Healthcare utilization among persons living with HIV in Manitoba, Canada, prior to HIV diagnosis: A case-control analysis

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Abstract

Background: Understanding care patterns of persons living with HIV prior to diagnosis can inform prevention opportunities, earlier diagnosis, and engagement strategies. We examined healthcare utilization among HIV-positive individuals and compared them to HIV-negative controls.

Methods: Data were from a retrospective cohort from Manitoba, Canada. Participants included individuals living with HIV presenting to care between 2007 and 2011, and HIV-negative controls, matched (1:5) by age, sex, and region. Data from population-based administrative databases included physician visits, hospitalizations, drug dispensation, and chlamydia and gonorrhea testing. Diagnoses associated with physician visits were classified according to International Classification of Diseases chapters. Conditional logistic regression models were used to compare cases/controls, with adjusted odds ratios (AORs) and their 95% confidence intervals (95% CI) reported.

Results: A total of 193 cases and 965 controls were included. Physician visits and hospitalizations were higher for cases, compared to controls. In the 2 years prior to case date, cases were more likely to be diagnosed with “blood disorders” (AOR: 4.2, 95% CI: 2.0–9.0), be treated for mood disorders (AOR: 2.4, 95% CI: 1.6–3.4), and to have 1+ visits to a hospital (AOR: 2.2, 95% CI: 1.4–3.6).

Conclusion: Opportunities exist for prevention, screening, and earlier diagnosis. There is a need for better integration of healthcare services with public health.

Keywords
HIV, North America, epidemiology, prevention

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Introduction

Despite the advent of combined antiretroviral therapy (ART), many people living with HIV continue to present at an advanced stage of the disease.¹⁻⁴ In industrialized countries, late presenters (defined as those who present with a CD4⁺ cell count of <200 cells/mm³ or who progress to AIDS within 1 year of presentation) account for 15–43% of new diagnoses.⁴ In Canada, where universal healthcare exists, 39% of reported new HIV cases present at this late stage,⁴ in the province of Manitoba, approximately 27% of new HIV diagnoses made in 2016 were in patients with CD4 count <200 cells/mm³.⁵

There are several important implications of delayed recognition of HIV.⁶⁻¹⁰ First, the longer patients have untreated disease the more opportunities there are for transmission.¹¹,¹²
Second, healthcare costs correlate inversely with CD4+ cell counts\(^{13,14}\), the annual cost for a patient with a CD4 count of \(<200\text{ cells/mm}^3\) is approximately double that of a patient with a count that is \(>500\text{ cells/mm}^3\).\(^{13}\) Finally, late presentation is known to increase mortality.\(^{15–17}\)

The reasons for late presentation are multiple and include both patient- and provider-related factors. Research has demonstrated that people living with HIV often present to healthcare providers at least once in the years immediately prior to their diagnosis.\(^{18–22}\) Duffus et al.\(^{19}\) observed that late presenters sought care more often than those diagnosed early in the disease. They noted that in 33% of prior visits, a high-risk feature, such as injection drug use was present, and yet testing for HIV was not performed. Shaw et al.\(^{23}\) found that in the 5-year period prior to their diagnosis, serological testing for other sexually transmitted infections (STIs) was higher among individuals living with HIV, compared to HIV-negative controls. A better understanding of healthcare seeking patterns prior to HIV diagnosis may offer insights into opportunities for HIV prevention, as well as opportunities for earlier HIV testing.\(^{23,24}\)

Using population-based administrative and public health databases linked to clinical data, our study aimed to explore the healthcare patterns of individuals living with HIV prior to their initiation into HIV care. By doing so, we aimed to understand missed opportunities for improved screening and earlier diagnosis for those individuals living with HIV, and to identify potential points of contact for prevention and care interventions.

**Methods**

**Study setting and population**

We conducted this study as a part of the Missed Opportunities for Diagnoses Epidemiological Study (MODES), a retrospective study using population-based administrative databases linked to HIV clinical data. The two clinical sites of the Manitoba HIV Program (MHP), based in Winnipeg, the capital city of the province of Manitoba, provided care to almost all (i.e., \(>95\%\)) adults living with HIV in Manitoba. As of 2018, there were approximately 1400 persons living with HIV receiving care through the MHP.\(^5\) Manitoba Health, Seniors, and Active Living (MHSAL) is the single insurer responsible for payment of health services. Information on physician claims, hospital discharge abstracts and pharmaceutical dispensations is contained within population-based administrative datasets, managed and maintained by MHSAL.

Ethical approval was obtained from the Institutional Review Boards (IRB) at the University of Manitoba and the Winnipeg Regional Health Authority. This study was also approved by the Assembly of Manitoba Chiefs’ Health Information Research Governance Committee and the Health Information Privacy Committee of MHSAL.

**Participants**

Similar to a previously published case-control study,\(^{23}\) cases were defined as individuals living with HIV, 18 years of age and older, who were newly enrolled in the MHP between 1 January 2007 and 31 December 2011. Recruitment took place from 1 January 2013 to 31 December 2013. From a potential population of 303 persons enrolled in the MHP within the study period, 208 were eligible for the study. Of these 208, 186 consented to participate in the study (consent rate = 76%). An additional 15 patients who were deceased at the time of study recruitment were added to the 186 patients for a final sample of 201 individuals. Ethics board review waived the need for informed consent for these 15 individuals. Of the 201 individuals, 193 were continuously enrolled in the 5-year period prior to case date and included in the final analysis. Case date was defined as the date the case enrolled in the MHP.

Controls were HIV-negative individuals drawn from the general population who were age-, sex- and region-matched to the cases at a 5:1 ratio. Using a previously published Canadian algorithm,\(^{25}\) controls were deemed “HIV-negative” if they had no existing claims for ICD-9-CM codes [042 or 043] or ICD-10-CA codes [Z20] in physician and hospital claims.

**Data sources**

Scrambled (i.e., de-identified) personal health identification numbers (PHINs) of cases and controls were used to link the following datasets.

**Clinical data**

Clinical data were obtained on individuals living with HIV who had provided written informed consent and were abstracted from MHP sites by a research assistant and reviewed by MLB and KK, using a standard data abstraction tool. Information included basic demographic information, date of entry into the MHP, risk factors associated with HIV acquisition, and selected clinical characteristics.

**Manitoba health insurance registry**

Since 1970, Manitoba Health, Seniors and Active Living (MHSAL) has maintained the Manitoba Health Insurance Registry (“The Registry”) to track individuals registered to receive health services in Manitoba. Date fields for registration, birth, entry into province, and migration in/out of province provide information to track residents for longitudinal analyses, and are updated annually.\(^{26}\)

**Physician claims and hospital discharge abstract data**

Universal health coverage is provided by MHSAL and computerized records of all physician billing claims and
hospitalizations are maintained by MHSAL. Each physician claim and hospitalization includes diagnoses coded using the International Classification of Diseases (ICD) system. For outpatient physician claims, only one diagnosis is entered into MHSAL databases, with diagnoses coded up to three digits using ICD-9-CM. For inpatient hospitalizations, multiple diagnoses can be coded per hospital visit; ICD-9-CM was used up to fiscal year 2004/2005, at which point the coding system was changed to ICD-10-CA. For both time periods, ICD codes were coded to the 5-digit level. The accuracy of these administrative health databases has been demonstrated.27–29

**Drug program information network data**

Information on all outpatient prescription dispensations is collected in the Drug Program Information Network (DPIN) dataset, which has been online since fiscal year 1995/1996. Within the DPIN, pharmaceutical products are identified by their unique drug identification numbers (DIN).29

**Sexually transmitted infections surveillance data**

MHSAL maintains the STI Surveillance Database, which contains socio-demographic, diagnostic, and treatment information on all positive cases of *Chlamydia trachomatis* (CT) and *Neisseria gonorrhoeae* (GC) infection for the province, regardless of where testing took place.30 CT and GC infections must be reported to MHSAL by the testing laboratory or healthcare provider. Information relevant for this study includes specimen collection date and type of infection (CT or GC).

**Measures**

With the exception of bacterial STIs, administrative data were searched for any evidence of healthcare utilization in the 2-year period prior to this date for both cases and controls. A 5-year period was used for bacterial STIs, due to the low number of infections recorded.

**Physician visits**

Physician visits prior to case date were determined using date of physician visit. Only unique visits, based on visit date and ICD-9-CM code were counted. Diagnoses were categorized according to ICD-9-CM chapters, with binary indicators denoting the presence of a diagnosis for any particular chapter. Any inpatient records (i.e., physician claims during hospital stays) were not counted.

**Hospitalizations**

Hospitalization prior to case date was defined by hospital admission date, and a binary indicator denoting a hospital visit created, with visits lasting more than 24 h included as a hospitalization.

**Pharmaceutical dispensations**

Dispensation date was used to determine pharmaceutical dispensations prior to case date; using DIN, and based on the work of Marrie et al. and Shaw et al.,31–33 the following prescription categories were created: antibiotics, asthma, diabetes, heart disease, hyperlipidemia, hypertension, respiratory illness, anxiety, bipolar disorder, depression, mood disorders, and schizophrenia.

**Chlamydial/Gonorrhea infections**

Using the MHSAL STI surveillance data, separate binary indicators were created for CT and GC, indicating at least one positive CT or GC test in the 5 years prior to case date. For all measures and to address confounding due to indication bias (i.e., co-occurrence of healthcare utilization with an HIV diagnosis), a washout period of 180 days prior to case date was used. Thus, for both cases and controls, any utilization within a 180-day period prior to the case date was not counted. Additionally, entry into MHP was chosen as ‘case date’ instead of the date of first positive HIV result because not all individuals living with HIV have a previous positive HIV test on record in Manitoba, prior to their entry into MHP. Analysis of individuals with a previous positive HIV test found that the average gap between a positive result and entry into care was less than 60 days.

**Statistical methods**

Only individuals who were continuously registered (i.e., no evidence of out-migration) and had a first registered date at least five years prior to the study period with the MHSAL registry for the duration of the study period were included in the study. Conditional logistic regression was used to test for the association between HIV status and the likelihood of each measure of healthcare utilization; odds ratios (ORs) and 95% confidence intervals (95% CIs) are reported. All analyses were performed using Stata 13 (College Station, TX).

**Results**

Of the 208 persons eligible for the study, 186 consented to participate (89.4%). A further 15 individuals who were deceased at the time of study recruitment were included for a final sample of 201 individuals. The IRB waived the need for informed consent for these 15 individuals. However, of these 201 participants, eight were excluded as they did not have evidence of continuous insurance coverage in Manitoba, resulting in a final sample size of 193 individuals in the case cohort (individuals living with HIV) and 965 individuals in the control cohort (HIV negative individuals). Table 1 shows the socio-demographic characteristics of cases and controls. The median age at time of entry into the
### Table 1. Selected characteristics of participants.

|                              | Controls (N = 965) | Cases (N = 193) | Total (N = 1158) |
|------------------------------|--------------------|-----------------|------------------|
| **Age at case date (median, IQR\(^a\))** | 38 (30–46)        | 38 (29–46)      | 38 (30–46)       |
| **Female sex (N, %)**        | 330 34            | 66 34           | 396 34           |
| **Resides in Winnipeg (N, %)** | — —              | 178 (94%)       | — —              |
| **Transmission risk (N, %)\(^b\)** |                    |                 |                  |
| Heterosexual sex             | 133 (69%)         | 47 (24%)        | 180 (15%)        |
| MSM\(^c\)                    | — —               | — —             | — —              |
| PWID\(^d\)                   | — —               | 26 (13%)        | — —              |
| **Endemic exposure**         | — —               | 28 (15%)        | — —              |
| **Infection from a bacterial STI\(^e\) in the 5-year period prior to case date** |                     |                 |                  |
| Chlamydia                    | 19 (2%)           | 11 (6%)         | 30 (3%)          |
| Gonorrhea                    | 2 (0.2%)          | 10 (5%)         | 12 (1%)          |
| **Physician visits—2 years prior to diagnosis, by ICD-9-CM chapter\(^f\)** | | | |
| Chapter 1: Infectious condition |                   |                 |                  |
| 0                            | 846 87.7          | 138 71.5        | 984 85.0         |
| 1+                           | 119 12.3          | 55 28.5         | 174 15.0         |
| Chapter 2: Neoplasm          |                   |                 |                  |
| 0                            | 924 95.8          | 177 91.7        | 1101 95.1        |
| 1+                           | 41 4.2            | 16 8.3          | 57 4.9           |
| Chapter 3: Endocrine         |                   |                 |                  |
| 0                            | 825 85.5          | 161 83.4        | 986 85.1         |
| 1+                           | 140 14.5          | 32 16.6         | 172 14.9         |
| Chapter 4: Blood disorders   |                   |                 |                  |
| 0                            | 944 97.8          | 179 92.7        | 1123 97.0        |
| 1+                           | 21 2.2            | 14 7.3          | 35 3.0           |
| Chapter 5: Mental health     |                   |                 |                  |
| 0                            | 713 73.9          | 124 64.2        | 837 72.3         |
| 1+                           | 252 26.1          | 69 35.8         | 321 27.7         |
| Chapter 6: Nervous system    |                   |                 |                  |
| 0                            | 766 79.4          | 131 67.9        | 897 77.5         |
| 1+                           | 199 20.6          | 62 32.1         | 261 22.5         |
| Chapter 7: Circulatory system|                   |                 |                  |
| 0                            | 834 86.4          | 168 87.0        | 1002 86.5        |
| 1+                           | 131 13.6          | 25 13.0         | 156 13.5         |
| Chapter 8: Respiratory condition |                 |                 |                  |
| 0                            | 641 66.4          | 97 50.3         | 738 63.7         |
| 1+                           | 324 33.6          | 96 49.7         | 420 36.3         |
| Chapter 9: Digestive system  |                   |                 |                  |
| 0                            | 819 84.9          | 141 73.1        | 960 82.9         |
| 1+                           | 146 15.1          | 52 26.9         | 198 17.1         |
| Chapter 10: Genito-urinary system | | | |
| 0                            | 793 82.2          | 150 77.7        | 943 81.4         |
| 1+                           | 172 17.8          | 43 22.3         | 215 18.6         |
| Chapter 11: Pregnancy-related|                   |                 |                  |
| 0                            | 927 96.1          | 190 98.4        | 1117 96.5        |
| 1+                           | 38 3.9            | 3 1.6           | 41 3.5           |
| Chapter 12: Skin disorders   |                   |                 |                  |
| 0                            | 788 81.7          | 121 62.7        | 909 78.5         |
| 1+                           | 177 18.3          | 72 37.3         | 249 21.5         |
| Chapter 13: Musculo-skeletal system | | | |
| 0                            | 716 74.2          | 133 68.9        | 849 73.3         |
| 1+                           | 249 25.8          | 60 31.1         | 309 26.7         |

(continued)
Table 1. (continued)

| Chapter 14: Congenital condition | Controls (N = 965) |  | Cases (N = 193) |  | Total (N = 1158) |  |
|----------------------------------|-------------------|---|----------------|---|-----------------|---|
|                                  | 955               | 99.0 | 189          | 97.9 | 1144           | 98.8 |
|                                  | 10                | 1.0  | 4            | 2.1  | 14              | 1.2  |
| Chapter 15: Perinatal condition  |                   |     |              |     |                 |     |
|                                  | 963               | 99.8 | 193          | 100.0 | 1156           | 99.8 |
|                                  | 2                 | 0.2  | 0            | 0.0  | 2               | 0.2  |
| Chapter 17: Symptoms, ill-defined |                   |     |              |     |                 |     |
|                                  | 676               | 70.1 | 116          | 60.1  | 792            | 68.4 |
|                                  | 289               | 29.9 | 77           | 39.9  | 366            | 31.6 |
| Chapter 18: Injury and poisoning |                   |     |              |     |                 |     |
|                                  | 730               | 75.6 | 129          | 66.8  | 859            | 74.2 |
|                                  | 235               | 24.4 | 64           | 33.2  | 299            | 25.8 |
| Chapter 19: Supplementary—health services contacts |     |     |              |     |                 |     |
|                                  | 545               | 56.5 | 115          | 59.6  | 660            | 57.0 |
|                                  | 420               | 43.5 | 78           | 40.4  | 498            | 43.0 |
| Any physician visit             |                   |     |              |     |                 |     |
|                                  | 518               | 53.7 | 66           | 34.2  | 584            | 50.4 |
|                                  | 444               | 46.3 | 127          | 65.8  | 574            | 49.6 |
| Hospitalizations                |                   |     |              |     |                 |     |
|                                  | 894               | 92.6 | 164          | 85.0  | 1058           | 91.4 |
|                                  | 71                | 7.4  | 29           | 15.0  | 100            | 8.6  |

Pharmaceutical dispensations

| Antioxidants | Controls (N = 965) |  | Cases (N = 193) |  | Total (N = 1158) |  |
|--------------|-------------------|---|----------------|---|-----------------|---|
|              | 547               | 56.6 | 69            | 35.8  | 616            | 53.2 |
|              | 418               | 43.4 | 124           | 64.2  | 542            | 46.8 |
| Medication for asthma |                   |     |              |     |                 |     |
|              | 851               | 88.2 | 162          | 83.9  | 1013           | 87.5 |
|              | 114               | 11.8 | 31           | 16.1  | 145            | 12.5 |
| Medication for diabetes |                   |     |              |     |                 |     |
|              | 913               | 94.6 | 175          | 90.7  | 1088           | 94.0 |
|              | 52                | 5.4  | 18           | 9.3   | 70             | 6.0  |
| Medication for heart disease |                   |     |              |     |                 |     |
|              | 953               | 98.8 | 190          | 98.4  | 1143           | 98.7 |
|              | 12                | 1.2  | 3            | 1.6   | 15             | 1.3  |
| Medication for hyperlipidemia |                   |     |              |     |                 |     |
|              | 898               | 93.0 | 181          | 93.8  | 1079           | 93.2 |
|              | 67                | 7.0  | 12           | 6.2   | 79             | 6.8  |
| Medication for hypertension |                   |     |              |     |                 |     |
|              | 842               | 87.2 | 168          | 87.0  | 1010           | 87.2 |
|              | 123               | 12.8 | 25           | 13.0  | 148            | 12.8 |
| Medication for respiratory conditions |                   |     |              |     |                 |     |
|              | 849               | 88.0 | 162          | 83.9  | 1011           | 87.3 |
|              | 116               | 12.0 | 31           | 16.1  | 147            | 12.7 |
| Medication for anxiety |                   |     |              |     |                 |     |
|              | 895               | 92.7 | 161          | 83.4  | 1056           | 91.2 |
|              | 70                | 7.3  | 32           | 16.6  | 102            | 8.8  |
| Medication for bipolar diagnoses |                   |     |              |     |                 |     |
|              | 948               | 98.2 | 188          | 97.4  | 1136           | 98.1 |
|              | 17                | 1.8  | 5            | 2.6   | 22             | 1.9  |
| Medication for depression |                   |     |              |     |                 |     |
|              | 848               | 87.9 | 170          | 88.1  | 1018           | 87.9 |
|              | 117               | 12.1 | 23           | 11.9  | 140            | 12.1 |

(continued)
MHP was 38 years (IQR: 30–46) and 34% of cases were women. Almost all participants lived in Winnipeg (94%).

**Physician visits**

Overall, individuals living with HIV were significantly more likely to have visited a physician at least once in the 2-year period prior to case date as compared to HIV uninfected controls (AOR: 1.7, 95% CI: 1.2–2.8). With respect to specific diagnoses, differences between cases and controls varied by ICD-9-CM chapter, as shown in Table 2. In the 2-year period prior to case date, the largest odds ratios were observed for "Blood and Blood Disorders" (AOR: 4.2, 95% CI: 2.3–5.5), "Infectious Conditions" (AOR: 3.1, 95% CI: 2.1–4.4), and "Skin Disorders" (AOR: 3.0, 95% CI: 2.1–4.4). Examples of "Blood and Blood Disorders" include anemias and hemorrhagic conditions; "Infectious Conditions" include a variety of infectious diseases; while examples of "Skin Disorders" include disorders specific to the skin—cellulitis, impetigo, cysts, and dermatitis. Table 3 shows the top five most frequent diagnoses related to "Infectious Conditions" and "Blood and Blood Disorders."

**Hospitalizations**

Hospital visits were also significantly associated with HIV status; those with one or more hospital visits in the 2-year period prior to case date were at over twice the odds of being HIV positive (AOR: 2.2, 95% CI: 1.4–3.6; Table 2).

**Prescription use**

Prescription dispensation was associated with HIV status, with the strength and direction of association dependent on type of pharmaceutical. In the 2-year period prior to case date, prescriptions for the following were associated with being HIV-positive (Table 4): antibiotics (AOR: 3.4, 95% CI: 2.3–4.9), asthma (AOR: 1.8, 95% CI: 1.1–2.9), diabetes (AOR: 2.1, 95% CI: 1.1–4.0), respiratory conditions (AOR: 1.8, 95% CI: 1.1–2.8), and anxiety disorders (AOR: 2.9, 95% CI: 1.8–4.8).

**Bacterial Sexually transmitted infections**

Persons living with HIV (cases) were more likely to have had at least one chlamydial (AOR: 3.1, 95% CI: 1.6–5.9; 180-day washout period) or one gonorrheal infection (AOR: 11.8, 95% CI: 3.6–13.4; 180-day washout period) in the 5-year period prior to HIV case date, as compared to HIV uninfected controls (Table 5).

**Discussion**

Building on earlier work demonstrating the higher likelihood of serological tests among individuals eventually diagnosed with HIV, our results demonstrate that healthcare utilization was higher among those who were subsequently diagnosed with HIV, compared to their controls. Our analyses also reveal that utilization patterns differ amongst those diagnosed with HIV. Persons living with HIV were more likely to have diagnoses related to infectious conditions, and blood and blood disorders. They were more likely to have received dispensations for antibiotics, and for medications used in the treatment of diabetes and mood disorders. Individuals living with HIV were at higher odds of diagnosed bacterial STIs, with the odds of a GC infection particularly high. These analyses indicate that opportunities exist for earlier diagnosis and screening for those persons living with HIV and suggest that earlier interactions may serve as points of contacts for prevention/intervention opportunities. For example, more active follow-up of novel gonorrhea cases may help prevent subsequent HIV infection.

With respect to the association between diagnoses of blood and blood disorders and subsequent HIV, the MHP gets referrals for patients presenting with lymphadenopathy, anemia and/or thrombocytopenia; disorders associated with HIV.
incorporating these disorders in clinical practice may lead to earlier diagnoses of HIV. In describing the co-occurring epidemics of HIV, and substance use, Singer et al. were one of the first to place HIV within a "syndemics" framework, recognizing that risk and vulnerability of individuals to HIV occurs in environments of harmful social/structural conditions. Thus, these harmful conditions contribute to poorer health outcomes, including HIV; the higher use of healthcare services of cases in our study aligns with this perspective.

Our findings can contribute to frameworks used to examine missed opportunities for HIV diagnoses. Several factors have been proposed to explain the heterogeneity in missed opportunities for HIV diagnosis. For example, availability of services has been acknowledged as a barrier to services, such as where socio-economically disadvantaged and marginalized populations are more likely to reside in areas where preventive and screening services are not available. Conversely, accessibility of services is a factor in situations where various individual, practice-based, or structural barriers deter an individual or certain sub-populations from accessing available services. Our study showed that within the context of a publicly-funded healthcare system, HIV-positive individuals were accessing health services at a higher rate than their controls, prior to their diagnosis. Thus, despite the known marginalization of populations that are at risk for HIV, barriers deterring this population of HIV-positive individuals from seeking healthcare were overcome. Still unknown is the nature of healthcare sought; whether the care sought was consistent and comprehensive, or a more episodic/chaotic, multi-provider type of care.

More research to understand the structural and practice level issues contributing to gaps in prevention and care services may help to optimize HIV prevention. For example, in Manitoba, responsibility for follow-up of individuals testing positive for CT or GC, including partner notification, is left to the discretion of the testing practitioner, who may refer follow-up to public health. Although follow-up screening with individuals testing positive for CT or GC is recommended in the Canadian Guidelines on STIs, there is very little information available on how well follow-up recommendations are implemented. Evidence suggests that placing the onus of follow-up on practitioners has resulted in an uncoordinated and passive system. More effective coordination between public health and general practitioners can lead to better navigation of the healthcare system, and improved delivery of prevention interventions. Without better coordination, those at highest risk of STIs may continue to be denied access to testing, and among those that do, a proportion may continue to fall through cracks in the healthcare system.

At the same time, individual-level behavioral factors are also likely at play; strengthening community-based prevention efforts, such as outreach to high-risk individuals and other priority populations, and which focus on health promotion, a more enabling environment, and addressing other needs such as housing, mental health and addictions issues may also reduce gaps in prevention.

Our findings illustrating the higher likelihood of dispensations for mental health conditions among individuals with HIV supports prioritization of mental health services. Community organizations and primary and public healthcare have historically been underfunded in Canada.
Strengths and limitations

Our study had a number of strengths, including the population-based nature of the MHP, as well as empirical data on healthcare utilization. Although we sampled only a portion of the total MHP population available, the socio-demographic characteristics of our sample did not differ substantially from other publications using the entire MHP population. Our control group allowed for comparisons to the general population.

Our study had some limitations. CT/GC incidence is likely underestimated as data collected by MHSAL is based on a passive surveillance system. However, since populations at higher risk for HIV and other STIs are less likely to access care, this underestimation should have driven differences between cases and controls to the null. Case date was defined as the date of MHP entry; this date was chosen instead of the date of first positive HIV result as not all HIV-

Table 3. Top five most frequent Chapter 1 and Chapter 4 diagnoses from physician visits, HIV-positive participants (2 years prior to HIV case date), and 180-day washout period.

| Diagnosis | Freq (%) |
|-----------|---------|
| Infectious condition (chapter 1, ICD-9-CM<sup>a</sup>) | |
| Other venereal disease | 14.5 |
| Pediculosis and pthirus | 12.6 |
| Viral infection in other disease/not otherwise specified | 12.6 |
| Herpes simplex | 11.3 |
| Other viral disease | 8.8 |
| All others | 40.2 |
| Blood disorders (chapter 4, ICD-9-CM)<sup>a</sup> | |
| Iron deficiency anemias | 24.1 |
| Other blood disease | 20.7 |
| Anemia, not otherwise specified | 17.2 |
| Other deficiency anemia | 17.2 |
| Aplastic anemia | 13.8 |
| All others | 7.0 |

<sup>a</sup>International Classification of Diseases, Ninth Revision, Clinical Modification.

Table 4. One or more dispensations, by type of prescription, cases versus controls, adjusted odds ratios (AOR), and 95% confidence intervals (95% CI) from conditional logistic regression (2 years prior to HIV case date) adjusted for days registered, 180-day washout period.

| | AOR (95% CI) |
|-----------------|-------------|
| Antibiotics     | 3.35 (2.29–4.90)<sup>**</sup> |
| Asthma          | 1.82 (1.13–2.93)<sup>+</sup> |
| Diabetes        | 2.08 (1.09–3.97)<sup>+</sup> |
| Heart disease   | 2.07 (0.52–8.32) |
| Hyperlipidemia  | 1.01 (0.49–2.08) |
| Hypertension    | 1.13 (0.66–1.94) |
| Respiratory     | 1.77 (1.10–2.84)<sup>+</sup> |
| Anxiety         | 2.92 (1.79–4.76)<sup>**</sup> |
| Bipolar disorder| 1.43 (0.48–4.25) |
| Depression      | 1.28 (0.77–2.11) |
| Mood disorder   | 2.37 (1.64–3.43)<sup>**</sup> |
| Schizophrenia   | 1.35 (0.63–2.90) |

<sup>a</sup>International Classification of Diseases, Ninth Revision, Clinical Modification.

Table 5. Bacterial infection and HIV, odds ratios (OR), and 95% confidence intervals (95% CI) from conditional logistic regression.

| | OR (95% CI) |
|-----------------|-------------|
| Model I<sup>a</sup> | CT<sup>b</sup> | 3.1 (1.6–5.9) |
| GC<sup>c</sup> | 11.8 (3.6–13.4) |
| Model II<sup>d</sup> | CT<sup>b</sup> | 3.1 (1.5–6.4) |
| GC<sup>c</sup> | 10.4 (4.2–25.5) |

<sup>a</sup>180-day washout period.
<sup>b</sup>CT: chlamydia.
<sup>c</sup>GC: gonorrhea.
<sup>d</sup>365-day washout period.

**Strengths and limitations**

Our study had a number of strengths, including the population-based nature of the MHP, as well as empirical data on healthcare utilization. Although we sampled only a portion of the total MHP population available, the socio-demographic characteristics of our sample did not differ substantially from other publications using the entire MHP population. Our control group allowed for comparisons to the general population.

Our study had some limitations. CT/GC incidence is likely underestimated as data collected by MHSAL is based on a passive surveillance system. However, since populations at higher risk for HIV and other STIs are less likely to access care, this underestimation should have driven differences between cases and controls to the null. Case date was defined as the date of MHP entry; this date was chosen instead of the date of first positive HIV result as not all HIV-
positive individuals had a previous positive HIV test on record in Manitoba prior to their entry into MHP. This gap between first positive HIV test and entry into MHP care could have potentially biased rates of CT/GC incidence and testing; however, among those with a previous positive HIV test, the average gap between a positive result and entry into care was less than 60 days. Thus, our 180-day washout period was meant to err on the side of caution. Controls were assumed to be HIV-negative; but are more accurately referred to as not known to be positive.

In conclusion, our results demonstrate distinct patterns of healthcare utilization amongst HIV-positive individuals, prior to their HIV diagnosis. Stronger efforts to integrate the work of public health personnel, community organizations, and general practitioners are needed in the Canadian context to improve HIV prevention efforts, as well as support earlier HIV testing and linkage to care for those who test positive.

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