# Determinants of hospital admission among HIV-positive people in British Columbia

*Research*

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## Abstract

**Background:** This study was initiated to evaluate the demographic and clinical determinants of admission to hospital among HIV-positive men and women receiving antiretroviral therapy in British Columbia.

**Methods:** The analysis was restricted to participants enrolled in the HIV/AIDS Drug Treatment Program between September 1992 and March 1997 who had completed an annual participant survey, had a viral load determination and had signed a consent form allowing electronic access to their inpatient hospital records. A record linkage was conducted with the BC Ministry of Health to obtain all records of hospital admissions from April 1991 to March 1997. Statistical analyses were carried out using parametric and nonparametric methods and multivariate logistic analyses.

**Results:** The study sample comprised 947 participants (859 men, 88 women). Of these, 165 (17%) were admitted to hospital during the study period from May 1, 1996, to Mar. 31, 1997. The median number of admissions was 1 (interquartile range [IQR] 1–2 admissions), and the median length of stay per admission was 3 days (IQR 1–8 days). Admission to hospital was associated with being unemployed (82% of those admitted v. 58% of those not admitted), being an injection drug user (24% v. 17%), reporting a fair or poor health status (46% v. 29%) and having a physician experienced in the management of HIV/AIDS (31% v. 24%). Examination of clinical determinants demonstrated that hospital admission was associated with a previous admission (72% v. 46%), a high viral load (median 74 000 v. 14 000 HIV-1 RNA copies/mL), a low CD4 count (median 0.16 v. $0.27 \times 10^9$/L) and an AIDS diagnosis (44% v. 24%). Multivariate logistic regression analysis revealed that being admitted to hospital was independently associated with being unemployed (odds ratio [OR] 2.64, 95% confidence interval [CI] 1.66–4.20), having been previously admitted to hospital (OR 2.30, 95% CI 1.53–3.46), having a high viral load at baseline (OR 1.45, 95% CI 1.16–1.80), being an injection drug user (OR 1.63, 95% CI 1.02–2.62) and having an experienced physician (OR 1.98, 95% CI 1.29–3.03).

**Interpretation:** Hospital admission among participants in this study was found to be associated with marginalization and poor health status.

Infection with HIV leads to a progressive cell-mediated immunodeficiency, resulting in an increased risk of opportunistic infections and death.[1] As the CD4 cell count decreases and the viral load increases, an HIV-positive person becomes increasingly susceptible to opportunistic infections that may result in admission to hospital.

A rapid rise in hospital use by people with HIV infection or AIDS between 1989 and 1994 was noted by the US National Hospital Discharge Survey.[2] Hospital admission is a marker for substantial clinical morbidity.[3] The existing staging systems for people with AIDS rely on physiologic and diagnostic information.[4-6] However, the decision to use hospital services or other medical resources has been shown to be

influenced by social factors or measures of the patient's ability to function at certain levels of disability.[7–9] The effect of these factors may be direct, in that physicians' decisions to admit patients may be related to the patient's functional status or housing situation. The effect may also be indirect, in that the factors may serve as markers for unmeasured aspects of patient mix.[3]

The aim of this study was to determine the demographic and clinical determinants of hospital admission among HIV-positive men and women in British Columbia.

## Methods

The British Columbia Centre for Excellence in HIV/AIDS, through its Drug Treatment Program, provides antiretroviral, antimicrobial and prophylactic agents free of charge to eligible HIV-positive people throughout the province. About 2700 such patients and 400 physicians are currently active in the program. Eligibility criteria are HIV seropositivity, a CD4 cell count consistently below $0.50 \times 10^9$/L and a plasma viral load of more than 5000 HIV-1 RNA copies/mL.[10] After consent is obtained, participants are enrolled in the treatment program by their general practitioner on submission of a prescription for antiretroviral or antimicrobial medications, or both.

At enrolment, and annually thereafter, participants in the drug treatment program complete a self-administered questionnaire. They are asked about their health status (current status and how it compares with status in the previous year), current annual income, social support, educational and occupational status, and the current and past use of HIV-related drugs and complementary therapies.

For our analysis we included people who had had a viral load determination between May 1, 1996, (the date such testing became standard in British Columbia) and Dec. 31, 1996, and who had completed an annual participant survey within 12 months of the viral load test. Ethical approval for our study was granted by the University of British Columbia Clinical Ethics Board.

Physician experience was defined by the number of patients a physician followed in the treatment program. The median number of HIV-positive patients per physician in our study was 163. Thus, we classified a physician who had more than 163 patients in the program as experienced in the management of HIV/AIDS.

Patient consent is required to access data from a number of direct linkages between the centre's database and external administrative and surveillance data sources. Annual data linkages are performed with the Ministry of Health's Hospital Programs, Pharmacare and Vital Statistics databases.

Participant-specific hospital admissions data were obtained from the Hospital Programs database for the period Apr. 1, 1991, through Mar. 31, 1997. These data were compiled from hospital discharge abstract forms completed by the staff of the medical records department of each hospital. Ministry of Health case data include information on the hospital site, the patient's age and sex, the year of admission, the length of stay in days, the type of admission (elective or urgent), the level of care (acute or other), treatment in an intensive care unit (yes or no), hospital transfer (yes or no), and primary and other comorbid diagnoses.

We examined determinants of hospital admission of all participants in the program from May 1, 1996, to Mar. 31, 1997. Statistical comparisons were conducted using both parametric and distribution-free methods. Categorical data were analysed using Pearson's $\chi^2$ test. Fisher's exact test was used for contingency tables in which 25% or more of the expected cell frequencies were less than 5. Continuous variables were analysed using the Wilcoxon rank-sum test. Odds ratios (ORs) and 95% confidence intervals (CIs) were obtained using the Mantel–Haenszel test. Stepwise multivariate logistic regression analysis was used to identify independent predictors of hospital admission and to adjust for potential confounding variables. All statistically significant variables in the multivariate model were observed to be significant ($p < 0.05$) in the univariate analyses. Subjects with missing values for one or more of the independent variables of interest were excluded from the multivariate analysis. All reported $p$ values are two-tailed.

## Results

We examined data for 947 participants (859 men, 88 women). Of these, 165 (17%) were admitted to hospital during the study period. A total of 248 admissions were recorded for this group; the median number was 1 admission (interquartile range [IQR] 1–2 admissions), and the median length of stay per admission was 3 days (IQR 1–8 days). The 4 most common reasons for being admitted were HIV infection or AIDS (93 [38%] of the admissions), other viral infectious disease (12 [5%]), gastrointestinal disease (30 [12%]), and mental disorder or disease of the nervous system (18 [7%]). In only 49 (20%) of these admis-

**Table 1: Association between baseline sociodemographic characteristics of a sample of HIV-positive people in British Columbia and admission to hospital**

| Characteristic | Admitted to hospital; no. (and %) of patients* Yes *n = 165* | No *n = 782* | *p* value |
|---|---|---|---|
| **Median age (and IQR), yr** | 38 (33–44) | 37 (32–43) | 0.46 |
| **Sex** | *n = 165* | *n = 782* | |
| Female | 15 (9) | 73 (9) | 0.92 |
| Male | 150 (91) | 709 (91) | |
| **Unemployed** | *n = 158* | *n = 755* | |
| No | 29 (18) | 317 (42) | < 0.001 |
| Yes | 129 (82) | 438 (58) | |
| **Disability insurance** | *n = 165* | *n = 782* | |
| No | 135 (82) | 667 (85) | 0.26 |
| Yes | 30 (18) | 115 (15) | |
| **Injection drug use** | *n = 165* | *n = 782* | |
| No | 125 (76) | 651 (83) | 0.023 |
| Yes | 40 (24) | 131 (17) | |
| **Self-report of health as fair or poor** | *n = 155* | *n = 758* | |
| No | 83 (54) | 537 (71) | < 0.001 |
| Yes | 72 (46) | 221 (29) | |
| **Physician experienced in management of HIV/AIDS** | *n = 162* | *n = 775* | |
| No | 111 (69) | 592 (76) | 0.036 |
| Yes | 51 (31) | 183 (24) | |

Note: IQR = interquartile range.
*Unless otherwise stated.

**Table 2: Association between baseline clinical characteristics of HIV-positive subjects and admission to hospital**

| Variable | Admitted to hospital: Yes *n = 165* | Admitted to hospital: No *n = 782* | *p* value |
|---|---|---|---|
| Previous admission to hospital, no. (and %) of patients | | | |
| No | 47 (28) | 425 (54) | < 0.001 |
| Yes | 118 (72) | 357 (46) | |
| Median plasma viral load (and IQR), HIV-1 RNA copies/mL | 74 000 (74 000–210 000) | 14 000 (2000–73000) | < 0.001 |
| Median CD4 cell count (and IQR), x $10^9$/L | 0.16 (0.04–0.32) | 0.27 (0.14–0.42) | < 0.001 |
| AIDS diagnosis, no. (and %) of patients | | | |
| No | 92 (56) | 598 (76) | < 0.001 |
| Yes | 73 (44) | 184 (24) | |

**Table 3: Multivariate analysis of factors associated with hospital admission among HIV-positive subjects***

| Variable | Crude odds ratio (and 95% CI) | Adjusted odds ratio (and 95% CI) |
|---|---|---|
| Unemployed | 3.22 (2.10–4.94) | 2.64 (1.66–4.20) |
| Prior admission to hospital | 2.99 (2.07–4.31) | 2.30 (1.53–3.46) |
| Viral load† | 1.67 (1.39–2.00) | 1.45 (1.16–1.80) |
| Injection drug use | 1.59 (1.06–2.38) | 1.63 (1.02–2.62) |
| Experienced physician | 1.49 (1.03–2.15) | 1.98 (1.29–3.03) |

Note: CI = confidence interval.
*Controlling for age, sex, AIDS diagnosis, CD4 cell count at baseline and length of time enrolled in HIV/AIDS Drug Treatment Program, all of which were not statistically significant.
†Per log 10 increase in the plasma viral load measurement.

sions was HIV/AIDS not noted as either a primary or antecedent reason for admission to hospital.

Univariate analysis was used to examine baseline factors as predictors of hospital admission. Admission to hospital was associated with being unemployed (82% of those admitted v. 58% of those not admitted, $p < 0.001$), being an injection drug user (24% v. 17%, $p = 0.023$), reporting a fair or poor health status (46% v. 29%, $p < 0.001$) and having an experienced physician (31% v. 24%, $p = 0.036$) (Table 1). Examination of clinical determinants at baseline revealed that admission to hospital was associated with a previous admission to hospital (72% v. 46%, $p < 0.001$), a high viral load (median 74 000 v. 14 000 HIV-1 RNA copies/mL, $p < 0.001$), a low CD4 count (median 0.16 v. $0.27 \times 10^9$/L, $p < 0.001$) and an AIDS diagnosis (44% v. 24%, $p < 0.001$) (Table 2).

Multivariate logistic regression analysis revealed that admission to hospital was independently associated with being unemployed (OR 2.64, 95% CI 1.66–4.20), having been previously admitted to hospital (OR 2.30, 95% CI 1.53–3.46), having a high viral load at baseline (OR 1.45, 95% CI 1.16–1.80), being an injection drug user (OR 1.63, 95% CI 1.02–2.62) and having an experienced physician (OR 1.98, 95% CI 1.29–3.03) (Table 3). In this final model we controlled for age, AIDS diagnosis, CD4 cell count, sex and length of time enrolled in the program.

We also conducted a subgroup analysis to examine the impact of the use of triple-drug combinations on admission to hospital among the 713 patients receiving antiretroviral therapy at baseline. Of these patients 627 (88%) were taking double and 86 (12%) were on triple combination therapy. In the univariate analysis the use of double therapy at baseline was not associated with a higher rate of hospital admission ($p = 0.29$). However, after adjusting for all variables in the final model, we found that those receiving double therapy were marginally more likely to be admitted to hospital than those receiving triple therapy (OR 2.23, 95% CI 0.99–5.03).

## Interpretation

This study identified the demographic and clinical determinants of hospital admission for HIV-positive people enrolled in the BC HIV/AIDS Drug Treatment Program. The people who were admitted to hospital for HIV/AIDS are socially marginalized. A recent study involving injection drug users in Vancouver demonstrated that those who lived in unstable housing, who were women or who injected cocaine were most likely to use emergency and hospital services.[11] Our study did not reveal sex to be a predictor of admission to hospital. This is probably because our study was not limited to injection drug users and had a smaller proportion of women in the sample.

Lower socioeconomic status characterized by unemployment was found to be a predictor of hospital admission. In a study examining the impact of unstable housing on admission to hospital, Goldstone and colleagues[12] indicated that HIV-positive people with lower incomes showed a higher use of hospital care than those in higher income groups. Lower socioeconomic status has been linked to increased morbidity and mortality among patients with cardiovascular disease and cancer.[13,14]

We found that patients who were HIV-positive and who had an experienced physician were more likely than those without an experienced physician to be admitted to hospital. This finding is consistent with those from studies examining the impact of physician experience on survival.[15] In their study Kitahata and associates[15] showed that the experience of the primary care physician in the management of AIDS was significantly associated with increased patient survival. Physicians with experience may be more aware of current antiretroviral and prophylactic options and may be more likely to have patients admitted to hospital than

physicians who are not experienced in the area of HIV/AIDS. Also, physicians with more experience may have a wider spectrum of illness severity in their practices, hence a higher rate of hospital admissions.

Longitudinal studies have shown that viral load increases slowly, but progressively, over the course of HIV infection.[16,17] Increased plasma viral titres are associated with clinical progression that may lead to admission to hospital.[18]

Prior admission to hospital was found to be a determinant of future admission. A person who has been previously admitted to hospital may be in a state of poor health and, therefore, more susceptible to subsequent health complications or infections requiring admission.

Intravenous drug use was also detected as a determinant of hospital admission. The proportion of the AIDS epidemic that is related to injection drug use has increased steadily over the past decade.[19,20] Symptoms associated with HIV infection may be complicated or intensified by lower quality of life and poor health status associated with injection drug use. In other studies injection drug users with AIDS were more likely than injection drug users without AIDS to be admitted to hospital because of a lack of social support, unstable housing[21] and lower socioeconomic status.[22] One study showed that injection drug users were less likely than non-users to seek antiretroviral therapy and to consult physicians with HIV experience.[23] Thus, the population of people admitted to hospital because of HIV infection will probably be further marginalized as the proportion of injection drug users increases.[24]

Certain limitations must be considered in the interpretation of our findings. The most inherent problem in a study of this nature is finding a sample that is representative of the entire population of HIV-positive men and women in British Columbia. It has been estimated that about 9000 people have been infected with HIV in this province.[25] Our study sample is likely not entirely representative of this large, diverse population, which probably includes people who are not receiving antiretroviral or prophylactic treatments, or both, and may therefore have different determinants of hospital use.

Our data demonstrate that hospital admissions in this population-based study were concentrated among marginalized people. These findings are consistent with those from observational studies in the United States that showed a relation between disease severity and socioeconomic status in health resource use.[3,26,27]

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