BMJ Open

Characterising 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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To cite: Nickel NC, Enns JE, Freier A, *et al*. Characterising methamphetamine use to inform health and social policies in Manitoba, Canada: a protocol for a retrospective cohort study using linked administrative data. *BMJ Open* 2022;**12**:e062127. doi:10.1136/bmjopen-2022-062127

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2022-062127).

Received 17 February 2022
Accepted 26 September 2022

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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, haemorrhagic 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 to 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 have 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,

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ 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 (eg, paramedics) in Winnipeg extend the reach of the existing data repository and address 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 subpopulations.

⇒ 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 generalisable to rural areas.

service providers and knowledge users who will ensure that the analyses address the critical issues.

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 attention-deficit hyperactivity disorder (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, haemorrhagic or ischaemic 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 years 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 and the Canadian Student Tobacco, Alcohol and Drugs Survey showed that from 2013 to 2017 the national prevalence of lifetime use increased from 3.0% to 3.7% for Canadians aged 15 years 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 hospitalisation 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 to 2017, the number of illicit drug overdose deaths in which methamphetamine was detected increased by 360% in British Columbia, and from 2015 to 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 marginalising 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 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 (eg, the 'Sixties Scoop'), forced attendance at day schools and residential schools where many Indigenous children suffered physical, emotional and sexual abuse, institutionalised 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 multigenerational 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 (eg, 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 previously. 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 programmes help their clients manage short-term drug withdrawal symptoms and promote drug abstinence. Residential treatment centres, sometimes called 'halfway houses', provide medium-term 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 (eg, 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 previously, 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 level, making it possible to examine trends in health and social outcomes in detail. To date, the number of published studies using administrative data to look at methamphetamine use is limited, particularly in Canada. In the USA, researchers have been usingInternational Classification of Diseases (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-related 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 to 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 5 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 5 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 multidisciplinary 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 cobuild 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 E2A group that includes:

1. People with lived/living experience of methamphetamine use and their family members and loved ones;
2. First Nations and Métis elders, grandmothers and people with lived/living experience of methamphetamine use;
3. Healthcare workers providing services to Manitobans who use methamphetamine;
4. Decision makers from the government departments of health and justice;
5. Representatives from community organisations, including community health centres, serving Manitobans who use methamphetamine; and
6. 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[59] work on policy analysis and activation, which emphasises a multidisciplinary and iterative process. 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 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 organise 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 (>99.9%) of Manitoba. (Health records in a few datasets may be incomplete because they are under federal jurisdiction, (eg, records for military personnel, individuals incarcerated in federal prisons and individuals living in First Nations communities). 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 nine-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 geographical areas of higher risk.

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 and socioeconomic status.
Hospital Discharge Abstract Database	Information on hospitalisations.	ICD-10 codes for amphetamine-related disorders; harms related to amphetamine use (eg, poisoning from amphetamine).
Medical Claims	Information on ambulatory physician visits.	Five-digit ICD-9 codes for amphetamine dependence, amphetamine abuse and poisoning by amphetamines.
Emergency Department Information System	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	Data on all prescription drugs dispensed from retail pharmacies.	Prescriptions, drug characteristics (eg, type, dose, quantity and class), carriers, prescribers and pharmacy.

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.

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 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 1 January 2013 and 31 August 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 to 2019 in at least 5 years (ie, the individual had no other methamphetamine-related

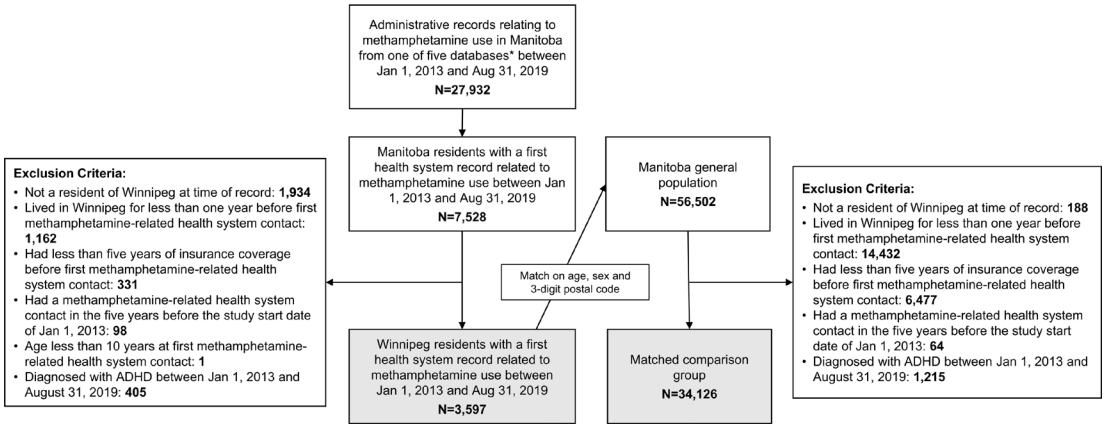

Figure 1 Cohort development flow chart. The five databases from which we derived information on methamphetamine use in Manitoba were the Winnipeg Fire Paramedic Service Database, the Emergency Department Information System, Medical Claims Data, the Hospital Discharge Abstract Database and the Diagnostic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

health system contacts in the 5 years prior to the index date).

Exclusions: although most of the repository datasets include data on all Manitobans, we narrowed the cohort to residents of Winnipeg, 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-based and methylphenidate-based medications for ADHD. This could result in people being treated for ADHD being included in the study cohort. To minimise 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 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±1 year), sex and three-digit postal code and applied the same exclusion criteria. The preliminary study cohort comprises 3597 individuals who had at least one methamphetamine-related health system contact in Winnipeg during the study period (but none in the 5 years prior to the study period) and 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 finalised, 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

1. We will determine the annual incidence of methamphetamine-related health system contacts among Winnipeg residents (ie, the rate of new methamphetamine-related contacts) between 2013 and 2021.
2. 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.
3. We will describe the cohort's sociodemographic characteristics, as listed in table 2.

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 six-digit postal codes
Income quintile	Based on average household income for their six-digit postal code
Indigenous identity	Registered First Nations or Métis
Comorbid mental disorder	Diagnosed with mental disorder during the 5 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

WFPS, Winnipeg Fire Paramedic Service.

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

We will use generalised 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 (eg, 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 5 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 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).

Using similar modelling techniques as described previously (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, hospitalisations 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 . These analyses will provide evidence of current health system needs and inform resource planning by health system decision makers.

Using an interrupted time series analysis with an additional analysis of concurrent unexposed controls (ie, 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 2018, 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).

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 arm's 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 atient and public involvement section previously.
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 two to three 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 (ie, 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 and knowledge translation).
5. Produce evaluation 'outputs' at the end of the study (eg, 'promising practice' guidelines, reports and 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 ownership, control, access and possession and the Métis principles of 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 three to four times per year. During these meetings, the research team will present plans (eg, for the study design) or new study results to the group, engage in facilitated discussion

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 hospitalisation with a diagnosis of depressive disorder, affective psychoses, neurotic depression, adjustment reaction or bipolar disorder; or at least one hospitalisation 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 hospitalisation 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 hospitalisation 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 hospitalisation with a diagnosis for alcohol or drug-induced psychosis, alcohol or drug dependence or non-dependent abuse of drugs; or at least one physician visit with a diagnosis for alcohol or drug-induced psychosis, alcohol or drug dependence or non-dependent abuse of drugs.
Other health services use (5 years before to 1 year after index date)	Winnipeg Fire Paramedic Service (WFPS) 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 hospitalisations	Hospitalisation (in Winnipeg) where methamphetamine use was documented.
	Any hospitalisations	Any hospitalisation (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: CTAS.

*See appendix 3 for diagnosis codes.
CTAS, Canadian Triage Acuity Scale; ED, emergency department.

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 synthesise new knowledge to refine existing methamphetamine harm reduction and treatment programmes, 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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Acknowledgements We acknowledge the Manitoba Centre for Health Policy (MCHP) for use of the Manitoba Population Research Data Repository and the Manitoba government agencies and departments that provide administrative data to the Manitoba Centre for Health Policy, including the Department of Manitoba Health and Seniors Care, the Winnipeg Regional Health Authority and Manitoba Justice. The Winnipeg Fire Paramedic Service also made their data available to the Repository for this study. We acknowledge the support for this study provided by the president and cabinet of the Manitoba Métis Federation and by the First Nations Health and Social Secretariat of Manitoba, both of whom granted approval for use of their respective population registries. The Health Information Privacy Committee of the Manitoba government (No. 2019/2020-32 and No. 2020/2021-43) also reviewed and approved this study.

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

Funding Funding for this work was provided through the Substance Use and Addictions Program at Health Canada (Health Canada ID# 007511055). The results and conclusions are those of the authors and no official endorsement by the funders was intended or should be inferred. The funders had no input into the study design, implementation or interpretation of the findings.

Competing interests None declared.

Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and was approved by University of Manitoba, Human Research Ethics Board: No. HS23220 (H2019:361) and No. HS24071 (H2020:323). The Manitoba Government's Health Information Privacy Committee (HIPC No. 2019/2020-32 and No. 2020/2021-43) reviewed the proposal and waived the requirement for individual informed consent on the basis that the study uses de-identified administrative data, none of the participants were directly involved in the study and there was low risk of any individual being personally identified.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available on reasonable request. Data used in this study were derived from administrative health and social data as a secondary use. The data were provided to the 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.

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