

Trends in HIV/AIDS Mortality in Canada, 1987-1998

Dena L. Schanzer, MSc

ABSTRACT

Objective: To monitor Canadian HIV/AIDS mortality following the introduction of antiretroviral therapies in 1996, and to compare this with the US experience.

Methods: Deaths were extracted by underlying cause of death, age, sex, marital status and place of residence at time of death. Age-specific leading causes of death, potential years of life lost before age 65, and rates are presented.

Results: HIV deaths peaked in 1995 at 1,764, representing 1% of all deaths, 15% of male deaths aged 25-44, and the second leading cause of death for males age 25-44, trailing suicides. From 1995 to 1997, HIV deaths dropped by 66% for males and 43% for females. Rates for Toronto, Vancouver and Montreal were 6 times higher than in rural areas, and 2.5 times higher than in other Census Metropolitan Areas.

Conclusions: As of 1998, HIV still was a leading cause of premature mortality. The trend in Canadian HIV mortality was similar to that in the US, though US rates remain double the Canadian rates. The drop in HIV deaths may not be sustained in the long term, as antiretroviral therapy is not a cure and the number of people living with HIV is increasing.

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

Centre for Infectious Disease Prevention and Control, Population and Public Health Branch, Health Canada

Correspondence and reprint requests: Dena Schanzer, Centre for Infectious Disease Prevention and Control, Population and Public Health Branch, Health Canada, AL 0900B1, Tunney's Pasture, Ottawa, ON K1A 0L2, Tel: 613-946-0461, Fax: 613-957-2842, E-mail: dena_schanzer@hc-sc.gc.ca

Acknowledgements: We thank Robert Semenciw and Ping Yan for helpful discussions on methodology for this paper.

The impact of HIV infection on mortality has reached unprecedented rates for an infective organism in recent times. Improved antiretroviral therapies, available since 1996, have been credited with recent declines in HIV mortality rates.¹⁻⁵ This report updates studies of HIV mortality in Canada⁶⁻⁸ that cover the period prior to the availability of highly affective antiretroviral therapies (HAART) and supplements national HIV and AIDS surveillance reports.⁹ The effectiveness of HAART in reducing HIV mortality in Canada is compared with the experience in the United States where deaths due to HIV infection increased an average of 16% per year, reaching a peak in 1995 at 2% of all deaths, and despite significant declines in mortality, HIV still accounted for 7% of all deaths in 25-44 year olds in 1999 in the United States.¹⁰⁻¹²

At the peak in 1995, HIV ranked 8th as a leading cause of death in the US, and 4th as a leading cause of potential years of life lost before age 65 (PYLL65).¹² This report includes a similar summary of Canadian leading causes of death. In contrast, the standard Statistics Canada report¹³ on leading causes of death ranks disease chapters, and HIV was not specifically included in the ranking.

HIV deaths occurred at a relatively young age and were concentrated in specific geographic locations;^{6,14} for example, most HIV deaths in British Columbia occurred among residents of Vancouver or Victoria.⁷ Changes in geographic pattern of HIV mortality are reviewed.

METHODS

Records of registrations of deaths occurring in Canada, maintained by the provincial and territorial registrars of the Offices of Vital Statistics, were coded by the provinces or Statistics Canada using the ninth revision of the International Classification of Disease (ICD-9). HIV (Human Immunodeficiency Virus) deaths were coded to ICD-9 042-044 since 1987. Mortality rates were calculated from deaths¹⁵ and population counts¹⁶ provided by Statistics Canada, by age, sex, area of residence and year using Health Canada's ORIOUS software.¹⁷ US age-specific mortality rates were provided by the National Center for Health Statistics.^{10,12}

Age-standardized mortality rates (ASMRs) were calculated for Canadian

TABLE I

Proportion of HIV Deaths* (ICD-9 042-044), Canada by Period, Sex, Marital Status, Place of Residence and Age Group

	1993-1995						1996-1998					
	No.	Male %	(95% CI)	No.	Female %	(95% CI)	No.	Male %	(95% CI)	No.	Female %	(95% CI)
Marital Status												
Single	3617	79.8	(78.6,80.9)	165	47.1	(41.8,52.5)	1649	77.1	(75.2,78.8)	115	46.6	(40.2,53.0)
Married	455	10.0	(9.2,10.9)	78	22.3	(18.0,27.0)	255	11.9	(10.6,13.4)	57	23.1	(18.0,28.8)
Widowed	42	0.9	(0.7,1.3)	43	12.3	(9.0,16.2)	32	1.5	(1.0,2.1)	25	10.1	(6.7,14.6)
Divorced/Separated	420	9.3	(8.4,10.1)	64	18.3	(14.4,22.7)	204	9.5	(8.3,10.9)	50	20.2	(15.4,25.8)
Place of Residence												
Montreal	1095	24.1	(22.9,25.4)	135	38.8	(33.6,44.1)	492	22.9	(21.1,24.7)	86	34.4	(28.5,40.6)
Toronto	1217	26.8	(25.6,28.2)	57	16.4	(12.6,20.7)	507	23.6	(21.8,25.4)	48	19.2	(14.5,24.6)
Vancouver	684	15.1	(14.1,16.2)	37	10.6	(7.6,14.4)	316	14.7	(13.2,16.3)	35	14.0	(9.9,18.9)
Other CMA's	995	21.9	(20.7,23.2)	66	19.0	(15.0,23.5)	515	24.0	(22.2,25.8)	52	20.8	(15.9,26.4)
CAs	272	6.0	(5.3, 6.7)	26	7.5	(4.9,10.8)	170	7.9	(6.8, 9.1)	18	7.2	(4.3,11.1)
Rural	272	6.0	(5.3, 6.7)	27	7.8	(5.2,11.1)	149	6.9	(5.9, 8.1)	11	4.4	(2.2, 7.7)
Age Group (years)												
0-14	20	0.4	(0.3, 0.7)	21	5.9	(3.7, 8.9)	9	0.4	(0.2, 0.8)	4	1.6	(0.4, 4.0)
15-24	53	1.2	(0.9, 1.5)	14	3.9	(2.2, 6.5)	23	1.1	(0.7, 1.6)	9	3.6	(1.7, 6.7)
25-44	3280	71.3	(70.0,72.6)	239	67.1	(62.0,72.0)	1450	67.0	(64.9,69.0)	186	74.1	(68.2,79.4)
45-64	1172	25.5	(24.2,26.8)	70	19.7	(15.7,24.2)	628	29.0	(27.1,31.0)	46	18.3	(13.7,23.7)
65+	73	1.6	(1.2, 2.0)	12	3.4	(1.8, 5.8)	55	2.5	(1.9, 3.3)	6	2.4	(0.9, 5.1)
Total	4598	100		356	100		2165	100		251	100	

* Data Source: Statistics Canada

CMA : Census Metropolitan Area, population > 100,000

CA : Census Agglomerate, population from 10,000 to 100,000

and US HIV mortality by directly adjusting the age-specific rates to the 1991 Canadian standard population. The statistical significance of differences in rates among sub-populations were assessed using the standardized mortality rate (SMR); the ratio of the observed number of deaths divided by the expected number of deaths based on the rates of the reference population. Confidence limits were calculated based on Byar's approximation.¹⁸

Leading causes of death were obtained by ranking mutually exclusive disease groups. ICD-9 groups causes of death into 16 disease chapters plus a supplementary classification for the coding of external causes of injuries and poisonings. Potential leading causes were primarily chosen from subgroups within a chapter, with the objective of having policy-relevant groupings and also minimizing the proportion of deaths not included in the top 20 causes. A cross-chapter disease group of drug and alcohol abuse (ICD-9 codes 291-292,303-305,E850-858,E860) was formed by including the drug and alcohol poisonings taken from the supplementary classification of external causes, and deaths related to drug or alcohol abuse from the chapter on mental illness. To better address premature mortality, age-specific causes of death and causes of PYLL65 were ranked. PYLL65 is a measure of premature mortal-

ity that is widely published, in part because PYLL65 relates to the economic costs of lost productivity. PYLL65 is calculated by weighting each death before the age of 65 by 65 minus age at death.

Place of residence of the decedent was coded to census subdivision (CSD) levels,¹⁷ a geopolitical region containing various mixes of urban and rural areas. For consistency, the CSDs representing the urban core and adjacent urban and rural areas that had a high degree of integration with the urban core were aggregated into either census metropolitan areas (CMA) if the combined population was at least 100,000, or census agglomerate (CA), for populations between 10,000 and 100,000. CMA's and CAs were delineated similarly across Canada for comparability.¹⁹ In this report, each CSD has been assigned to one of the following six types of place of residence based on 1998 borders: CMA of Montreal, Toronto, Vancouver, Other CMA, CA, or Rural.

RESULTS

The annual number of HIV deaths peaked in 1995 at 1,764 or 0.8% of all deaths. From 1995 to 1997, deaths dropped by 66% for males and 43% for females, as shown in Figure 1. The side plot, in log scale, shows that this divergence in trends

from 1995 to 1998 was the predominant difference between male and female trends. As a result, the proportion of female deaths has climbed from a low of 5% (95% CI 3%-6%) in 1990 to a high of 15% (95% CI 11%-18%) in 1998, driven by a strong reduction in the deaths among single males, particularly from the Toronto CMA (Table I). Overall, deaths dropped 51% from the 1993-1995 period to the 1996-1998 period; 53% for males, 29% for females, and 47% for ever-married males. The drop was sharpest for single males from Toronto CMA at 60%, and least for single males from CAs at 33%. Among females, the decline in mortality was homogeneous across marital status and place of residence, though varied with age group. The drop in the number of female deaths was sharpest for those aged 0-14 at 81%, and the proportion for this age group dropped from 5.9% to 1.6%. In the 1993-95 period, single males accounted for 73% of all HIV deaths, dropping to 68% for the 1996-1998 period. The median age at death has increased slightly from 37 in 1987 to 40 in 1998 for males and from 34 to 39 for females.

Approximately 50% of all HIV deaths were from the cities of Toronto, Montreal and Vancouver, which represented less than 10% of the Canadian population. The HIV mortality rates for the cities of

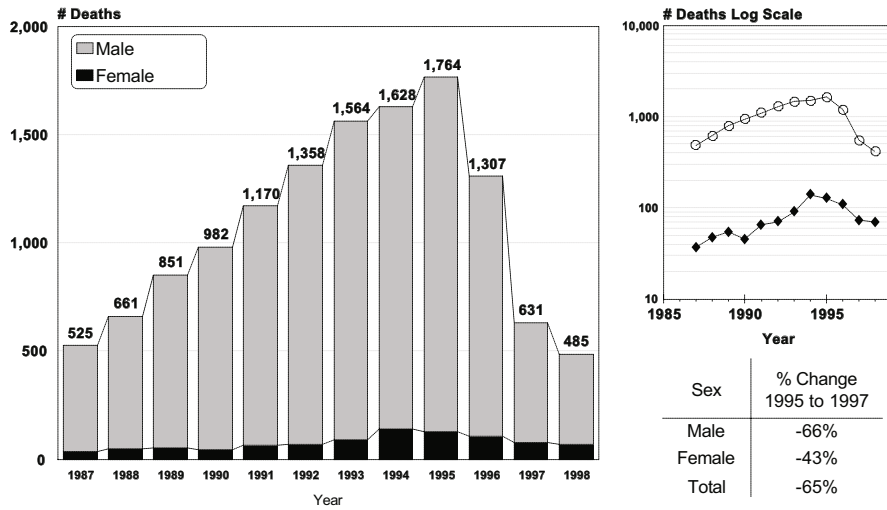


Figure 1. Number of deaths due to HIV infections, ICD-9 042-044, Canada by sex and year

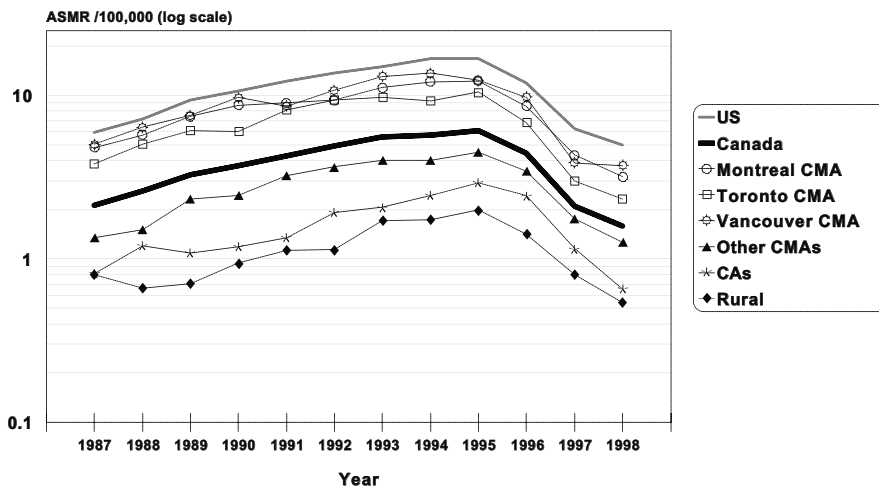


Figure 2. Age-standardized mortality rate (ASMR)/100,000 for HIV (ICD-9 042-044), Canada by type of place of residence at death

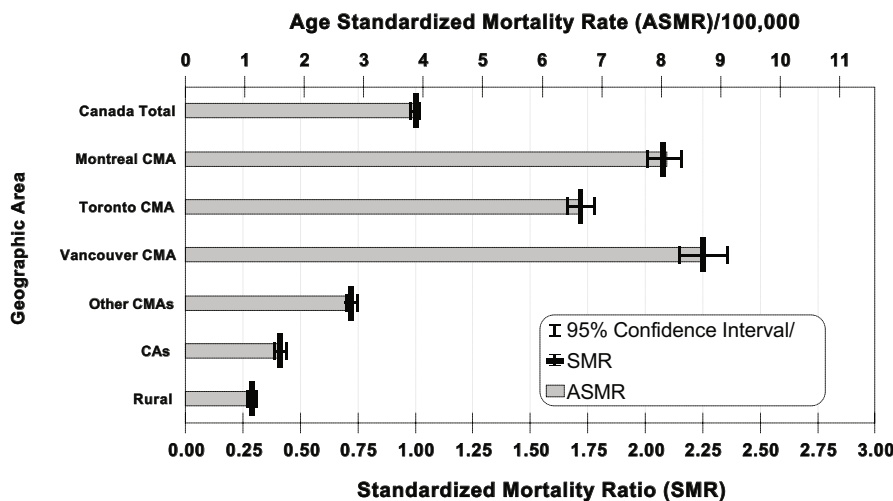


Figure 3. Standardized mortality ratio (SMR) for HIV infections, ICD-9 042-044, Canada, 1987-1988 by type of place of residence at death

Toronto, Montreal and Vancouver were more than double the rates for the rest of the CMA. However, due to the amalgamation of Toronto with the surrounding cities in 1998, and corresponding change in CSD definition, the analysis is presented at the CMA level only. Figure 2 illustrates the trend in the ASMRs by type of place of residence, including the US national rate for comparison. Despite a nearly 10-fold difference in the ASMR between the three major CMA and rural areas, the overall trends were similar. Also, the Canadian and American mortality trends were similar (Figure 2) though the US ASMR was twice the Canadian rate. Summary SMRs are provided in Figure 3.

Suicide was the leading cause of death for males aged 25-44 from 1987-1998 (Figure 4). Drug and alcohol abuse rose on average 6% per year from 1987-1998, while deaths attributed to most other leading causes have notably declined over the same period. HIV deaths rose sharply until 1995, when HIV became the second leading cause of death for males aged 25-44 and accounted for 15% of all deaths. HIV still ranked 7th in 1998, accounting for 4.1% of all deaths of males aged 25-44. For females aged 25-44, HIV peaked at 2.5% of all deaths, and in 1998 HIV ranked 10th, accounting for 1.5% of all deaths. In the US, HIV mortality reached a peak in 1995 at 19% and 11% of all deaths for males and females aged 25-44 respectively, and for males HIV was the leading cause of death while for females, it was the 3rd leading cause.¹⁰ Viral hepatitis deaths, though not a leading cause of death, had the sharpest increase at an average of 12% per year from 1987 to 1998 for this age group (not shown).

PYLL65 due to HIV increased from 1987 to 1995, and then sharply declined, while a decline in PYLL65 from 1987-1998 was apparent for most other causes (Figure 5). HIV ranked 8th from 1990-96, and in 1995 accounted for 4.7% of PYLL65, overtaking drug and alcohol abuse, homicide and lung cancer (not shown). By 1998, PYLL65 for HIV dropped in rank to 13th at 1.3% and drug and alcohol abuse became a more substantial cause of premature mortality. Among females, HIV reached a peak at 1.0% of PYLL65 from all causes. As of 1998, HIV still accounted for 1.3% of all PYLL65.

DISCUSSION

The drop in HIV mortality after 1995 has been primarily attributed to the use of improved antiretroviral therapies that were first available in late 1995 with the introduction of multiple reverse-transcriptase inhibitors and later protease inhibitors. These antiretrovirals significantly delayed the development of AIDS-defining illnesses²⁰ and improved survival.^{2,3,21} Various studies^{1,4,22} of AIDS cohorts have found that improved treatment explains the substantial drop in mortality rates among AIDS cases and that year of AIDS diagnosis was the main indicator of survival. It is important to continue to monitor AIDS deaths as sentinel events, since AIDS mortality captures the effects of incidence, testing behaviour, access to treatment, and effectiveness of treatment combined. Despite a trend of improved survival with each year of AIDS diagnosis,⁴ the national HIV mortality rate also faces upward pressure due to the growing number of people living with HIV.²³

The proportion of females among the HIV deaths has increased from a low of 5% in 1990 to 15% in 1998. Although, the number of new HIV positive diagnoses among females has remained steady over the same period, a similar trend has been observed in HIV positive tests, where the proportion of females rose from 10% prior to 1995 to 23% in 2000. The increasing trend is a direct result of a decline of 5% per year on average in new diagnoses among males.⁹ Among reported AIDS cases, approximately 15% were females.⁹ In the US, the proportion of females among HIV deaths was higher at 10% in 1987 and 23% in 1998.²⁴ This pattern suggests that a reduction in HIV incidence among males was more likely the main contributor to this upward trend in proportion of female deaths than poorer access to treatment for females or increased incidence among females.

The Canadian decline in HIV deaths of 67% from 1995 to 1997 was comparable to the US decline of 57%, as was the trend over the 1987 to 1998 period. While trends were similar between Canada and the US, the actual ASMR in the US was twice that of Canadian males, and five times that of Canadian women.¹⁰ For males aged 25-44, HIV deaths have risen

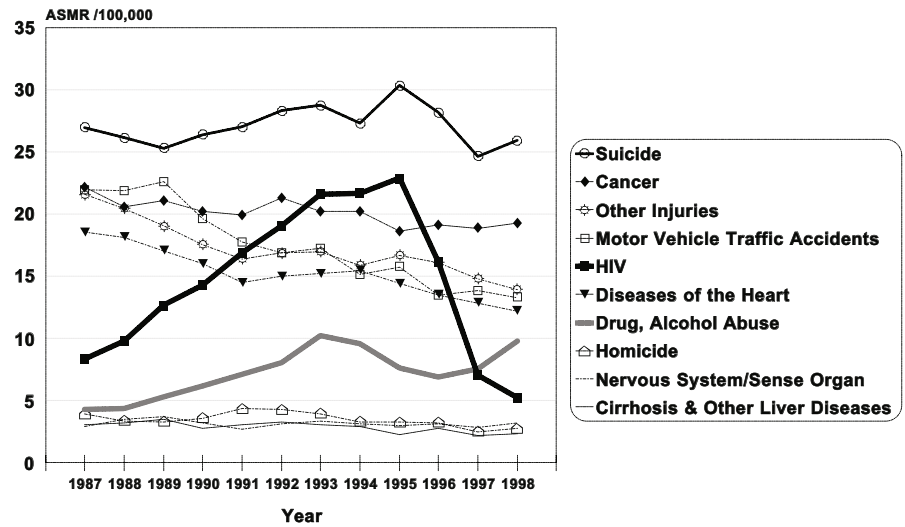


Figure 4. Top 10 leading causes of death for males aged 25-44, Canada, 1987-1998 age-standardized mortality rate (ASMR)/100,000

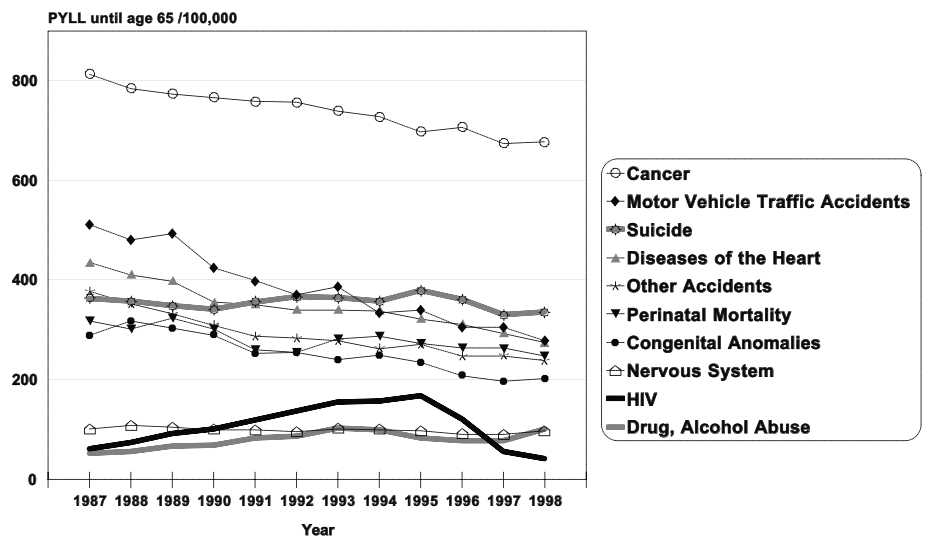


Figure 5. Top 10 leading causes of PYLL until age 65 (PYLL65)/100,000, Canada, 1987-1998

sharply until 1995, at which point HIV was the second leading cause of death, and has since declined to 7th in 1998 in Canada. Because of higher infection rates in the US, HIV was the leading cause of death among 25-44 year olds.

In Canada, suicide has consistently been the leading cause of death for males aged 25-44, and drug and alcohol abuse, which ranked 6th, has increased significantly. Studies that screen for psychiatric disorders among HIV positive cohorts have found strong links between HIV infection, psychiatric disorders, and substance abuse, and as rates of prior psychiatric diagnoses in excess of 50% have been reported, many have concluded that providing early psychiatric interventions should be considered

as part of the HIV prevention strategy.^{25,26}

Due to provincial and territorial legislation requiring compulsory registration of all deaths, under-reporting of deaths was minimal.¹⁵ An increasing proportion of deaths of persons living with HIV were due to other causes,^{24,27} so the number of deaths of persons living with HIV, though larger than the number of deaths attributed to HIV, is not available directly from the mortality database.

In summary, Canadian HIV mortality has increased from an unknown disease in 1980 to a leading cause of death by 1987, peaking in 1995. No other cause of death has demonstrated such volatility in recent times. The rates of decline in Canada and in the US were similar, and were attributed

primarily to effective antiretroviral treatment. Despite significant improvements in survival, the drop in HIV deaths since 1995 has slowed in recent years, as the number of people living with HIV has increased.

REFERENCES

- Palella FJ, Delaney KM, Moorman AC, Loveless MO, Fuhrer J, Satten GA, et al. Declining morbidity and mortality among patients with advanced human immunodeficiency virus infection. *N Engl J Med* 1998;338(13):853-60.
- The CASCADE Collaboration. Survival after introduction of HAART in people with known duration of HIV-1 infection. *Lancet* 2000;355:1158-59.
- Wong T, Chiasson MA, Reggy A, Simonds RJ, Heffess J, Loo V. Antiretroviral therapy and declining AIDS mortality in New York City. *J Urban Health* 2000;77(3):492-500.
- Lee LM, Karon JM, Selik R, Neal JJ, Fleming PL. Survival after AIDS diagnosis in adolescents and adults during the treatment era, United States, 1984-1997. *JAMA* 2001;285(10):1308-15.
- Rogers PA, Sinka KJ, Molesworth AM, Evans B, Allardice G. Survival after diagnosis of AIDS among adults resident in the United Kingdom in the era of multiple therapies. *Commun Dis Public Health* 2000;3(3):188-94.
- Hogg RS, Heath KV, Strathdee SA, Montaner JSG, O'Shaughnessy MV, Schechter MT. HIV/AIDS mortality in Canada: Evidence of gender, regional and local area differentials. *AIDS* 1996;10:889-94.
- Hogg RS, Schechter MT, Montaner JSG, Goldstone I, Craib K, O'Shaughnessy MV. Impact of HIV infection and AIDS on death rates in British Columbia and Canada. *CMAJ* 1994;150(5):711-17.
- Weber AE, Hogg RS. Morbidity and mortality related to human immunodeficiency virus in Canadian men and women, 1987-94. *Can J Public Health* 1999;90(2):127-32.
- Health Canada. *HIV and AIDS in Canada. Surveillance Report to December 31, 2000.* Ottawa: Division of HIV/AIDS Surveillance, Bureau of HIV/AIDS, STD and TB, 2001.
- Hoyert DL, Kochanek KD, Murphy SL. Deaths: Final data for 1997. Hyattsville, Maryland: National Center for Health Statistics, *National Vital Statistics Reports* 1999;47(19).
- Kochanek KD, Smith BL, Anderson RN. Deaths: Preliminary data for 1999. Hyattsville, Maryland: National Center for Health Statistics, *National Vital Statistics Reports* 2001;49(3).
- Murphy SL. Deaths: Final data for 1998. Hyattsville, Maryland: National Center for Health Statistics, *National Vital Statistics Reports* 2000;48(11).
- Statistics Canada. Leading Causes of Death at Different Ages, Canada, 1998 (Catalogue 84F0503XPB). Ottawa: Health Statistics Division, 2001.
- Remis R, Sutherland WD. The epidemiology of HIV and AIDS in Canada: Current perspectives and future needs. *Can J Public Health* 1993;84(Suppl 1):S34-S38.
- Statistics Canada. Causes of Death, 1997 (Catalogue 84-208-XPB). Ottawa: Health Statistics Division, 1999.
- Statistics Canada. Annual Demographic Statistics 1998 (Catalogue 91-213-XPB). Ottawa: Demography Division, 1999.
- On L, Semenciw RM, Mao Y. Orius software: Calculation of rates and epidemiologic indicators, and preparation of graphical output. *Chron Dis Can* 2000;21(3):134-36.
- Breslow NE, Day NE. *Statistical Methods in Cancer Research: Volume 1 - The Analysis of Case-control Studies.* Lyon: International Agency for Research on Cancer, 1980.
- Statistics Canada. Standard Geographical Classification SGC 1996: Volume I The Classification (Catalogue 12-571-XPB). Ottawa: Standards Division, 1997.
- Law MG, de Winter L, McDonald A, Cooper DA, Kaldor JM. AIDS diagnoses at higher CD4 counts in Australia following the introduction of highly active antiretroviral treatment. *AIDS* 1999;13(2):263-69.
- Rogers P, Sinka K, Molesworth A, Evans B, Allardice G. Survival after diagnosis of AIDS among adults resident in the United Kingdom in the era of multiple therapies. *Commun Dis Public Health* 2000;3(3):188-94.
- Mocroft A, Vella S, Benfield TL, Chiesi A, Miller V, Gargalianos P, et al. Changing patterns of mortality across Europe in patients infected with HIV-1. *Lancet* 1998;352:1725-30.
- Health Canada. National HIV Prevalence and Incidence Estimates for 1999: No Evidence of a Decline in Overall Incidence. *HIV/AIDS Epi Update.* Ottawa: Centre for Infectious Disease Prevention and Control, May 2001.
- Martin JA, Smith BL, Mathews TJ, Ventura SJ. Births and deaths: Preliminary data for 1998. Hyattsville, Maryland: National Center for Health Statistics, *National Vital Statistics Reports* 1999;47(25).
- Pao M, Lyon M, D'Angelo LJ, Schuman WB, Tipnis T, Mrazek DA. Psychiatric diagnoses in adolescents seropositive for the human immunodeficiency virus. *Arch Pediatr Adolesc Med* 2000;154:240-44.
- Treisnam GJ, Agelino AF, Hutton HE. Psychiatric issues in the management of patients with HIV infection. *JAMA* 2001;286(22):2857-64.
- Centers for Disease Control and Prevention. *HIV/AIDS Surveillance Report* 2000;12(2).

Received: November 2, 2001

Accepted: July 17, 2002

RÉSUMÉ

Objectif : Surveiller la mortalité canadienne due au VIH/sida après l'introduction des thérapies antirétrovirales en 1996, et la comparer à celle des États-Unis.

Méthodes : Les données sur les décès ont été dépouillées selon la cause sous-jacente de mortalité, l'âge, le sexe, l'état matrimonial et le lieu de résidence au moment du décès. Les principales causes de mortalité par groupe d'âge, les années de vie potentiellement perdues avant l'âge de 65 ans et les taux sont présentés.

Résultats : Les décès dus au VIH ont culminé à 1 764 en 1995, représentant 1 % de tous les décès et 15 % des décès d'hommes de 25 à 44 ans (c'est la plus importante cause de mortalité dans ce groupe, après les suicides). De 1995 à 1997, la mortalité due au VIH a chuté de 66 % chez les hommes et de 43 % chez les femmes. Les taux pour Toronto, Vancouver et Montréal étaient 6 fois plus élevés qu'en milieu rural et 2,5 fois plus élevés que dans les autres régions métropolitaines de recensement.

Conclusions : En 1998, le VIH demeure une cause principale de mortalité prématurée. La tendance dans la mortalité canadienne due au VIH était semblable à celle des États-Unis, bien que les taux des États-Unis demeurent le double des taux canadiens. Il est possible que la chute de la mortalité due au VIH ne persiste pas à long terme, puisque la thérapie antirétrovirale ralentit seulement la progression de la maladie, sans la guérir, et que le nombre de personnes qui vivent avec le VIH augmente.