

Hospital utilization and costs in a cohort of injection drug users

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Abstract

Background: Many injection drug users (IDUs) seek care at emergency departments and some require hospital admission because of late presentation in the course of their illness. We determined the predictors of frequent emergency department visits and hospital admissions among community-based IDUs and estimated the incremental hospital utilization costs incurred by IDUs with early HIV infection relative to costs incurred by HIV-negative IDUs.

Methods: The Vancouver Injection Drug User Study (VIDUS) is a prospective cohort study involving IDUs that began in 1996. Our analyses were restricted to the 598 participants who gave informed consent for our study. We used the participants' responses to the baseline VIDUS questionnaire and, from medical records at St. Paul's Hospital, Vancouver, we collected detailed information about the frequency of emergency department visits, hospital admissions and the primary diagnosis for all visits or hospital stays between May 1, 1996, and Aug. 31, 1999. The incremental difference in hospital utilization costs by HIV status was estimated, based on 105 admissions in a subgroup of 64 participants.

Results: A total of 440 (73.6%) of the 598 IDUs made 2763 visits to the emergency department at St. Paul's Hospital during the study period. Of these 440, 265 (60.2%) made frequent visits (3 or more). The following factors were associated with frequent use: HIV-positive status (seroprevalent: adjusted odds ratio [OR] 1.7, 95% confidence interval [CI] 1.2–2.6; seroconverted during study period: adjusted OR 3.0, 95% CI 1.6–5.7); more than 4 injections daily (adjusted OR 1.5, 95% CI 1.1–2.1); cocaine use more frequent than use of other drugs (adjusted OR 2.0, 95% CI 1.2–3.6); and unstable housing (adjusted OR 1.5, 95% CI 1.1–2.2). During the study period 210 of the participants were admitted to hospital 495 times; 118 (56.2%) of them were admitted frequently (2 or more admissions). The 2 most common reasons for admission were pneumonia (132 admissions among 79 patients) and soft-tissue infections (cellulitis and skin abscess) (90 admissions among 59 patients). The following factors were independently associated with frequent hospital admissions: HIV-positive status (seroprevalent: adjusted OR 5.4, 95% CI 3.4–8.6; seroconverted during study period: adjusted OR 2.9, 95% CI 1.4–6.0); and female sex (adjusted OR 1.8, 95% CI 1.1–3.1). The incremental hospital utilization costs incurred by HIV-positive IDUs relative to the costs incurred by HIV-negative IDUs were \$1752 per year.

Interpretation: Hospital utilization was significantly higher among community-based IDUs with early HIV disease than among those who were HIV negative. Much of the hospital use was related to complications of injection drug use and may be reduced with the establishment of programs that integrate harm reduction strategies with primary care and addiction treatment.

Many injection drug users (IDUs) use emergency departments as a regular source of care because of the lack of accessible primary care services or their inability to attend set appointment times.¹⁻⁴ Poor health status among IDUs because of drug use, HIV infection or hepatitis C is common, and some IDUs present later in the course of an illness and thus require hospital admission.⁴⁻⁸ IDUs at all stages of HIV infection are admitted to hospital significantly more often than non-IDUs with HIV infection.⁹

Research

Recherche

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Because hospital admissions among HIV-positive IDUs are largely attributable to complications of injection drug use¹⁰ that are not directly related to the HIV infection, it is unclear whether community-based HIV-negative IDUs have similar hospital utilization patterns as IDUs with early HIV disease. Other studies of health care use by IDUs have been in the setting of drug treatment or clinics and reflect a highly selected population.^{11,12} We therefore conducted this study to determine the predictors of frequent emergency department use among community-based IDUs. We also examined the predictors of frequent hospital admission and reviewed the primary diagnosis for each encounter. To assess whether there was a difference in hospital utilization costs according to HIV status, we estimated the incremental costs incurred by IDUs with early stage disease relative to costs incurred by HIV-negative IDUs. With the rising prevalence of HIV infection among IDUs in many Canadian cities, including Vancouver,^{13,14} these data may be crucial for planning and evaluating programs that provide appropriate health care services to reduce drug-related harm among active IDUs with or at risk of HIV infection.

Methods

We obtained informed consent from 598 participants of the Vancouver Injection Drug User Study (VIDUS) to review their medical records at St. Paul's Hospital, the main teaching hospital for IDUs and HIV care in Vancouver. The hospital's Committee on Human Experimentation approved the study. The research design and methods of the VIDUS have been previously described;¹³ the primary aim was to determine the risk practices associated with HIV seroconversion. In brief, subjects were eligible to participate in the VIDUS if they had injected illicit drugs in the month before enrolment and resided in the Greater Vancouver region. Most participants (82%) were recruited through word of mouth and street outreach programs. Participants provided blood samples for HIV antibody testing and responded to an interviewer-administered questionnaire semi-annually. Responses from the baseline survey were used for our analyses. We reviewed medical records from St. Paul's Hospital for the 598 participants to determine the frequency of emergency department use and hospital admissions as well as the presenting problem for each emergency department visit and the primary diagnosis for each hospital admission between May 1, 1996, and Aug. 31, 1999.

Hospital utilization costs were estimated according to the inpatient resource-utilization profiles of a random sample of 64 participants who were admitted to hospital during the study period. Our cost estimates were for the first 105 admissions. For each admission, information was abstracted from the medical records, including the nursing ward, medications received, investigations, physicians' visits and length of stay. To distinguish between costs and charges,¹⁵ we estimated inpatient unit costs using a model of simultaneous allocation¹⁶ of all expenditures including overhead, opportunity cost of hospital resources as well as a 5% global depreciation of capital equipment.

Contingency tables were used to examine associations between frequent users and nonfrequent users of the emergency department and hospital by their HIV status and other sociodemographic and behavioural characteristics. We defined a priori fre-

quent emergency department use as 3 or more visits and frequent hospital admission as 2 or more stays during the study period. We classified HIV status as seroprevalent ($n = 166$), seroconverted (for HIV seroconversions that occurred during the study period) ($n = 51$) and negative ($n = 381$). Unstable housing was defined as living in a single-occupancy room hotel, boarding room, hostel, transition house, jail or on the street in the 6 months before enrolment in the study.^{3,13} The Wilcoxon rank-sum test was used to compare continuous variables.

To identify independent predictors of frequent emergency department use, variables significant at the 0.05 level in the univariate analysis were entered into logistic regression models in a stepwise, hierarchical fashion. In the final model, all relevant 2-way interactions were considered. This procedure was also performed to identify predictors of frequent hospital admission. We also compared self-reported hospital admissions in the 6 months before entry into the study and at follow-up (1999) by HIV status to assess the extent to which HIV-negative IDUs could have been admitted to hospital elsewhere.

To estimate the incremental difference in hospital utilization costs between IDUs with early HIV infection and HIV-negative IDUs, the average daily cost was multiplied by the median length

Table 1: Ten most frequent reasons for emergency department visits and hospital admissions among injection drug users (IDUs) in Vancouver between May 1, 1996, and Aug. 31, 1999*

Reason	No. (and %) of visits/admissions
Emergency department visit, presenting problem	
Soft-tissue infection†	460 (16.6)
Problem related to illicit drug use‡	322 (11.7)
Musculoskeletal problem	255 (9.2)
Laceration or contusion	193 (7.0)
Medication request or refill	165 (6.0)
Abdominal pain or gastrointestinal problem	141 (5.1)
Physical assault	99 (3.6)
Dental problem	94 (3.4)
Follow-up antibiotics§	90 (3.3)
Fracture	80 (2.9)
Hospital admission, primary diagnosis	
Pneumonia	132 (26.7)
Soft-tissue infection†	90 (18.2)
Sepsis	39 (7.9)
Fracture	25 (5.1)
Endocarditis	19 (3.8)
Psychiatric illness	16 (3.2)
Trauma (stabbing or laceration)	14 (2.8)
Septic arthritis	13 (2.6)
Osteomyelitis	11 (2.2)
Pyelonephritis	8 (1.6)

*During the study period 440 IDUs visited the emergency department 2763 times and 210 IDUs were admitted to hospital 495 times.

†Cellulitis and skin abscess.

‡Drug intoxication, overdose or withdrawal.

§Patients return to the emergency department on a daily basis for intravenous antibiotics.

of stay and then the annualized frequency of hospital admission per person by HIV status.¹⁷ We performed 2-way sensitivity analyses using the lower and upper limits of the 95% confidence interval (CI) for the hospital utilization costs and simultaneously varying the length of stay by calculating the difference in length of stay by HIV status using the 25th and 75th percentiles.

Results

Hospital utilization

Of the 598 participants included in our analysis, 440 (73.6%) of them visited the emergency department a total of 2763 times during the 39-month study period. Of these 440 IDUs, 265 (60.2%) visited the emergency department frequently and 91 (20.7%) visited more than 10 times. The annualized frequency of emergency department use by HIV status was 2.6 for the IDUs with seroprevalent HIV infection (1171 visits among 137 patients), 2.9 for the IDUs with seroconverted HIV infection (387 visits among 41 patients) and 1.4 for the HIV-negative IDUs (1205 among 262 patients). The 2 most common reasons for visiting the emergency department were soft-tissue infections (cellulitis and skin abscess) and problems directly related to illicit

drug use (e.g., drug intoxication, overdose and drug withdrawal) (Table 1).

Overall, 210 (35.1%) of the 598 participants were admitted to the hospital 495 times during the study period. Of these 210, 118 (56.2%) were admitted frequently and 21 (10.0%) had 5 or more admissions. The annualized frequency of hospital admissions by HIV status was 0.89 for the IDUs with seroprevalent HIV infection (294 admissions among 102 patients), 0.80 for the IDUs with seroconverted HIV infection (52 admissions among 20 patients) and 0.52 for the HIV-negative IDUs (149 admissions among 88 patients). The 2 most common reasons for admission were pneumonia (132 admissions among 79 patients) and soft-tissue infections (cellulitis and skin abscess, 90 admissions among 59 patients) (Table 1). The HIV-negative IDUs were less likely than the HIV-positive IDUs to report hospital admissions in the 6 months before entry into the study (odds ratio [OR] 0.43, 95% CI 0.29–0.67) and in the 6 months before follow-up (OR 0.48, 95% CI 0.29–0.77).

The crude and adjusted ORs for the predictors of frequent emergency department use and frequent hospital admission are shown in Tables 2 and 3 respectively. Logistic regression analysis showed that frequent emergency department use was associated with HIV infection (seropreva-

Table 2: Predictors of frequent emergency department use by IDUs

Predictor	Total no. of IDUs <i>n</i> = 598	No. (and %) of IDUs who made frequent visits*	Crude OR (and 95% CI)	Adjusted OR (and 95% CI)†
HIV status				
Seroprevalent HIV infection	166	89 (53.6)	1.9 (1.3–2.8)	1.7 (1.2–2.6)
Seroconverted HIV infection	51	34 (66.7)	3.4 (1.9–6.1)	3.0 (1.6–5.7)
HIV negative‡	381	142 (37.3)	1.0	1.0
Sex				
Female	197	85 (43.1)	0.9 (0.7–1.3)	0.8 (0.5–1.2)
Male‡	401	180 (44.9)	1.0	1.0
Sex trade worker§				
Yes	152	69 (45.4)	1.1 (0.7–1.5)	1.0 (0.6–1.6)
No‡	446	196 (43.9)	1.0	1.0
Injecting > 4 times/d				
Yes	212	111 (52.4)	1.6 (1.2–2.3)	1.5 (1.1–2.1)
No‡	386	154 (39.9)	1.0	1.0
Drug used most often				
Cocaine	522	245 (46.9)	2.5 (1.5–4.2)	2.0 (1.2–3.6)
Other‡	76	20 (26.3)	1.0	1.0
Unstable housing¶				
Yes	379	186 (49.1)	1.7 (1.2–2.4)	1.5 (1.1–2.2)
No‡	219	79 (36.1)	1.0	1.0
Previous addiction treatment				
Yes	460	215 (46.7)	1.5 (1.0–2.3)	1.5 (1.0–2.4)
No‡	138	50 (36.2)	1.0	1.0

Note: OR = odds ratio, CI = confidence interval.

*Frequent = 3 or more visits to the emergency department during the study period.

†All ORs were adjusted for age, ethnic background, needle sharing and hepatitis C status.

‡Reference group.

§Received money, goods, drugs or shelter in exchange for sex in the 6 months before study entry.

¶Living in a single-occupancy room hotel, boarding room, hostel, transition house, jail or on the street in the 6 months before study entry.

lent: adjusted OR 1.7, 95% CI 1.2–2.6; seroconverted: adjusted OR 3.0, 95% CI 1.6–5.7), injection more than 4 times daily (adjusted OR 1.5, 95% CI 1.1–2.1), cocaine use more frequent than use of other drugs; adjusted OR 2.0, 95% CI 1.2–3.6) and unstable housing (adjusted OR 1.5, 95% CI 1.1–2.2). The following factors were independently associated with frequent hospital admission: HIV infection (seroprevalent: adjusted OR 5.4, 95% CI 3.4–8.6; seroconverted: adjusted OR 2.9, 95% CI 1.4–6.0) and female sex (adjusted OR 1.8, 95% CI 1.1–3.1).

Utilization costs

The 64 IDUs included in the subgroup cost analysis were admitted to hospital 184 times during the study period. Of the 64 participants, 33 had seroprevalent HIV infection at baseline and 5 became HIV positive during the study period, with a median CD4 count of $389 \times 10^6/L$ (interquartile range [IQR] $216\text{--}592 \times 10^6/L$) at their first hospital admission. The 5 who became HIV positive during the study period had not been admitted to hospital when they were HIV negative. The IDUs who were HIV-positive had a longer length of stay (median 7 days, IQR 5–12 days) than the HIV-negative IDUs (median 5 days, IQR 4–8 days). The annualized frequency of hospital ad-

missions was 0.96 among the seroprevalent HIV-positive IDUs and 0.77 among the HIV-negative IDUs. The fully allocated average hospital utilization cost per day was \$610.33 (95% CI \$575.70–\$644.96). The incremental hospital utilization cost incurred by the HIV-positive IDUs relative to the HIV-negative IDUs was \$1752 per year (the sensitivity analyses showed that the incremental cost varied from \$990 to \$3457 per year).

Interpretation

We found that the HIV-positive IDUs visited the emergency department and were admitted to hospital substantially more often than the HIV-negative IDUs. This may have been due to continued high-risk injection behaviours, particularly among the IDUs who became HIV positive during the study period. Our annualized frequency of emergency department use among the HIV-negative IDUs was higher than the estimate reported by French and associates⁴ (1.4 v. 0.78); the same was true for the annualized frequency of hospital admissions (0.52 v. 0.32). These differences may have been due to differences in population, health care systems and ascertainment of health care use (self-report versus actual).

Our finding that female sex was an independent predic-

Table 3: Predictors of frequent hospital admission among IDUs in Vancouver

Predictor	Total no. of IDUs <i>n</i> = 598	No. (and %) of IDUs admitted frequently*	Crude OR (and 95% CI)	Adjusted OR (and 95% CI)†
HIV status				
Seroprevalent HIV infection	166	66 (39.8)	5.9 (3.8–9.1)	5.4 (3.4–8.6)
Seroconverted HIV infection	51	13 (25.5)	3.0 (1.5–6.1)	2.9 (1.4–6.0)
HIV negative‡	381	39 (10.2)	1.0	1.0
Sex				
Female	197	54 (27.4)	2.0 (1.3–3.0)	1.8 (1.1–3.1)
Male‡	401	64 (16.0)	1.0	1.0
Sex trade worker				
Yes	152	37 (24.3)	1.5 (0.9–2.3)	0.8 (0.5–1.5)
No‡	446	81 (18.2)	1.0	1.0
Injecting > 4 times/d				
Yes	212	49 (23.1)	1.4 (0.9–2.1)	1.1 (0.7–1.7)
No‡	386	69 (17.9)	1.0	1.0
Drug used most often				
Cocaine	522	108 (20.7)	1.9 (0.9–3.9)	1.5 (0.7–3.2)
Other‡	76	10 (13.2)	1.0	1.0
Unstable housing				
Yes	379	83 (21.9)	1.5 (1.0–2.4)	1.2 (0.8–2.0)
No‡	219	35 (16.0)	1.0	1.0
Previous addiction treatment				
Yes	458	97 (21.2)	1.6 (0.9–2.6)	1.6 (0.9–2.8)
No‡	140	21 (15.0)	1.0	1.0

*Frequent = 2 or more hospital admissions during the study period.

†All ORs were adjusted for age, ethnic background, needle sharing and hepatitis C status.

‡Reference group.

tor of frequent hospital admission is consistent with previous findings.^{6,18,19} The recent HIV Costs and Services Utilization Study in the United States reported that the sub-optimal pattern of care among women and IDUs was largely mitigated by adjusting for insurance coverage and race or ethnic background.²⁰ Comparisons with US findings are difficult given differences in the health care systems and the demographic composition of the study populations. The association between the use of cocaine and unstable housing with frequent emergency department use has been noted elsewhere.²¹⁻²⁴

The predominant reasons for hospital admission (pneumonia and soft-tissue infections) in our study are directly and indirectly related to needle use and highlight the importance of counselling and providing the tools necessary to practise safe injection techniques. In a study by Stein,¹⁰ HIV-positive IDUs were admitted to an urban hospital primarily because of injection-related complications. In another study, involving IDUs in drug treatment, those with early HIV infection used more ambulatory and inpatient services than HIV-negative IDUs.¹² An increased biological susceptibility to bacterial infections^{8,25} or poor hygiene and high-risk drug injection practices^{13,26} are possible explanations for the higher frequency of hospital admissions among HIV-positive IDUs.

Our study had several limitations. First, we may have underestimated the emergency department and hospital use because the participants may have received care from other hospitals. Second, we did not capture outpatient clinic visits. Third, we used a relatively small sample of IDUs to estimate the hospital utilization costs. Finally, the study participants may not be representative of all IDUs, because those in the lowest socioeconomic group may have been overrepresented in our study population.

Our cost analysis builds on previous work in that we examined actual hospital costs for IDUs by assigning fully allocated costs of actual resource use. In other studies costs were derived from charge data,^{4,10,27} or aggregated service utilization costs were used to calculate costs per patient-year.^{28,29} The incremental hospital utilization costs incurred by the HIV-positive IDUs relative to the costs incurred by the HIV-negative IDUs were \$1752 per person; this translates into an additional \$197 976 per year for hospital care for the 113 HIV-positive IDUs who were admitted to hospital during our study period.

A recent study reported high hospital use and costs among poor people in Toronto.³⁰ Our results provide some reasons for their findings among the IDU subgroup. Much of the health care use was largely attributable to complications of injection drug use, regardless of HIV status. The use of sterile injecting equipment and safe injection practices might have prevented many of these conditions and, thus, reduced the need for emergency department visits or hospital admissions.^{31,32} Programs that integrate harm reduction strategies with primary care and addiction treatment^{33,34} should be considered by jurisdictions serving this vulnerable population.

Competing interests: None declared.

Contributors: Anita Palepu was the principal author, conceived and designed the study and was responsible for the interpretation of the data. Mark Tyndall was responsible for the analysis and interpretation of data and for revising the manuscript. Hector Leon was responsible for the costing of the hospital resource use profiles and for revising the manuscript. Jennifer Muller was responsible for data collection and linkage to the Vancouver Injection Drug User Study survey data and for revising the manuscript. Michael O'Shaughnessy and Martin Schechter contributed to the interpretation of the data and revision of the manuscript. Aslam Anis contributed to the study design, was responsible for the costing methodology and interpretation and for revising the manuscript.

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HOLIDAY REVIEW 2001

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