Regional and Temporal Trends in Migration among People Living with HIV/AIDS in British Columbia, 1993-2005

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ABSTRACT

Objectives: To examine regional and temporal trends in migration among patients receiving HIV treatment in British Columbia (BC).

Methods: Patients initiating antiretroviral therapy in BC between January 1993 and November 2004 were followed until November 2005. Migration was calculated as the cumulative number of times a patient's residential address changed during their course of treatment. Analyses were performed at the provincial and at the regional health authority (HA) and local health area levels. Demographic methods were used to estimate the in- and out-migration rates, indices of dissimilarity and concentration across regions over time.

Results: A total of 3,588 participants were followed during the study period. Individuals who migrated most often migrated to the Vancouver Coastal HA (from the Interior: 30%, Fraser: 41%, Vancouver Island: 28%, and Northern: 19%), specifically the city of Vancouver, which has been treating the most patients with HIV since the early stages of the epidemic. We also showed that this movement intensified as more contemporary HAART regimens became available (p-value for trend <0.01).

Discussion: Our results demonstrate that migration among people with HIV in BC is not homogeneous, with areas around large urban centres having the highest influx of patients. It is thus important that health authorities in BC work in partnership to monitor and evaluate accessibility of HIV-related health care services to ensure universal access for all patients. Furthermore, enhanced HIV care and support services need to be developed, on a province-wide basis, and funding allocation needs to be adjusted to reflect patient migration in BC.

Key words: HIV/AIDS; migration; regional analysis; trend; British Columbia; Canada

La traduction du résumé se trouve à la fin de l'article.

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It was estimated that 12,300 individuals were living with HIV in British Columbia (BC) in 2005, representing 21% of all prevalent HIV cases in Canada, next only to Ontario (48%) and Québec (28%).[1-4] In BC, new HIV infections were historically observed in gay and bisexual men, most residing in Vancouver. Specialized HIV-related services have therefore been centralized in Vancouver.[5] However, over time an increasing number of new infections have been observed in other subpopulations, such as disadvantaged individuals and visible minorities, some of whom reside outside Vancouver.[6]

Two earlier studies indicate that when antiretroviral therapy became widely available throughout the province in the early to mid-1990s, a large number of people migrated to Vancouver from other parts of the province.[7,8] This was believed to be driven by the availability of specialized HIV-related services in Vancouver.[9] Therefore, moving to Vancouver was seen as a way to alleviate problems related to the geographical accessibility of services. However, despite a universal health care system where medically necessary services and antiretroviral therapy are provided free of charge to clinically eligible people with HIV, it is estimated that only 50% of the eligible HIV-positive individuals in BC are currently accessing therapy.[10]

The purpose of this study was to examine regional and temporal trends in migration among patients receiving antiretroviral therapy for the treatment of HIV in BC. Analyses were stratified by regional health authority and local health areas during 1993-2005. Estimates of migration between and within regions over time can provide useful information for health planners and policy-makers to make informed decisions regarding the allocation of services for those in medical need.

METHODS

Study population

Data for this study were drawn from the BC Centre for Excellence in HIV/AIDS Drug Treatment Program (DTP). The DTP has a provincial mandate to distribute antiretroviral therapy at no cost to all clinically eligible HIV-positive patients in BC.[11,12] The guidelines for clinical eligibility of antiretroviral therapy are consistent with those published by the International AIDS Society-USA. The DTP administrative database includes information on patients' residential address, history of antiretroviral medication, markers of HIV disease progression (i.e., HIV viral load, CD4 cell count, antiretroviral

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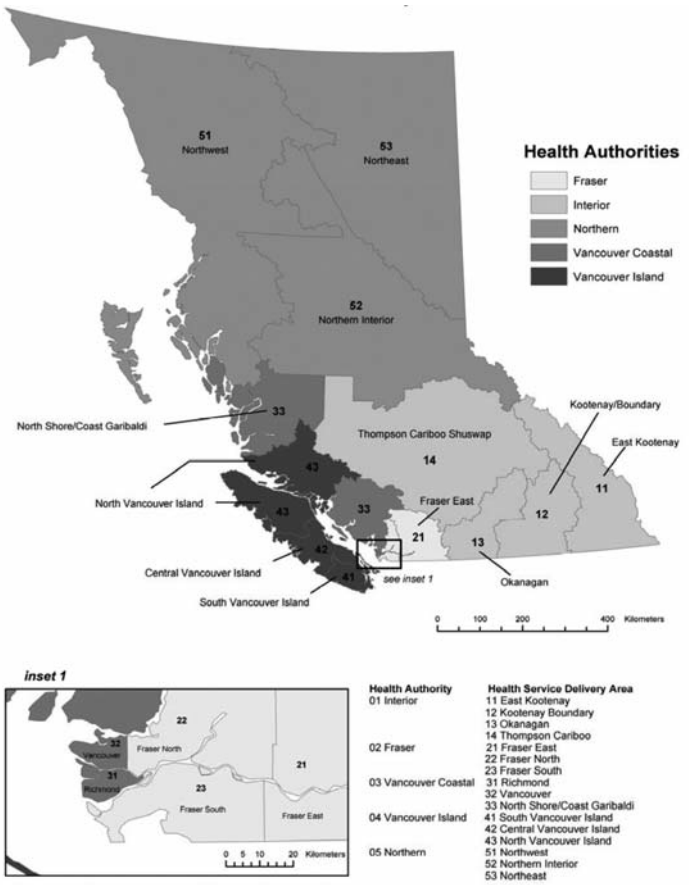
resistance), mortality, and co-morbidities, among other clinically relevant factors. Typically, patients on antiretroviral therapy are monitored by physicians at intervals no longer than three months, at which time prescriptions are renewed or modified and patients' addresses are updated in the DTP database. Since 1992, the DTP has provided treatment to over 9,000 individuals in BC.[12]

The data used in this study were a subset of the DTP, and include administrative records of patients ≥18 years of age who started antiretroviral therapy between January 1, 1993 and November 30, 2004, and followed until death, the last contact date, or the end of study follow-up (November 30, 2005). This analysis has received ethical approval from the University of British Columbia/ Providence Health Care Research Ethics Board.

Regional health boundaries in BC

Our analyses were conducted using the following geographical boundaries defined by the BC Ministry of Health: 89 local health areas (LHA) nested within 16 health services delivery areas (HSDA), within 5 health authorities (HA).[13] The 5 HAs – Interior, Fraser, Vancouver Coastal, Vancouver Island and Northern – are responsible for the management and delivery of health services in geographically defined subpopulations in BC. The 89 LHAs are used predominantly for data-disseminating purposes within each HSDA. The HSDAs are responsible for managing the delivery of health services in their respective areas, and meeting performance objectives set by HAs. The LHAs and HAs were used to define place of residence of the patients in this study. The map of BC stratified by HSDA and HA, with their respective names, is presented in Figure 1.

Figure 1. Map of British Columbia at the Health Authority and Health Service Delivery Area levels



Migration indicators and analyses

We define migration (or internal migration) as the movement from one LHA (or HA) to another. This movement can be temporary or permanent and may be for voluntary or involuntary reasons.[14] A number of population and migration indicators were used to study the migration trends across the HAs during 1993-2005.[14,15] First, we assessed internal migration of different HAs by comparing the last recorded HA of residence to the first recorded HA of residence for each patient. Second, we calculated three common migration rates for each HA defined as:

- In-migration rate: $\frac{I_{HA_{[i]}}}{P_{HA_{[i]}}}$ x 1000, where $I_{HA_{[i]}}$ is the number of in-migrants during a specified time for the i^{th} HA (i = Interior, Fraser, Vancouver Coastal, Vancouver Island and Northern); and $P_{HA_{[i]}}$ is the population of the i^{th} HA at the mid-point of the migration interval.
- Out-migration rate: $\frac{O_{HA_{[i]}}}{P_{HA_{[i]}}}$ x 1000, where $O_{HA_{[i]}}$ is the number of out-migrants during a specified time for the i^{th} HA (i = Interior, Fraser, Vancouver Coastal, Vancouver Island and Northern); and $P_{HA_{[i]}}$ is defined above.
- Net-migration rate: $\frac{I_{HA_{[i]}} - O_{HA_{[i]}}}{P_{HA_{[i]}}}$ x 1000, where $I_{HA_{[i]}}$, $O_{HA_{[i]}}$ and $P_{HA_{[i]}}$ are defined above.

Third, we calculated three measures of population distribution. The first two measures examine the degree of non-uniformity in the distribution of the patients' residence across the HAs; they are called the concentration ratio and the index of concentration. They both measure the degree of variability of the population distribution at a given point in time. They can also be interpreted as the percentage of HIV-infected patients who would need to move locations so that an even distribution of HIV-positive individuals is obtained among the different HAs. These indexes usually give very similar results, however the index of concentration is less computationally intensive. The third measure is called the index of dissimilarity, and it measures the change in the degree of variability in a given area between two points in time. In our database, it was possible to account for all migration movements, provided the participant communicated a change in address when they refilled their prescriptions. Therefore, a patient can move more than one time during a particular era, or even during a particular year, and the data were built to account for all such movements. Thus, we calculated these measures comparing different milestone years in our drug treatment program: 1993 (pre-highly active antiretroviral therapy (HAART)) & 1996 (first time HAART became available containing non-boosted protease inhibitors), 1996 & 1999 (when HAART containing non-nucleoside reverse transcriptase inhibitors became available), 1996 & 2001 (when boosted protease inhibitors [more potent than the unboosted version of this drug] became available), 1996 & 2003 (newer drug combinations introduced to patients in our Centre) and 1996 & 2005 (the latest drug combinations available to our patients).

We also used mapping to contrast low and high disease risk areas, identify geographical clusters of disease incidence, and provide eti-

Table 1. Mobility indicators, British Columbia, 1993-2005

(a) Inter-regional migration rates per 1000 population

	First Residence Recorded					
Last Residence Recorded	**Interior**	**Fraser**	**Vancouver Coastal**	**Vancouver Island**	**Northern**	**Total**
Interior	**101**	20	42	10	2	**175**
Fraser	34	**365**	295	31	7	**732**
Vancouver Coastal	65	299	**1766**	117	12	**2259**
Vancouver Island	12	32	56	**248**	12	**360**
Northern	5	10	8	8	**31**	**62**
Total	**217**	**726**	**2167**	**414**	**64**	**3588**

Region	**Population at Risk**	**In Migrants**	**Out Migrants**	**In-migration Rate**	**Out-migration Rate**	**Net-migration Rate**
Interior	175	74	116	422.9	662.9	-240.0
Fraser	732	367	361	501.4	493.2	8.2
Vancouver Coastal	2259	493	401	218.2	177.5	40.7
Vancouver Island	360	112	166	311.1	461.1	-150.0
Northern	62	31	33	500.0	532.3	-32.3
Life-time migrants	3588	1077	1077			

(b) Concentration ratio, index of concentration and indice of dissimilarity

	Years				
Indicators	**1993 & 1996 %**	**1996 & 1999 %**	**1996 & 2001 %**	**1996 & 2003 %**	**1996 & 2005 %**
Concentration ratio	39.5	45.9	49.8	54.1	57.4
Index of concentration	73.4	79.1	81.6	86.2	88.9
Index of dissimilarity	12.1	16.5	13.2	17.1	26.0

ological clues based on the distribution of disease risk.[16] Crude migration rates at the LHA level were mapped over time to show the spatial distribution of place of residence of patients. We calculated these crude rates using non-overlapping time intervals, defined by the periods 1993-1996, 1997-1999, 2000-2002, and 2003-2005. To calculate the migration rates over time, we used the annual BC population size estimates for 1993-2005 as a denominator.[17] These population estimates represent individuals aged 15-64 years and are specific to each HA and LHA. Analyses were conducted using SAS version 9.1.3 (SAS, Cary, NC) and ArcView version 9 (ESRI, Redlands, CA).

RESULTS

A total of 3,588 patients enrolled in the DTP were followed between January 1, 1993 and November 30, 2005, translating into a median follow-up time of 3.9 years (interquartile range: 1.8-6.7 years). At the end of follow-up, 19.3% of patients died of non-AIDS or AIDS-related causes (rate 44.8 per 1000 person-years), 7.9% were lost to follow-up (rate 18.3 per 1000 person-years), 3.5% moved out of BC (rate 8.1 per 1000 person-years), 2.3% were censored because they had enrolled in a blinded trial involving receiving placebo medication, and 67.0% were followed until the study ending date (rate 155.1 per 1000 person-years).

Table 1 displays the results of the different migration and population indicators. Table 1(a) shows the distribution of the patient's initial residence recorded at the beginning of the study period by their last residence recorded. We observed that for all HAs except Vancouver Coastal, about half of the patients did not migrate during the study period, or if they did, they returned to their first residence recorded by the end of the study (Interior: 47%, Fraser: 50%, Vancouver Island: 60%, and Northern: 48%). Most patients living in Vancouver Coastal remained in this region during this period, or at least had the same first and last residences during the study period (81%). Patients who migrated most often migrated to the Vancouver Coastal HA (from the Interior: 30%, Fraser: 41%, Vancouver Island: 28%, and Northern: 19%). Consequently, we obtained negative net-migration rates of -240.0, -150.0, and -32.3 per 1000 population for the Interior, Vancouver Island, and Northern HAs, respectively, indicating that patients were leaving these HAs at a higher rate than entering them. Vancouver Coastal HA had a net-migration rate of 40.7 per 1000 population. What is perhaps more interesting is that the Fraser HA also had a positive net migration rate (8.2%), with most of these patients coming from the Vancouver Coastal HA.

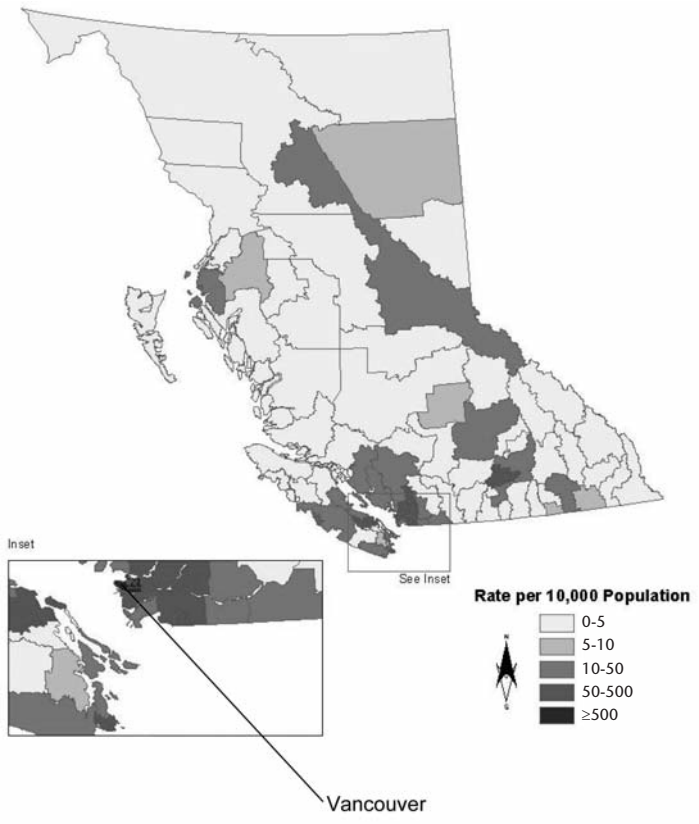
The maps in Figure 2 illustrate the distribution of patients' place of residence while on treatment, for every 10,000 population by LHA. In the pre-HAART period (panel A), most patients were living in areas around the large cities in BC: Vancouver (Vancouver Coastal), Victoria (Vancouver Island), Prince George (Northern), Penticton, Vernon, Central Okanagan and Kamloops (Interior), and Surrey, Coquitlam, and Burnaby (Fraser). When HAART first became available (panel B), there was a high migration from remote areas to these large population centres, especially those close to Vancouver. This pattern became more evident as we approached the year 2005 (panels B-D).

Figure 3 shows the distribution of patients' place of residence from 1993 to 2005. No obvious trends were observed in Northern, Vancouver Island or Interior. As expected, the majority of patients are receiving treatment in Vancouver Coastal ($p<0.01$). Note that the percentage of patients residing in Fraser, while fluctuating, has been increasing since 1998 with an approximate increase of 46% in the average number of patients treated during 1993-1997 as opposed to 1998-2005 ($p<0.01$).

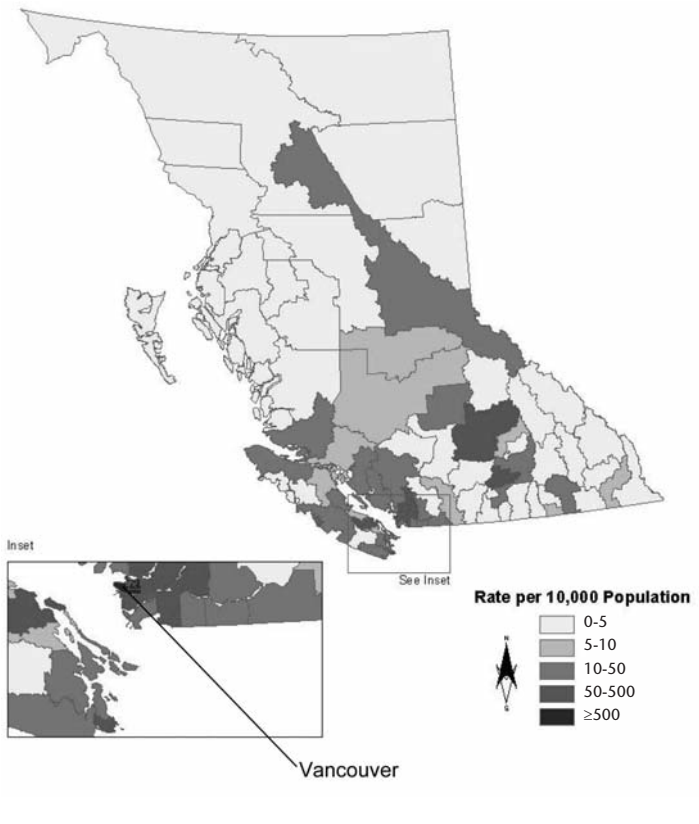
The concentration ratio, index of concentration and index of dissimilarity between different periods of time are shown in Table 1(b). These population indicators have changed significantly over time, showing that in more recent years, when compared to the first time HAART became available (1996), the heterogeneity in the distribution of the population across health regions in BC has increased over time.

Figure 2. Mapping migration patterns in British Columbia at the Local Health Area level

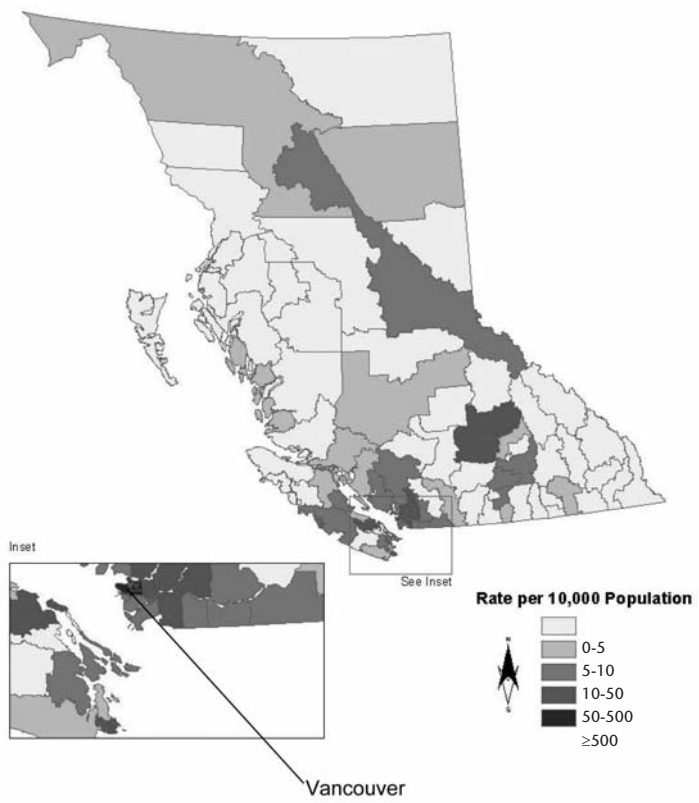
Panel A: Years 1993 to 1996



Panel B: Years 1997 to 1999



Panel C: Years 2000 to 2002



Panel D: Years 2003 to 2005

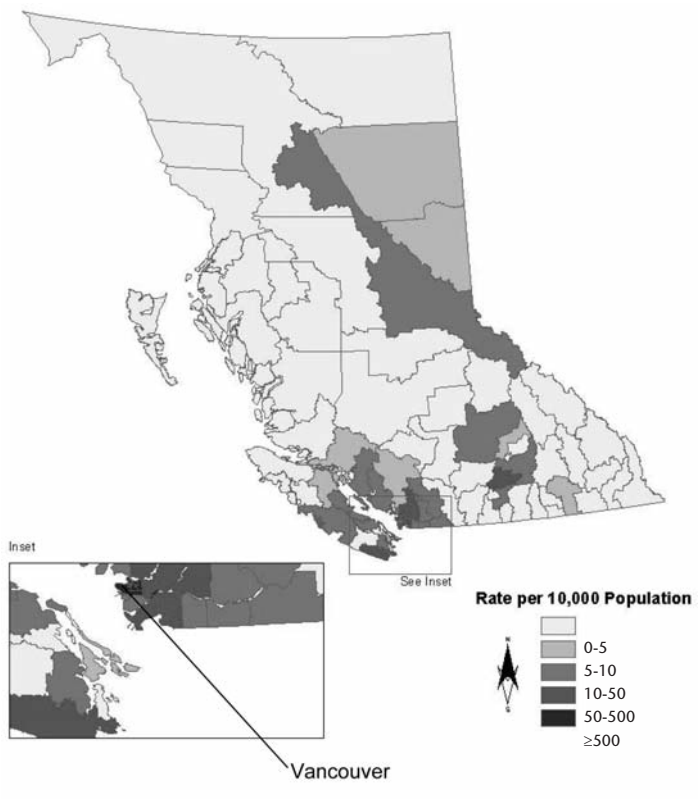
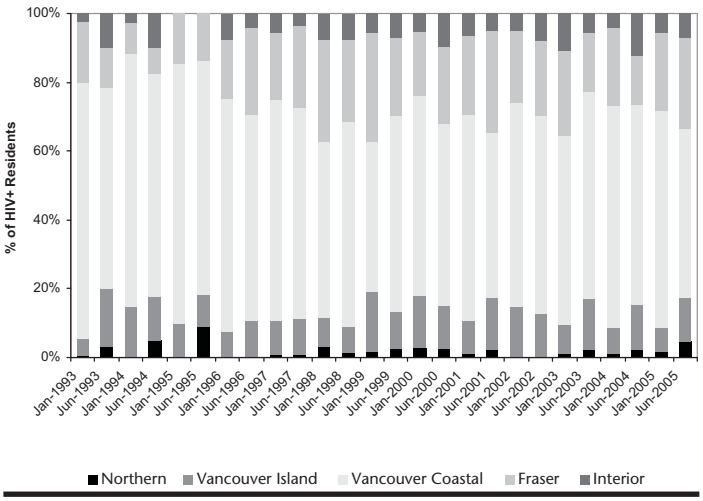


Figure 3. Distribution of HIV/AIDS participants in the Drug Treatment Program at the Health Authority level, 1993-2005



DISCUSSION

The results of this study demonstrated that Vancouver Coastal, specifically the LHAs representing Vancouver, has attracted the majority of migrant patients with HIV since the early stages of the epidemic in BC. This area attracted patients from all other regions in BC and this movement intensified over time. We also demonstrated that more patients are either migrating to Fraser (hosting the second largest centre for treatment in BC) – most likely from Vancouver Coastal – or deciding to stay in Fraser.

The results are comparable to those of other studies, where people with HIV are highly likely to move between communities and regions.[8,18-22] Reasons for migration may range from the desire to be near caregivers, specialized care, and better access to health care services, to being in communities with members of similar social interests or close to family or friends. Therefore, with inadequate health care planning, migration can impose a tremendous burden on health care systems of larger communities/cities not prepared to accommodate these extra patients. Future analysis should focus on understanding the reasons for migration of HIV patients in BC.

There are several features of this study that should be highlighted. First, this study was based on a large sample of patients within a province-wide treatment program, in which all patients had free access to medical attention, combination antiretroviral therapy, and laboratory monitoring. We are confident, therefore, that our results were not seriously influenced by inadequate sample size. Second, delayed reporting of deaths was not likely a factor since most deaths were reported within three months through active follow-up with physicians and regular linkages to the BC Vital Statistics Agency. Third, in this group of patients, given that 19.3% of patients died and 13.7% of patients were censored and not followed until the end of the study, our migration rates and indicators may have been underestimated. Finally, it is likely that over time, patients might be treated by more experienced physicians and therefore be more likely to migrate.[9,22]

Our results demonstrate that migration among patients receiving antiretroviral therapy in BC is not homogeneous, with areas around large urban centres having the highest influx of patients. It is thus important that health authorities in BC work in partnership to monitor and evaluate accessibility of HIV-related health care services to ensure universal access for all patients. Furthermore, enhanced HIV care and support services need to be developed, on a province-wide basis, and funding allocation needs to be adjusted to reflect patient migration in BC.

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RÉSUMÉ

Objectifs : Examiner les tendances migratoires régionales et temporelles chez les patients traités contre le VIH en Colombie-Britannique (C.-B.).

Méthode : Nous avons suivi jusqu'en novembre 2005 les patients ayant commencé un traitement antirétroviral en C.-B. entre janvier 1993 et novembre 2004. Leurs migrations ont été calculées selon le nombre total de changements d'adresse domiciliaire des patients durant leur traitement. Nous avons analysé les données à l'échelle provinciale et à l'échelle des régies régionales de la santé (RRS) et des services de santé municipaux. Des méthodes démographiques ont servi à estimer les taux d'immigration et d'émigration, les indices de dissimilarité et la concentration par région au fil du temps.

Résultats : Nous avons suivi 3 588 participants durant la période de l'étude. Les sujets ayant migré se déplaçaient le plus souvent vers la RRS de la région côtière de Vancouver (en provenance de l'intérieur de la province : 30 %, de la vallée du Fraser : 41 %, de l'île de Vancouver : 28 %, et du Nord de la province : 19 %), plus précisément vers la ville de Vancouver, qui traite le plus grand nombre de patients atteints de VIH depuis les premières manifestations de l'épidémie. Nous avons également montré que ce mouvement s'est intensifié lorsque la multithérapie antirétrovirale est devenue disponible (valeur prédictive de la tendance <0,01).

Discussion : Nos résultats montrent que les flux migratoires des personnes atteintes du VIH en C.-B. ne sont pas homogènes, car ce sont les zones périphériques des grands centres urbains qui reçoivent le plus de patients. Il est donc important que les autorités sanitaires de la province travaillent en partenariat pour surveiller et évaluer l'accessibilité des services de santé liés au VIH pour que tous les patients y aient droit. Il faudrait aussi mettre au point des services de soins et de soutien améliorés, dans toute la province, et réviser l'affectation des fonds en fonction des flux migratoires des patients atteints du VIH.

Mots clés : VIH; migration; analyse régionale; tendance; Colombie-Britannique; Canada