Hepatitis A Among Residents of First Nations Reserves in British Columbia, 1991-1996

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ABSTRACT

Background: Hepatitis A spreads by the fecal-oral route. We hypothesize that it is more common in Aboriginal communities because of poverty, crowded housing and inadequate or substandard water and sewage systems.

Methods: We tabulated on-reserve cases reported to First Nations and Inuit Health Branch, Health Canada. We obtained information on community water supply, sewage disposal and mean population per housing unit, from site inspections in a 1994 survey.

Results: Crude incidence on-reserve was 31 per 100,000 persons per year (95% CI: 25 to 37), twice as high as in the general population of BC (15.1 per 100,000). Higher incidence of hepatitis A was associated with more persons per housing unit and with presence of community water supply problems.

Conclusions: An ecologic, multi-factorial approach to disease prevention is needed, including upgrading housing and sanitary infrastructure, specific measures (i.e., hepatitis A vaccination) and general measures (e.g., education, poverty reduction, population planning).

Hepatitis A is an acute illness caused by Enterovirus Type 72, commonly called Hepatitis A Virus. The case fatality is about 0.6%,¹ a chronic-active or chronic-carrier state is not recognized, and one episode confers life-time immunity. The virus is present in the blood and feces of infected persons. Transmission occurs directly (person-to-person) by the fecal-oral route, through contaminated drinking water or food (including food prepared by infected food-handlers, and raw or undercooked shellfish harvested from polluted waters), and, rarely, through blood transfusion.² In developed nations, cases occur sporadically or as localized outbreaks, usually involving daycare facilities enrolling children in diapers, institutions for developmentally challenged persons, correctional facilities, travellers to endemic areas, homosexual males, household and sexual contacts of acute cases, injecting drug users, and persons living in conditions of poor environmental sanitation, particularly in rural or remote areas. Epidemics may also occur, lasting many months, involving large geographic areas and affecting mostly school-age children and young adults.¹

In British Columbia (BC), it is mandatory for health care providers to report known cases of hepatitis A to public health authorities. As shown in Table I, during the 69-month period of January 1991 to September 1996, 2,933 cases of hepatitis A were reported in BC^{3,4} (incidence: 15.1 per 100,000 population per year). Ethnicity of cases is not routinely recorded and surveillance reports to date have not provided separate tallies for Aboriginal communities. The purpose of this study was to determine if the incidence of hepatitis A among Aboriginal British Columbians – in particular, among residents of First Nations reserves – is higher than in the total BC population, and to test hypotheses that it is associated with poverty and crowded, unsanitary living conditions.

METHODS

Identification of cases

The Pacific Region of the First Nations and Inuit Health Branch of Health Canada (FNIHB-HC, formerly called the Medical Services Branch) provides public health services to First Nations reserves in BC. FNIHB-HC receives notification of

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hepatitis A and other reportable communicable diseases occurring among reserve residents through its own on-reserve community health facilities, from facilities operated by bands or tribal councils funded under First Nations Health Transfer Agreements, from provincial regional health authorities and from the Provincial Laboratory of the BC Centres for Disease Control. The Provincial Laboratory is the only laboratory in BC that performs serologic anti-Hepatitis A IgM antibody testing. For this analysis, a case of hepatitis A was defined as a person with a clinical diagnosis of hepatitis A entered into the FNIHB-HC communicable disease report database between 1 January 1991 and 22 October 1996. A laboratory-confirmed case was defined as a case seropositive for anti-Hepatitis A IgM antibody.

Community infrastructure

Environmental Health Services, FNIHB-HC maintains a database of community water supply and sewage disposal system characteristics for reserve communities. This database was compiled in September 1994 from the reports of on-site inspections conducted in a national survey targeting all reserves with five or more residents. The record for a particular reserve is updated whenever there is structural change to a community's water system and whenever Environmental Health Services investigates an operational or performance problem. To assess conditions as they existed at the mid-point of the case-reporting period (January 1991 to October 1996), we retrieved the filed paper reports of the 1994 inspections for every surveyed community in BC (257 reserves, belonging to 197 bands). From these reports, for each community we determined:

- predominant type of water supply system (a system type was considered predominant if it served 50% or more of the houses in the community),
- functional category of the predominant water supply system,
- predominant type of sewage disposal system,
- functional category of the predominant sewage disposal system, and
- population per housing unit.

We retained the functional categories (1-A, 1-B, 1-C, 2, 3 and 4) used nationally

TABLE I
Reported Cases of Hepatitis A in BC, 1991-1996

Period	Cases*	Incidence†
1991	347	10.3
1992	1,017	30.2
1993	475	14.1
1994	279	8.3
1995	408	12.1
1996, Jan-Sept	407	16.1
Total	2,933	15.1

* Notifiable disease statistics. *BC Health and Disease Surveillance* Oct 1996;5(10):106, Jan 1996;5(1):12, Jan 1995;4(1):17, Jan 1994;3(1):10, Jan 1993;2(1):14, Jan 1992;1(1):6, *BC Disease Surveillance* Dec 1991;12(13):215, Nov 1991;12(12):199, Oct 1991;12(11):180.

† Number of cases per 100,000 population per year; based on 1992 BC population of 3,371,372 persons.

TABLE II
Hepatitis A Cases on Reserves in BC, Jan 1991 to Oct 1996

	Population*	Cases†	Rate‡	95% CI§
	No.	%		
Total	49,756	90	100%	31 25 to 37
Gender				
Male	25,896	50	56%	33 24 to 42
Female	23,860	40	44%	29 20 to 38
Age in years				
0-4	4,520	11	14%	42 17 to 66
5-9	5,667	20	25%	61 34 to 87
10-14	5,266	10	13%	33 12 to 53
15-19	4,696	11	14%	40 16 to 64
20-24	4,493	11	14%	42 17 to 67
25-29	4,508	7	9%	27 7 to 46
30-39	8,727	4	5%	8 2 to 16
40-49	5,202	3	4%	10 0 to 23
50-89	6,677	3	4%	8 0 to 18

* on-reserve Status Indian population, 31-Dec-1993, INAC population file

† cases reported to Pacific Region, First Nations & Inuit Health Branch, Health Canada; 83% of cases confirmed by IgM

‡ cases per 100,000 persons in the population per year

§ 95% confidence interval for incidence rate

|| not included: 10 cases of unknown age

in the FNIHB-HC Environmental Health Services inspection database system.⁵ These categories are explained in the side bars accompanying Table III. For purposes of our data analysis, we regrouped these into the super-categories, "Substandard" and "Satisfactory".

Population counts

At each site visit in the 1994 survey, inspectors counted numbers of houses and residents served by each water and sewage system. We calculated the community's population density as the total number of residents in the community divided by the total number of housing units in the community. The 1994 survey did not record the age and gender of residents, therefore we used the Indian and Northern Affairs 1993 BC Population File (based on Indian Status registration as of 31 December 1993) to calculate the BC on-reserve Status Indian population for categories of age and gender. The total populations (Status Indian persons living on reserves in BC) recorded by the two methods are not mate-

rially different (50,787 in the 1994 water and sewage survey versus 49,756 according to the 1993 population file).

Statistical methods

For the total on-reserve Status Indian population of BC, for types and functional categories of water and sewage system, and for categories of community population per housing unit, age and gender, we calculated hepatitis A incidence rates as the number of cases per 100,000 persons in the population per year. For each calculated incidence rate, we determined the 95% confidence interval using the normal approximation of the binomial distribution if the numerator (i.e., the number of cases) was 5 or more. If the numerator was 1, 2, 3 or 4, we used exact binomial probabilities. If the numerator was zero, we considered the lower limit of the 95% confidence limit to be zero and we calculated the upper limit as 1 minus the n^{th} root of 0.05, where "n" was the population.⁶ For dichotomous risk markers, we calculated relative risk of hepatitis A as the ratio of

TABLE III

Hepatitis A and Community Infrastructure on Reserves in BC, Jan 1991 to Oct 1996

	Pop‡	HA cases§ No.	%	Rate	95% CI¶
Water delivery*,†					
Untreated surface water	1,550	0	0%	0	0 to 33
Untreated groundwater	2,073	5	6%	41	8 to 83
Centrally treated, substandard	22,710	63	71%	48	36 to 60
Centrally treated, satisfactory	24,454	21	24%	15	9 to 21
Sewage disposal*,†,**					
None/other	1,616	1	1%	11	0 to 32
Septic field	21,562	20	22%	16	10 to 23
Centrally treated, substandard	6,777	1	1%	3	0 to 8
Centrally treated, satisfactory	20,203	67	75%	57	43 to 70
Pop. per housing unit,††					
6+	3,358	5	6%	26	5 to 48
4 to 5	20,846	68	76%	56	43 to 69
1 to 3	26,583	16	18%	10	5 to 15

* resident of a reserve or a group of reserves where >50% of homes have this type of service

† Source: 1994 INA/Health Canada National Water & Sewage Survey of First Nations Communities

‡ population counted in 1994 INA/Health Canada National Water & Sewage Survey

§ Cases reported to Pacific Region, First Nations & Inuit Health Branch, Health Canada, not included: one case whose community of residence was unknown

|| Cases per 100,000 persons in the population per year

¶ 95% confidence interval for incidence rate

** not included: 629 persons residing in communities with unknown type of sewage system

†† mean for community of residence

Classification of water supply systems

Substandard

- 1-A: System incapable of consistently meeting health parameters of the Guidelines for Canadian Drinking Water Quality.
 1-B: Untreated surface source.
 2: System neglected and may malfunction posing a health risk; system must be preserved/repared.
 3: Insufficient quantity of water is objectionable aesthetically.

Satisfactory

- 4: No problem.

Classification of sewage disposal systems

Substandard

- 1-A: Sewage chronically dumped or leached into ground where residents susceptible to contact, presents a public health risk.
 1-B: Not capable of meeting Federal/Provincial guidelines/standards for discharge.
 1-C: Hydro-geological conditions not conducive to installation of individual sewage disposal systems and no community system in place.
 2: Requirement to repair/reconstruct to preserve existing asset.
 3: Upgrading required since the community is expanding and/or there are aesthetic problems.

Satisfactory

- 4: No problem.

TABLE IV

Community Risk Markers for Hepatitis A on Reserves in BC, Jan 1991 to Oct 1996

Risk Marker	Exposed Population No.	%	Hep A Cases No.	%	Rate*	RR†	95% CI‡
Water problem§	26,333	52%	69	78%	45	3.2	2.0 to 5.3
Crowding	24,204	48%	73	82%	52	5.0	2.9 to 8.6
Water problem or Crowding	38,058	75%	81	91%	36	3.4	1.5 to 6.0
Water problem and Crowding	12,479	25%	61	69%	84	6.7	4.3 to 10.5

* cases per 100,000 persons in the population per year

† risk relative to persons without the risk marker

‡ Taylor Series 95% confidence interval for relative risk

§ 50% or more of homes are not supplied from centrally treated system, or central system is substandard

|| mean no. of persons per dwelling unit is 4 or more

the incidence rate in the population with the risk marker to incidence rate in the population without the risk marker. We determined the 95% confidence interval for the relative risk using a Taylor Series calculation.⁷

RESULTS

Table II shows the occurrence of hepatitis A according to categories of year of onset, age and gender. Incidence rates were highest among children and young adults, and approximately equal between males and females. The crude incidence rate among residents of First Nations reserves, 31 per 100,000 persons per year (95% confidence interval: 25 to 37), was twice as high as the crude incidence in the general population of BC, 15.1 per 100,000 persons per year during the same period of time (see Table I).

Table III shows the occurrence of hepatitis A according to categories of community water delivery system, sewage disposal system and population per house. Further collapsing the categories, we created dichotomous (exposed or unexposed) risk markers representing water delivery system and population density. In Table IV, these risk markers are defined, and we present the size of the population exposed to the risk marker, the number and percent of hepatitis A cases occurring among exposed persons, the observed hepatitis A incidence rate for the exposed fraction of the population, the relative risk of hepatitis A associated with exposure to the risk marker, and the 95% confidence interval for the relative risk. For all of the risk markers in Table IV, the lower limit of the 95% confidence interval for the relative risk is greater than one, so there is a statis-

tically significant association between exposure to the risk marker and higher risk of hepatitis A ($p < 0.05$, 2-sided).

DISCUSSION

The incidence of hepatitis A among residents of First Nations reserves was twice as high as for the rest of the BC population. Clearly, First Nations people living on reserves in BC are at increased risk of contracting hepatitis A. The age distribution (i.e., most cases occurring in school-aged children and young adults) is typical of slowly-developing, widespread epidemics occurring in developed countries. It is also consistent with the age distribution of cases seen in areas of intermediate endemicity (i.e., developing nations with transitional economies, or socioeconomically disadvantaged regions within developed nations).²

We observed an association between greater numbers of persons per housing unit and higher incidence of hepatitis A, and an association between the presence of community water supply problems (i.e., no community system, untreated water, or a central treatment system with operational or performance problems) and higher incidence of hepatitis A. It is plausible that there is a direct causal relationship between these factors and hepatitis A transmission. Crowding within houses increases opportunities for person-to-person fecal-oral transmission of disease. Impure drinking water may be a disease vector. An insufficient or unreliable supply of running water to the home may result in infrequent hand-washing or inadequate cleaning of food preparation surfaces and food serving vessels. The associations may also be due in part to other, poverty-related factors which we did not measure, but which could increase the risk of disease transmission, for example, low educational level, unsanitary food preparation practices, bad food supply and poor personal hygiene. Another possible explanation is the confounding effect of age. We do not know the population age distributions of the individual reserves surveyed in 1994 (age distributions are only known for reserves aggregated according to band affiliation). It is possible that reserves with crowded housing and water supply system problems were communities with higher than average birth rates, rapidly expanding populations (leading to housing shortages and excessive demands on the community water supply) and a higher proportion of the population in the age range most susceptible to hepatitis A (i.e., children and young adults).

We did not find an association between community sewage disposal system type or presence of operational or performance problems and the incidence of hepatitis A. This probably occurred because there was insufficient variability in our data to ade-

quately test the hypothesis. In BC, only 8% of reserve residents live in communities where the predominant form of sewage disposal is grossly substandard (i.e., pit-prives, cesspools periodically emptied by a visiting truck, or a system in functional categories 1-A, 1-B or 1-C). It is also possible that prevailing methods of inspecting and classifying sewage disposal systems may not adequately assess the health risks.

Our findings suggest that for First Nations reserve communities in BC, population per housing unit and water supply system characteristics can be useful as risk markers for hepatitis A and other diseases transmitted by the fecal-oral route, i.e., as means of identifying communities at greater risk from such diseases. However, this analysis does not point to specific preventive interventions; if anything, it argues for an ecologic, multi-factorial approach to disease prevention. Upgrading of housing, water supply and sewage disposal systems will of course be an important part of a program of primary prevention, but community infrastructure improvement cannot be considered independent of other measures, both those more specific (i.e., hepatitis A vaccination) and those more general (e.g., education, poverty reduction, population planning).

It is widely assumed that minimally acceptable housing and sanitation are available to practically all Canadians and that existing variations in the quality of housing and infrastructure are of negligible importance to population health. This study's findings contradict such complacent assumptions. Traditional public health programs still matter.

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RÉSUMÉ

Contexte : L'hépatite A se propage par la voie oro-fécale. Nous avons supposé qu'elle est plus répandue dans les collectivités autochtones en raison de la pauvreté, des logements surpeuplés et des canalisations d'aqueduc et d'égout inadéquates ou inférieures aux normes.

Méthode : Nous avons totalisé les cas dans les réserves signalés à la Direction générale de la santé des Premières Nations et des Inuits de Santé Canada. Les données sur les équipements collectifs d'adduction d'eau et d'évacuation des eaux usées et sur la population moyenne par unité d'habitation proviennent d'inspections sur place menées dans le cadre d'une enquête en 1994.

Résultats : Le taux brut d'hépatite A dans les réserves était de 31 pour 100 000 personnes par année (IC de 95 % = 25-37), deux fois plus que dans la population générale de la Colombie-Britannique (15,1 pour 100 000). Des taux supérieurs étaient associés aux unités d'habitation plus peuplées et à la présence de problèmes dans les équipements collectifs d'adduction d'eau.

Conclusion : Il faudrait prévenir cette maladie selon une approche écologique et plurifactorielle, notamment en modernisant les logements et l'infrastructure sanitaire et en adoptant des mesures spécifiques (vaccination contre l'hépatite A) et générales (sensibilisation, réduction de la pauvreté, planification démographique).