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Complete List of Authors:	Nickel, Nathan C.; Rady Faculty of Health Sciences University of Manitoba, Department of Community Health Sciences; Manitoba Inuit Association Enns, Jennifer; University of Manitoba Faculty of Health Sciences, Manitoba Centre for Health Policy Freier, Amy; University of Manitoba Faculty of Health Sciences, Manitoba Centre for Health Policy McCulloch, Scott; University of Manitoba Faculty of Health Sciences, Manitoba Centre for Health Policy Chartier, Mariette; University of Manitoba Faculty of Health Sciences, Manitoba Centre for Health Policy Casidsid, Hera J. M.; University of Manitoba Faculty of Health Sciences, Manitoba Centre for Health Policy Balogun, Oludolapo Deborah ; University of Manitoba Faculty of Health Sciences, Manitoba Centre for Health Policy Mulhall, Drew; University of Manitoba College of Medicine, Orthopedic Surgery Dragan, Roxana; University of Manitoba Faculty of Health Sciences, Manitoba Centre for Health Policy Sarkar, Joykrishna; University of Manitoba Faculty of Health Sciences, Manitoba Centre for Health Policy Bolton, James; University of Manitoba College of Medicine, Psychiatry Konrad, Geoffrey; University of Manitoba College of Medicine, Psychiatry Phillips-Beck, Wanda; First Nations Health and Social Secretariat of Manitoba Sanguins, Julianne; Manitoba Metis Federation Shimmin, Carolyn; George and Fay Yee Center for Healthcare Innovation McDonald, Neil; Winnipeg Fire Paramedic Service Mignone, Javier; University of Manitoba Faculty of Health Sciences, Community Health Sciences Hinds, Aynslie; University of Manitoba Faculty of Health Sciences, Community Health Sciences Methamphetamine Use In Manitoba Research Team*, .; University of Manitoba Faculty of Health Sciences
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Characterizing methamphetamine use to inform health and social policies in Manitoba, Canada: A protocol for a retrospective cohort study using linked administrative data

Authors and Affiliations:

[1,2]Nathan C. Nickel, [1]Jennifer E. Enns, [1]Amy Freier, [1]Scott McCulloch, [1,2]Mariette Chartier, [1,2]Hera J.M. Casidsid, [1,2]Oludolapo Deborah Balogun, [3]Drew Mulhall, [1]Roxana Dragan, [1]Joykrishna Sarkar, [4]James M. Bolton, [4]Geoffrey Konrad, [5,6]Wanda Phillips-Beck, [7]Julianne Sanguins, [8]Carolyn Shimmin, [9]Neil McDonald, [2]Javier Mignone, [2]Aynslie Hinds, and the Methamphetamine Use in Manitoba Research Team*

[1]Manitoba Centre for Health Policy, Dept of Community Health Sciences, Rady Faculty of Health Sciences, University of Manitoba
[2]Dept of Community Health Sciences, Rady Faculty of Health Sciences, University of Manitoba
[3]Dept of Surgery, Rady Faculty of Health Sciences, University of Manitoba
[4]Dept of Psychiatry, Rady Faculty of Health Sciences, University of Manitoba
[5]College of Nursing, Rady Faculty of Health Sciences, University of Manitoba
[6]First Nations Health and Social Secretariat of Manitoba
[7]Manitoba Métis Federation
[8]Centre for Healthcare Innovation, University of Manitoba
[9]Winnipeg Fire and Paramedic Service

Corresponding Author

Mr. Scott McCulloch
Manitoba Centre for Health Policy
Department of Community Health Sciences
408-727 McDermot Ave
Winnipeg, Manitoba, Canada
R3E 3P5
scott.mcculloch@umanitoba.ca
1-204-789-3669

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Abstract

Introduction

Rising use of methamphetamine is causing significant public health concern in Canada. The biological and behavioural effects of methamphetamine range from wakefulness, vigour and euphoria to adverse physical health outcomes like myocardial infarction, hemorrhagic stroke, arrhythmia and seizure. It can also cause severe psychological complications such as psychosis. National survey data point to increasing rates of methamphetamine use, as well as increasing ease of access and serious methamphetamine-related harms. There is an urgent need for evidence to address knowledge gaps, provide direction to harm reduction and treatment efforts, and inform health and social policies for people using methamphetamine. This protocol describes a study that aims to address this need for evidence.

Methods

The study will use linked, whole-population, de-identified administrative data from the Manitoba Population Research Data Repository. The cohort will include individuals in the city of Winnipeg, Manitoba, who came into contact with the health system for reasons related to methamphetamine use from 2013-2021 and a comparison group matched on age, sex and geography. We will describe the cohort's sociodemographic characteristics, calculate incidence and prevalence of mental disorders associated with methamphetamine use, and examine rates of health and social service use. We will evaluate the use of olanzapine pharmacotherapy in reducing adverse emergency department outcomes. In partnership with Indigenous co-investigators, outcomes will be stratified by First Nations and Métis identity.

Ethics and Dissemination

The study was approved by the University of Manitoba Health Research Ethics Board and access datasets has been granted by all data providers. We also received approval from the First Nations Health and Social Secretariat of Manitoba's Health Information Research Governance Committee and the Manitoba Métis Federation. Dissemination will be guided by an "Evidence 2 Action" group of public rightsholders, service providers and knowledge users who will ensure that the analyses address the critical issues.

Strengths and Limitations

- One of the major strengths of the study is the use of a de-identified, linkable population-based administrative data repository that allows identification of all methamphetamine-related contacts with the health system and provides detailed information on sociodemographic characteristics and other health service use; in particular, new data from emergency medical service providers (e.g., paramedics) in Winnipeg extends the reach of the existing data repository and addresses the selection bias associated with capturing only hospital/physician contacts.
- The administrative health data used in the study are routinely collected through the health system and are thus not subject to recall, sample, follow-up or social desirability bias.
- Our study features a well-developed patient and public engagement strategy, an evaluation component and a knowledge exchange plan that aims to improve access to services for people using methamphetamine and inform policy planning, development and implementation across Manitoba.
- Strong partnerships with First Nations and Métis partners enable us to stratify our analyses by these important sub-populations.
- Studies relying on administrative data may underestimate the burden of methamphetamine use and the prevalence of comorbid mental disorders in the population, because they do not capture information from individuals unless or until they come into contact with the health system. The data cannot be used to detect first use of methamphetamine, only first methamphetamine-related health system contact.
- Our data on methamphetamine-related health system contacts are for the city of Winnipeg, Manitoba, since we are using a dataset from the Winnipeg Fire Paramedic Service to develop the study cohort, thus the results may not be generalizable to rural areas.

Introduction

Methamphetamine is a widely-used illicit drug that is causing significant public health concern in Canada. Methamphetamine is a central nervous system stimulant once used in the treatment of narcolepsy, obesity and ADHD; however, unlike related amphetamines used for similar purposes, methamphetamine is neurotoxic and causes a range of biological and behavioural effects such as wakefulness, vigour, euphoria, improved sexual performance and reduced appetite. Acute signs of physical health complications may include hypertension, tachycardia, hyperthermia and rapid breathing, and severe complications can include lethal hyperthermia, myocardial infarction, hemorrhagic or ischemic stroke, arrhythmia, seizures and death. Methamphetamine can also cause severe psychological complications such as psychosis, sometimes persisting after the acute intoxication period and becoming permanent with chronic use of the drug [1]. Depending on the route of administration and dose taken, methamphetamine can cause a “high” lasting for up to 12 hours, and repeated use can allow the user to stay awake on “a run” for more than a week [2]. A person using methamphetamine may experience a post-intoxication “crash” for several days, manifesting as depressive symptoms, fatigue, confusion, headaches, increased sleep and irritability. Dependent users go through physiological withdrawal for 1-2 weeks after cessation of use, experiencing similar symptoms as well as anxiety, poor concentration/memory, aches, pains and severe cravings [3].

Methamphetamine Use in Canada

In Canada, national survey data point to rising trends in methamphetamine use. The 2004 Canadian Addiction Survey revealed 6.4% of Canadians aged 15 and older reported lifetime methamphetamine (or “speed”) use, up from 1.8% in 1989, and 0.8% reported using methamphetamine in the previous year [2,4]. The Canadian Tobacco, Alcohol and Drugs Survey (CTADS) and the Canadian Student Tobacco, Alcohol and Drugs Survey (CSTADS) showed that from 2013-17 the national prevalence of lifetime use increased from 3.0% to 3.7% for Canadians aged 15 and older. However, national survey data tell only a small part of the story. There is substantial variation in rates of methamphetamine use across smaller jurisdictions, and problematic use tends to be concentrated among populations that are under-represented in national surveys. While the proportion of the general population using methamphetamine remains relatively low, there has been an increase in the availability, use and harms associated with methamphetamine, particularly in the western provinces of Canada

[5]. For example, between 2010 and 2015, the rate of hospitalization due to people seeking treatment for stimulants increased more than 600% in Manitoba, almost 800% in Alberta, and nearly 500% in British Columbia [6]. Presently, there are no national-level statistics to quantify the number of deaths attributable specifically to methamphetamine in Canada. However, from 2008-2017, the number of illicit drug overdose deaths in which methamphetamine was detected increased by 360% in British Columbia, and from 2015-2017, they increased by 260% in Alberta and 170% in Manitoba [5].

Methamphetamine is easily manufactured, accessible and cheap, and the cost has been declining steadily since the 1980s [7]. While there is regional variation across North America, the British Columbia Drug Overdose and Alert Partnership reported in 2014 that 0.1g of methamphetamine costs approximately $10 Cdn [8]. A 2005 report from British Columbia stated that “$5 of methamphetamine can give a high for 24 hours” [9]. Similar prices have been cited in Manitoba, along with the estimation that in urban areas, methamphetamine can be accessed in about 10 minutes [10]. There have even been recent media reports from Saskatchewan that the price of 0.1g of methamphetamine has reached as little as $3 Cdn [11]. The low cost of methamphetamine may be contributing to the increase in use [8].

Specific Populations at Risk of Methamphetamine Use

When discussing specific populations at higher risk of using methamphetamine than the general population, there is also a risk of further marginalizing people who already face numerous challenges. We include a short section here on populations most at risk of methamphetamine use with the intent of bringing to light the specific challenges and barriers they face to develop targeted and appropriate harm reduction and intervention strategies for these groups. The section following this one provides additional context by describing some of the underlying reasons people use methamphetamine.

Certain subpopulations in North America are at greater risk of methamphetamine use than the general population. For example, the number of street-involved youth using methamphetamine in British Columbia has increased [8]. Homelessness has also been identified as a predictor of initiating methamphetamine injection among adult intravenous drug users [12]. Reasons for drug use by these population have been cited as a way to cope with the conditions of homelessness and endure the extremities and stressors of street life, for example, to provide warmth from the cold and to help with wakefulness and self-protection [13].

A higher risk of methamphetamine use among youth who are gay, bisexual, transgender, or who have a history of mental illness or family history of drug use has been reported [14–16]. Youth who identify as LGBTQ may bear a greater risk for drug use for reasons like stigmatization based on their sexual identity and disparities in health and access to care [17]. It has been suggested that higher rates of use may be associated with the subculture of using methamphetamine as a sex drug in the gay community [18,19]. However, risky sexual behaviour is also common among heterosexual methamphetamine users [20,21]. Mental disorders that have been associated with methamphetamine use among youth include conduct disorder, adjustment disorder and ADHD (Russell & Friesen, 2006). As well, a family history of alcohol misuse has been shown to triple the risk of methamphetamine use among young people (Russell & Friesen, 2006).

Higher rates of substance use, including opioids, marijuana, alcohol, and methamphetamine, have also been reported in Indigenous populations versus general populations in Canada and Australia [10,23–26]. In addition to higher substance use rates, Indigenous populations also experience higher rates of mental disorders, suicide attempts and premature mortality as the result of overdoses [27,28]. However, it is important to understand these reports in the context of Canada's violent colonial history and the harms the government has enacted against Indigenous inhabitants of this country. Some of colonialist policies that have targeted Indigenous People include forced family separations, ongoing multi-generational trauma from the day school and residential school systems, institutionalized and structural racism, and a lack of Indigenous-led health and social services. These policies have caused great damage to the health and well-being of Indigenous populations [29], thus we consider them to be contributors to the risk of methamphetamine use.

Reasons People Use Methamphetamine

The research literature includes a small number of studies examining the reasons why people use methamphetamine. Among 30 active users from Cape Town, South Africa, the four major themes for initiating use that emerged were social pressure, lack of recreational or employment opportunities, using/selling to generate income, and coping with high levels of crime [30]. Other users cited weight loss, enhanced sexual performance and prolonged wakefulness as key reasons [31,32]. Canadian Addictions Survey respondents listed "to try out or because of curiosity", "to get high", and "because friends and family were using" as the top three reasons among Canadian youth [4]. And among a small sample of street-involved youth,

reasons for using included wakefulness to protect belongings, enhancement of social interaction, coping with negative emotions and substitution of psychiatric medications [33].

Besides survey data collected directly from people using methamphetamine, there is emerging evidence that the social determinants of health are major contributors to methamphetamine use. For example, data from the Fire Paramedic Service in Winnipeg, Manitoba, show that most emergency calls related to methamphetamine use occur in low-income neighbourhoods with high proportions of unstably housed individuals [10,34].

Health and Social Outcomes of Methamphetamine Use

Methamphetamine users have higher mortality rates than the general population and users of other illicit drugs (except for opioids) [35,36]. In Manitoba, methamphetamine-related deaths have been increasing steadily in recent years [34]. Some of the conditions contributing to methamphetamine-related deaths include cardiovascular complications (e.g. stroke, cardiomyopathy), HIV/AIDS, overdose, cancer and homicide [37–40]. There are also significant psychiatric consequences of methamphetamine use, namely higher risk of depression, anxiety, psychosis and suicide, especially among chronic users [41].

The impact of methamphetamine use on the health system and social services extends intuitively from the health outcomes described above. Although national survey data would seem to indicate that methamphetamine use has remained relatively stable over time, this interpretation stands in stark contrast to the steep rise in methamphetamine-related health and social service use. For example, high demand has been placed on mental health services, acute medical care services and hospitals with respect to methamphetamine-related visits [10,42,43]. There has also been increased demand for addiction treatment and counselling, higher crime rates, and other non-survey indicators of system use [10,44–46]. Given the breadth of system impacts from methamphetamine use, a multi-level response to address the use of the drug and its associated harms is required.

Interventions against Methamphetamine Use

There are several different types of interventions against methamphetamine dependence and its associated harms. In this section, we narrow our focus to examples of interventions in the city of Winnipeg, Manitoba, to better contextualize the study population, the available data and the objectives. Winnipeg (pop ~800,000) is the major urban centre of Manitoba, a central

Canadian province with a population of 1.4M. Outside of Winnipeg, most of the remaining population of Manitoba lives in smaller cities and towns or in rural/remote communities.

Detoxification Programs: Detoxification services help their clients manage short-term drug withdrawal symptoms and promote drug abstinence. In Winnipeg, the community-based Main Street Project operates a free 10-day detox program to help clients decrease the risks associated with drug use and access longer treatment programs [47]. At the city's largest hospital, the Health Sciences Centre, the RR2 outpatient physical medicine and rehab clinic also provides medically monitored detoxification and treatment planning.

Residential Treatment Centres: Individuals in residential treatment centres or "halfway houses" receive medium- to long-term care and monitoring in a home-like setting. Most residential treatment centres require that clients be detoxified and in reasonably good health before admission, and clients are often expected to participate in regular house meetings or step programs during their stay. Residential treatment centres in Winnipeg include Addictions Recovery Inc., the Addictions Foundation of Manitoba, the Behavioural Health Foundation, the Indigenous Women's Healing Centre, St. Raphael Wellness Centre Pritchard House (administered by the Native Addictions Council of Manitoba), the Anchorage Addiction Treatment Program (the Salvation Army), and Morberg House (St. Boniface Street Links) [48–56].

Pharmacological Treatment for Methamphetamine Dependence: The research literature on pharmacological treatment for methamphetamine dependence suggests that there are a number of medications that show promise in reducing methamphetamine cravings (e.g., bupropion, methylphenidate, mirtazapine, naltrexone, topiramate, aripiprazole, and N-acetylcysteine) or methamphetamine-induced psychotic symptoms (e.g., olanzapine) [1,57–64]. However, a number of methodological issues make these study findings difficult to interpret. For example, some trials have included people who use opioid or cocaine in their study populations but people who use methamphetamine behave differently from people who use other illicit drugs [57,58,62]; other limitations include less-than-optimal participant adherence to the medications during the trial [57,59], and the possibility that a single medication (or indeed, an approach that relies only on medication) may be insufficient to address the effects of methamphetamine on multiple body systems [59].

Non-Pharmacological Interventions: Other types of interventions for methamphetamine use include educational campaigns and psychotherapy (including contingency management and

cognitive behavioural therapy) [65,66]. Although the latter approaches have been shown to be at least somewhat successful, therapy is not widely available or accessible to all populations, and for those who underwent psychotherapy, improvements in behaviour were rarely sustained past the counselling period [54,67–69]. Cognitive and behavioral interventions have also been criticized for framing methamphetamine use solely as a behavioural problem, thereby failing to account for the role of social and structural drivers of drug use [70].

Harm Reduction Strategies: Harm reduction strategies are a type of treatment specifically designed to connect people using illicit drugs with services and supports to help them reduce use or stop using. These strategies facilitate the development of relationships with healthcare and social service providers who aim to meet people where they are and respect their recovery goals [71]. Although the ultimate goal of treatment is abstinence, the recovery process is unique for each individual, and a harm reduction approach recognizes that abstinence may not be the top priority for all clients. Treatment may be considered successful if there is any improvement from initial use or a reduction in drug-related harm [62,71], or more broadly, if it addresses the social determinants of health like basic income, housing or violence prevention. Examples of harm reduction strategies for methamphetamine users include safe consumption kits (injecting or smoking equipment) to prevent transmission of blood-borne disease, safe consumption sites (injecting or smoking facilities) to help prevent overdose, and other strategies that help to provide convenient access to other health and social supports [72].

Studying Methamphetamine Use with Administrative Data

For the reasons noted above, national surveys are not ideal for capturing an accurate picture of methamphetamine users. However, the routinely collected administrative data available in Manitoba, Canada, can offer several advantages over surveys for studying methamphetamine use: they describe the whole provincial population (not just a sample); they capture each encounter individuals have with emergency services, the health system and social services, thus providing a broader perspective than survey questions might offer; and they are linkable at the individual person level, making it possible to examine trends in health and social outcomes at a very detailed level.

To date, the number of published studies using administrative data to look at methamphetamine use is limited, particularly in Canada. In the US, researchers have been using ICD-9 or ICD-10 codes to identify individual users; however, there is currently no ICD code that is specific to methamphetamine use disorder. An alternative would be to use a set

of amphetamine- and psychostimulant-related codes. The limitation with this approach is that although the validity of these codes in detecting individuals with drug use disorder has been shown to have high specificity and positive predictive value [73–79], sensitivity is low, suggesting a possible underestimation in prevalence [74,76–78,80]. The authors of these studies recommend that additional sources of information should be used to supplement ICD codes.

Our study has the advantage of an additional dataset not typically included in administrative health data repositories. We are using data from the Winnipeg Fire Paramedic Service (WFPS), which contains information on patient assessments, vital signs and interventions undertaken following an emergency call to a specific location, to construct the study cohort. Our partnership with WFPS and the dataset they have provided represent an important and unique component of the study since the data allow us to identify individuals of interest, follow the outcomes of interventions given in a pre-hospital setting and determine geographical areas of higher risk. We have also partnered with co-investigators from the First Nations Health and Social Secretariat of Manitoba and the Manitoba Métis Federation. Together, we sought approvals to access provincial First Nations and Métis registries and link them to the Repository datasets so that we can conduct analyses by Indigenous identity. The design and interpretation of these distinctions-based analyses will be guided by Indigenous co-investigators on the team and will inform health and social planning and policy priorities for the respective Nations.

Study Rationale

Given the rising prevalence and incidence of methamphetamine use across Canada and the dearth of research evidence, there is an urgent need for studies that address knowledge gaps required to further develop harm reduction and treatment efforts for methamphetamine use, to inform health and social policy, and to support people using methamphetamine. This is particularly true as the impacts of the COVID-19 pandemic become clearer and evidence of worsening trends comes to light [81,82]. In late 2019, we obtained funding from Health Canada for a study using whole-population administrative datasets from Manitoba to describe the population of people who use methamphetamine and evaluate the effectiveness of available interventions in improving access to services and reducing methamphetamine-related harms. Study results will be shared with key audiences though a sophisticated knowledge translation strategy to inform broader policy change and development across Canada.

Methods and Analysis

Study Objectives

Our research objectives are to:

1) **Identify and characterize Winnipeg residents who use methamphetamine.**
   a. Determine the incidence of methamphetamine-related health system contacts in Winnipeg using administrative health data from 2013-2021 (or the most recent year of data available at the time of analysis).
   b. Describe the geographic distribution of methamphetamine-related health system contacts in Winnipeg.
   c. Describe the sociodemographic characteristics of the population who have had one or more methamphetamine-related health system contacts during the study period.
   d. Determine the five-year prevalence and distribution of mental disorders in this population.
2) **Evaluate the services and interventions for methamphetamine in Winnipeg.**
   Among Manitobans who use methamphetamine:
   a. Conduct time trajectory analyses of health and social service use, starting 5 years before first use to 2021 (or the most recent year of data available at the time of analysis).
   b. Evaluate the effectiveness of pharmaceutical interventions (e.g., olanzapine) by looking at the health and social outcomes of those who received the intervention.
3) **Conduct knowledge transfer and exchange to inform health policy.**
   a. Establish a multi-disciplinary Evidence-to-Action (E2A) group comprising Manitobans who use methamphetamine, people providing services to them, and researchers studying substance use.
   b. Hold regular meetings with the E2A group to share and discuss research findings, and to co-build knowledge of effective interventions that improve access to services, reduce harms, and inform policy planning, development and implementation.

Patient and Public Involvement

This study will use routinely collected administrative data to examine outcomes and evaluate existing interventions for people using methamphetamine. The administrative data are de-identified and will not be used directly as a way of recruiting patients or members of the public

to be involved in the study as partners. However, a major component of the study is to develop an "Evidence-to-Action" (E2A) group that includes:

i. people with lived/living experience of methamphetamine use and their family members and loved ones;
ii. First Nations and Métis Elders, Grandmothers, and people with lived/living experience of methamphetamine use;
iii. healthcare workers providing services to Manitobans who use methamphetamine;
iv. decision-makers from the government departments of health and justice;
v. representatives from community organizations, including community health centres, serving Manitobans who use methamphetamine; and
vi. academic researchers.

The E2A group will be led by two research team members with expertise in patient and public engagement, and guided by Pal's (2014) work on policy analysis and activation, which emphasizes a multidisciplinary and iterative process [83]. Pal points to the benefits of a broader and more inclusive approach to policy development for complex problems, such as the high prevalence of methamphetamine use in Manitoba. We will recruit members to the E2A group through patient and public engagement experts at the George and Fay Yee Centre for Healthcare Innovation (CHI), a Canadian Institutes of Health Research (CIHR) Strategy for Patient-Oriented Research (SPOR) Support Unit at the University of Manitoba. The SPOR Support Units provide decision-makers and healthcare providers with the ways and means to connect research with patient needs so that evidence-based solutions can be applied to healthcare. Representatives from the Mental Health Crisis Response Centre in Winnipeg, the Manitoba Association of Community Health Centres, the First Nations Health and Social Secretariat of Manitoba, and the Manitoba Métis Federation will work with CHI to create the E2A group and organize regular meetings. Because we are conducting this work during the COVID-19 pandemic, we are facing a number of challenges as we are not able to meet in person, and we will draw on our team's creativity and resourcefulness in planning virtual sessions that will engage the E2A group and ensure our meetings are a safe space for all participants. Our goal in engaging public rightsholders, service providers and knowledge users in the research is to ensure that their first-hand knowledge and perspectives are represented in the work, that our interpretations of the findings are reflective of their lived or living

experiences, and that our analyses address the critical issues they identify in a culturally sensitive and equity-focused way.

Data Sources

The study will use linked administrative data from the Manitoba Population Research Data Repository at the Manitoba Centre for Health Policy (MCHP). The Repository is a secure information-rich environment containing de-identified individual-level records on nearly the entire population of Manitoba[1]. The Repository data come to MCHP from the Manitoba Department of Health and Seniors Care, who remove all identifying information (such as names and addresses) and attach a scrambled 9-digit personal health identification number to each record before they are transferred to the Repository. Because this numeric identifier is scrambled in the same way for everyone, it serves as a link across all of an individual's records from multiple datasets and over time while protecting the privacy of the person's health information. One of the major advantages of using linked administrative data for retrospective observational studies is their versatility: they can provide broad overviews, give brief snapshot perspectives, or serve as the basis for in-depth investigations into population health issues over the course of many years. The Repository data have been used in many previous population health studies and their validity has been well established [84–88]. Repository databases accessed for this study are listed in **Table 1**.

[1] The Manitoba Population Research Data Repository contains administrative records on more than 99.9% of the Manitoba population. Health records in a few select datasets may be incomplete because they are under federal jurisdiction (e.g., for military personnel, individuals incarcerated in federal prisons, and individuals living in First Nations communities).

Table 1. Key Databases from the Manitoba Population Research Data Repository

Database	Description	Data Extracted
Manitoba Health Insurance Registry	A registry of all Manitobans registered for universal health insurance	Age, sex, coverage status, location of residence, marital and family status, socioeconomic status
Hospital Discharge Abstract Database	Information on hospitalizations	ICD-10 codes for amphetamine-related disorders; harms related to amphetamine use (e.g., poisoning from amphetamine).
Medical Claims	Information on ambulatory physician visits	5-digit ICD-9 codes for amphetamine dependence, amphetamine abuse and poisoning by amphetamines.
Emergency Department Information System (EDIS)	Emergency department data (Winnipeg only)	Keyword searches of triage notes to identify people presenting with an indication of having used methamphetamine.
Winnipeg Fire Paramedic Service Database	Data on emergency response type and patient	Codes for poisoning, overdose, exposure to methamphetamine, and codes for administration of olanzapine; key word searches for methamphetamine.
Diagnostic Services Manitoba Database	Records of hospital laboratory services	Diagnostic laboratory tests where methamphetamine was identified.
Drug Program Information Network (DPIN)	Data on all prescription drugs dispensed from retail pharmacies	Prescriptions, drug characteristics (e.g., type, dose, quantity, class), carriers, prescribers, pharmacy
Prosecutions Information and Scheduling Management (PRISM), Criminal Courts Automated Information Network (CCAIN), and Corrections Offender Management System (COMS)	A registry of all Manitobans' contacts with the criminal justice system	Criminal charges, court appearances, court proceedings and dispositions

Study Cohort

Our method for constructing the study cohort is illustrated in **Figure 1**. At this time, we are using data from the Hospital Discharge Abstract Database, physician visit claims (medical claims), the Emergency Department Information System, the Winnipeg Fire Paramedic Service (WFPS), and Diagnostic Services Manitoba (laboratory data) to identify individuals who came into contact with the health system for reasons related to methamphetamine use between Jan 1, 2013, and Aug 31, 2019. Additional study years will be added as they are made available to MCHP; we plan to conduct the final analyses with data up to December 2021. The WFPS dataset has a large free-text component. Together with WFPS co-investigators, we developed a list of search terms to identify records relating to methamphetamine use (**Appendix 1**) and included those individuals in the study cohort.

Exclusions: Although the repository datasets are nearly all Manitoba-wide, we narrowed the cohort to residents of Winnipeg only, because the WFPS data represent a key part of our strategy to identify methamphetamine-related health system contacts and are available only for residents of the city of Winnipeg. We also excluded individuals who did not have health insurance at the time of their health system contact, individuals younger than 10 years old, and individuals diagnosed with or prescribed medication for ADHD. This latter group were excluded because of the potential overlap in codes that could result from medically indicated use of amphetamines.

To create a comparison group, we matched on age (using birth year ± one year), sex and 3-digit postal code and applied the same exclusion criteria. The preliminary study cohort comprises n=3,597 individuals who had at least one methamphetamine-related health system contact in Winnipeg during the study period (but none in the five years prior to the study period) and n=34,126 individuals in the comparison group.

Analysis Plan

Objectives 1 and 2 will be achieved by conducting analyses using generalized linear models and adjusting for differences between those who had a methamphetamine-related health system contact and their matched comparison group.

Objective 1: Characterizing methamphetamine use in Winnipeg

We will determine the annual incidence of methamphetamine-related health system contacts among Winnipeg residents (i.e., the rate of new methamphetamine-related contacts) between 2013-2021, and then describe the geographic distribution of methamphetamine use in

Winnipeg. With geographic coordinates recorded in the WFPS data, we will identify where individuals received services from WFPS throughout the city, and then generate maps of these locations to identify areas of highest activity. We will describe the cohort's sociodemographic characteristics (listed in **Table 2**). Finally, we will calculate the prevalence (existing cases) of mental disorder diagnoses in the cohort during the five years leading up to the first methamphetamine-related health system contact, and the incidence (new cases) of new mental disorder diagnoses in the year after the first methamphetamine-related health system contact. These outcomes will be presented for the overall cohort and by Indigenous identity (First Nations or Métis). See **Table 3** for a full list of outcome variables and their definitions.

Table 2. Exposure Variables

Variable	Definition
Age at first methamphetamine-related health system contact	Based on birthdate
Biological sex	Male or female
Urbanicity	Urban: Winnipeg and Brandon Rural: Rest of Manitoba
Regional Health Authority of residence	Based on 6-digit postal codes
Income quintile	Based on average household income for their 6-digit postal code
Indigenous identity	Registered First Nations or Métis
Comorbid mental disorder	Diagnosed with mental disorder during the five years leading up to their first methamphetamine use recorded in the administrative data
Justice System Charge	Violent or non-violent criminal charge
Received olanzapine treatment	Based on documented olanzapine administration

Table 3. Outcome Variables

Outcome	Variable	Definition
Mental Disorder Diagnosis* (5 years before to 1 year after index date)	Mood or Anxiety Disorder	At least one hospitalization with a diagnosis of depressive disorder, affective psychoses, neurotic depression, adjustment reaction or bipolar disorder; or at least one hospitalization with a diagnosis for an anxiety state, phobic disorder or obsessive compulsive disorder; or two or more physician visits with a diagnosis of depressive disorder, affective psychoses, adjustment reaction or anxiety disorders.
	Psychotic Disorder	At least one hospitalization with a diagnosis of a psychotic disorder; or at least one physician visit with a diagnosis of a psychotic disorder.
	Personality Disorder	At least one hospitalization with a diagnosis for a personality disorder; or at least one physician visit with a diagnosis for a personality disorder.
	Substance Use Disorder	Comorbid substance use disorders other than a disorder for (or as a result of) methamphetamine use: at least one hospitalization with a diagnosis for alcohol or drug-induced psychosis, alcohol or drug dependence, or nondependent abuse of drugs; or at least one physician visit with a diagnosis for alcohol or drug-induced psychosis, alcohol or drug dependence, or nondependent abuse of drugs.
Health Services Use (5 years before to 1 year after index date)	Winnipeg Fire Paramedic Service (WFPS) encounter	Any engagement with WFPS, regardless of documented methamphetamine use
	Visits to Emergency Department (methamphetamine-related)	Emergency department visit (in Winnipeg) where methamphetamine use was documented
	Hospitalizations (methamphetamine-related)	Hospitalization (in Winnipeg) where methamphetamine use was documented
	Hospitalizations (any)	Any hospitalization (in Winnipeg)
	Physician visits (methamphetamine-related)	Physician visit (in Winnipeg) where methamphetamine use was documented
	Physician visits (any)	Any physician visit (in Winnipeg)
Social Outcomes/ Justice System (5 years before to 1 year after index date)	Justice system charge or court proceeding	At least one charge or court proceeding with the criminal justice system

*See Appendix 2 for diagnosis codes

Objective 2: Evaluating service use and interventions for methamphetamine use in Winnipeg

We will calculate the cohort's rate of health system use by identifying WFPS contacts, visits to the emergency department (ED), hospitalizations and physician visits in the year following the first methamphetamine-related health system contact and the annual rate from first contact until the end of the study. We will evaluate the effectiveness of the pharmaceutical intervention olanzapine given by paramedics in the prehospital setting in reducing adverse outcomes in the ED, including use of chemical or physical restraints, having the patient leave the ED without receiving care or against medical advice, and we will also examine whether the use of olanzapine is associated with length of ED stay, length of time between paramedic arrival and transfer to the ED, and differences in triage classification. We selected olanzapine as the primary focus of this evaluation because it is the antipsychotic medication WFPS received approval to administer in the field starting in late 2019, allowing us to examine patient outcomes before and after it was available as an intervention.

For a future study, we are also seeking access to data from a social/justice system intervention known as the Winnipeg Drug Treatment Court, a program available to people with drug-related offences that takes into account the specific challenges, history and support systems available to offenders and aims to divert them away from incarceration and instead into rehabilitation.

Objective 3: Conducting knowledge transfer and exchange to inform health policy

Our plan for addressing this objective is presented in detail in the Patient and Public Involvement section above and in the Dissemination Plan below.

Evaluation Plan

An evaluation of the research study is one of the requirements for our funding approval from Health Canada and will help answer the question of whether we were able to meet our objectives through this research. We have engaged members of our academic institution who were not involved with the research proposal to lead an arms-length evaluation of the study. A general outline of the evaluation plan they are developing is as follows:

1. Invite research study partners and rightsholders to be part of the evaluation working group. We will aim to have representation from each of the six groups listed in the Patient and Public Involvement section above.

2. Facilitate a discussion with the evaluation working group to decide on the overall purpose of the evaluation. The evaluation should be useful to the group as a whole and provide some tangible benefits.
3. Choose 2-3 evaluation questions for the group to explore. The questions should be feasible within the time and resource limitations of the working group and the study as a whole and should fall within the study's ethical framework (i.e., they should not push ethical boundaries to examine topics people in the working group do not want to discuss). The questions should be linked to specific action, and the working group should be clear what they want to use the answers for.
4. Involve the evaluation working group in an ongoing way throughout the different stages of the study (study design, tool creation and selection of indicators and measures, data analysis, interpretation, knowledge translation).
5. Produce evaluation "outputs" at the end of the study (for example, 'promising practice' guidelines, reports, virtual dashboards) [89]. Findings or outputs from the evaluation will also be included in the final manuscripts.

Ethics and Dissemination Plan

Ethics

Ethics approval was obtained from the University of Manitoba Health Research Ethics Board (Approval No. HS23220 (H2019:361) and No. HS24071 (H2020:323)). The Manitoba Health Information Privacy Committee reviewed the study proposal to ensure individual Manitobans' privacy will be protected throughout the study (Approval No. 2019/2020-32 and No. 2020/2021-43). We have also received approval from Manitoba Health and other respective data providers for linking the administrative data in the Repository for this research study. To ensure that our study proposal aligns with the First Nations principles of OCAP™ (Ownership, Control, Access and Possession) and the Métis principles of OCAS (Ownership, Control, Access and Stewardship), we obtained approvals from the First Nations Health and Social Secretariat of Manitoba's Health Information Research Governance Committee and the Manitoba Métis Federation, respectively.

Dissemination Plan

The members of the E2A group and the Indigenous members of our team will guide our knowledge dissemination and exchange strategy. Because this study was launched during the COVID-19 pandemic, we have initially planned to conduct early meetings by videoconference or teleconference, with later meetings hopefully occurring in person. The E2A group, led by two research team members with expertise in patient and public engagement, will meet with the research team 3-4 times per year. During these meetings, the research team will present plans (e.g., for the study design) or new study results to the group, engage in facilitated discussion about the plans or the interpretation of the results, reflect on feedback from the E2A group and incorporate their expertise, and then follow the E2A group's lead in delivering the findings to target audiences. Through an iterative process, the E2A group will identify the appropriate audiences for the findings and help synthesize new knowledge to refine existing methamphetamine harm reduction and treatment programs, develop decision-making and policy tools to better serve individuals who use methamphetamine, and create knowledge translation tools such as infographics, video clips, media briefs and interactive web platforms. Study progress and findings will also be shared and discussed in community settings where an invitation will be issued through a member of the E2A or research team, such as meetings of First Nations and Métis Knowledge Keepers and Elders, and in traditional academic settings

such as scientific conferences, forums and journal publications.

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Members of the **Methamphetamine Use in Manitoba Research Team** include: Nathan C. Nickel, Jennifer E. Enns, Amy Freier, Scott McCulloch, Mariette Chartier, James Bolton, Roxana Dragan, Charles Burchill, Geoffrey Konrad, Jitender Sareen, Wanda Phillips-Beck, Julianne Sanguins, A. Frances Chartrand, Olena Kloss, Joykrishna Sarkar, Carolyn Shimmin, Neil McDonald, Erin Weldon, Hera Casidsid, Deborah Balogun, Javier Mignone, Aynslie Hinds, Chris Green, Joss Reimer and Joshua Jones.

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Author Contributions

NCN is the principal investigator and wrote the funding application to secure funds for the study with JEE. NCN, JEE and SM are involved in data management and study design decisions. JSarkar and RD are conducting the data analyses. All authors, including MC, HC, JB, DB, RD, GK, WP-B, JSanguins, CS, NM, JM, and AH and the other members of the Methamphetamine Use in Manitoba Research Team, are involved in the interpretation and contextualizing of study results as they become available. AF is leading the knowledge translation strategy. JEE drafted this manuscript with support from HC, DB, SM, AF and NCN. All other authors critically reviewed and approved the final version.

Data Sharing Statement

Data used in this study were derived from administrative health and social data as a secondary use. The data were provided to the Manitoba Centre for Health Policy (MCHP) under specific data sharing agreements only for approved use at MCHP. The original source data is not owned by the researchers or MCHP and as such cannot be provided to a public repository. The original data source and approval for use have been noted in the acknowledgments of the article. Where necessary, source data specific to this article or project may be reviewed at MCHP with the consent of the original data providers, along with the required privacy and ethical review bodies.

Competing interests:

All authors declare that they have not received any support from any organizations for the submitted work, that they have no financial relationships with any organizations that might have an interest in the submitted work in the previous three years, and that they have not engaged in other relationships or activities that could appear to have influenced the submitted work.

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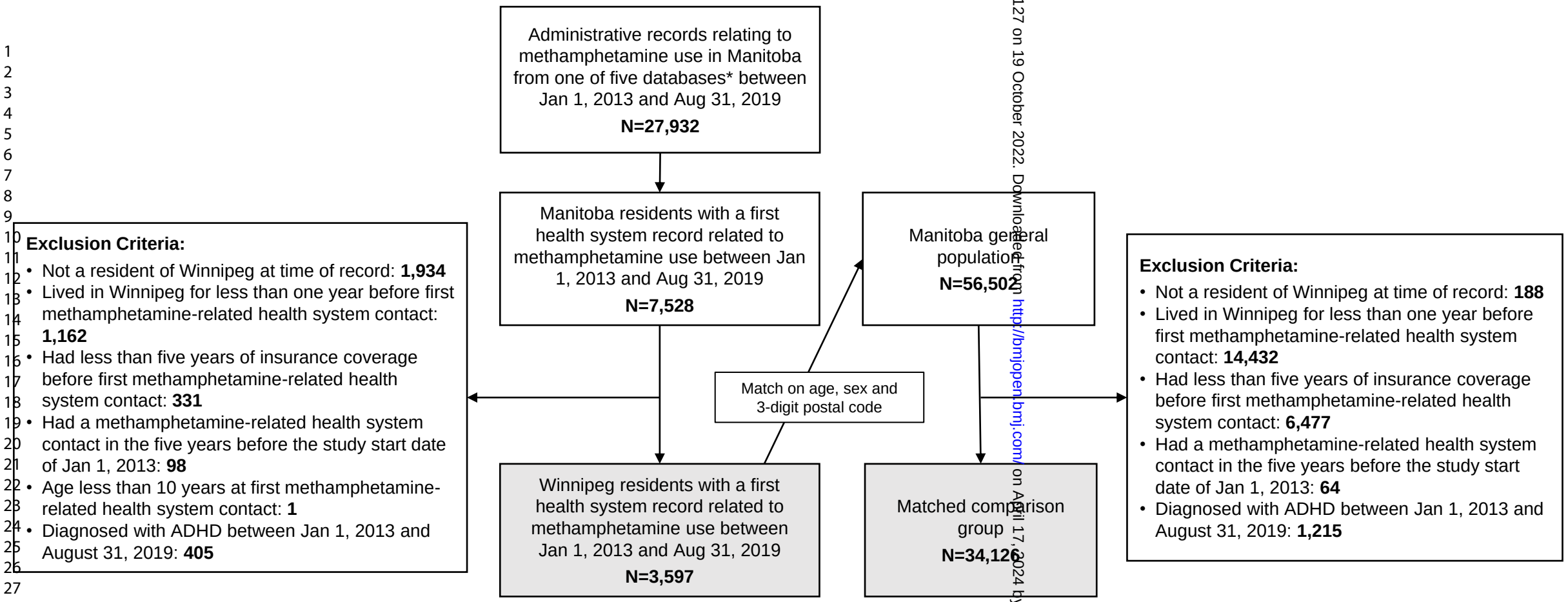

Figure 1. Cohort Development Flowchart

* The five databases were the Winnipeg Fire Paramedic Service Database, the Emergency Department Information System, Medical Claims Data, the Hospital Discharge Abstract Database, and the Diagnostic Services Manitoba Database.

Appendix 1: Search Strategy used to Identify Records relating to Methamphetamine Use in the Winnipeg Fire Paramedic Service Dataset

We searched for indications of methamphetamine use in the database of WFPS electronic patient care reports. Two research team members did a preliminary review of approximately 15% of free-text fields to develop inclusion criteria. All remaining records were reviewed by one team member with assistance from a WFPS analyst. A portion (10%) of these records was randomly selected to be independently coded by both reviewers; decisions on these records showed very good agreement: kappa = 0.865 (95% CI 0.814 - 0.916), p < 0.0005.

Search Terms:

'amphetamine'
'amphetamines'
'amphetimine'
'amphetimens'
'cristalmeth'
'crystalmeth'
'ivmeth'
'meth'
'nmeth'
'methamphetamine'
'methampetamine'
'methamhetamine'
'methamphetaminee'
'methamphetamines'
'methamphetmine'
'methanphetamine'
'methapmhetamine'
'methemphetamine'
'metamphetamines'
'metamphetamoine'
'meth1'
'meth12'
'methamp'
'methampheta'
'methamphetatime'
'methamphetimine'
'methamphetimines'
'methamphitamine'
'methaphetamine'

Appendix 2: Detailed Definitions of Mental Disorder Diagnoses

Mood or Anxiety Disorder

One or more hospitalizations with a diagnosis for depressive disorder, affective psychoses, neurotic depression, adjustment reaction or bipolar disorder (looking at ICD-10 only) ICD-10-CA codes F30, F31, F32, F33, F34, F38, F41.2, F43, F53.0; OR one or more hospitalizations with a diagnosis for an anxiety state, phobic disorders or obsessive-compulsive disorders: ICD-10-CA codes F40, F41.0, F41.1, F41.3, F41.8, F41.9, F42;

or

Two or more physician visits with a diagnosis for depressive disorder or affective psychoses: ICD-9-CM codes 296, 311; OR 2 or more physician visits with a diagnosis for adjustment reaction: ICD-9-CM code 309; OR 2 or more physician visits with a diagnosis for anxiety disorders (including dissociative and somatoform disorders)*: ICD-9-CM code 300.

Psychotic Disorder

One or more hospitalizations with a diagnosis of psychotic disorders: ICD-9-code - 295 (schizophrenic disorders) or 297 (delusional disorders) or 298 (other nonorganic psychoses): ICD-10 codes - F11.5, F12.5, F13.5, F14.5, F15.5, F16.5, F18.5, F19.5 (psychotic disorders due to opioids, cannabinoids…etc. do not include F17.5 psychotic disorders due to tobacco), F20 (schizophrenia), F22 (delusional disorder), F23 (acute and transient psychotic disorders), F24 (induced delusional disorder), F25 (schizoaffective disorders), F28 (other nonorganic psychotic disorders), F29 (unspecified nonorganic psychosis);

or

One or more physician visits with a diagnosis of psychotic disorders: ICD-9-code - 295 (schizophrenic disorders) or 297 (delusional disorders) or 298 (other nonorganic psychoses).

Personality Disorder

One or more hospitalization with a diagnosis for personality disorders: ICD-10-CA codes: F21, F60, F61, F62, OR F69

or

One or more physician visits with a diagnosis of personality disorders: ICD-9-CM code: 301

Substance Use Disorder

At least one hospitalization with a diagnosis for alcohol or drug-induced psychosis, alcohol or drug dependence, or nondependent abuse of drugs: ICD-9-CM codes 291 (alcoholic psychoses), 292 (drug psychoses), 303 (alcohol dependence), 304 (drug dependence), or 305 (nondependent abuse of drugs) or ICD-10-CA codes F10-F19, F55, Z50.2 and Z50.3 (ICD-9-CM: 291, 292, 303, 304, 305

ICD-10-CA: F10-F19, F55, Z50.2, Z50.3)

or

At least one physician visit with a diagnosis for alcohol or drug-induced psychosis, alcohol or drug dependence, or nondependent abuse of drugs: ICD-9-CM codes 291 (alcoholic psychoses),

292 (drug psychoses), 303 (alcohol dependence), 304 (drug dependence), or 305 (nondependent abuse of drugs)

Removed Meth related diagnostics from med and hosp: med: diag_icd5 in: ('3044', '30440', '30441', '30442', '30443', '30570', '30571', '30572', '30573', '96972'); hosp: ('F15', 'T436').

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Characterizing methamphetamine use to inform health and social policies in Manitoba, Canada: A protocol for a retrospective cohort study using linked administrative data

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Characterizing methamphetamine use to inform health and social policies in Manitoba, Canada: A protocol for a retrospective cohort study using linked administrative data

Authors and Affiliations:

[1,2]Nathan C. Nickel, [1]Jennifer E. Enns, [1]Amy Freier, [1]Scott McCulloch, [1,2]Mariette Chartier, [1,2]Hera J.M. Casidsid, [1,2]Oludolapo Deborah Balogun, [3]Drew Mulhall, [1]Roxana Dragan, [1]Joykrishna Sarkar, [4]James M. Bolton, [4]Geoffrey Konrad, [5,6]Wanda Phillips-Beck, [7]Julianne Sanguins, [8]Carolyn Shimmin, [9]Neil McDonald, [2]Javier Mignone, [2]Aynslie Hinds, and the Methamphetamine Use in Manitoba Research Team*

[1]Manitoba Centre for Health Policy, Dept of Community Health Sciences, Rady Faculty of Health Sciences, University of Manitoba
[2]Dept of Community Health Sciences, Rady Faculty of Health Sciences, University of Manitoba
[3]Dept of Surgery, Rady Faculty of Health Sciences, University of Manitoba
[4]Dept of Psychiatry, Rady Faculty of Health Sciences, University of Manitoba
[5]College of Nursing, Rady Faculty of Health Sciences, University of Manitoba
[6]First Nations Health and Social Secretariat of Manitoba
[7]Manitoba Métis Federation
[8]Centre for Healthcare Innovation, University of Manitoba
[9]Winnipeg Fire and Paramedic Service

Corresponding Author

Mr. Scott McCulloch
Manitoba Centre for Health Policy
Department of Community Health Sciences
408-727 McDermot Ave
Winnipeg, Manitoba, Canada
R3E 3P5
scott.mcculloch@umanitoba.ca
1-204-789-3669

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Abstract

Introduction

Rising use of methamphetamine is causing significant public health concern in Canada. The biological and behavioural effects of methamphetamine range from wakefulness, vigour and euphoria to adverse physical health outcomes like myocardial infarction, hemorrhagic stroke, arrhythmia and seizure. It can also cause severe psychological complications such as psychosis. National survey data point to increasing rates of methamphetamine use, as well as increasing ease of access and serious methamphetamine-related harms. There is an urgent need for evidence to address knowledge gaps, provide direction to harm reduction and treatment efforts, and inform health and social policies for people using methamphetamine. This protocol describes a study that aims to address this need for evidence.

Methods

The study will use linked, whole-population, de-identified administrative data from the Manitoba Population Research Data Repository. The cohort will include individuals in the city of Winnipeg, Manitoba, who came into contact with the health system for reasons related to methamphetamine use from 2013-2021 and a comparison group matched on age, sex and geography. We will describe the cohort's sociodemographic characteristics, calculate incidence and prevalence of mental disorders associated with methamphetamine use, and examine rates of health and social service use. We will evaluate the use of olanzapine pharmacotherapy in reducing adverse emergency department outcomes. In partnership with Indigenous co-investigators, outcomes will be stratified by First Nations and Métis identity.

Ethics and Dissemination

The study was approved by the University of Manitoba Health Research Ethics Board and access datasets has been granted by all data providers. We also received approval from the First Nations Health and Social Secretariat of Manitoba's Health Information Research Governance Committee and the Manitoba Métis Federation. Dissemination will be guided by an "Evidence 2 Action" group of public rightsholders, service providers and knowledge users who will ensure that the analyses address the critical issues.

Strengths and Limitations

- One of the major strengths of the study is the use of a de-identified, linkable population-based administrative data repository that allows identification of all methamphetamine-related contacts with the health system and provides detailed information on sociodemographic characteristics and other health service use; in particular, new data from emergency medical service providers (e.g., paramedics) in Winnipeg extends the reach of the existing data repository and addresses the selection bias associated with capturing only hospital/physician contacts.
- Our study features a well-developed patient and public engagement strategy, an evaluation component and a knowledge exchange plan that aims to improve access to services for people using methamphetamine and inform policy planning, development and implementation across Manitoba.
- Strong partnerships with First Nations and Métis partners enable us to stratify our analyses by these important sub-populations.
- Studies relying on administrative data may underestimate the burden of methamphetamine use and the prevalence of comorbid mental disorders in the population, because they do not capture information from individuals unless or until they come into contact with the health system. The data cannot be used to detect first use of methamphetamine, only first methamphetamine-related health system contact.
- Our data on methamphetamine-related health system contacts are for the city of Winnipeg, Manitoba, since we are using a dataset from the Winnipeg Fire Paramedic Service to develop the study cohort, thus the results may not be generalizable to rural areas.

Introduction

Methamphetamine is a widely-used illicit drug that is causing significant public health concern globally [1]. Methamphetamine is a central nervous system stimulant once used in the treatment of narcolepsy, obesity and ADHD; however, unlike related amphetamines used for similar purposes, methamphetamine is neurotoxic and causes a range of biological and behavioural effects such as wakefulness, vigour, euphoria, improved sexual performance and reduced appetite [2–4]. Acute signs of physical health complications may include hypertension, tachycardia, hyperthermia and rapid breathing, and severe complications can include lethal hyperthermia, myocardial infarction, hemorrhagic or ischemic stroke, arrhythmia, seizures and death. Methamphetamine can also cause severe psychiatric symptoms such as psychosis, sometimes persisting after the acute intoxication period and becoming permanent with chronic use of the drug [5,6]. Depending on the route of administration and dose, methamphetamine can cause a “high” lasting for up to 12 hours, and repeated use can allow the user to stay awake on “a run” for more than a week [7]. A person using methamphetamine may experience a post-intoxication “crash” for several days, manifesting as depressive symptoms, fatigue, confusion, headaches, increased sleep and irritability. Dependent users go through physiological withdrawal for 1-2 weeks after cessation of use, experiencing similar symptoms as well as anxiety, poor concentration/memory, aches, pains and severe cravings [3].

Methamphetamine Use in Canada

In Canada, national survey data point to rising trends in methamphetamine use. The 2004 Canadian Addiction Survey revealed 6.4% of Canadians aged 15 and older reported lifetime methamphetamine (or “speed”) use, up from 1.8% in 1989, and 0.8% reported using methamphetamine in the previous year [7,8]. The Canadian Tobacco, Alcohol and Drugs Survey (CTADS) and the Canadian Student Tobacco, Alcohol and Drugs Survey (CSTADS) showed that from 2013-17 the national prevalence of lifetime use increased from 3.0% to 3.7% for Canadians aged 15 and older. However, national survey data tell only a small part of the story. There is substantial variation in rates of methamphetamine use across smaller jurisdictions, and problematic use tends to be concentrated among populations that are under-represented in national surveys. While the proportion of the general population using methamphetamine remains relatively low, there has been an increase in the availability, use and harms associated with methamphetamine, particularly in the western provinces of Canada [9]. For example, between 2010 and 2015, the rate of hospitalization due to people seeking

treatment for stimulants increased more than 600% in Manitoba, almost 800% in Alberta, and nearly 500% in British Columbia [10]. Presently, there are no national-level statistics to quantify the number of deaths attributable specifically to methamphetamine in Canada. However, from 2008-2017, the number of illicit drug overdose deaths in which methamphetamine was detected increased by 360% in British Columbia, and from 2015-2017, they increased by 260% in Alberta and 170% in Manitoba [9].

Indigenous Populations at Risk of Methamphetamine Use

When discussing specific populations at higher risk of using methamphetamine than the general population, there is also a risk of further marginalizing people who already face numerous challenges. We include a short section here on Indigenous populations with the intent of bringing to light some of the specific challenges and barriers they face, and with the aim of using the evidence generated in this study to develop targeted and appropriate harm reduction and intervention strategies.

Canada's colonial history continues to shape health and social outcomes for Indigenous peoples in Canada [11]. Government policies that have caused harm to the health and well-being of Indigenous families include forced family separations (e.g. the 'Sixties Scoop'), forced attendance at day schools and residential schools where many Indigenous children suffered physical, emotional and sexual abuse, institutionalized and structural racism, and a lack of Indigenous-led health and social services [12–15]. Many families and communities who were subject to these policies and practices are still experiencing ongoing multi-generational trauma today [16]. This trauma is a major driver of the higher rates of poor mental health [17–22] and substance use [23,24] documented among Indigenous people.

Health and Social Outcomes of Methamphetamine Use

Methamphetamine users have higher mortality rates than the general population and users of other illicit drugs (except for opioids) [25,26]. In Manitoba, methamphetamine-related deaths have been increasing steadily in recent years [27]. Some of the conditions contributing to methamphetamine-related deaths include cardiovascular complications (e.g. stroke, cardiomyopathy), HIV/AIDS, overdose, cancer and homicide [28–31]. There are also significant psychiatric consequences of methamphetamine use, namely higher risk of depression, anxiety, psychosis and suicide, especially among chronic users [4].

The impact of methamphetamine use on the health system extends from the health outcomes described above. Although national survey data in Canada would seem to indicate that methamphetamine use has remained relatively stable over time, this interpretation stands in stark contrast to the steep rise in methamphetamine-related health and social service use documented in other studies. For example, high demand has been placed on mental health services, acute medical care services and hospitals with respect to methamphetamine-related visits [22,32,33]. There has also been increased demand for addiction treatment and counselling, higher crime rates, and other non-survey indicators of system use [22,34–36]. Given the substantial health system impacts from methamphetamine use, a multi-level response to address the use of the drug and its associated harms is required.

Interventions to Reduce Methamphetamine Use

There are several different types of inpatient and outpatient interventions aiming to reduce methamphetamine dependence and its associated harms [37,38]. For example, detoxification programs help their clients manage short-term drug withdrawal symptoms and promote drug abstinence. Residential treatment centres, sometimes called “halfway houses”, provide medium- to long-term care and monitoring in a home-like setting. Other interventions for methamphetamine use include educational campaigns, psychotherapy (including contingency management and cognitive behavioural therapy), and harm reduction strategies. The availability of these interventions varies across Canadian cities and towns; a brief summary of the local Manitoba context can be found in **Appendix 1**.

Research on pharmacological treatments for methamphetamine dependence (e.g., bupropion, methylphenidate, mirtazapine, naltrexone, topiramate, aripiprazole, and N-acetylcysteine) is ongoing [2,38–45], but to date there are no effective or approved medications to reduce methamphetamine cravings [46]. Olanzapine, an antipsychotic prescription drug used to treat schizophrenia, bipolar disorder and depression [45,47], is currently being used by paramedics in Manitoba to treat methamphetamine-induced psychotic symptoms [48].

Studying Methamphetamine Use with Administrative Data

For the reasons noted above, national surveys are not ideal for capturing an accurate picture of methamphetamine users. However, the routinely collected administrative data available in Manitoba, Canada, can offer several advantages over surveys for studying methamphetamine use: they describe the whole provincial population (not just a sample); they capture each

encounter individuals have with emergency services, the health system and social services, thus providing a broader perspective than survey questions might offer; and they are linkable at the individual person level, making it possible to examine trends in health and social outcomes at a very detailed level. To date, the number of published studies using administrative data to look at methamphetamine use is limited, particularly in Canada. In the US, researchers have been using ICD-9 or ICD-10 codes to identify individual users; however, there is currently no ICD code that is specific to methamphetamine use disorder. An alternative would be to use a set of amphetamine- and psychostimulant-related codes. The limitation with this approach is that although the validity of these codes in detecting individuals with drug use disorder has been shown to have high specificity and positive predictive value [49–55], sensitivity is low, suggesting a possible underestimation in prevalence [50,52–54,56]. The authors of these studies recommend that additional sources of information should be used to supplement ICD codes.

Given the rising prevalence and incidence of methamphetamine use across Canada, there is an urgent need for studies that address the knowledge gaps identified here to further develop harm reduction and treatment efforts for methamphetamine use, to inform health and social policy, and to support people using methamphetamine. This is particularly true as the impacts of the COVID-19 pandemic become clearer and evidence of worsening trends comes to light [57,58]. In late 2019, we obtained funding from Health Canada for a study using whole-population administrative datasets from Manitoba to describe the population of people who use methamphetamine and evaluate the effectiveness of available interventions in improving access to services and reducing methamphetamine-related harms. Study results will be shared with key audiences though a sophisticated knowledge translation strategy to inform broader policy change and development across Canada.

Methods and Analysis

Study Objectives

Our research objectives are to:

1) **Describe the sociodemographic characteristics of individuals with a history of methamphetamine use.**

a. Determine the incidence of methamphetamine-related health system contacts in Winnipeg using administrative health data from 2013-2021 (or the most recent year of data available at the time of analysis).
b. Describe the geographic distribution of methamphetamine-related health system contacts in Winnipeg.
c. Describe the sociodemographic characteristics of the population who have had one or more methamphetamine-related health system contacts during the study period.

2) Evaluate health services use and pharmaceutical interventions for methamphetamine use in Winnipeg.

Among Manitobans who use methamphetamine:

a. Determine the prevalence of diagnosed mental disorders in the five years before first methamphetamine-related health system contact, and the incidence of diagnosed mental disorders in the year after first methamphetamine-related health system contact.
b. Conduct time trajectory analyses of health service use (contacts with paramedics or other emergency services; emergency department (ED) admissions; hospital admissions; physician visits), starting five years before first methamphetamine-related health system contact to 2021 (or the most recent year of data available at the time of analysis).
c. Evaluate the effectiveness of the pharmaceutical intervention olanzapine by looking at ED outcomes of those who received the intervention.

3) Conduct knowledge transfer and exchange to inform health policy.

a. Establish a multi-disciplinary Evidence-to-Action (E2A) group comprising Manitobans who use methamphetamine, people providing services to them, and researchers studying substance use.
b. Hold regular meetings with the E2A group to share and discuss research findings, and to co-build knowledge of effective interventions that improve access to services, reduce harms, and inform policy planning, development and implementation.

Patient and Public Involvement

This study will use routinely collected administrative data to examine outcomes and evaluate existing interventions for people using methamphetamine. The administrative data are de-identified and will not be used directly as a way of recruiting patients or members of the public

to be involved in the study as partners. However, a major component of the study is to develop an "Evidence-to-Action" (E2A) group that includes:

i. people with lived/living experience of methamphetamine use and their family members and loved ones;
ii. First Nations and Métis Elders, Grandmothers, and people with lived/living experience of methamphetamine use;
iii. healthcare workers providing services to Manitobans who use methamphetamine;
iv. decision-makers from the government departments of health and justice;
v. representatives from community organizations, including community health centres, serving Manitobans who use methamphetamine; and
vi. academic researchers.

The E2A group will be led by two research team members with expertise in patient and public engagement, and guided by Pal's (2014) work on policy analysis and activation, which emphasizes a multidisciplinary and iterative process [59]. Pal points to the benefits of a broader and more inclusive approach to policy development for complex problems, such as the high prevalence of methamphetamine use in Manitoba. We will recruit members to the E2A group through patient and public engagement experts at the George and Fay Yee Centre for Healthcare Innovation (CHI), a Canadian Institutes of Health Research (CIHR) Strategy for Patient-Oriented Research (SPOR) Support Unit at the University of Manitoba. The SPOR Support Units provide decision-makers and healthcare providers with the ways and means to connect research with patient needs so that evidence-based solutions can be applied to healthcare. Representatives from the Mental Health Crisis Response Centre in Winnipeg, the Manitoba Association of Community Health Centres, the First Nations Health and Social Secretariat of Manitoba, and the Manitoba Métis Federation will work with CHI to create the E2A group and organize regular meetings. Because we are conducting this work during the COVID-19 pandemic, we are facing a number of challenges as we are not able to meet in person, and we will draw on our team's creativity and resourcefulness in planning virtual sessions that will engage the E2A group and ensure our meetings are a safe space for all participants. Our goal in engaging public rightsholders, service providers and knowledge users in the research is to ensure that their first-hand knowledge and perspectives are represented in the work, that our interpretations of the findings are reflective of their lived or living

experiences, and that our analyses address the critical issues they identify in a culturally sensitive and equity-focused way.

Data Sources

The study will use linked administrative data from the Manitoba Population Research Data Repository at the Manitoba Centre for Health Policy (MCHP). The Repository is a secure information-rich environment containing de-identified individual-level records on nearly the entire population of Manitoba[1]. The Repository data come to MCHP from the Manitoba Department of Health and Seniors Care, who remove all identifying information (such as names and addresses) and attach a scrambled 9-digit personal health identification number to each record before they are transferred to the Repository. Because this numeric identifier is scrambled in the same way for everyone, it serves as a link across all of an individual's records from multiple datasets and over time while protecting the privacy of the person's health information. One of the major advantages of using linked administrative data for retrospective observational studies is their versatility: they can provide broad overviews, give brief snapshot perspectives, or serve as the basis for in-depth investigations into population health issues over the course of many years. However, administrative data also have important limitations, the major one being that they are not created for research purposes; when used in research, they often lack valuable context needed to interpret the findings. We are addressing this limitation by involving our E2A group in the interpretation of the research and development of knowledge translation products. The Repository data have been used in many previous population health studies and their validity has been well established [60–64]. Repository databases accessed for this study are listed in **Table 1**.

Our study has the advantage of using a few additional datasets not typically included in administrative health data repositories. First, we are using data from the Winnipeg Fire Paramedic Service (WFPS), which contains information on patient assessments, vital signs and interventions undertaken following an emergency call to a specific location, to construct the study cohort. Our partnership with WFPS and the dataset they have provided represent an important and unique component of the study since the data allow us to identify individuals of interest, follow the outcomes of interventions given in a pre-hospital setting and determine

[1] The Manitoba Population Research Data Repository contains administrative records on more than 99.9% of the Manitoba population. Health records in a few select datasets may be incomplete because they are under federal jurisdiction (e.g., for military personnel, individuals incarcerated in federal prisons, and individuals living in First Nations communities).

geographical areas of higher risk. Second, we have also partnered with co-investigators from the First Nations Health and Social Secretariat of Manitoba and the Manitoba Métis Federation. Together, we sought approvals to access provincial First Nations and Métis registries and link them to the Repository datasets so that we can conduct analyses by Indigenous identity. The design and interpretation of these distinctions-based analyses will be guided by Indigenous co-investigators on the team and will inform health and social planning and policy priorities for the respective Nations.

Table 1. Key Databases from the Manitoba Population Research Data Repository

Database	Description	Data Extracted
Manitoba Health Insurance Registry	A registry of all Manitobans registered for universal health insurance	Age, sex, coverage status, location of residence, marital and family status, socioeconomic status
Hospital Discharge Abstract Database	Information on hospitalizations	ICD-10 codes for amphetamine-related disorders; harms related to amphetamine use (e.g., poisoning from amphetamine).
Medical Claims	Information on ambulatory physician visits	5-digit ICD-9 codes for amphetamine dependence, amphetamine abuse and poisoning by amphetamines.
Emergency Department Information System (EDIS)	Emergency department data (Winnipeg only)	Keyword searches of triage notes to identify people presenting with an indication of having used methamphetamine.
Winnipeg Fire Paramedic Service Database	Data on emergency response type and patient	Codes for poisoning, overdose, exposure to methamphetamine, and codes for administration of olanzapine; key word searches for methamphetamine.
Diagnostic Services Manitoba Database	Records of hospital laboratory services	Diagnostic laboratory tests where methamphetamine was identified.
Drug Program Information Network (DPIN)	Data on all prescription drugs dispensed from retail pharmacies	Prescriptions, drug characteristics (e.g., type, dose, quantity, class), carriers, prescribers, pharmacy

Study Cohort

Our method for constructing the study cohort is illustrated in **Figure 1**. We are using data from the Hospital Discharge Abstract Database, physician visit claims (medical claims), the Emergency Department Information System, the Winnipeg Fire Paramedic Service (WFPS), and Diagnostic Services Manitoba (laboratory data) to identify individuals who came into contact with the health system for reasons related to methamphetamine use between Jan 1, 2013, and Aug 31, 2019. Additional study years will be added as they are made available to MCHP; we plan to conduct the final analyses with data up to December 2021. The WFPS dataset has a large free-text component. Together with WFPS co-investigators, we developed a list of search terms to identify records relating to methamphetamine use (**Appendix 2**) and included those individuals in the study cohort. We defined an individual's *first* methamphetamine-related health system contact (index date) as the first contact occurring from 2013-2019 in at least five years (i.e. the individual had no other methamphetamine-related health system contacts in the five years prior to the index date).

Exclusions: Although most of the repository datasets are Manitoba-wide, we narrowed the cohort to residents of Winnipeg only, because the WFPS data represent a key part of our strategy to identify methamphetamine-related health system contacts and are available only for residents of the city of Winnipeg. We excluded individuals who did not have health insurance at the time of their health system contact, individuals younger than 10 years old, and individuals diagnosed with or prescribed medication for ADHD.

Several important limitations of this cohort development strategy should be noted. The first is that ICD codes from hospital and physician claims data are not detailed enough to distinguish between methamphetamine and closely related amphetamine- and methylphenidate-based medications for ADHD. This could result in people being treated for ADHD being included in the study cohort. To minimize ascertainment bias, we excluded individuals diagnosed with or being treated for ADHD, but because of strong links between ADHD, mental health issues and substance use [65,66], we will conduct a sensitivity analysis to determine whether this exclusion significantly impacts our findings. A second limitation is that only people interacting with the health system following methamphetamine use will be included in the study. However, even in this smaller population of Manitobans, the planned analysis and the input of the E2A group will still contribute to our understanding of the burden of methamphetamine use in

Manitoba, and will generate important evidence to reduce stigma and provide better care for people using methamphetamine.

Comparison Group: To create a comparison group, we matched 1:10 on age (using birth year ± one year), sex and 3-digit postal code and applied the same exclusion criteria. The preliminary study cohort comprises n=3,597 individuals who had at least one methamphetamine-related health system contact in Winnipeg during the study period (but none in the five years prior to the study period) and n=34,126 individuals in the comparison group. When we examine the outcomes in First Nations and Metis population separately, we will also match on Indigenous identity.

Once the study cohort has been finalized, we will assess the sensitivity of the ICD-9 and ICD-10 codes for ascertaining methamphetamine-related health system contacts and will report descriptive data on the percent of the study cohort identified from each of the five databases.

Analysis Plan

Objective 1: Describing the sociodemographic characteristics of individuals with a history of methamphetamine use

a. We will determine the annual incidence of methamphetamine-related health system contacts among Winnipeg residents (i.e., the rate of new methamphetamine-related contacts) between 2013-2021.
b. We will describe the geographic distribution of methamphetamine use in Winnipeg. With geographic coordinates recorded in the WFPS data, we will identify where individuals received services from WFPS throughout the city, and then generate maps of these locations to identify community group areas of highest activity.
c. We will describe the cohort's sociodemographic characteristics, as listed in **Table 2**.

Objective 2: Examining health service use and interventions for methamphetamine use

a. We will use generalized linear mixed models with binomial or negative binomial distributions (depending on model fit statistics) to model rates of mental health-related health system contacts in the study population. In these models, we will adjust for any remaining differences between those who had a methamphetamine-related health system contact and their matched comparison group (e.g., differences in age, physical health comorbidities). To examine whether the study population had pre-existing mental disorders before their first methamphetamine-related health system contact, we will

calculate the prevalence (existing cases) of mental disorder diagnoses in the cohort during the previous five years. To examine whether the study population had new (incident) mental disorder diagnoses after their first methamphetamine-related health system contact, we will calculate the incidence of mental disorder diagnoses in the cohort during the following year. Outcomes (shown in **Table 3**) will be presented for the overall cohort and by Indigenous identity (First Nations or Métis). These analyses will provide evidence to guide healthcare practitioners and health policy decision makers in addressing mental health issues earlier to prevent possible escalation to substance use (including meth use).

b. Using similar modelling techniques as described above (and additionally adjusting for differences in mental health comorbidities), we will calculate the cohort's rate of health system use (WFPS contacts, visits to the ED, hospitalizations and physician visits) in the year following the first methamphetamine-related health system contact and the annual rate from first contact until the end of the study (also see **Table 3**). These analyses will provide evidence of current health system needs and inform resource planning by health system decision makers.
c. Using an interrupted time series analysis with an additional analysis of concurrent unexposed controls (i.e., people who were not provided olanzapine), we will evaluate the effectiveness of the pharmaceutical intervention olanzapine given by paramedics in the prehospital setting in reducing adverse outcomes in the ED. We will compare outcomes before and after olanzapine was available as an intervention and compare individuals who did and did not receive olanzapine once it was available. Outcomes we plan to measure include: use of chemical or physical restraints, having the patient leave the ED without receiving care or against medical advice, and whether the use of olanzapine is associated with length of ED stay, length of time between paramedic arrival and transfer to the ED, and differences in triage classification (**Table 3**). We selected olanzapine as the primary focus of this evaluation because it is the antipsychotic medication WFPS received approval to administer in the field starting in late 2019, allowing us to examine patient outcomes before and after it was available as an intervention. These analyses will provide evidence of the utility of olanzapine in improving ED outcomes for people with methamphetamine-related psychosis symptoms.

Objective 3: Conducting knowledge transfer and exchange to inform health policy

Our plan for addressing this objective is presented in detail in the Patient and Public Involvement section above and in the Dissemination Plan below.

Table 2. Sociodemographic Variables

Variable	Definition
Age at first methamphetamine-related health system contact	Based on birthdate
Biological sex	Male or female
Urbanicity	Urban: Winnipeg and Brandon Rural: Rest of Manitoba
Regional Health Authority of residence	Based on 6-digit postal codes
Income quintile	Based on average household income for their 6-digit postal code
Indigenous identity	Registered First Nations or Métis
Comorbid mental disorder	Diagnosed with mental disorder during the five years leading up to their first methamphetamine use recorded in the administrative data
Received olanzapine treatment	Based on documented olanzapine administration in the WFPS data

Table 3. Outcome Variables

Outcome	Variable	Definition
Mental Disorder Diagnosis* (5 years before to 1 year after index date)	Mood or anxiety disorder	At least one hospitalization with a diagnosis of depressive disorder, affective psychoses, neurotic depression, adjustment reaction or bipolar disorder; or at least one hospitalization with a diagnosis for an anxiety state, phobic disorder or obsessive compulsive disorder; or two or more physician visits with a diagnosis of depressive disorder, affective psychoses, adjustment reaction or anxiety disorders.
	Psychotic disorder	At least one hospitalization with a diagnosis of a psychotic disorder; or at least one physician visit with a diagnosis of a psychotic disorder.
	Personality disorder	At least one hospitalization with a diagnosis for a personality disorder; or at least one physician visit with a diagnosis for a personality disorder.
	Substance use disorder	Comorbid substance use disorders other than a disorder for (or as a result of) methamphetamine use: at least one hospitalization with a diagnosis for alcohol or drug-induced psychosis, alcohol or drug dependence, or nondependent abuse of drugs; or at least one physician visit with a diagnosis for alcohol or drug-induced psychosis, alcohol or drug dependence, or nondependent abuse of drugs.
Other Health Services Use (5 years before to 1 year after index date)	Winnipeg Fire Paramedic Service contact	Any engagement with WFPS, regardless of documented methamphetamine use
	Methamphetamine-related ED visits	Emergency department visit (in Winnipeg) where methamphetamine use was documented
	Methamphetamine-related hospitalizations	Hospitalization (in Winnipeg) where methamphetamine use was documented
	Any hospitalizations	Any hospitalization (in Winnipeg)
	Methamphetamine-related physician visits	Physician visit (in Winnipeg) where methamphetamine use was documented
	Any physician visits	Any physician visit (in Winnipeg)
ED Outcomes after Olanzapine Administration	Use of chemical or physical restraints	Documentation of chemical or physical restraint use in the WFPS data
	Patient left the ED	From ED data, determine whether patient - Left against medical advice - Left prior to discharge - Elopement (left treatment space without discussion with provider) - Left without being seen
	Length of ED stay	From ED data, determine time until seen by a physician, time until treatment, length of treatment time
	Triage classification	From ED data: Canadian Triage Acuity Scale (CTAS)

*See Appendix 3 for diagnosis codes

ED: emergency department; CTAS: Canadian Triage Acuity Scale; WFPS: Winnipeg Fire Paramedic Service

Evaluation Plan

An evaluation of the research study is one of the requirements for our funding approval from Health Canada and will help answer the question of whether we were able to meet our objectives through this research. We have engaged members of our academic institution who were not involved with the research proposal to lead an arms-length evaluation of the study. A general outline of the evaluation plan they are developing is as follows:

1. Invite research study partners and rightsholders to be part of the evaluation working group. We will aim to have representation from each of the six groups listed in the Patient and Public Involvement section above.
2. Facilitate a discussion with the evaluation working group to decide on the overall purpose of the evaluation. The evaluation should be useful to the group as a whole and provide some tangible benefits.
3. Choose 2-3 evaluation questions for the group to explore. The questions should be feasible within the time and resource limitations of the working group and the study as a whole and should fall within the study's ethical framework (i.e., they should not push ethical boundaries to examine topics people in the working group do not want to discuss). The questions should be linked to specific action, and the working group should be clear what they want to use the answers for.
4. Involve the evaluation working group in an ongoing way throughout the different stages of the study (study design, tool creation and selection of indicators and measures, data analysis, interpretation, knowledge translation).
5. Produce evaluation "outputs" at the end of the study (for example, 'promising practice' guidelines, reports, virtual dashboards) [67]. Findings or outputs from the evaluation will also be included in the final manuscripts.

Ethics and Dissemination Plan

Ethics

Ethics approval was obtained from the University of Manitoba Health Research Ethics Board (Approval No. HS23220 (H2019:361) and No. HS24071 (H2020:323)). The Manitoba Health Information Privacy Committee reviewed the study proposal to ensure individual Manitobans' privacy will be protected throughout the study (Approval No. 2019/2020-32 and No. 2020/2021-43). We have also received approval from Manitoba Health and other respective

data providers for linking the administrative data in the Repository for this research study. To ensure that our study proposal aligns with the First Nations principles of OCAP™ (Ownership, Control, Access and Possession) and the Métis principles of OCAS (Ownership, Control, Access and Stewardship), we obtained approvals from the First Nations Health and Social Secretariat of Manitoba's Health Information Research Governance Committee and the Manitoba Métis Federation, respectively.

Dissemination Plan

The members of the E2A group and the Indigenous members of our team will guide our knowledge dissemination and exchange strategy. Because this study was launched during the COVID-19 pandemic, we have initially planned to conduct early meetings by videoconference or teleconference, with later meetings hopefully occurring in person. The E2A group, led by two research team members with expertise in patient and public engagement, will meet with the research team 3-4 times per year. During these meetings, the research team will present plans (e.g., for the study design) or new study results to the group, engage in facilitated discussion about the plans or the interpretation of the results, reflect on feedback from the E2A group and incorporate their expertise, and then follow the E2A group's lead in delivering the findings to target audiences. Through an iterative process, the E2A group will identify the appropriate audiences for the findings and help synthesize new knowledge to refine existing methamphetamine harm reduction and treatment programs, develop decision-making and policy tools to better serve individuals who use methamphetamine, and create knowledge translation tools such as infographics, video clips, media briefs and interactive web platforms. Study progress and findings will also be shared and discussed in community settings where an invitation will be issued through a member of the E2A or research team, such as meetings of First Nations and Métis Knowledge Keepers and Elders, and in traditional academic settings such as scientific conferences, forums and journal publications.

Figure Captions

Figure 1. **Cohort Development Flowchart**
The five databases from which we derived information on methamphetamine use in Manitoba were the Winnipeg Fire Paramedic Service Database, the Emergency Department Information System, Medical Claims Data, the Hospital Discharge Abstract Database, and the Diagnostic Services Manitoba Database.

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Members of the **Methamphetamine Use in Manitoba Research Team** include: Nathan C. Nickel, Jennifer E. Enns, Amy Freier, Scott McCulloch, Mariette Chartier, James Bolton, Roxana Dragan, Charles Burchill, Geoffrey Konrad, Jitender Sareen, Wanda Phillips-Beck, Julianne Sanguins, A. Frances Chartrand, Olena Kloss, Joykrishna Sarkar, Carolyn Shimmin, Neil McDonald, Erin Weldon, Hera Casidsid, Deborah Balogun, Javier Mignone, Aynslie Hinds, Chris Green, Joss Reimer and Joshua Jones.

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Author Contributions

NCN is the principal investigator and wrote the funding application to secure funds for the study with JEE. NCN, JEE and SM are involved in data management and study design decisions. JSarkar and RD are conducting the data analyses. All authors, including MC, HC, JB, DB, RD, GK, WP-B, JSanguins, CS, NM, DM, JM, and AH and the other members of the Methamphetamine Use in Manitoba Research Team, are involved in the interpretation and contextualizing of study results as they become available. AF is leading the knowledge translation strategy. JEE drafted this manuscript with support from HC, DB, SM, AF and NCN. All other authors critically reviewed and approved the final version.

Data Sharing Statement

Data used in this study were derived from administrative health and social data as a secondary use. The data were provided to the Manitoba Centre for Health Policy (MCHP) under specific data sharing agreements only for approved use at MCHP. The original source data is not owned by the researchers or MCHP and as such cannot be provided to a public repository. The original data source and approval for use have been noted in the acknowledgments of the article. Where necessary, source data specific to this article or project may be reviewed at MCHP with the consent of the original data providers, along with the required privacy and ethical review bodies.

Competing Interests

All authors declare that they have not received any support from any organizations for the submitted work, that they have no financial relationships with any organizations that might have an interest in the submitted work in the previous three years, and that they have not engaged in other relationships or activities that could appear to have influenced the submitted work.

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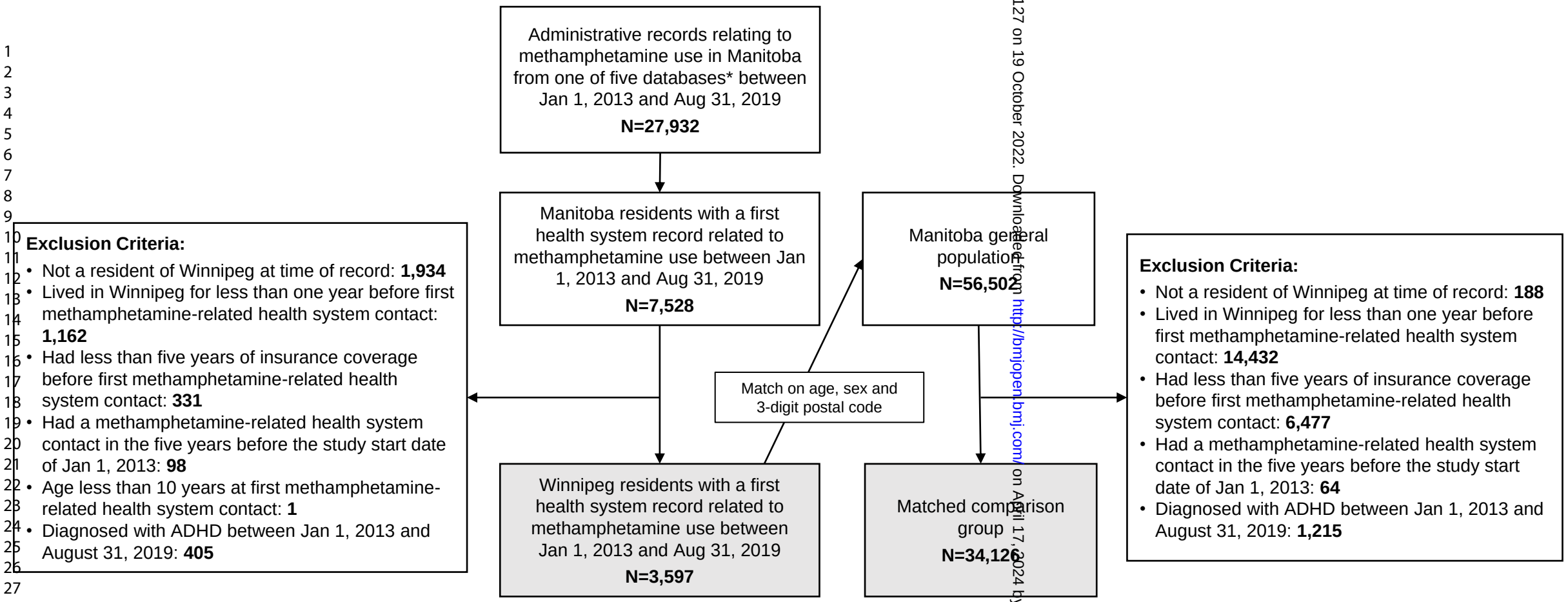

Figure 1. Cohort Development Flowchart

* The five databases were the Winnipeg Fire Paramedic Service Database, the Emergency Department Information System, Medical Claims Data, the Hospital Discharge Abstract Database, and the Diagnostic Services Manitoba Database.

Appendix 1: Non-Pharmaceutical Interventions to Reduce Methamphetamine Use in Manitoba

Detoxification services help their clients manage short-term drug withdrawal symptoms and promote drug abstinence. In Winnipeg, the community-based Main Street Project operates a free 10-day detox program to help clients decrease the risks associated with drug use and access longer treatment programs [1]. At the city's largest hospital, the Health Sciences Centre, the RR2 outpatient physical medicine and rehab clinic also provides medically monitored detoxification and treatment planning.

Individuals in residential treatment centres or "halfway houses" receive medium- to long-term care and monitoring in a home-like setting. Most residential treatment centres require that clients be detoxified and in reasonably good health before admission, and clients are often expected to participate in regular house meetings or step programs during their stay. Residential treatment centres in Winnipeg include Addictions Recovery Inc., the Addictions Foundation of Manitoba, the Behavioural Health Foundation, the Indigenous Women's Healing Centre, St. Raphael Wellness Centre Pritchard House (administered by the Native Addictions Council of Manitoba), the Anchorage Addiction Treatment Program (the Salvation Army), and Morberg House (St. Boniface Street Links) [2–10].

Harm reduction strategies are specifically designed to connect people using illicit drugs with services and supports to help them reduce use or stop using. These strategies facilitate the development of relationships with healthcare and social service providers who aim to meet people where they are and respect their recovery goals [11]. Although the goal of treatment is abstinence, the recovery process is unique for each individual, and a harm reduction approach recognizes that abstinence may not be the top priority for all clients. Treatment may be considered successful if there is any improvement from initial use or a reduction in drug-related harm [11,12], or more broadly, if it addresses the social determinants of health like basic income, housing or violence prevention. Examples of harm reduction strategies for methamphetamine users include safe consumption kits (injecting or smoking equipment) to prevent transmission of blood-borne disease, safe consumption sites (injecting or smoking facilities) to help prevent overdose, and other strategies that help to provide convenient access to other health and social supports [13].

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Appendix 2: Search Strategy used to Identify Records relating to Methamphetamine Use in the Winnipeg Fire Paramedic Service Dataset

We searched for indications of methamphetamine use in the database of WFPS electronic patient care reports. Two research team members did a preliminary review of approximately 15% of free-text fields to develop inclusion criteria. All remaining records were reviewed by one team member with assistance from a WFPS analyst. A portion (10%) of these records was randomly selected to be independently coded by both reviewers; decisions on these records showed very good agreement: kappa = 0.865 (95% CI 0.814 - 0.916), $p < 0.0005$.

Search Terms:

'amphetamine'
'amphetamines'
'amphetimine'
'amphetimens'
'cristalmeth'
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Appendix 3: Detailed Definitions of Mental Disorder Diagnoses

Mood or Anxiety Disorder

One or more hospitalizations with a diagnosis for depressive disorder, affective psychoses, neurotic depression, adjustment reaction or bipolar disorder (looking at ICD-10 only) ICD-10-CA codes F30, F31, F32, F33, F34, F38, F41.2, F43, F53.0; OR one or more hospitalizations with a diagnosis for an anxiety state, phobic disorders or obsessive-compulsive disorders: ICD-10-CA codes F40, F41.0, F41.1, F41.3, F41.8, F41.9, F42;

or

Two or more physician visits with a diagnosis for depressive disorder or affective psychoses: ICD-9-CM codes 296, 311; OR 2 or more physician visits with a diagnosis for adjustment reaction: ICD-9-CM code 309; OR 2 or more physician visits with a diagnosis for anxiety disorders (including dissociative and somatoform disorders)*: ICD-9-CM code 300.

Psychotic Disorder

One or more hospitalizations with a diagnosis of psychotic disorders: ICD-9-code - 295 (schizophrenic disorders) or 297 (delusional disorders) or 298 (other nonorganic psychoses): ICD-10 codes - F11.5, F12.5, F13.5, F14.5, F15.5, F16.5, F18.5, F19.5 (psychotic disorders due to opioids, cannabinoids…etc. do not include F17.5 psychotic disorders due to tobacco), F20 (schizophrenia), F22 (delusional disorder), F23 (acute and transient psychotic disorders), F24 (induced delusional disorder), F25 (schizoaffective disorders), F28 (other nonorganic psychotic disorders), F29 (unspecified nonorganic psychosis);

or

One or more physician visits with a diagnosis of psychotic disorders: ICD-9-code - 295 (schizophrenic disorders) or 297 (delusional disorders) or 298 (other nonorganic psychoses).

Personality Disorder

One or more hospitalization with a diagnosis for personality disorders: ICD-10-CA codes: F21, F60, F61, F62, OR F69

or

One or more physician visits with a diagnosis of personality disorders: ICD-9-CM code: 301

Substance Use Disorder

At least one hospitalization with a diagnosis for alcohol or drug-induced psychosis, alcohol or drug dependence, or nondependent abuse of drugs: ICD-9-CM codes 291 (alcoholic psychoses), 292 (drug psychoses), 303 (alcohol dependence), 304 (drug dependence), or 305 (nondependent abuse of drugs) or ICD-10-CA codes F10-F19, F55, Z50.2 and Z50.3 (ICD-9-CM: 291, 292, 303, 304, 305

ICD-10-CA: F10-F19, F55, Z50.2, Z50.3)

or

At least one physician visit with a diagnosis for alcohol or drug-induced psychosis, alcohol or drug dependence, or nondependent abuse of drugs: ICD-9-CM codes 291 (alcoholic psychoses),

292 (drug psychoses), 303 (alcohol dependence), 304 (drug dependence), or 305 (nondependent abuse of drugs)

Removed Meth related diagnostics from med and hosp: med: diag_icd5 in: ('3044', '30440', '30441', '30442', '30443', '30570', '30571', '30572', '30573', '96972'); hosp: ('F15', 'T436').