. Psychology [Internet]. 2014;05(09):1001–10. Available from: http://www.scirp.org/journal/doi.aspx?DOI=10.4236/psych.2014.59112

9. Arcaya MC, Arcaya AL, Subramanian S V. Inequalities in health: definitions, concepts, and theories. Glob Health Action [Internet]. 2015 Dec 24;8(1):27106. Available from: https://www.tandfonline.com/doi/full/10.3402/gha.v8.27106

10. Kawachi I. A glossary for health inequalities. J Epidemiol Community Heal [Internet]. 2002 Sep 1;56(9):647–52. Available from: https://jech.bmj.com/lookup/doi/10.1136/jech.56.9.647

11. Whitehead M. The concepts and principles of equity and health. Int J Heal Serv [Internet]. 1992 Jul 1;22(3):429–45. Available from: http://journals.sagepub.com/doi/10.2190/986L-LHQ6-2VTE-YRRN

12. Global Health Europe. Inequity and inequality in health [Internet]. 2009. Available from: https://globalhealtheurope.org/values/inequity-and-inequality-in-health/

13. Douglas V. An introduction to Indigenous Health and healthcare in Canada [Internet]. 2nd ed. New York, NY: Springer Publishing Company; 2020. Available from: http://connect.springerpub.com/lookup/doi/10.1891/9780826164131

14. First Nations Studies Program. The residential school system [Internet]. 2008. Available from: https://indigenousfoundations.arts.ubc.ca/the_residential_school_system/
15. Kirmayer LJ, Gone JP, Moses J. Rethinking historical trauma. Transcult Psychiatry. 2014;51(3):299–319.

16. Sinclair R. The Indigenous child removal system in Canada: an examination of legal decision-making and racial bias. First Peoples Child Fam Rev [Internet]. 2016;11(2):8–18. Available from: https://fpcfr.com/index.php/FPCFR/article/view/310

17. Juutilainen SA, Miller R, Heikkilä L. Structural racism and Indigenous Health: what Indigenous perspectives of residential school and boarding school tell us? A case study of Canada and Finland. Int Indig Policy J. 2014;5(3).

18. Hatala AR, Njeze C, Morton D, Pearl T, Bird-Naytowhow K. Land and nature as sources of health and resilience among Indigenous youth in an urban Canadian context: a photovoice exploration. BMC Public Health [Internet]. 2020 Dec 20;20(1):538. Available from: https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-020-08647-z

19. United Nations. United Nations Declaration on the rights of Indigenous Peoples [Internet]. 2007. Available from: https://www.un.org/development/desa/indigenouspeoples/wp-content/uploads/sites/19/2018/11/UNDRIP_E_web.pdf

20. International Labour Organization. C169 - Indigenous and Tribal Peoples Convention, 1989 (No. 169) [Internet]. 1991. Available from: https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_ILO_CODE:C169

21. Greenley RN, Stephens M, Doughty A, Raboin T, Kugathasan S. Barriers to adherence among adolescents with inflammatory bowel disease. Inflamm Bowel Dis [Internet]. 2010 Jan;16(1):36–41. Available from: https://academic.oup.com/ibdjournal/article/16/1/36-41/4628180

22. Durie M. Providing health services to indigenous peoples: a combination of conventional services and indigenous programmes is needed. BMJ. 2003;327:408–9.

23. Ly A, Crowshoe L. 'Stereotypes are reality': addressing stereotyping in Canadian Aboriginal medical education. Med Educ [Internet]. 2015 Jun;49(6):612–22. Available from: http://doi.wiley.com/10.1111/medu.12725

24. Peiris D, Brown A, Cass A, Miph M, Brown A, Mph B, et al. Addressing inequities in access to quality health care for indigenous people. Can Med Assoc J [Internet]. 2008 Nov 4;179(10):985–6. Available from: http://www.cmaj.ca/cgi/doi/10.1503/cmaj.081445

25. Jacklin KM, Henderson RI, Green ME, Walker LM, Calam B, Crowshoe LJ, et al. Health care experiences of Indigenous people living with type 2 diabetes in Canada. Can Med Assoc J [Internet]. 2017 Jan 23;189(3):E106–12. Available from: http://www.cmaj.ca/lookup/doi/10.1503/cmaj.161098

26. Webster P. Language barriers restricting access to health care for Indigenous populations. Can Med Assoc J [Internet]. 2018 Jun 18;190(24):E754–5. Available from: http://www.cmaj.ca/lookup/doi/10.1503/cmaj.109-5613

27. Brierley C, Arora G, Graham D SN, Arora G, Graham D, Suarez N, Brierley CK. Healthcare access and health beliefs of the Indigenous Peoples in remote Amazonian Peru. Am J Trop Med Hyg [Internet]. 2014 Jan 8;90(1):180–3. Available from: http://www.ajtmh.org/content/journals/10.4269/ajtmh.13-0547

28. Sexton SM, Richardson CR, Schrager SB, Bowman MA, Hickner J, Morley CP, et al. Systemic racism and health disparities: a statement from editors of family medicine journals. Ann Fam Med [Internet]. 2021 Jan 11;19(1):2–3. Available from: http://www.annfammed.org/lookup/doi/10.1370/afm.2613

29. National Collaborating Centre for Indigenous Health. Social determinants of health: access to health services as a social determinant of First Nations, Inuit and Metis Health [Internet]. National Collaborating Centre for Indigenous Health. 2019. Available from: https://www.nccih.ca/docs/determinants/FS-AccessHealthServicesSDOH-2019-EN.pdf

30. Government of Canada. Highlights from the report of the Royal Commission on Aboriginal Peoples [Internet]. 2010. Available from: https://www.rcaanc-cirnac.gc.ca/eng/1100100014597/1572547985018#chp5

31. Truth and Reconciliation Commission of Canada. Truth and Reconciliation Commission of Canada: Calls to Action [Internet]. 2015. Available from: http://trc.ca/assets/pdf/Calls_to_Action_English2.pdf

32. Assembly of First Nations. Progress on realizing the Truth and Reconciliation Commission's Calls to Action [Internet]. 2019. Available from: https://www.afn.ca/wp-content/uploads/2020/12/2020_TRC-Report-Card_ENG.pdf

33. Huot S, Ho H, Ko A, Lam S, Tactay P, MacLachlan J, et al. Identifying barriers to healthcare delivery and access in the Circumpolar North: important insights for health professionals. Int J Circumpolar Health [Internet]. 2019 Jan 1;78(1):1571385. Available from: https://www.tandfonline.com/doi/full/10.1080/22423982.2019.1571385

34. Mew EJ, Ritchie SD, VanderBurgh D, Beardy JL, Gordon J, Fortune M, et al. An environmental scan of emergency response systems and services in remote First Nations

communities in Northern Ontario. Int J Circumpolar Health [Internet]. 2017 Jan 11;76(1):1320208. Available from: https://www.tandfonline.com/doi/full/10.1080/22423982.2017.1320208

35. Shah TI, Milosavljevic S, Bath B. Determining geographic accessibility of family physician and nurse practitioner services in relation to the distribution of seniors within two Canadian Prairie Provinces. Soc Sci Med [Internet]. 2017 Dec;194:96–104. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0277953617306342

36. Shah TI, Milosavljevic S, Bath B. Measuring geographical accessibility to rural and remote health care services: challenges and considerations [Internet]. Vol. 21, Spatial and Spatio-temporal Epidemiology. 2017. p. 87–96. Available from: https://linkinghub.elsevier.com/retrieve/pii/S187758451630048X

37. Government of Canada. About the Non-Insured Health Benefits program [Internet]. 2019. Available from: https://www.sac-isc.gc.ca/eng/1572537161086/1572537234517

38. Horrill T, McMillan DE, Schultz ASH, Thompson G. Understanding access to healthcare among Indigenous peoples: A comparative analysis of biomedical and postcolonial perspectives. Nurs Inq [Internet]. 2018 Jul;25(3):e12237. Available from: http://doi.wiley.com/10.1111/nin.12237

39. Cameron BL, Carmargo Plazas M del P, Salas AS, Bourque Bearskin RL, Hungler K. Understanding inequalities in access to health care services for Aboriginal People. Adv Nurs Sci [Internet]. 2014;37(3):E1–16. Available from: http://journals.lww.com/00012272-201407000-00013

40. Smith R, Lavoie JG. First nations health networks: a collaborative system approach to health transfer. Healthc Policy [Internet]. 2008 Nov;4(2):101–12. Available from: http://www.ncbi.nlm.nih.gov/pubmed/19377374

41. Northern Inter-Tribal Health Authority. 1st, 2nd, 3rd level services [Internet]. 2020. Available from: http://www.nitha.com/our-history/

42. Northern Inter-Tribal Health Authority. Our history [Internet]. 2020. Available from: http://www.nitha.com/our-history/

43. Northern Inter-Tribal Health Authority. Home [Internet]. 2020. Available from: http://www.nitha.com/

44. Haver C. First Nations and Métis Health Service: navigation services literature review [Internet]. Saskatoon; 2014. Available from: https://www.saskatoonhealthregion.ca/locations_services/Services/fnmh/service/Documents/About-Us FNMHS/FNMH_FINAL_Navigation_Services_Literature_Review_Oct_21_2014.pdf

45. Interior Health Authority. Aboriginal Patient Navigator: helping Aboriginal people access health services [Internet]. 2021. Available from: https://www.interiorhealth.ca/YourHealth/AboriginalHealth/Partnerships/Pages/APN.aspx

46. Eschiti V, Burhansstipanov L, Watanabe-Galloway S. Native cancer navigation: the state of the science. Clin J Oncol Nurs [Internet]. 2012 Feb 1;16(1):73–82. Available from: http://cjon.ons.org/cjon/16/1/native-cancer-navigation-state-science

47. Whop LJ, Valery PC, Besley VL, Moore SP, Lokuge K, Jacka C, et al. Navigating the cancer journey: A review of patient navigator programs for Indigenous cancer patients. Asia Pac J Clin Oncol [Internet]. 2012 Dec;8(4):e89–96. Available from: http://doi.wiley.com/10.1111/j.1743-7563.2012.01532.x

48. Guadagnolo BA, Boylan A, Sargent M, Koop D, Brunette D, Kanekar S, et al. Patient navigation for American Indians undergoing cancer treatment. Cancer [Internet]. 2011 Jun 15;117(12):2754–61. Available from: http://doi.wiley.com/10.1002/cncr.25823

49. Petereit DG, Molloy K, Reiner ML, Helbig P, Cina K, Miner R, et al. Establishing a patient navigator program to reduce cancer disparities in the American Indian Communities of Western South Dakota: initial observations and results. Cancer Control [Internet]. 2008 Jul;15(3):254–9. Available from: http://journals.sagepub.com/doi/10.1177/107327480801500309

50. Statistics Canada. Table 3 - Distribution of First Nations people, First Nations people with and without registered Indian status, and First Nations people with registered Indian status living on or off reserve, Canada, provinces and territories, 2011 [Internet]. 2015. Available from: https://www12.statcan.gc.ca/nhs-enm/2011/as-sa/99-011-x/2011001/tbl/tbl03-eng.cfm

51. Government of Saskatchewan. Who is eligible for the Non-Insured Health Benefits program [Internet]. 2019. Available from: https://www.sac-isc.gc.ca/eng/1574187596083/1576511384063

52. Government of Saskatchewan. Saskatchewan health services card application [Internet]. 2020. Available from: https://www.ehealthsask.ca/residents/health-cards/PublishingImages/Pages/Apply-for-a-Health-Card/Health_Card_Application_Form.pdf

53. Saskatchewan Ministry of Health. The population of Saskatchewan. 2011; Available from: https://www.saskatchewan.ca/government/government-structure/ministries/health/other-reports/health-status-reports

54. Yeates K, Tonelli M. Chronic kidney disease among Aboriginal people living in Canada. Clin Nephrol [Internet]. 2010 Nov;74 Suppl 1:S57-60. Available from: http://www.ncbi.nlm.nih.gov/pubmed/20979965

55. Kappelman MD, Porter CQ, Galanko JA, Rifas-Shiman SL, Ollendorf DA, Sandler RS, et al. Utilization of healthcare resources by U.S. children and adults with inflammatory bowel disease. Inflamm Bowel Dis [Internet]. 2011 Jan;17(1):62–8. Available from: https://academic.oup.com/ibdjournal/article/17/1/62-68/4631080

56. Orchard T, Goldin R, Tekkis P, Williams H. Inflammatory bowel disease: an atlas of investigation and management. 1st ed. Dorset: Clinical Publishing; 2011. 109 p.

57. Ho S-M, Lewis JD, Mayer EA, Plevy SE, Chuang E, Rappaport SM, et al. Challenges in IBD research: environmental triggers. Inflamm Bowel Dis [Internet]. 2019 May 16;25(Supplement_2):S13–23. Available from: http://www.ncbi.nlm.nih.gov/pubmed/31095702

58. Ananthakrishnan AN. Epidemiology and risk factors for IBD. Nat Rev Gastroenterol Hepatol [Internet]. 2015;12(4):205–17. Available from: http://dx.doi.org/10.1038/nrgastro.2015.34

59. Wardle RA, Wardle AJ, Charadva C, Ghosh S, Moran GW. Literature review: Impacts of socioeconomic status on the risk of inflammatory bowel disease and its outcomes. Eur J Gastroenterol Hepatol. 2017;29(8):879–84.

60. Bernstein CN, Walld R, Marrie RA. Social determinants of outcomes in inflammatory bowel disease. Am J Gastroenterol [Internet]. 2020 Dec;115(12):2036–46. Available from: https://journals.lww.com/10.14309/ajg.0000000000000794

61. Michael MD, Bálint A, Lovász BD, Gulácsi L, Strbák B, Golovics PA, et al. Work disability and productivity loss in patients with inflammatory bowel diseases in Hungary in the era of biologics. Eur J Heal Econ [Internet]. 2014 May 16;15(S1):121–8. Available from: http://link.springer.com/10.1007/s10198-014-0603-7

62. Irvine EJ. Patients' fears and unmet needs in inflammatory bowel disease. Aliment Pharmacol Ther [Internet]. 2004;20(s4):54–9. Available from: http://doi.wiley.com/10.1111/j.1365-2036.2004.02053.x

63. Mikocka-Walus A, Knowles SR, Keefer L, Graff L. Controversies revisited: a systematic review of the comorbidity of depression and anxiety with inflammatory bowel diseases. Inflamm Bowel Dis. 2015;22(3):752–62.

64. Lönnfors S, Vermeire S, Greco M, Hommes D, Bell C, Avedano L. IBD and health-related quality of life — discovering the true impact. J Crohn's Colitis [Internet]. 2014 Oct;8(10):1281–6. Available from: https://academic.oup.com/ecco-jcc/article-lookup/doi/10.1016/j.crohns.2014.03.005

65. Huppertz-hauss G, Høivik ML, Langholz E, Odes S. Health-related quality of life in inflammatory bowel disease in a European-wide population-based cohort 10 years after diagnosis. 2015;21(2):337–44.

66. Benchimol EI, Bernstein CN, Bitton A, Murthy SK, Nguyen GC, Lee K, et al. The impact of inflammatory bowel disease in Canada 2018: a scientific report from the Canadian Gastro-Intestinal Epidemiology Consortium to Crohn's and Colitis Canada. J Can Assoc Gastroenterol [Internet]. 2019 Feb 2;2(Supplement_1):S1–5. Available from: https://academic.oup.com/jcag/article/2/Supplement_1/S1/5107699

67. Stein DJ, Shaker R. Inflammatory bowel disease: a point of care clinical guide [Internet]. Cham: Springer International Publishing; 2015. 244 p. Available from: https://link.springer.com/book/10.1007%2F978-3-319-14072-8

68. Fakhoury M, Al-Salami H, Negrulj R, Mooranian A, Al-Salami H. Inflammatory bowel disease: clinical aspects and treatments. J Inflamm Res [Internet]. 2014 Jun;7(1):113. Available from: http://www.dovepress.com/inflammatory-bowel-disease-clinical-aspects-and-treatments-peer-reviewed-article-JIR

69. Dorrington AM, Selinger CP, Parkes GC, Smith M, Pollok RC, Raine T. The historical role and contemporary use of corticosteroids in inflammatory bowel disease. J Crohn's Colitis [Internet]. 2020 Sep 16;14(9):1316–29. Available from: https://academic.oup.com/ecco-jcc/article/14/9/1316/5805149

70. Sica GS. Surgery for inflammatory bowel disease in the era of laparoscopy. World J Gastroenterol [Internet]. 2013;19(16):2445. Available from: http://www.wjgnet.com/1007-9327/full/v19/i16/2445.htm

71. Maggiori L, Brouquet A, Zerbib P, Lefevre JH, Denost Q, Germain A, et al. Penetrating Crohn disease is not associated with a higher risk of recurrence after surgery. Ann Surg [Internet]. 2019 Nov;270(5):827–34. Available from: https://journals.lww.com/10.1097/SLA.0000000000003531

72. Yanai H, Ben-Shachar S, Mlynarsky L, Godny L, Leshno M, Tulchinsky H, et al. The outcome of ulcerative colitis patients undergoing pouch surgery is determined by pre-surgical factors. Aliment Pharmacol Ther [Internet]. 2017 Sep;46(5):508–15. Available from: http://doi.wiley.com/10.1111/apt.14205

73. Ng SC, Shi HY, Hamidi N, Underwood FE, Tang W, Benchimol EI, et al. Worldwide incidence and prevalence of inflammatory bowel disease in the 21st century: a systematic review of population-based studies. Lancet [Internet]. 2017 Dec;390(10114):2769–78. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0140673617324480

74. Kaplan GG, Ng SC. Understanding and preventing the global increase of inflammatory bowel disease. Gastroenterology [Internet]. 2017 Jan;152(2):313-321.e2. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0016508516352672

75. Molodecky NA, Soon INGS, Rabi DM, Ghali WA, Ferris M, Chernoff G, et al. Increasing incidence and prevalence of the inflammatory bowel diseases with time, based on systematic review. YGAST. 2012;142(1):46-54.e42.

76. Benchimol EI, Walters TD, Kaufman M, Frost K, Fiedler K, Chinea Z, et al. Assessment of knowledge in adolescents with inflammatory bowel disease using a novel transition tool. Inflamm Bowel Dis. 2011;17(5):1131–7.

77. Coward S, Clement F, Benchimol EI, Bernstein CN, Avina-Zubieta JA, Bitton A, et al. Past and future burden of inflammatory bowel diseases based on modeling of population-based

data. Gastroenterology [Internet]. 2019 Apr;156(5):1345-1353.e4. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0016508519300216

78. Kaplan GG, Windsor JW. The four epidemiological stages in the global evolution of inflammatory bowel disease. Nat Rev Gastroenterol Hepatol [Internet]. 2020 Oct 8; Available from: http://www.nature.com/articles/s41575-020-00360-x

79. Green C, Elliott L, Beaudoin C, Bernstein CN. A population-based ecologic study of inflammatory bowel disease: searching for etiologic clues. Am J Epidemiol [Internet]. 2006 Oct 1;164(7):615–23. Available from: http://academic.oup.com/aje/article/164/7/615/62916/A-Populationbased-Ecologic-Study-of-Inflammatory

80. Iyngkaran G, Hunt J, Thambimuthu T, Bottolfsen M, Tse E, Sivanesan S, et al. P669 Inflammatory Bowel Disease is prevalent in Australia but rare in Indigenous Australians. In: European Crohn's and Colitis Organisation [Internet]. 2015. Available from: https://www.ecco-ibd.eu/publications/congress-abstract-s/abstracts-2015/item/p669-inflammatory-bowel-disease-is-prevalent-in-australia-but-rare-in-indigenous-australians.html

81. Leach ST, Day AS, Moore D, Lemberg DA. Low rate of inflammatory bowel disease in the Australian indigenous paediatric population. J Paediatr Child Health [Internet]. 2014 Apr;50(4):328–9. Available from: http://doi.wiley.com/10.1111/jpc.12535

82. King M, Smith A, Gracey M, King M, Smith A GM. Indigenous health part 2: the underlying causes of the health gap. Lancet [Internet]. 2009 Jul;374(9683):76–85. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0140673609608278

83. Jayanthi V, Probert CS, Pinder D, Wicks AC, Mayberry JF. Epidemiology of Crohn's disease in Indian migrants and the indigenous population in Leicestershire. Q J Med [Internet]. 1992 Feb;82(298):125–38. Available from: http://www.ncbi.nlm.nih.gov/pubmed/1620813

84. Misra R, Faiz O, Munkholm P, Burisch J, Arebi N. Epidemiology of inflammatory bowel disease in racial and ethnic migrant groups. World J Gastroenterol [Internet]. 2018 Jan 21;24(3):424–37. Available from: http://www.ncbi.nlm.nih.gov/pubmed/29391765

85. Rizzello F, Spisni E, Giovanardi E, Imbesi V, Salice M, Alvisi P, et al. Implications of the Westernized diet in the onset and progression of IBD. Nutrients [Internet]. 2019 May 8;11(5):1033. Available from: https://www.mdpi.com/2072-6643/11/5/1033

86. Peña-Sánchez J, Jennings D, Andkhoie M, Brass C, Bukassa-Kazadi G, Fowler S, et al. A4 A framework to study inflammatory bowel disease among indigenous peoples and preliminary results from Saskatchewan, Canada. J Can Assoc Gastroenterol [Internet]. 2020 Feb 26;3(Supplement_1):5–6. Available from: https://academic.oup.com/jcag/article/3/Supplement_1/5/5760412

87. Peña-Sánchez JN, Jennings D, Osei JA, Andkhoie M, Brass C, Bukassa Kazadi G, et al. P767 Prevalence and incidence rates of inflammatory bowel disease among First Nations: population-based evidence from Saskatchewan, Canada. J Crohn's Colitis [Internet]. 2020 Jan

15;14(Supplement_1):S608–9. Available from: https://academic.oup.com/ecco-jcc/article/14/Supplement_1/S608/5705036

88. Peña-Sánchez JN, Osei JA, Marques-Santos JD, Jennings D, Andkhoie M, Brass C, et al. Increasing prevalence and stable incidence rates of inflammatory bowel disease among First Nations: Population-based evidence from a Western Canadian province. Inflamm Bowel Dis. Forthcoming 2021.

89. Government of Saskatchewan. Saskatchewan Aboriginal Peoples [Internet]. 2017. Available from: http://publications.gov.sk.ca/documents/15/104388-2016 Census Aboriginal.pdf

90. Statistics Canada. Census Profile, 2016 Census: Saskatchewan [Province] and Canada [Country] [Internet]. 2019. Available from: https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/details/page.cfm?Lang=E&Geo1=PR&Code1=47&Geo2=PR&Code2=01&Data=Count&SearchText=47&SearchType=Begins&SearchPR=01&B1=All&Custom=&TABID=3

91. Kaplan GG, Bernstein CN, Coward S, Bitton A, Murthy SK, Nguyen GC, et al. The impact of inflammatory bowel disease in Canada 2018: epidemiology. J Can Assoc Gastroenterol [Internet]. 2019 Feb 2;2(Supplement_1):S6–16. Available from: https://academic.oup.com/jcag/article/2/Supplement_1/S6/5145703

92. Statistics Canada. Focus on Geography Series, 2016 Census, Aboriginal Peoples, province of Saskatchewan [Internet]. 2016. Available from: https://www12.statcan.gc.ca/census-recensement/2016/as-sa/fogs-spg/Facts-PR-Eng.cfm?TOPIC=9&LANG=Eng&GK=PR&GC=47

93. Benchimol EI, Kuenzig ME, Bernstein CN, Nguyen GC, Guttmann A, Jones JL, et al. Rural and urban disparities in the care of Canadian patients with inflammatory bowel disease: a population-based study. Clin Epidemiol [Internet]. 2018 Nov;Volume 10:1613–26. Available from: https://www.dovepress.com/rural-and-urban-disparities-in-the-care-of-canadian-patients-with-infl-peer-reviewed-article-CLEP

94. Tae CH, Jung S-AA, Moon HS, Seo J-AA, Song HK, Moon CM, et al. Importance of patients' knowledge of their prescribed medication in improving treatment adherence in inflammatory bowel disease. J Clin Gastroenterol [Internet]. 2016 Feb;50(2):157–62. Available from: http://content.wkhealth.com/linkback/openurl?sid=WKPTLP:landingpage&an=00004836-201602000-00013

95. Higgins PDR, Rubin DT, Kaulback K, Schoenfield PS, Kane S V. Systematic review: impact of non-adherence to 5-aminosalicylic acid products on the frequency and cost of ulcerative colitis flares. Aliment Pharmacol Ther. 2009;29(3):247–57.

96. Santos JDM, Brass C, Sanderson R, Pena-Sanchez J-N. Storytelling: amplifying the voices of Indigenous people in the search for IBD care [video file]. 2020 Mar 4 [cited 2021 Mar 13]. [Internet]. Available from: https://www.youtube.com/watch?v=J3CvliwMZ8Y

97. Devlen J, Beusterien K, Yen L, Ahmed A, Cheifetz AS, Moss AC. The burden of inflammatory bowel disease: A patient-reported qualitative analysis and development of a conceptual model. Inflamm Bowel Dis. 2014;20(3):545–52.

98. Osei JA, Peña-Sánchez JN, Fowler SA, Muhajarine N, Kaplan G, Lix LM. P771 Increasing prevalence and direct health care cost of inflammatory bowel disease: A population-based evidence from a western Canadian province. J Crohn's Colitis [Internet]. 2020 Jan 15;14(Supplement_1):S611–2. Available from: https://academic.oup.com/ecco-jcc/article/14/Supplement_1/S611/5705073

99. Hinds A, Lix LM, Smith M, Quan H, Sanmartin C. Quality of administrative health databases in Canada: A scoping review. Can J Public Heal [Internet]. 2016 Jan 1;107(1):e56–61. Available from: http://link.springer.com/10.17269/cjph.107.5244

100. Roos LL, Gupta S, Soodeen R-A, Jebamani L. Data quality in an information-rich environment: Canada as an example. Can J Aging [Internet]. 2005;24 Suppl 1:153–70. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16080132

101. Melesse DY, Lix LM, Nugent Z, Targownik LE, Singh H, Blanchard JF, et al. Estimates of Disease Course in Inflammatory Bowel Disease Using Administrative Data: A Population-level Study. J Crohn's Colitis [Internet]. 2016 Nov 4;jjw201. Available from: https://academic.oup.com/ecco-jcc/article-lookup/doi/10.1093/ecco-jcc/jjw201

102. Bernstein CN, Wajda A, Svenson LW, MacKenzie A, Koehoorn M, Jackson M, et al. The epidemiology of inflammatory bowel disease in Canada: a population-based study. Am J Gastroenterol [Internet]. 2006 Jul;101(7):1559–68. Available from: http://www.nature.com/doifinder/10.1111/j.1572-0241.2006.00603.x

103. Osei JA, Peña-Sánchez JN, Fowler SA, Muhajarine N, Kaplan GG, Lix LM. Population-based evidence from a Western Canadian province of the decreasing incidence rates and trends of inflammatory bowel disease among adults. J Can Assoc Gastroenterol [Internet]. 2020 Aug 21; Available from: https://academic.oup.com/jcag/advance-article/doi/10.1093/jcag/gwaa028/5895259

104. Peña-Sánchez JN, Lix LM, Teare GF, Li W, Fowler SA, Jones JL. Impact of an integrated model of care on outcomes of patients with inflammatory bowel diseases: evidence from a population-based study. J Crohn's Colitis [Internet]. 2017 Dec 4;11(12):1471–9. Available from: http://academic.oup.com/ecco-jcc/article/11/12/1471/4060514

105. Bernstein CN, Blanchard JF, Rawsthorne P, Wajda A. Epidemiology of Crohn's disease and ulcerative colitis in a central Canadian province: a population-based study. Am J Epidemiol [Internet]. 1999 May 15;149(10):916–24. Available from: https://academic.oup.com/aje/article-lookup/doi/10.1093/oxfordjournals.aje.a009735

106. Statistics Canada. Focus on Geography Series, 2016 Census [Internet]. 2016. Available from: https://www12.statcan.gc.ca/census-recensement/2016/as-sa/fogs-spg/Index-eng.cfm

107. Statistics Canada. Focus on Geography Series, 2016 Census: province of Manitoba [Internet]. 2016. Available from: https://www12.statcan.gc.ca/census-recensement/2016/as-sa/fogs-spg/Facts-PR-Eng.cfm?TOPIC=9&LANG=Eng&GK=PR&GC=46

108. Benchimol EI, Guttmann A, Mack DR, Nguyen GC, Marshall JK, Gregor JC, et al. Validation of international algorithms to identify adults with inflammatory bowel disease in health administrative data from Ontario, Canada. J Clin Epidemiol. 2014 Aug;67(8):887–96.

109. Government of Canada. What is Indian status? [Internet]. 2018. Available from: https://www.sac-isc.gc.ca/eng/1100100032463/1572459644986

110. Dyck R, Osgood N, Lin TH, Gao A, Stang MR. Epidemiology of diabetes mellitus among First Nations and non-First Nations adults. Can Med Assoc J [Internet]. 2010 Feb 23;182(3):249–56. Available from: http://www.cmaj.ca/cgi/doi/10.1503/cmaj.090846

111. Hernández-Ronquillo L, Thorpe L, Pahwa P, Téllez-Zenteno JF. Secular trends and population differences in the incidence of epilepsy. A population-based study from Saskatchewan, Canada. Seizure [Internet]. 2018 Aug;60:8–15. Available from: https://linkinghub.elsevier.com/retrieve/pii/S1059131118302036

112. Benchimol EI, Mack DR, Nguyen GC, Snapper SB, Li W, Mojaverian N, et al. Incidence, outcomes, and health services burden of very early onset inflammatory bowel disease. Gastroenterology [Internet]. 2014 Oct;147(4):803-813.e7. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0016508514008002

113. Ma C, Crespin M, Proulx M-C, DeSilva S, Hubbard J, Prusinkiewicz M, et al. Postoperative complications following colectomy for ulcerative colitis: a validation study. BMC Gastroenterol [Internet]. 2012 Dec 27;12(1):39. Available from: http://bmcgastroenterol.biomedcentral.com/articles/10.1186/1471-230X-12-39

114. Mortensen LQ, Andresen K, Burcharth J, Pommergaard H-C, Rosenberg J. Matching cases and controls using SAS® Software. Front Big Data [Internet]. 2019 May 8;2. Available from: https://www.frontiersin.org/article/10.3389/fdata.2019.00004/full

115. Benchimol EI, Kaplan GG, Otley AR, Nguyen GC, Underwood FE, Guttmann A, et al. Rural and urban residence during early life is associated with risk of inflammatory bowel disease: a population-based inception and birth cohort study. Am J Gastroenterol [Internet]. 2017 Sep;112(9):1412–22. Available from: http://journals.lww.com/00000434-201709000-00016

116. Needham DM, Scales DC, Laupacis A, Pronovost PJ. A systematic review of the Charlson comorbidity index using Canadian administrative databases: a perspective on risk adjustment in critical care research. J Crit Care. 2005 Mar;20(1):12–9.

117. Munkholm P, Langholz E, Davidsen M, Binder V. Frequency of glucocorticoid resistance and dependency in Crohn's disease. Gut [Internet]. 1994 Mar 1;35(3):360–2. Available from: https://gut.bmj.com/lookup/doi/10.1136/gut.35.3.360

118. Yao S, Lix LM, Li W, Shevchuk Y, Teare G, Champagne A, et al. Utilization of biologics in Saskatchewan. J Popul Ther Clin Pharmacol [Internet]. 2017;23(3). Available from: http://www.jptcp.com/abstract/utilization-of-biologics-in-saskatchewan-0.html

119. Rezaie A, Quan H, Fedorak RN, Panaccione R, Hilsden RJ. Development and validation of an administrative case definition for inflammatory bowel diseases. Can J Gastroenterol [Internet]. 2012 Oct;26(10):711–7. Available from: http://www.hindawi.com/journals/cjgh/2012/278495/

120. Lafond G, Haver CRA, McLeod V, Clarke S, Horsburgh B, McLeod KM. Characteristics and residence of First Nations patients and their use of health care services in Saskatchewan, Canada: informing First Nations and Métis health services. J Eval Clin Pract [Internet]. 2017 Apr 15;23(2):294–300. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/jep.12601

121. Schultz A, Dahl L, McGibbon E, Brownlie J, Cook C, Elbarouni B, et al. Differences in coronary artery disease complexity and associations with mortality and hospital admissions among First Nations and non–First Nations patients undergoing angiography: a comparative retrospective matched cohort study. C Open [Internet]. 2020 Oct 2;8(4):E685–94. Available from: http://cmajopen.ca/lookup/doi/10.9778/cmajo.20190171

122. Gao S. Chronic kidney disease among First Nations people in Alberta: prevalence, health services utilization and access to quality care. ProQuest Diss Theses [Internet]. 2006;113. Available from: https://search.proquest.com/docview/305361475?accountid=14660

123. Longobardi T, Bernstein CN. Utilization of health-care resources by patients with IBD in Manitoba: a profile of time since diagnosis. Am J Gastroenterol [Internet]. 2007 Aug;102(8):1683–91. Available from: http://www.nature.com/doifinder/10.1111/j.1572-0241.2007.01232.x

124. Nguyen GC, Bollegala N, Chong CA. Factors associated with readmissions and outcomes of patients hospitalized for inflammatory bowel disease. Clin Gastroenterol Hepatol [Internet]. 2014 Nov;12(11):1897-1904.e1. Available from: https://linkinghub.elsevier.com/retrieve/pii/S1542356514004480

125. King JA, Underwood FE, Panaccione N, Quan J, Windsor JW, Kotze PG, et al. Trends in hospitalisation rates for inflammatory bowel disease in western versus newly industrialised countries: a population-based study of countries in the Organisation for Economic Co-operation and Development. Lancet Gastroenterol Hepatol [Internet]. 2019 Apr;4(4):287–95. Available from: https://linkinghub.elsevier.com/retrieve/pii/S2468125319300135

126. Golovics PA, Lakatos L, Mandel MD, Lovasz BD, Vegh Z, Kurti Z, et al. Does hospitalization predict the disease course in ulcerative colitis? prevalence and predictors of hospitalization and re-hospitalization in ulcerative colitis in a population-based inception cohort. J Gastrointest Liver Dis [Internet]. 2015 Sep 1;24(3):287–92. Available from: https://www.jgld.ro/jgld/index.php/jgld/article/view/1184

127. Golovics PA, Lakatos L, Mandel MD, Lovasz BD, Vegh Z, Kurti Z, et al. Prevalence and predictors of hospitalization in Crohn's disease in a prospective population-based inception cohort from 2000-2012. World J Gastroenterol [Internet]. 2015 Jun 21;21(23):7272–80. Available from: http://www.wjgnet.com/1007-9327/full/v21/i23/7272.htm

128. Chu A, Han L, Roifman I, Lee DS, Green ME, Jacklin K, et al. Trends in cardiovascular care and event rates among First Nations and other people with diabetes in Ontario, Canada, 1996–2015. Can Med Assoc J [Internet]. 2019 Nov 25;191(47):E1291–8. Available from: http://www.cmaj.ca/lookup/doi/10.1503/cmaj.190899

129. Dahl L, Schultz A, McGibbon E, Brownlie J, Cook C, Elbarouni B, et al. Cardiovascular medication use and long-term outcomes of First Nations and Non–First Nations patients following diagnostic angiography: a retrospective cohort study. J Am Heart Assoc [Internet]. 2019 Aug 20;8(16). Available from: https://www.ahajournals.org/doi/10.1161/JAHA.119.012040

130. Wardman AED, Khan NA. Tobacco cessation pharmacotherapy use among First Nations persons residing within British Columbia. Nicotine Tob Res [Internet]. 2004 Aug 1;6(4):689–92. Available from: https://academic.oup.com/ntr/article-lookup/doi/10.1080/14622200410001734094

131. Hayward M, Kuzmina E, Dannenbaum D, Torrie J, Huynh J, Harris S. Room for improvement in diabetes care among First Nations in northern Quebec (Eeyou Istchee): reasonable management of glucose but poor management of complications. Int J Circumpolar Health [Internet]. 2012 Jan 31;71(1):18418. Available from: https://www.tandfonline.com/doi/full/10.3402/ijch.v71i0.18418

132. First Nations Information Governance Centre [FNIGC]. National report of the First Nations Regional Health Survey Phase 3: Volume Two [Internet]. Ottawa, ON; 2018. Available from: https://fnigc.ca/wp-content/uploads/2020/09/fnigc_rhs_phase_3_volume_two_en_final_screen.pdf

133. Lenti MV, Selinger CP. Medication non-adherence in adult patients affected by inflammatory bowel disease: a critical review and update of the determining factors, consequences and possible interventions. Expert Rev Gastroenterol Hepatol [Internet]. 2017 Jan 31;1–12. Available from: https://www.tandfonline.com/doi/full/10.1080/17474124.2017.1284587

134. Lakatos PL. Prevalence, predictors, and clinical consequences of medical adherence in IBD: how to improve it? World J Gastroenterol [Internet]. 2009;15(34):4234. Available from: http://www.wjgnet.com/1007-9327/full/v15/i34/4234.htm

135. Santos JDM, Peña-Sánchez JN, Fowler SA. Patients' perspectives on medication for inflammatory bowel disease: a mixed-method systematic review. Eur J Gastroenterol Hepatol [Internet]. 2020 Aug 7;Publish Ah. Available from: https://journals.lww.com/10.1097/MEG.0000000000001861

136. Crengle S, Luke JN, Lambert M, Smylie JK, Reid S, Harré-Hindmarsh J, et al. Effect of a health literacy intervention trial on knowledge about cardiovascular disease medications among

Indigenous peoples in Australia, Canada and New Zealand. BMJ Open [Internet]. 2018 Jan 24;8(1):e018569. Available from: https://bmjopen.bmj.com/lookup/doi/10.1136/bmjopen-2017-018569

137. Carlson T, Moewaka Barnes H, McCreanor T. Health literacy in action: Kaupapa Māori evaluation of a cardiovascular disease medications health literacy intervention. Altern An Int J Indig Peoples [Internet]. 2019 Jun 14;15(2):101–10. Available from: http://journals.sagepub.com/doi/10.1177/1177180119828050

138. Rumer KK, Dehghan MS, Sceats LA, Trickey AW, Morris AM, Kin C. Use of biological medications does not increase postoperative complications among patients with ulcerative colitis undergoing colectomy: a retrospective cohort analysis of privately insured patients. Dis Colon Rectum [Internet]. 2020 Nov 6;63(11):1524–33. Available from: https://journals.lww.com/10.1097/DCR.0000000000001684

139. Jeuring SFG, Bours PHA, Zeegers MP, Ambergen TW, van den Heuvel TRA, Romberg-Camps MJL, et al. Disease outcome of ulcerative colitis in an era of changing treatment strategies: results from the Dutch Population-Based IBDSL cohort. J Crohn's Colitis [Internet]. 2015 Oct;9(10):837–45. Available from: https://academic.oup.com/ecco-jcc/article-lookup/doi/10.1093/ecco-jcc/jjv129

140. Targownik LE, Kaplan GG, Witt J, Bernstein CN, Singh H, Tennakoon A, et al. Longitudinal trends in the direct costs and health care utilization ascribable to inflammatory bowel disease in the biologic era. Am J Gastroenterol [Internet]. 2020 Jan;115(1):128–37. Available from: http://journals.lww.com/10.14309/ajg.0000000000000503

141. Olivera P, Spinelli A, Gower-Rousseau C, Danese S, Peyrin-Biroulet L. Surgical rates in the era of biological therapy. Curr Opin Gastroenterol [Internet]. 2017 Jul;33(4):246–53. Available from: https://journals.lww.com/00001574-201707000-00007

142. Lindström C, Rosvall M, Lindström M. Socioeconomic status, social capital and self-reported unmet health care needs: a population-based study. Scand J Public Health [Internet]. 2017 May 8;45(3):212–21. Available from: http://journals.sagepub.com/doi/10.1177/1403494816689345

143. Soon IS, Molodecky NA, Rabi DM, Ghali WA, Barkema HW, Kaplan GG. The relationship between urban environment and the inflammatory bowel diseases: a systematic review and meta-analysis. BMC Gastroenterol [Internet]. 2012 Dec 24;12(1):51. Available from: http://bmcgastroenterol.biomedcentral.com/articles/10.1186/1471-230X-12-51

144. Place J. The health of Aboriginal People residing in urban areas. Natl Collab Cent Aborig Heal [Internet]. 2012;7–10. Available from: http://www.nccah-ccnsa.ca/Publications/Lists/Publications/Attachments/53/Urban_Aboriginal_Health_EN_web.pdf

145. Reading J, Loppie C, O'Neil J. Indigenous health systems governance. Int J Heal Gov [Internet]. 2016 Dec 5;21(4):222–8. Available from: https://www.emerald.com/insight/content/doi/10.1108/IJHG-08-2016-0044/full/html

146. Barlow K, Loppie C, Jackson R, Akan M, Maclean L, Reimer G. Culturally competent service provision issues experienced by Aboriginal People living with HIV/AIDS. Pimatisiwin [Internet]. 2008;6(2):155–80. Available from: http://www.ncbi.nlm.nih.gov/pubmed/20835301

147. Hammond C, Thomas R, Gifford W, Poudrier J, Hamilton R, Brooks C, et al. Cycles of silence: First Nations women overcoming social and historical barriers in supportive cancer care. Psychooncology [Internet]. 2017 Feb;26(2):191–8. Available from: http://doi.wiley.com/10.1002/pon.4335

148. Kitching GT, Firestone M, Schei B, Wolfe S, Bourgeois C, O'Campo P, et al. Unmet health needs and discrimination by healthcare providers among an Indigenous population in Toronto, Canada. Can J Public Heal [Internet]. 2020 Feb 21;111(1):40–9. Available from: http://link.springer.com/10.17269/s41997-019-00242-z

149. Soto-Perez-de-Celis E, Chavarri-Guerra Y, Ramos-Lopez WA, Alcalde-Castro J, Covarrubias-Gomez A, Navarro-Lara Á, et al. Patient navigation to improve early access to supportive care for patients with advanced cancer in resource-limited settings: a randomized controlled trial. Oncologist. 2021;26(2):157–64.

150. Natale-Pereira A, Enard KR, Nevarez L, Jones LA. The role of patient navigators in eliminating health disparities. Cancer [Internet]. 2011 Aug 1;117(S15):3541–50. Available from: http://doi.wiley.com/10.1002/cncr.26264

151. Manuel DG, Rosella LC, Stukel TA. Importance of accurately identifying disease in studies using electronic health records. BMJ [Internet]. 2010 Aug 19;341(aug19 1):c4226–c4226. Available from: https://www.bmj.com/lookup/doi/10.1136/bmj.c4226

152. Smylie J, Firestone M. Back to the basics: Identifying and addressing underlying challenges in achieving high quality and relevant health statistics for Indigenous populations in Canada. Stat J IAOS [Internet]. 2015;31(1):67–87. Available from: https://www.medra.org/servlet/aliasResolver?alias=iospress&doi=10.3233/SJI-150864

153. Austin PC. An introduction to propensity score methods for reducing the effects of confounding in observational studies. Multivariate Behav Res [Internet]. 2011 May 31;46(3):399–424. Available from: http://www.tandfonline.com/doi/abs/10.1080/00273171.2011.568786

154. Smylie J, Olding M, Ziegler C. Sharing what we know about living a good life: Indigenous approaches to knowledge translation. J Can Heal Libr Assoc / J l'Association des bibliothèques la santé du Canada. 2014 Apr;35(1):16.

155. Roy S, Campbell B. An Indigenous epistemological approach to promote health through effective knowledge translation. J Indig Res. 2015;4(Iss. 2015):1–10.

156. Bartlett C, Marshall M, Marshall A. Two-Eyed Seeing and other lessons learned within a co-learning journey of bringing together indigenous and mainstream knowledges and ways of knowing. J Environ Stud Sci. 2012 Nov;2(4):331–40.

157. Abonyi S, Jeffery B. Developing a community health tool kit with Indigenous health organizations. In: Moving population and public health knowledge into action [Internet]. Ottawa (ON): Canadian Institutes of Health Research; 2006. Available from: https://secure.cihi.ca/free_products/IPPHPDF_Feb28_06_e.pdf

158. Morton Ninomiya ME, Atkinson D, Brascoupé S, Firestone M, Robinson N, Reading J, et al. Effective knowledge translation approaches and practices in Indigenous health research: a systematic review protocol. Syst Rev. 2017 Dec;6(1):34.

159. Crohn's and Colitis Canada. 2018 impact of inflammatory bowel disease in Canada [Internet]. Toronto; 2018. Available from: http://crohnsandcolitis.ca/News-Events/News-Releases/The-2018-Impact-of-Inflammatory-Bowel-Disease-in-C

APPENDIX A

Table A.1 - Codes for colonoscopy procedures

CODES	CANADIAN CLASSIFICATION OF DIAGNOSTIC – CCP
01.21	Colonoscopy through existing artificial stoma
01.22	Other nonoperative colonoscopy
01.23	Proctosigmoidoscopy through existing artificial stoma
01.24	Other nonoperative proctosigmoidoscopy
01.25	Anoscopy
57.93	Brush biopsy of large intestine
57.94	Other biopsy of large intestine
57.95	Biopsy of intestine, unquantified
CODES	**CANADIAN CLASSIFICATION OF HEALTH INTERVENTIONS – CCI**
2.NM.70	Colonoscopy (for inspection) /Sigmoidoscopy (for inspection)
2.NM.71	Colonoscopy with biopsy
2.NQ.70	Rectoscopy (for inspection)
2.NQ.71	Biopsy of rectum

APPENDIX B

Medications for IBD

This code list was developed by other researchers and used in previous population-based studies in Saskatchewan. Sources:

- Peña-Sánchez JN, Lix LM, Teare GF, Li W, Fowler SA, Jones JL. Impact of an integrated model of care on outcomes of patients with inflammatory bowel diseases: Evidence from a population-based study. Journal of Crohn's and Colitis. 2017;11(12): 1471-9. http://dx.doi.org/10.1093/ecco-jcc/jjx106
- Targownik LE, Bernstein CN, Singh H, Lix L, Tennakoon A, Leung S, Aviña-Zubieta A, Coward S, Jones J, Kaplan GG, Murthy SK, Nguyen GC, Peña-Sánchez JN. Combined Biologic and Immunomodulatory Therapy is Superior to Monotherapy for Decreasing the Risk of Inflammatory Bowel Disease-Related Complication. Journal of Crohn's and Colitis. 2020 (February); jjaa050. https://doi.org/10.1093/ecco-jcc/jjaa050

Table B.1 - Medication codes for IBD

MED_GROUP	DIN	DRUG_NAME	GENERIC_NAME
BIOLOGICS	00950898	REMICADE	INFLIXIMAB
BIOLOGICS	00950899	REMICADE (EDS)	INFLIXIMAB
BIOLOGICS	02244016	REMICADE (EDS)	INFLIXIMAB
BIOLOGICS	02258595	HUMIRA (EDS)	ADALIMUMAB
BIOLOGICS	02324776	SIMPONI (EDS)	GOLIMUMAB
BIOLOGICS	02324784	SIMPONI (EDS)	GOLIMUMAB
BIOLOGICS	02331675	CIMZIA (EDS)	CERTOLIZUMAB PEGOL
BIOLOGICS	02413175	SIMPONI	GOLIMUMAB
BIOLOGICS	02413183	SIMPONI	GOLIMUMAB
BIOLOGICS	02417472	SIMPONI I.V.	GOLIMUMAB
BIOLOGICS	02419475	INFLECTRA	INFLIXIMAB
BIOLOGICS	02419483	REMSIMA	INFLIXIMAB
BIOLOGICS	02436841	ENTYVIO	VEDOLIZUMAB
BIOLOGICS	97799756	HUMIRA PF SYRINGE (EDS)	ADALIMUMAB
BIOLOGICS	97799757	HUMIRA PEN (EDS)	ADALIMUMAB
BIOLOGICS	02320673	STELARA	USTEKINUMAB
BIOLOGICS	02320681	STELARA	USTEKINUMAB
BIOLOGICS	02459671	STELARA	USTEKINUMAB
IMMUNUMODULATORS	00004596	IMURAN	AZATHIOPRINE
IMMUNUMODULATORS	00004723	PURINETHOL (EDS)	MERCAPTOPURINE
IMMUNUMODULATORS	00014915	METHOTREXATE	METHOTREXATE
IMMUNUMODULATORS	00321397	METHOTREXATE	METHOTREXATE
IMMUNUMODULATORS	00321400	METHOTREXATE	METHOTREXATE
IMMUNUMODULATORS	00519286	METHOTREXATE	METHOTREXATE
IMMUNUMODULATORS	00593249	SANDIMMUNE (EDS)	CYCLOSPORINE (T)
IMMUNUMODULATORS	00614327	METHOTREXATE	METHOTREXATE
IMMUNUMODULATORS	00614335	METHOTREXATE	METHOTREXATE
IMMUNUMODULATORS	00614343	METHOTREXATE	METHOTREXATE
IMMUNUMODULATORS	00632619	METHOTREXATE	METHOTREXATE
IMMUNUMODULATORS	00755591	SANDIMMUNE (EDS)	CYCLOSPORINE (TRANSPLANT)
IMMUNUMODULATORS	00755605	SANDIMMUNE (EDS)	CYCLOSPORINE (T)
IMMUNUMODULATORS	00950513	SANDIMMUNE (EDS)	CYCLOSPORINE (P)
IMMUNUMODULATORS	00950521	SANDIMMUNE (EDS)	CYCLOSPORINE (P)
IMMUNUMODULATORS	00950548	SANDIMMUNE (EDS)	CYCLOSPORINE (P)
IMMUNUMODULATORS	00950556	SANDIMMUNE (EDS)	CYCLOSPORINE (P)
IMMUNUMODULATORS	00950792	NEORAL (EDS)	CYCLOSPORINE
IMMUNUMODULATORS	00950793	NEORAL (EDS)	CYCLOSPORINE
IMMUNUMODULATORS	00950807	NEORAL (EDS)	CYCLOSPORINE

IMMUNUMODULATORS	00950815	NEORAL (EDS)	CYCLOSPORINE
IMMUNUMODULATORS	00950823	NEORAL (EDS)	CYCLOSPORINE
IMMUNUMODULATORS	00950887	CELLCEPT (EDS)	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	00950888	CELLCEPT (EDS)	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	00950897	MYCOPHENOLATE	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	00950937	CELLCEPT	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	00951163	APO-MYCOPHENOLATE (EDS)	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	00951164	APO-MYCOPHENOLATE (EDS)	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	00951165	MYLAN-MYCOPHENOLATE (EDS)	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	00951166	MYLAN-MYCOPHENOLATE (EDS)	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	00951167	NOVO-MYCOPHENOLATE (EDS)	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	00951168	NOVO-MYCOPHENOLATE (EDS)	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	00951169	SANDOZ MYCOPHENOLATE(EDS)	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	00951170	SANDOZ MYCOPHENOLATE(EDS)	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	00951171	CO MYCOPHENOLATE (EDS)	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	00951172	MYCOPHENOLATE MOFETIL(EDS	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	00951174	MYCOPHENOLATE MOFETIL(EDS	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	00951175	JAMP-MYCOPHENOLATE (EDS)	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	00951176	JAMP-MYCOPHENOLATE (EDS)	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	01907182	SANDIMMUNE (EDS)	CYCLOSPORINE (T)
IMMUNUMODULATORS	01907204	METHOTREXATE	METHOTREXATE
IMMUNUMODULATORS	02099705	METHOTREXATE	METHOTREXATE
IMMUNUMODULATORS	02150662	NEORAL (EDS)	CYCLOSPORINE (TRANSPLANT)
IMMUNUMODULATORS	02150670	NEORAL (EDS)	CYCLOSPORINE (TRANSPLANT)
IMMUNUMODULATORS	02150689	NEORAL (EDS)	CYCLOSPORINE (TRANSPLANT)
IMMUNUMODULATORS	02150697	NEORAL (EDS)	CYCLOSPORINE (TRANSPLANT)
IMMUNUMODULATORS	02161168	METHOTREXATE SODIUM INJEC	METHOTREXATE (METHOTREXATE SODIUM)
IMMUNUMODULATORS	02170663	METHOTREXATE	METHOTREXATE
IMMUNUMODULATORS	02170671	METHOTREXATE	METHOTREXATE
IMMUNUMODULATORS	02170698	METHOTREXATE	METHOTREXATE
IMMUNUMODULATORS	02182750	METHOTREXATE	METHOTREXATE
IMMUNUMODULATORS	02182777	METHOTREXATE	METHOTREXATE
IMMUNUMODULATORS	02182947	METHOTREXATE	METHOTREXATE
IMMUNUMODULATORS	02182955	METHOTREXATE	METHOTREXATE
IMMUNUMODULATORS	02182963	APO-METHOTREXATE	METHOTREXATE
IMMUNUMODULATORS	02182971	METHOTREXATE INJECTION, U	METHOTREXATE (METHOTREXATE SODIUM)
IMMUNUMODULATORS	02192748	CELLCEPT (EDS)	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	02231491	MYLAN-AZATHIOPRINE	AZATHIOPRINE
IMMUNUMODULATORS	02236799	RATIO-AZATHIOPRINE	AZATHIOPRINE
IMMUNUMODULATORS	02236819	TEVA-AZATHIOPRINE	AZATHIOPRINE
IMMUNUMODULATORS	02237484	CELLCEPT (EDS)	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	02237671	NEORAL (EDS)	CYCLOSPORINE (TRANSPLANT)
IMMUNUMODULATORS	02240347	CELLCEPT IV	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	02242145	CELLCEPT (EDS)	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	02242907	APO-AZATHIOPRINE	AZATHIOPRINE
IMMUNUMODULATORS	02243371	AZATHIOPRINE-50	AZATHIOPRINE
IMMUNUMODULATORS	02244324	APO-CYCLOSPORINE (EDS)	CYCLOSPORINE
IMMUNUMODULATORS	02244798	RATIO-METHOTREXATE	METHOTREXATE
IMMUNUMODULATORS	02244895	IMURAN	AZATHIOPRINE (AZATHIOPRINE SODIUM)
IMMUNUMODULATORS	02248843	NU-AZATHIOPRINE	AZATHIOPRINE
IMMUNUMODULATORS	02264560	MYFORTIC (EDS)	MYCOPHENOLATE SODIUM

IMMUNUMODULATORS	02264579	MYFORTIC (EDS)	MYCOPHENOLATE SODIUM
IMMUNUMODULATORS	02304767	METOJECT	METHOTREXATE
IMMUNUMODULATORS	02313855	SANDOZ MYCOPHENOLATE(EDS)	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	02320029	METOJECT	METHOTREXATE
IMMUNUMODULATORS	02320037	METOJECT	METHOTREXATE
IMMUNUMODULATORS	02320045	METOJECT	METHOTREXATE
IMMUNUMODULATORS	02320053	METOJECT	METHOTREXATE
IMMUNUMODULATORS	02320630	SANDOZ MYCOPHENOLATE(EDS)	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	02327236	METHOTREXATE INJECTION, B	METHOTREXATE
IMMUNUMODULATORS	02343002	AZATHIOPRINE	AZATHIOPRINE
IMMUNUMODULATORS	02348675	NOVO-MYCOPHENOLATE (EDS)	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	02352559	APO-MYCOPHENOLATE (EDS)	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	02352567	APO-MYCOPHENOLATE (EDS)	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	02364883	NOVO-MYCOPHENOLATE (EDS)	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	02370549	MYLAN-MYCOPHENOLATE (EDS)	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	02371154	MYLAN-MYCOPHENOLATE (EDS)	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	02372738	APO-MYCOPHENOLIC ACID(EDS	MYCOPHENOLATE SODIUM
IMMUNUMODULATORS	02372746	APO-MYCOPHENOLIC ACID(EDS	MYCOPHENOLATE SODIUM
IMMUNUMODULATORS	02378574	MYCOPHENOLATE MOFETIL(EDS	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	02379996	CO MYCOPHENOLATE (EDS)	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	02380382	JAMP-MYCOPHENOLATE (EDS)	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	02383780	MYCOPHENOLATE MOFETIL(EDS	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	02386399	JAMP-MYCOPHENOLATE (EDS)	MYCOPHENOLATE MOFETIL
IMMUNUMODULATORS	02398427	METHOTREXATE INJECTION	METHOTREXATE
IMMUNUMODULATORS	02415275	MERCAPTOPURINE TABLETS(ED	MERCAPTOPURINE
IMMUNUMODULATORS	02417626	METHOTREXATE INJECTION, U	METHOTREXATE (METHOTREXATE SODIUM)
IMMUNUMODULATORS	02419173	JAMP-METHOTREXATE	METHOTREXATE (METHOTREXATE SODIUM)
IMMUNUMODULATORS	02422166	METHOTREXATE INJECTION, B	METHOTREXATE
IMMUNUMODULATORS	02422174	METHOTREXATE INJECTION, B	METHOTREXATE
IMMUNUMODULATORS	02422182	METHOTREXATE INJECTION, B	METHOTREXATE
IMMUNUMODULATORS	02422190	METHOTREXATE INJECTION, B	METHOTREXATE
IMMUNUMODULATORS	02422204	METHOTREXATE INJECTION, B	METHOTREXATE
5-ASA	00263869	S.A.S. 500	SULFASALAZINE (SALICYLAZOSULFAPYRIDINE)
5-ASA	00410640	APO SULFASALAZINE TAB 500	SULFASALAZINE
5-ASA	00445126	S.A.S. 500	SULFASALAZINE (SALICYLAZOSULFAPYRIDINE)
5-ASA	00598461	PMS-SULFASALAZINE	SULFASALAZINE (SALICYLAZOSULFAPYRIDINE)
5-ASA	00598488	PMS-SULFASALAZINE	SULFASALAZINE (SALICYLAZOSULFAPYRIDINE)
5-ASA	00613568	SAS ENEMA 3GM/100ML	SULFASALAZINE
5-ASA	00685925	RATIO-SULFASALAZINE	SULFASALAZINE (SALICYLAZOSULFAPYRIDINE)
5-ASA	00685933	RATIO-SULFASALAZINE	SULFASALAZINE (SALICYLAZOSULFAPYRIDINE)
5-ASA	01914030	MESASAL	5-AMINOSALICYLIC ACID (MESALAMINE)

5-ASA	01940384	PENTASA	5-AMINOSALICYLIC ACID (MESALAMINE)
5-ASA	01997580	ASACOL	5-AMINOSALICYLIC ACID (MESALAMINE)
5-ASA	02004658	SALAZOPYRIN	SULFASALAZINE (SALICYLAZOSULFAPYRIDINE)
5-ASA	02004682	SALAZOPYRIN	SULFASALAZINE (SALICYLAZOSULFAPYRIDINE)
5-ASA	02004690	SALAZOPYRIN	SULFASALAZINE (SALICYLAZOSULFAPYRIDINE)
5-ASA	02006413	DIPENTUM	OLSALAZINE SODIUM
5-ASA	02063808	DIPENTUM	OLSALAZINE SODIUM
5-ASA	02064472	SALAZOPYRIN	SULFASALAZINE (SALICYLAZOSULFAPYRIDINE)
5-ASA	02064480	SALAZOPYRIN	SULFASALAZINE (SALICYLAZOSULFAPYRIDINE)
5-ASA	02064499	SALAZOPYRIN	SULFASALAZINE (SALICYLAZOSULFAPYRIDINE)
5-ASA	02099675	PENTASA	5-AMINOSALICYLIC ACID (MESALAMINE)
5-ASA	02099683	PENTASA	5-AMINOSALICYLIC ACID (MESALAMINE)
5-ASA	02112752	SALOFALK	5-AMINOSALICYLIC ACID (MESALAMINE)
5-ASA	02112760	SALOFALK	5-AMINOSALICYLIC ACID (MESALAMINE)
5-ASA	02112787	SALOFALK	5-AMINOSALICYLIC ACID (MESALAMINE)
5-ASA	02112795	SALOFALK RETENTION ENEMA	5-AMINOSALICYLIC ACID (MESALAMINE)
5-ASA	02112809	SALOFALK RETENTION ENEMA	5-AMINOSALICYLIC ACID (MESALAMINE)
5-ASA	02153521	PENTASA	5-AMINOSALICYLIC ACID (MESALAMINE)
5-ASA	02153556	PENTASA	5-AMINOSALICYLIC ACID (MESALAMINE)
5-ASA	02153564	PENTASA	5-AMINOSALICYLIC ACID (MESALAMINE)
5-ASA	02171929	NOVO-5-ASA	5-AMINOSALICYLIC ACID (MESALAMINE)
5-ASA	02242146	SALOFALK	5-AMINOSALICYLIC ACID (MESALAMINE)
5-ASA	02267217	ASACOL 800	5-AMINOSALICYLIC ACID (MESALAMINE)
5-ASA	02297558	MEZAVANT	5-AMINOSALICYLIC ACID (MESALAMINE)
5-ASA	02351463	5-AMINOSALICYLIC ACID	5-AMINOSALICYLIC ACID (MESALAMINE)
5-ASA	02399466	PENTASA	5-AMINOSALICYLIC ACID (MESALAMINE)

APPENDIX C

IBD hospitalizations

Classification of IBD-specific and related hospitalizations. Note that description of IBD-related diagnoses in the text refer to all diagnostic codes classified as IBD-specific. This code list was developed by Benchimol et al., 2018. Source: Benchimol EI, Kuenzig ME, Bernstein CN, Nguyen GC, Guttmann A, Jones JL, et al. Rural and urban disparities in the care of Canadian patients with inflammatory bowel disease: a population-based study. Clin Epidemiol [Internet]. 2018 Nov; 10:1613–26. https://doi.org/10.2147/CLEP.S178056

Table C.1 - IBD hospitalization codes

CONDITION	ICD-9	ICD-10
IBD-SPECIFIC:		
Crohn's	555.x	K50.x
UC	556.x	K51.x
IBD SIGNS/SYMPTOMS:		
Anorexia	783.0	R63.0
Abnormal Weight Gain	783.1	R63.5
Abnormal Weight Loss	783.2	R63.4
Underweight	783.22	R62.8
Failure to thrive, child	783.4	R62.8 R62.9
Failure to thrive, adult	783.7	R62.8 R62.9
Symptoms involving digestive system, including: (787.0) Nausea and vomiting (787.01) Nausea w/vomiting (787.02) Nausea, alone (787.03) Vomiting, alone (787.1) Heartburn (787.2) Dysphagia (787.3) Gas/bloating (787.6) Encopresis, fecal incontinence (787.9) Other symptoms involving digestive system (787.91) Diarrhea, NOS	787.x	R11.x R12.x R13.x R14.x R15.x R19.x
Abdominal pain	789.0	R10.x
Dyspepsia	536.8	K30.x
Cachexia	799.4	R64.x
Esophagitis	530.1	K20.x K21.x
Esophagial ulcer	530.2	K22.1
Gastric ulcer	531.x	K25.x

Duodenal ulcer	532.x	K26.x
Peptic ulcer	533.x	K27.x
GJ ulcer	534.x	K28.x
Gastritis/duodenitis	535.x	K29.x
Intestinal obstruction	560.8 560.9	K31.5 K56.6
Rectal/anal haemorrhage	569.3	K62.5
Other disorder of rectum/anus, including: (569.41) Ulcer	569.4	K62.6 K62.8
(569.42) Pain (569.43) Sphincter tear (healed) (569.44) Dysplasia (569.45) Other specified, including proctitis, inflammation		
Abscess of the intestine	569.5	K63.0
Other disorders of intestine, including: (569.81) Fistula (excl rectum) (569.82) Ulcer of intestine (569.83) Perforation (569.84) Angiodysplasia, no haemorrhage (569.85) Angiodysplasia, with haemorrhage (569.86) Dieulafoy (569.89) Other, including: - Enteroptosis - Granuloma of intestine - Prolapse of intestine - Pericolitis - Perisigmoiditis - Visceroptosis	569.8	K63.2 K63.3 K63.1 K55.2 K63.8
Malabsorption	262.x 263.0 263.1 263.2 263.9 579.8 579.9	E43.x E44.0 E44.1 E45.x E46.x K90.8 K90.9
EXTRA-INTESTINAL MANIFESTATIONS:		
Anal Fistula	565.1	K60.3

Anal Abscess	566.x	K61.0 K61.1 K61.2 K61.3 K61.4
Ureteral Fistula	593.8	N28.81 N28.88
Urethral Fistula	599.1	N36.0
Fistula of stomach & duodenum	537.4	K31.6
Vesical fistula	596.2	N32.2
Fistula involving female GU	619.x	N82.x
Haemorrhoids, including: (455.9) Anal skin tags	455.x	I84.x
Rheumatoid arthritis	713.1	M052 M053 M058 M059 M060 M061 M062 M064 M068 M069 M070 M080 M081 M082 M083 M084 M088 M089 M090 M091 M092 M098 M130 M131 M139
Arthropathy associated with GI cause	713.3	M074 M075 M076
Inflammatory spondylopathies, including: (720.0) Ankylosing spondylitis (720.1) Spinal enthesopathy	720.x	M45.x M46.x

(720.2) Sacroiliitis (720.8) Other inflammatory (720.9) Other unspecified inflammatory		
Scleritis & episcleritis	379.x	H15.x
Unspecified iridocyclitis (uveitis NOS)	364.3	H20.9
Chorioretinitis, unspecified (unveitis, posterior NOS)	363.2	H30.9
Acute and subacute iridocyclitis	364.0	H20.0
Erythema nodosum	695.2	L52
Pyoderma	686.0	L08.0
Pyogenic granuloma of the skin and soft tissue	686.1	L98.0
Oral aphthae	528.2	K12.0
Short stature	783.4	E34.3
Osteoporosis	733.0 733.1	M80.x M81.x M82.x M83.x
Osteomyelitis	730.0 730.1 730.2	M86.x
Acute glomerulonephritis	580.x	N00.x
Nephrolithiasis	592.x	N20.x
Primary Sclerosing Cholangitis	576.1	K83.0
Venous embolism/thrombosis	453.x	I82.x

APPENDIX D

IBD-related and specific surgeries

This code list was developed by Benchimol et al., 2018. This code list was developed by Benchimol et al., 2018.

Source: Benchimol EI, Kuenzig ME, Bernstein CN, Nguyen GC, Guttmann A, Jones JL, et al. Rural and urban disparities in the care of Canadian patients with inflammatory bowel disease: a population-based study. Clin Epidemiol [Internet]. 2018 Nov;Volume 10:1613–26. https://doi.org/10.2147/CLEP.S178056

Table D.1 - CCI Intervention Coding by Surgical Indication

RESECTIVE SURGERY	
1.NK.87 1.NK.87.BA 1.NK.87.DA 1.NK.87.LA 1.NK.87.DN 1.NK.87.RE 1.NK.87.DP 1.NK.87.RF 1.NK.87.DX 1.NK.87.TF 1.NK.87.DY 1.NK.87.TG	**Excision partial, small intestine** Simple excision, per orifice Simple excision, laparoscopic Simple excision, open Enterocolostomy anastomosis, laparoscopic Enterocolostomy anastomosis, open Enteroenterostomy anastomosis, laparoscopic Enteroenterostomy anastomosis, open Stoma formation with distal closure, laparoscopic Stoma formation with distal closure, open Stoma formation with mucous fistula, laparoscopic Stoma formation with mucous fistula,, open
1.NM.87 1.NM.87.BA 1.NM.87.DA 1.NM.87.LA 1.NM.87.DF 1.NM.87.RN 1.NM.87.DE 1.NM.87.RD 1.NM.87.DN 1.NM.87.RE 1.NM.87.DX 1.NM.87.TF 1.NM.87.DY 1.NM.87.TG	**Excision partial, large intestine** Simple excision, per orifice Simple excision, laparoscopic Simple excision, open Colocolostomy anastomosis, laparoscopic Colocolostomy anastomosis, open Colorectal anastomosis, laparoscopic Colorectal anastomosis, open Enterocolostomy anastomosis, laparoscopic Enterocolostomy anastomosis, open Stoma formation and distal closure, laparoscopic Stoma formation and distal closure, open Stoma formation with mucous fistula, laparoscopic Stoma formation with mucous fistula, open

1.NM.89 1.NM.89.DF 1.NM.89.RN 1.NM.89.DX 1.NM.89.TF	**Excision total, large intestine** Ileorectal anastomosis, laparoscopic Ileorectal anastomosis, open Stoma formation with distal closure, laparoscopic Stoma formation with distal closure, open
1.NM.91 1.NM.91.DF 1.NM.91.RN 1.NM.91.DE 1.NM.91.RD 1.NM.91.DN 1.NM.91.RE 1.NM.91.DX 1.NM.91.TF	**Excision radical, large intestine** (including en bloc resection) Colocolostomy anastomosis, laparoscopic Colocolostomy anastomosis, open Colorectal anastomosis, laparoscopic Colorectal anastomosis, open Enterocolostomy anastomosis, laparoscopic Enterocolostomy anastomosis, open Stoma formation with distal closure, laparoscopic Stoma formation with distal closure, open

Table D.2 - CCP Intervention Coding by Surgical Indication

RESECTION/COLECTOMY FOR CROHN'S	**COLECTOMY FOR ULCERATIVE COLITIS**
5741- multiple segmental resection of small intestine	
5742- Another partial resection of small intestine	
5743- Total removal of small intestine	
575- partial excision of large intestine	575- partial excision of large intestine
5751- multiple segmental resection of large intestine	5751- multiple segmental resection of large intestine
5753-right hemicolectomy	5753-right hemicolectomy
5755-left hemicolectomy	5755-left hemicolectomy
576-total colectomy	576-total colectomy
5752- cecectomy	5752- cecectomy
5754- resection of transverse colon	5754- resection of transverse colon

5756- sigmoidectomy	5756- sigmoidectomy
5759- other partial excision of large intestine	5759- other partial excision of large intestine

APPENDIX E

Research Ethics Approval

UNIVERSITY OF SASKATCHEWAN

Behavioural Research Ethics Board (Beh-REB) 02-Apr-2020

Certificate of Re-Approval

Application ID: 977

Principal Investigator: Juan-Nicolas Pena-Sanchez Department: Department of Community Health and Epidemiology

Locations Where Research Activities are Conducted: University of Saskatchewan, Canada

Student(s): Jessica Osei
Jose Diego Marques Santos
Mustafa Andkhoie

Funder(s): Saskatchewan Centre for Patient-Oriented Research
Saskatchewan Health Research Foundation

Sponsor: College of Medicine

Title: Understanding And Advocating For Miyo-Mhcihowin (Good Health And Well-Being) Among Indigenous Peoples Living With Inflammatory Bowel Disease

Approved On: 08/04/2020

Expiry Date: 07/04/2021

Acknowledgment Of: n/a

Review Type: Delegated Review

* This study, inclusive of all previously approved documents, has been re-approved until the expiry date noted above

CERTIFICATION

The University of Saskatchewan Behavioural Research Ethics Board (Beh-REB) is constituted and operates in accordance with the current version of the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2 2014). The University of Saskatchewan Behavioural Research Ethics Board has reviewed the above-named project. The proposal was found to be acceptable on ethical grounds. The principal investigator has the responsibility for any other administrative or regulatory approvals that may pertain to this project, and for ensuring that the authorized project is carried out according to the conditions outlined in the original protocol submitted for ethics review. This Certificate of Approval is valid for the above time period provided there is no change in experimental protocol or consent process or documents.

ONGOING REVIEW REQUIREMENTS

In order to receive annual renewal, a status report must be submitted to the REB Chair for Board consideration within one month prior to the current expiry date each year the project remains open, and upon project completion. Please refer to the following website for further instructions: https://vpresearch.usask.ca/researchers/forms.php.

Digitally Approved by Diane Martz
Chair, Behavioural Research Ethics Board
University of Saskatchewan

APPENDIX F

Table F.1 - Sample characteristics, unmatched cohort

	Matched cohort [n=5173]	Group	
		General population [n= 5057]	First Nations [n= 116]
Age at diagnosis of IBD, mean [SD], years	42.45 [17.6]	41.49 [17.7]	41.21 [15.1]
Age groups, No. [%]			
≤30	1518 [29.3]	1491 [29.5]	27 [23.3]
31-49	1883 [36.4]	1824 [36.1]	59 [50.9]
≥50	1772 [34.3]	1742 [24.4]	30 [25.9]
Sex, n[%]			
Female	2742 [53.0]	2637 [52.9]	69 [59.5]
Male	2431 [47.0]	2384 [47.1]	47 [40.5]
Income quintiles,* No. [%]			
1 (Lowest)	695[14.3]	656 [13.8]	39 [36.1]
2	992[20.4]	972 [20.4]	20 [18.5]
3	973[20.0]	956 [20.1]	17[15.7]
4	1171[24.1]	1152 [24.2]	19[17.6]
5 (Highest)	1032[21.2]	1019 [21.4]	13[12.0]
Residence location, ** **No. [%]**			
Rural	1542 [19.9]	1493 [29.6]	49 [42.2]
Urban	3621 [70.1]	3554 [70.4]	67 [57.8]
Region of residence,* **No. [%]**			
Regina, Saskatoon, and surrounding	2956 [57.2]	2908 [57.5]	48 [41.4]
Northern Saskatchewan	830 [16.0]	781 [15.5]	49 [42.2]
Southern Saskatchewan	1384 [26.8]	1365 [27.0]	19 [16.4]
Diagnostic type, No. [%]			
Crohn's Disease	2796 [54.0]	2754 [54.5]	42 [36.2]
Ulcerative Colitis	2377 [46.0]	2303 [45.5]	74 [63.8]
Date of IBD diagnosis, No. [%]			
Before April 1, 2008	3175 [61.4]	3117 [61.6]	58 [50.0]
On or after April 1, 2008	1998 [38.6]	1940 [38.4]	58 [50.0]
Length of follow-up, years, mean [SD]	10.42 [5.47]	10.46 [5.46]	8.78 [5.43]

IBD: inflammatory bowel disease, SD: standard deviation
* Data not available for all subjects [missing values = 310].
** Data not available for all subjects [missing values = 10].
*** Data not available for all subjects [missing values=3]

Table F.2 - Mean length of follow-up for each study outcomes, matched cohort. Time measured in years from first eligible diagnosis and terminated by either failure or censoring date

		Group	
	Matched cohort [n=696]	**General population [n= 580]**	**First Nations [n= 116]**
Length of follow-up, mean [SD], years			
Outpatient gastroenterologist visit	3.55 [5.43]	3.74 [5.59]	2.61 [4.45]
Access to a colonoscopy	2.09 [3.92]	2.24 [4.07]	1.34 [2.98]
Prescription claim for IBD	2.10 [4.26]	1.78 [4.13]	3.68 [4.57]
Prescription claim of a Biologic	9.48 [5.87]	9.73 [5.92]	8.21 [5.44]
Prescription claim of an IM	7.86 [6.19]	7.98 [6.31]	7.30 [5.57]
Prescription claim of a 5-ASA	2.66 [4.76]	2.40 [4.72]	3.96 [4.75]
IBD-specific hospitalization	6.24 [6.35]	6.55 [6.46]	4.72 [5.55]
IBD-related hospitalization	5.89 [6.26]	6.30 [6.41]	3.83 [4.98]
Surgeries for IBD	8.66 [5.78]	8.96 [5.77]	7.19 [5.63]

IBD: inflammatory bowel disease, IM: immune modulator, 5-ASA: 5-aminosalicylic acid, SD: standard deviation.

APPENDIX G

Table G.1 - Covariates, matched cohort

	Matched cohort [n=696]	Group	
		General population [n= 580]	First Nations [n= 116]
Comorbidity Index, No. [%]			
0	509 [73.1]	429 [74.0]	80 [69.0]
≥1	187 [26.9]	151 [26.0]	36 [31.0]
Visits with a general practitioner a year before diagnosis, No. [%]			
≤ 4	223 [32.0]	195 [33.6]	28 [24.1]
≥ 5	473 [68.0]	385 [66.4]	88 [75.9]
Visits to a specialist [specifically to a rheumatologist, ophthalmologist, surgeon, or gastroenterologist] No. [%]			
No	423 [60.8]	360 [62.1]	63 [54.3]
Yes	273 [39.2]	220 [37.9]	53 [45.7]
IBD medication prescription claim a year before diagnosis, No. [%]			
No	549 [78.9]	448 [77.2]	101 [87.1]
Yes	147 [21.1]	132 [22.8]	15 [12.9]
CsDep a year before diagnosis No. [%]			
No	672 [96.6]	*	*
Yes	24 [3.4]	*	*
Corticosteroid prescription claim a year before diagnosis, No. [%]			
No	638 [91.7]	530 [91.4]	108 [93.1]
Yes	58 [8.3]	50 [8.6]	8 [6.9]

* Data not available due to small cell value, specifically the number of First Nations with corticosteroid dependency before the date of diagnosis

APPENDIX H

Table H.1 - Bivariate analysis between each of the study outcomes

[n=696]	**Outpatient gastroenterologist visit** [HR (95%CI)]	**Access to a colonoscopy** [HR (95%CI)]	**Prescription claim for IBD** [HR (95%CI)]	**Prescription claim of a Biologic** [HR (95%CI)]	**Prescription claim of an IM** [HR (95%CI)]	**Prescription claim of a 5-ASA** [HR (95%CI)]	**IBD-specific hospitalization** [HR (95%CI)]	**IBD-related hospitalization** [HR (95%CI)]	**Surgeries for IBD** [HR (95%CI)]
Age at diagnosis of IBD									
≤30	**1.27 (1.01-1.60)**	1.12 (0.89-1.40)	1.07 (0.85-1.33)	**2.16 (1.40-3.34)**	**2.17 (1.55-3.05)**	0.99 (0.79-1.26)	**1.52 (1.14-2.03)**	**1.34 (1.02-1.77)**	**0.36 (0.24-0.56)**
31-49	0.91 (0.75-1.11)	1.03 (0.85-1.24)	0.92 (0.76-1.12)	1.04 (0.69-1.56)	1.12 (0.82-1.53)	0.93 (0.76-1.13)	1.00 (0.77-1.30)	0.91 (0.72-1.17)	**0.61 (0.46-0.81)**
≥50(Ref.)	1	1	1	1	1	1	1	1	1
Sex									
Female	1.06 (0.89-1.25)	0.92 (0.78 - 1.08)	1.00 (0.85-1.17)	1.09 (0.79-1.50)	1.06 (0.82-1.35)	0.98 (0.83-1.16)	1.08 (0.87-1.34)	1.08 (0.88-1.33)	**0.68 (0.53-0.88)**
Male (Ref.)	1	1	1	1	1	1	**1**	**1**	1
Income quintiles*									
1 (Lowest)	0.91 (0.69-1.22)	1.18 (0.89-1.56)	0.98 (0.74-1.29)	0.80 (0.45-1.43)	0.91 (0.59-1.40)	1.07 (0.80-1.43)	**1.55 (1.08-2.23)**	**1.66 (1.18-2.34)**	1.10(0.68-1.77)
2	0.82 (0.63-1.06)	0.96 (0.74-1.24)	1.02 (0.79-1.31)	1.08 (0.66-1.75)	0.99 (0.68-1.45)	1.07 (0.82-1.40)	1.05 (0.74-1.49)	1.07 (0.76-1.49)	1.28(0.84-1.94)
3	1.07 (0.82-1.40)	0.84 (0.65-1.10)	0.85 (0.65-1.11)	1.28 (0.79-2.08)	1.01 (0.68-1.49)	0.91 (0.69-1.20)	1.19 (0.84-1.70)	1.12 (0.80-1.58)	1.09(0.70-1.70)
4	0.91 (0.70-1.18)	0.93 (0.72-1.20)	1.00 (0.78-1.29)	0.77 (0.46-1.29)	0.87 (0.59-1.28)	1.04 (0.80-1.35)	1.07 (0.76-1.52)	1.04 (0.75-1.45)	1.22(0.80-1.86)
5 (Highest)(Ref.)	1	1	1	1	1	1	1	1	1
Residence location**									
Rural	**0.80 (0.67-0.95)**	0.98 (0.83-1.16)	1.09 (0.92-1.28)	0.77 (0.55-1.08)	0.88 (0.68-1.15)	1.16 (0.98-1.38)	1.07 (0.86-1.33)	1.09 (0.89-1.35)	1.18 (0.90-1.54)
Urban (Ref.)	1	1	1	1	1	1	1	1	1
Region of residence***									
Northern Saskatchewan	**0.65 (0.53-0.81)**	1.05 (0.85-1.29)	0.93 (0.76-1.15)	0.75 (0.49-1.15)	**0.67 (0.48-0.94)**	1.01 (0.81-1.25)	1.31 (1.00-1.70)	**1.36 (1.05-1.75)**	0.74 (0.52-1.06)
Southern Saskatchewan	**0.64 (0.53-0.78)**	1.01 (0.84-1.22)	1.09 (0.90-1.31)	0.89 (0.62-1.28)	0.90 (0.68-1.19)	1.06 (0.87-1.29)	1.16 (0.91-1.48)	1.18 (0.93-1.50)	0.90 (0.67-1.22)
Regina, Saskatoon, and surrounding (Ref.)	1	1	1	1	1	1	1	1	1
Diagnosis type									
Crohn's Disease	1.05 (0.90-1.24)	**0.56 (0.48-0.66)**	**0.65 (0.55-0.76)**	**2.10 (1.52-2.90)**	**2.34 (1.82-3.01)**	**0.51 (0.43-0.61)**	**1.48 (1.20-1.83)**	**1.41 (1.15-1.73)**	1.16 (0.90-1.51)
Ulcerative Colitis (Ref.)	1	1	1	1	1	1	1	1	1
Date of IBD diagnosis									
On or after April 1, 2008	**2.16 (1.81-2.57)**	1.18 (1.00-1.40)	**1.44 (1.22-1.70)**	-	**2.20 (1.70-2.85)**	1.11 (0.93-1.32)	1.12 (0.90-1.40)	1.12 (0.90-1.39)	**1.85 (1.36-2.53)**
Before April 1, 2008 (Ref.)	1	1	1	-	1	1	1	1	1

HR: hazard ratio, 95%CI: 95% coinfidence interval, IBD: inflammatory bowel disease, IM: immune modulator, 5-ASA: 5-aminosalicylic acid. * Data not available for all subjects [missing values = 5]. * Data not available for all subjects [Unknown = 38]. ** Data not available for all subjects [missing values = 5]. ***Data not available for all subjects [missing values = 1].

APPENDIX I

Table I.1 - Magnitude of confounding effect of age (≤30, 31-49, and ≥50) at the date of diagnosis

Outcomes	**Model 1 (n=691)*** HR (95%CI)	**Model 2 (n=691)**** HR (95%CI)	**Change** %
Outpatient gastroenterologist visit	1.13 (0.90-1.41)	1.12 (0.90-1.40)	0.4
Access to a colonoscopy	1.14 (0.92-1.41)	1.14 (0.92-1.40)	0.2
Prescription claim for IBD	**0.52 (0.41-0.65)**	**0.51 (0.41-0.65)**	0.2
Prescription claim of a Biologic	0.65 (0.38-1.11)	0.62 (0.37-1.06)	4.3
Prescription claim of an IM	0.79 (0.55-1.15)	0.75 (0.51-1.08)	5.8
Prescription claim of a 5-ASA	**0.56 (0.45-0.71)**	**0.56 (0.45-0.71)**	0.0
IBD-specific hospitalization	**1.33 (1.01-1.75)**	**1.33 (1.01-1.75)**	-0.1
IBD-related hospitalization	**1.55 (1.20-2.01)**	**1.55 (1.20-2.01)**	-0.2
Surgeries for IBD	1.14 (0.80-1.64)	1.23 (0.86-1.77)	-7.6

HR: hazard ratio, 95%CI: 95% confidence interval
* Models adjusted by rural or urban status, and diagnostic type.
** Models adjusted by rural or urban status, diagnostic type, and age at the date of diagnosis.

Table I.2 - Magnitude of confounding effect of sex (female or male)

Outcomes	**Model 1 (n=691)*** HR (95%CI)	**Model 2 (n=691)**** HR (95%CI)	**Change** %
Outpatient gastroenterologist visit	1.13 (0.90-1.41)	1.13 (0.90-1.41)	-0.1
Access to a colonoscopy	1.14 (0.92-1.41)	1.14 (0.92-1.41)	0.0
Prescription claim for IBD	**0.52 (0.41-0.65)**	**0.52 (0.41-0.65)**	0.0
Prescription claim of a Biologic	0.65 (0.38-1.11)	0.65 (0.38-1.11)	0.2
Prescription claim of an IM	0.79 (0.55-1.15)	0.79 (0.55-1.15)	0.0
Prescription claim of a 5-ASA	**0.56 (0.45-0.71)**	**0.56 (0.45-0.71)**	0.0
IBD-specific hospitalization	**1.33 (1.01-1.75)**	**1.33 (1.01-1.75)**	0.0
IBD-related hospitalization	**1.55 (1.20-2.01)**	**1.55 (1.20-2.01)**	0.1
Surgeries for IBD	1.14 (0.80-1.64)	1.15 (0.80-1.64)	-0.3

HR: hazard ratio, 95%CI: 95% confidence interval
* Models adjusted by rural or urban status, and diagnostic type.
** Models adjusted by rural or urban status, diagnostic type, and sex.

Table I.3 - Magnitude of confounding effect of income quintiles

	Model 1 (n=658)*	**Model 2 (n=658)****	**Change**
Outcomes	HR (95%CI)	HR (95%CI)	%
Outpatient gastroenterologist visit	1.11 (0.88-1.40)	1.12 (0.89-1.43)	-1.0
Access to a colonoscopy	1.18 (0.95-1.46)	1.13 (0.90-1.42)	4.0
Prescription claim for IBD	**0.54 (0.43-0.68)**	**0.53 (0.41-0.67)**	2.6
Prescription claim of a Biologic	0.60 (0.34-1.06)	0.60 (0.34-1.07)	-0.2
Prescription claim of an IM	0.78 (0.53-1.15)	0.78 (0.53-1.16)	0.1
Prescription claim of a 5-ASA	**0.59 (0.47-0.75)**	**0.57 (0.45-0.73)**	3.4
IBD-specific hospitalization	**1.31 (0.98-1.74)**	1.18 (0.87-1.59)	9.7
IBD-related hospitalization	**1.55 (1.18-2.02)**	**1.38 (1.04-1.82)**	**10.8**
Surgeries for IBD	1.21 (0.84-1.75)	1.23 (0.85-1.79)	-1.7

HR: hazard ratio, 95%CI: 95% confidence interval
* Models adjusted by rural or urban status, and diagnostic type.
** Models adjusted by rural or urban status, diagnostic type, and income quintile.
Missing data of income quintile=38

Table I.4 - Magnitude of confounding effect of date of IBD diagnosis (before April 1, 2008/on or after April 1, 2008)

	Model 1 (n=691)*	**Model 2 (n=691)****	**Change**
Outcomes	HR (95%CI)	HR (95%CI)	%
Outpatient gastroenterologist visit	1.13 (0.90-1.41)	1.01 (0.81-1.27)	**10.0**
Access to a colonoscopy	1.14 (0.92-1.41)	1.12 (0.90-1.38)	1.8
Prescription claim for IBD	**0.52 (0.41-0.65)**	**0.52 (0.41-0.65)**	-0.6
Prescription claim of a Biologic	0.65 (0.38-1.11)	-	-
Prescription claim of an IM	0.79 (0.55-1.15)	0.72 (0.50-1.04)	9.1
Prescription claim of a 5-ASA	**0.56 (0.45-0.71)**	**0.57 (0.45-0.72)**	-0.5
IBD-specific hospitalization	**1.33 (1.01-1.75)**	**1.32 (1.00-1.74)**	0.8
IBD-related hospitalization	**1.55 (1.20-2.01)**	**1.54 (1.19-2.00)**	0.6
Surgeries for IBD	1.14 (0.80-1.64)	1.09 (0.76-1.56)	4.7

HR: hazard ratio, 95%CI: 95% confidence interval
* Models adjusted by rural or urban status, and diagnostic type.
** Models adjusted by rural or urban status, diagnostic type, and date of IBD diagnosis.

Table I.5 - Magnitude of confounding effect of residence location (Regina, Saskatoon, and surrounding; Northern Saskatchewan; and Southern Saskatchewan)

	Model 1 (n=691)*	**Model 2 (n=691)****	**Change**
Outcomes	HR (95%CI)	HR (95%CI)	%
Outpatient gastroenterologist visit	1.13 (0.90-1.41)	1.17 (0.93-1.47)	-4.1
Access to a colonoscopy	1.14 (0.92-1.41)	1.14 (0.91-1.42)	0.1
Prescription claim for IBD	**0.52 (0.41-0.65)**	**0.52 (0.41-0.65)**	-0.4
Prescription claim of a Biologic	0.65 (0.38-1.11)	0.66 (0.39-1.14)	-2.0
Prescription claim of an IM	0.79 (0.55-1.15)	0.84 (0.58-1.23)	-6.2
Prescription claim of a 5-ASA	**0.56 (0.45-0.71)**	**0.56 (0.44-0.71)**	0.5
IBD-specific hospitalization	**1.33 (1.01-1.75)**	1.28 (0.96-1.71)	3.4
IBD-related hospitalization	**1.55 (1.20-2.01)**	**1.50 (1.15-1.97)**	2.9
Surgeries for IBD	1.14 (0.80-1.64)	1.24 (0.86-1.79)	-8.2

HR: hazard ratio, 95%CI: 95% confidence interval

* Models adjusted by rural or urban status, and diagnostic type.

** Models adjusted by rural or urban status, diagnostic type, and residence location.

Table I.6 - Magnitude of confounding effect of corticosteroid prescription claim a year before the date of diagnosis (yes/no)

	Model 1 (n=691)*	**Model 2 (n=691)****	**Change**
Outcomes	HR (95%CI)	HR (95%CI)	%
Outpatient gastroenterologist visit	1.13 (0.90-1.41)	1.14 (0.91-1.42)	-1.2
Access to a colonoscopy	1.14 (0.92-1.41)	1.14 (0.92-1.41)	-0.2
Prescription claim for IBD	**0.52 (0.41-0.65)**	**0.52 (0.42-0.66)**	-1.4
Prescription claim of a Biologic	0.65 (0.38-1.11)	0.66 (0.39-1.13)	-2.0
Prescription claim of an IM	0.79 (0.55-1.15)	0.80 (0.55-1.16)	-0.6
Prescription claim of a 5-ASA	**0.56 (0.45-0.71)**	**0.57 (0.45-0.72)**	-1.2
IBD-specific hospitalization	**1.33 (1.01-1.75)**	**1.33 (1.01-1.76)**	-0.2
IBD-related hospitalization	**1.55 (1.20-2.01)**	**1.56 (1.20-2.01)**	-0.4
Surgeries for IBD	1.14 (0.80-1.64)	1.18 (0.82-1.69)	-3.2

HR: hazard ratio, 95%CI: 95% confidence interval

* Models adjusted by rural or urban status, and diagnostic type.

** Models adjusted by rural or urban status, diagnostic type, and corticosteroid prescription claim a year before the date of diagnosis.

Table I.7 - Magnitude of confounding effect of CsDep 12 months before the date of diagnosis (yes/no)

	Model 1 (n=691)*	**Model 2 (n=691)****	**Change**
Outcomes	HR (95%CI)	HR (95%CI)	[%]
Outpatient gastroenterologist visit	1.13 (0.90-1.41)	1.13 (0.90-1.41)	-0.4
Access to a colonoscopy	1.14 (0.92-1.41)	1.13 (0.92-1.41)	0.4
Prescription claim for IBD	**0.52 (0.41-0.65)**	**0.52 (0.42-0.66)**	-1.7
Prescription claim of a Biologic	0.65 (0.38-1.11)	0.66 (0.38-1.12)	-0.5
Prescription claim of an IM	0.79 (0.55-1.15)	0.80 (0.55-1.16)	-0.6
Prescription claim of a 5-ASA	**0.56 (0.45-0.71)**	**0.57 (0.46-0.73)**	-1.8
IBD-specific hospitalization	**1.33 (1.01-1.75)**	**1.34 (1.01-1.76)**	-0.5
IBD-related hospitalization	**1.55 (1.20-2.01)**	**1.56 (1.20-2.02)**	-0.6
Surgeries for IBD	1.14 (0.80-1.64)	1.15 (0.81-1.65)	-1.0

HR: hazard ratio, 95%CI: 95% confidence interval

* Models adjusted by rural or urban status, and diagnostic type.

** Models adjusted by rural or urban status, diagnostic type, and CsDep.

Table I.8 - Magnitude of confounding effect of outpatient general practitioner visits a year before the date of diagnosis (yes/no)

	Model 1 (n=691)*	**Model 2 (n=691)****	**Change**
Outcomes	HR (95%CI)	HR (95%CI)	%
Outpatient gastroenterologist visit	1.13 (0.90-1.41)	1.10 (0.88-1.38)	2.0
Access to a colonoscopy	1.14 (0.92-1.41)	1.12 (0.90-1.38)	1.8
Prescription claim for IBD	**0.52 (0.41-0.65)**	**0.51 (0.40-0.64)**	1.7
Prescription claim of a Biologic	0.65 (0.38-1.11)	0.64 (0.38-1.10)	1.4
Prescription claim of an IM	0.79 (0.55-1.15)	0.78 (0.54-1.13)	1.8
Prescription claim of a 5-ASA	**0.56 (0.45-0.71)**	**0.55 (0.44-0.70)**	2.3
IBD-specific hospitalization	**1.33 (1.01-1.75)**	**1.32 (1.00-1.75)**	0.4
IBD-related hospitalization	**1.55 (1.20-2.01)**	**1.54 (1.18-1.99)**	0.9
Surgeries for IBD	1.14 (0.80-1.64)	1.13 (0.79-1.62)	1.2

HR: hazard ratio, 95%CI: 95% confidence interval

* Models adjusted by rural or urban status and diagnostic type.

** Models adjusted by rural or urban status, diagnostic type, and outpatient general practitioner visits a year before the date of diagnosis.

Table I.9 - Magnitude of confounding effect of IBD medication prescription claim a year before the date of diagnosis (yes/no)

	Model 1 (n=691)*	**Model 2 (n=691)****	**Change**
Outcomes	HR (95%CI)	HR (95%CI)	%
Outpatient gastroenterologist visit	1.13 (0.90-1.41)	1.14 (0.91-1.43)	-1.2
Access to a colonoscopy	1.14 (0.92-1.41)	1.11 (0.90-1.38)	2.1
Prescription claim for IBD	**0.52 (0.41-0.65)**	-	-
Prescription claim of a Biologic	0.65 (0.38-1.11)	-	-
Prescription claim of an IM	0.79 (0.55-1.15)	-	-
Prescription claim of a 5-ASA	**0.56 (0.45-0.71)**	-	-
IBD-specific hospitalization	**1.33 (1.01-1.75)**	1.30 (0.98-1.72)	2.3
IBD-related hospitalization	**1.55 (1.20-2.01)**	**1.53 (1.18-1.99)**	1.1
Surgeries for IBD	1.14 (0.80-1.64)	1.19 (0.82-1.71)	-3.8

HR: hazard ratio, 95%CI: 95% confidence interval

* Models adjusted by rural or urban status, and diagnostic type.

** Models adjusted by rural or urban status, diagnostic type, and IBD medication a year before the date of diagnosis.

Table I.10 - Magnitude of confounding effect of visits to a specialist [rheumatologist, ophthalmologist, surgeon, or gastroenterologist] a year before the date of diagnosis (yes/no)

	Model 1 (n=691)*	**Model 2 (n=691)****	**Change**
Outcomes	HR (95%CI)	HR (95%CI)	%
Outpatient gastroenterologist visit	1.13 (0.90-1.41)	1.14 (0.91-1.42)	-1.2
Access to a colonoscopy	1.14 (0.92-1.41)	1.13 (0.91-1.39)	1.0
Prescription claim for IBD	**0.52 (0.41-0.65)**	**0.50 (0.40-0.63)**	3.1
Prescription claim of a Biologic	0.65 (0.38-1.11)	0.64 (0.38-1.09)	1.7
Prescription claim of an IM	0.79 (0.55-1.15)	0.79 (0.54-1.14)	0.8
Prescription claim of a 5-ASA	**0.56 (0.45-0.71)**	**0.55 (0.44-0.69)**	2.7
IBD-specific hospitalization	**1.33 (1.01-1.75)**	**1.34 (1.01-1.77)**	-0.8
IBD-related hospitalization	**1.55 (1.20-2.01)**	**1.54 (1.19-1.99)**	0.8
Surgeries for IBD	1.14 (0.80-1.64)	1.12 (0.78-1.61)	2.0

HR: hazard ratio, 95%CI: 95% confidence interval

* Models adjusted by rural or urban status, and diagnostic type.

** Models adjusted by rural or urban status, diagnostic type, and visits to a surgeon, rheumatologist, gastroenterologist, or ophthalmologist a year before the date of diagnosis.

APPENDIX J

Table J.1 - Sample characteristics, matched cohort using Rezaie's case definition

		Group	
	Matched cohort [n=990]	**General population [n= 825]**	**First Nations [n= 165]**
Age at diagnosis of IBD, mean [SD], years	44.14 [14.9]	44.15 [14.9]	44.10 [14.9]
Age groups, No. [%]			
≤30	195 [19.7]	163 [19.8]	32 [19.4]
31-49	440 [44.4]	365 [44.2]	75 [45.5]
≥50	355 [35.9]	297 [36.0]	58 [35.2]
Sex, n[%]			
Female	594 [60.0]	495 [60.0]	99 [60.0]
Male	396 [40.0]	330 [40.0]	66 [40.0]
Income quintiles,* No. [%]			
1 (Lowest)	171 [18.1]	111 [14.1]	60 [38.5]
2	176 [18.6]	146 [18.5]	30 [19.2]
3	206 [21.8]	180 [22.8]	26 [16.7]
4	205 [21.7]	179 [22.7]	26 [16.7]
5 (Highest)	187 [19.8]	173 [21.9]	14 [9.0]
Residence location, No. [%]**			
Rural	324 [32.9]	253 [30.8]	71 [43.0]
Urban	662 [67.1]	568 [69.2]	94 [57.0]
Region of residence,* No. [%]**			
Regina, Saskatoon, and surrounding	551 [55.8]	483 [58.8]	68 [41.2]
Northern Saskatchewan	212 [21.5]	142 [17.3]	70 [42.4]
Southern Saskatchewan	224 [22.7]	197 [24.0]	27 [16.4]
Diagnostic type, No. [%]			
Crohn's Disease	526 [53.1]	460 [55.76]	66 [40.0]
Ulcerative Colitis	464 [46.9]	365 [44.2]	99 [60.0]
Date of IBD diagnosis, No. [%]			
Before April 1, 2008	519 [52.4]	457 [55.4]	62 [37.6]
On or after April 1, 2008	471 [47.6]	368 [44.6]	103 [62.4]
Length of follow-up, mean [SD], years	9.03 [5.87]	9.49 [5.81]	6.76 [5.63]

IBD: inflammatory bowel disease, SD: standard deviation
* Data not available for all subjects [missing values = 45]. ** Data not available for all subjects [missing values = 4]. *** Data not available for all subjects [missing values = 3].

Table J.2 - Study outcomes, matched cohort using Rezaie's case definition

	Matched cohort [n=990]	**General population [n=825]**	**First Nations [n=165]**
Outpatient gastroenterologist visit, No. [%]			
No	211 [21.3]	160 [19.4]	51 [30.9]
Yes	779 [78.7]	665 [80.6]	114 [69.1]
Access to a colonoscopy, No. [%]			
No	258 [26.1]	204 [24.7]	54 [32.7]
yes	732 [73.9]	621 [75.3]	111 [67.3]
Prescription claim for IBD, No. [%]			
No	228 [23.0]	180 [21.8]	48 [29.1]
Yes	762 [77.0]	645 [78.2]	117 [70.9]
Prescription claim of a Biologic, No. [%]			
No	789 [79.7]	644 [78.1]	145 [87.9]
Yes	201 [20.3]	181 [21.9]	20 [12.1]
Prescription claim of an IM, No. [%]			
No	674 [68.1]	544 [65.9]	130 [78.8]
Yes	316 [31.9]	281 [34.1]	35 [21.2]
Prescription claim of a 5-ASA, No. [%]			
No	324 [32.7]	267 [32.4]	57 [34.5]
Yes	666 [62.3]	558 [67.6]	108 [65.4]
IBD-specific hospitalization, No. [%]			
No	587 [59.3]	492 [59.6]	95 [57.6]
Yes	403 [40.7]	333 [40.4]	70 [42.4]
IBD-related hospitalization, No. [%]			
No	530 [53.5]	448 [54.3]	82 [49.7]
Yes	460 [46.5]	377 [45.7]	83 [50.3]
Surgeries for IBD, No. [%]			
No	708 [71.5]	583 [70.7]	125 [75.8]
Yes	282 [28.5]	242 [29.3]	40 [24.4]

IBD: inflammatory bowel disease, IM: immune modulator, 5-ASA: 5-aminosalicylic acid, SD: standard deviation

Table J.3 - Sensitivity analysis using Rezaie's case definition

	Full-group analysis (n=990)		Stratified analysis			
			Crohn's Disease (n=526)		Ulcerative Colitis (n=464)	
Outcomes	Unadjusted HR (95%CI)	Adjusted HR (95%CI)*	Unadjusted HR (95%CI)	Adjusted HR (95%CI)**	Unadjusted HR (95%CI)	Adjusted HR (95%CI)***
Outpatient gastroenterologist visit	0.86 (0.70-1.05)	0.87 (0.71-1.06)	0.80 (0.58-1.10)	0.81 (0.59-1.11)	0.90 (0.70-1.17)	0.91 (0.70-1.18)
Access to a colonoscopy	0.96 (0.79-1.18)	0.90 (0.73-1.10)	0.82 (0.58-1.15)	0.81 (0.58-1.15)	0.95 (0.73-1.22)	0.95 (0.74-1.23)
Prescription claim for IBD	**0.74 (0.61-0.90)**	**0.68 (0.56-0.83)**	**0.61 (0.44-0.86)**	**0.61 (0.43-0.85)**	**0.74 (0.58-0.95)**	**0.74 (0.57-0.95)**
Prescription claim of a Biologic	0.66 (0.42-1.05)	0.74 (0.46-1.17)	0.77 (0.43-1.39)	0.78 (0.43-1.41)	0.67 (0.32-1.41)	0.67 (0.32-1.42)
Prescription claim of an IM	**0.66 (0.44-0.93)**	0.74 (0.52-1.05)	0.63 (0.39-1.04)	0.65 (0.40-1.07)	0.82 (0.50-1.36)	0.85 (0.51-1.42)
Prescription claim of a 5-ASA	0.86 (0.70-1.06)	**0.74 (0.60-0.91)**	**0.66 (0.45-0.97)**	**0.63 (0.43-0.92)**	0.80 (0.62-1.03)	0.79 (0.62-1.02)
IBD-specific hospitalization	1.21 (0.93-1.56)	1.28 (0.99-1.67)	1.28 (0.88-1.86)	1.31 (0.90-1.91)	1.25 (0.87-1.80)	1.25 (0.87-1.80)
IBD-related hospitalization	**1.33 (1.04-1.68)**	**1.39 (1.09-1.77)**	1.29 (0.90-1.84)	1.28 (0.89-1.83)	**1.48 (1.06-2.06)**	**1.47 (1.06-2.05)**
Surgeries for IBD	1.06 (0.76-1.48)	1.04 (0.74-1.46)	0.83 (0.48-1.43)	0.82 (0.47-1.43)	1.26 (0.82-1.94)	1.23 (0.80-1.89)

HR: hazard ratio, 95%CI: 95% confidence interval

* Models adjusted by rural or urban status, and diagnostic type (n=986).

** Crohn's Disease group, models adjusted by rural or urban status (n=524).

*** Ulcerative colitis group, models adjusted by rural or urban status (n=462).

APPENDIX K

Table K.1 - Sample characteristics, matched cohort using Benchimol's case definition

		Group	
	Matched cohort [n=708]	**General population [n= 590]**	**First Nations [n= 118]**
Age at diagnosis of IBD, mean [SD], years	42.06 [12.9]	42.09 [12.9]	41.91 [13.1]
Age groups, No. [%]			
≤30	133 [18.8]	110 [18.6]	23 [19.5]
31-49	386 [54.5]	322 [54.6]	64 [54.2]
≥50	189 [26.7]	158 [26.8]	31 [26.3]
Sex, n[%]			
Female	402 [56.8]	335 [56.8]	67 [56.8]
Male	306 [43.2]	255 [43.2]	51 [43.2]
Income quintiles,* No. [%]			
1 (Lowest)	124 [18.7]	81 [14.7]	43 [38.7]
2	124 [18.7]	104 [18.8]	20 [18.0]
3	139 [21.0]	122 [22.1]	17 [15.3]
4	145 [21.9]	125 [22.6]	20 [18.0]
5 (Highest)	131 [19.8]	120 [21.7]	11 [9.9]
Residence location, No. [%]**			
Rural	201 [28.4]	147 [25.0]	54 [45.8]
Urban	506 [71.6]	442 [75.0]	64 [54.2]
Region of residence, No. [%]			
Regina, Saskatoon, and surrounding	401 [56.6]	355 [60.2]	46 [39.0]
Northern Saskatchewan	134 [18.9]	81 [13.7]	53 [44.9]
Southern Saskatchewan	173 [24.4]	154 [26.1]	19 [16.1]
Diagnostic type, No. [%]			
Crohn's Disease	365 [51.6]	321 [54.4]	44 [37.3]
Ulcerative Colitis	343 [48.4]	269 [45.6]	74 [62.7]
Date of IBD diagnosis, No. [%]			
Before April 1, 2008	427 [60.3]	367 [62.2]	60 [50.9]
On or after April 1, 2008	281 [39.7]	223 [37.8]	58 [49.1]
Length of follow-up, mean [SD], years	10.48 [5.70]	10.88 [5.63]	8.46 [5.67]

IBD: inflammatory bowel disease, SD: standard deviation
* Data not available for all subjects [missing values = 45] ** Data not available for all subjects [missing values = 1].

Table K.2 - Study outcomes, matched cohort using Benchimol's case definition

	Matched cohort [n=708]	**General population [n=590]**	**First Nations [n=118]**
Outpatient gastroenterologist visit, No. [%]			
No	112 [15.8]	92 [15.6]	20 [15.8]
Yes	596 [84.2]	498 [84.4]	98 [83.1]
Access to a colonoscopy, No. [%]			
No	95 [13.4]	81 [13.7]	14 [11.9]
yes	613 [86.6]	509 [86.3]	104 [88.1]
Prescription claim for IBD, No. [%]			
No	96 [13.6]	68 [11.5]	28 [23.7]
Yes	612 [86.4]	522 [88.5]	90 [76.3]
Prescription claim of a Biologic, No. [%]			
No	547 [77.3]	446 [75.6]	101 [85.6]
Yes	161 [22.7]	144 [24.1]	17 [14.1]
Prescription claim of an IM, No. [%]			
No	453 [64.0]	366 [62.0]	87 [73.7]
Yes	255 [36.0]	224 [38.0]	31 [26.3]
Prescription claim of a 5-ASA, No. [%]			
No	156 [22.0]	123 [20.9]	33 [18.0]
Yes	552 [78.0]	467 [79.1]	85 [72.0]
IBD-specific hospitalization, No. [%]			
No	375 [53.0]	317 [53.7]	58 [49.1]
Yes	333 [47.0]	273 [46.3]	60 [50.9]
IBD-related hospitalization, No. [%]			
No	333 [47.0]	288 [48.8]	45 [38.1]
Yes	375 [53.0]	302 [51.2]	73 [61.9]
Surgeries for IBD, No. [%]			
No	476 [67.2]	395 [67.0]	81 [68.6]
Yes	232 [32.7]	195 [33.0]	37 [31.4]

IBD: inflammatory bowel disease, IM: immune modulator, 5-ASA: 5-aminosalicylic acid, SD: standard deviation

Table K.3 - Sensitivity analysis using Benchimol's case definition

	Full-group analysis (n=708)		Stratified analysis			
			Crohn's Disease (n=365)		Ulcerative Colitis (n=343)	
Outcomes	Unadjusted HR (95%CI)	Adjusted HR (95%CI)*	Unadjusted HR (95%CI)	Adjusted HR (95%CI)**	Unadjusted HR (95%CI)	Adjusted HR (95%CI)***
Outpatient gastroenterologist visit	1.11 (0.90-1.38)	1.17 (0.93-1.45)	0.85 (0.59-1.24)	0.92 (0.63-1.35)	**1.34 (1.02-1.77)**	**1.36 (1.03-1.80)**
Access to a colonoscopy	1.19 (0.97-1.47)	1.11 (0.90-1.38)	1.04 (0.72-1.50)	1.07 (0.73-1.55)	1.13 (0.87-1.47)	1.15 (0.88-1.49)
Prescription claim for IBD	**0.59 (0.47-0.74)**	**0.50 (0.40-0.63)**	**0.56 (0.38-0.82)**	**0.54 (0.36-0.80)**	**0.48 (0.36-0.64)**	**0.49 (0.37-0.65)**
Prescription claim of a Biologic	0.68 (0.41-1.13)	0.78 (0.47-1.30)	0.78 (0.40-1.55)	0.78 (0.39-1.56)	0.72 (0.34-1.53)	0.77 (0.36-1.64)
Prescription claim of an IM	0.73 (0.50-1.06)	0.83 (0.56-1.21)	0.72 (0.43-1.23)	0.70 (0.41-1.20)	0.93 (0.54-1.59)	0.98 (0.57-1.70)
Prescription claim of a 5-ASA	**0.69 (0.55-0.87)**	**0.54 (0.43-0.69)**	**0.64 (0.41-0.98)**	**0.61 (0.40-0.95)**	**0.51 (0.39-0.68)**	**0.51 (0.39-0.68)**
IBD-specific hospitalization	1.26 (0.95-1.67)	1.30 (0.98-1.74)	**1.53 (1.02-2.28)**	1.37 (0.91-2.08)	1.23 (0.83-1.83)	1.22 (0.82-1.82)
IBD-related hospitalization	**1.46 (1.13-1.89)**	**1.50 (1.16-1.96)**	**1.67 (1.14-2.45)**	**1.51 (1.02-2.24)**	**1.48 (1.04-2.10)**	**1.48 (1.04-2.10)**
Surgeries for IBD	1.15 (0.81-1.63)	1.14 (0.80-1.63)	1.16 (0.66-2.02)	1.10 (0.63-1.95)	1.16 (0.74-1.84)	1.17 (0.74-1.86)

HR: hazard ratio, 95%CI: 95% confidence interval

* Models adjusted by rural or urban status, and diagnostic type (n=707).

** Crohn's Disease group, models adjusted by rural or urban status (n=364).

*** Ulcerative colitis group, models adjusted by rural or urban status (n=343).