Hepatitis C is currently and will continue to be an important public health problem worldwide. Seroprevalence rates in blood donors range from 0.05% to 2.5% (1,2). An exceptionally high rate (13% to 20%) is encountered in Egyptian donors and the reason for this remains unknown (3). In North America, the seroprevalence rate among volunteer blood donors varies from 0.05% to 0.7% (4). In the general population the rate is believed to be higher than that found in blood donors since the latter are initially screened for risk factors and hepatitis C seropositivity (4). In the United States, 150,000 cases of hepatitis C virus (HCV) infections are estimated to have occurred annually over the past 10 years (5). HCV infection is characterized by its high rate of chronicity; 60% to 80% of infected individuals develop chronic liver disease of varying degrees of severity, including cirrhosis in 20% of cases and, more rarely, hepatocellular carcinoma.

Distinct genomic variants of HCV have been identified with different geographic distributions (6). Phylogenetic analysis of nucleotide sequences from isolates worldwide show that they cluster into major groups. Isolates within major groups may in turn cluster into additional groups (subgroups). A system of nomenclature designating major groups as types and subgroups as subtypes has been proposed (7). The genotypes referred to in this report correspond to those assigned by this classification scheme.

In this study, we have analyzed the distribution of the major HCV types among 132 viremic patients followed at the hepatology unit of Hôpital Saint-Luc in Montreal between 1991 and 1994 and 132 viremic voluntary blood donors from the Montreal area found anti-HCV positive by RIBA 2.0 (Chiron Corporation, Emeryville, CA) between 1992 and 1994. HCV RNA was detected in serum of patients and donors by reverse-transcription polymerase chain reaction (9). Genomes were typed by restriction fragment length polymorphism analysis of amplified 5' noncoding region (NCR) sequences according to an updated version of our previously described procedure (10). In addition, nucleotide sequence analysis of amplified 5' NCR sequences was performed as confirmatory assay for one unclassifiable type (putative new type). Typing results are shown in Table 1.

The distribution of genotypes between patients and blood donors was not significantly different (p > 0.05). In both groups, type 1 was predominant followed by type 2 and type 3, respectively; these three types together accounted for 88% of the isolates in patients and 92% of the isolates in donors. Types 4 and 5 were also found in both groups. A single type 6 was found in a blood donor and a putative new type was found among one of the patients. Type 4 and 5 were also found in both groups. A single type 6 was found in a blood donor and a putative new type was found among one of the patients. Type 4 and 5 were also found in both groups. A single type 6 was found in a blood donor and a putative new type was found among one of the patients. Most of the persons infected with types 1, 2, and 3 were of Canadian origin. Eleven of the 12 persons infected with type 4 were immigrants from Africa or the Middle East. This is not surprising since type 4 is found mainly in Egypt, the Middle East and Central Africa (6). The other patient infected with type 4 is of Canadian origin. This patient reported intravenous (IV) drug use as risk factor and no travel history to Africa or the Middle East. Surprisingly, we found 12 persons of Canadian and one of European origin to be infected with type 5. Type 5 isolates have been previously encountered in patients and donors from South Africa and rarely elsewhere. A travel history to South Africa was not reported by these individuals. Six reported receiving blood products as risk factor. Sexual/household contact, IV drug use, acupuncture and tattooing were each reported once, while in three the mode of transmission remained unknown. The person with sexual/household contact as risk factor is the spouse of one of the
six who reported receiving blood products. The donor infected
with a type 6 isolate is an immigrant from Vietnam, an area where
additional type 6 isolates have been found\(^{(13)}\). The patient infected
with a putative new type immigrated to Canada from Somalia (East
Africa). Thus, 1, 2, 3, and 5 are the principal types transmitted in
Canada while other types are mostly encountered in persons who
acquired the infection outside of Canada.

Type 2 is the second predominant genotype in the Montreal area
with a prevalence of 15\%. This is noteworthy since patients
infected with type 2 appear to respond better to interferon therapy
and to have lower serum HCV RNA levels than their type 1
infected counterparts. Since the distribution of HCV types
between patients and asymptomatic blood donors is similar, it may
be tempting to hypothesize that the types do not associate with
different disease severities. However, patients followed also
include asymptomatic individuals referred solely on the basis of
elevated serum aminotransferases or a positive serology.

Histologic examination of blood donors is underway to assess the
relationship between genotypes and disease severity. Two recent
studies in American patients report rates of 75\% to 80\%, 15\%, and
5\% to 6\% for types 1, 2, and 3, respectively\(^{(14,15)}\). This distribution
is different from that observed among our patients (p < 0.05) and
may be explained by the higher frequency of types other than 1, 2,
and 3 and by a lower frequency of type 1 in the Montreal area.
Note that only one of the two studies in American patients would
have been able to identify type 5 genomes, if present, and none
were reported\(^{(15)}\). Identification of HCV genotypes will allow the
relation with clinical courses and may be helpful for studying
epidemiologic outbreaks of HCV and in identifying sources of
transmission.

Recent data from Vietnam indicate the existence of three new
types (7, 8, and 9) contributing to 20\% of types found in that
country\(^{(13)}\). These new types have 5' NCR sequences
indistinguishable from that of type 1 isolates. Sequence analysis of
the coding regions of numerous isolates worldwide, including a
substantial number from the United States\(^{(13)}\), would indicate that
these isolates are seldom found outside of Vietnam. Therefore,
types 7, 8, and 9 are expected to be rare in Quebec.

Knowledge of the distribution of HCV genotypes is of
importance considering that efforts are being made towards the
development of a vaccine\(^{(16)}\). The occurrence of different
genotypes could represent a problem since an immune response
towards one genotype may not protect against infection with a
different genotype. Unfortunately, the existence of HCV variants is
not the only concern in the development of a vaccine. Of great
worry is the observation that infection may not protect from
reinfection with a homologous genotype\(^{(17)}\). The high level of
chronicity observed indicates that in most persons a protective
immunity does not develop. An understanding of the factors
involved in the establishment of immunity will be important for
devising an effective vaccine. Public awareness of the
consequences of acquiring HCV infection and of the risk factors
for transmission will continue to play an important role in the fight
against hepatitis C.

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<table>
<thead>
<tr>
<th>Group</th>
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<th>HCV types (%)</th>
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<tr>
<td></td>
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<tr>
<td>Patients</td>
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<td>Blood donors</td>
<td>132</td>
<td>77</td>
</tr>
<tr>
<td>Total</td>
<td>264</td>
<td>164</td>
</tr>
</tbody>
</table>

Table 1
Distribution of the major HCV types in patients and blood donors, Hepatology Unit, Hôpital Saint-Luc, Montreal 1991 to 1994

F-2
A recent study of hepatitis C seroprevalence among volunteers in a male federal penitentiary in Western Canada showed a seropositivity rate of 25% among the 23% of prisoners who volunteered to be tested. The main mode of transmission of hepatitis C is either blood transfusion or intravenous (IV) drug use with sexual transmission a less likely possibility. Apart from hepatitis C is either blood transfusion or intravenous (IV) drug use volunteered to be tested. The main mode of transmission of hepatitis C in a male federal penitentiary in Western Canada showed a seroprevalence rate for hepatitis C in North American prisons.

We report a voluntary linked, anonymous cross-sectional study of hepatitis C virus carried out in the Federal Prison for Women at Kingston, Ontario, in conjunction with a study of HIV seroprevalence in the same population.

Methods

The study protocol was similar to that used for the HIV-1 seroprevalence study carried out in Joyceville Penitentiary in April of 1993. The original intent was to test solely for HIV serology, but during the pretesting educational sessions the prisoners asked that we also test for hepatitis C and the protocol and pretest educational sessions were changed accordingly.

Pretest education sessions included viewing a video of the Joyceville study and group meetings with one of the study physicians, an AIDS project worker and a social worker to talk about both HIV and hepatitis C. Educational material on HIV and hepatitis C prepared for the study was also distributed to all American prisons.

In May 1994 the prison was shut down for the day while blood samples were sent to the Kingston Public Health Laboratory, Ontario Ministry of Health, for testing. Samples tested for hepatitis C were screened by Ortho 3.0 ELISA, and positives and “grey zone” specimens were further tested using the third generation Organon Technika UBV HCV EIA and/or the Chiron RIBA HCV 3.0 assay. Hepatitis C testing was performed at the Central Public Health Laboratory, Ontario Ministry of Health, Toronto.

A social worker or AIDS project worker was available for counselling when results were handed out and for 2 weeks after.

Results

The Prison for Women at Kingston houses both medium and maximum security prisoners. Length of sentence ranges from 2 to 20 years with the majority serving less than 5 years. Ages range from 18 to over 50 with the majority falling between 25 and 40. On the day of the study the prison population was 130 and 113 from 18 to over 50 with the majority falling between 25 and 40.

No attempt was made to evaluate risk behaviour as it was made clear by inmate representatives that this would jeopardize the participation rate.
those who appeared to have active disease as a consequence of hepatitis C infection. This would involve all those who knew they were positive on study results and any others wishing to be tested coming forward for non-anonymous (nominal) testing. This follow-up is currently being carried out and, as of this time, around 90% of the population has presented for nominal testing.

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We wish to thank Dr. M. Fearon and her staff at the Central Public Health Laboratory, Toronto, for carrying out the hepatitis C testing on the blood samples.

We also wish to thank the women who volunteered to give blood without whose enthusiastic cooperation and participation this study would not have been possible.

References

Source: PM Ford, MB, FRCP, Department of Medicine, Queen’s University; C White, BA, MA, Prison Outreach Worker, Kingston AIDS Project; H Kaufmann, BA, MSc, Social Worker, AIDS Clinic, Kingston General Hospital; J MacTavish, Support Services Coordinator, Kingston AIDS Project; M Pearson, MD, CCFP, Prison Physician and Lecturer, Department of Family Medicine, Queen’s University; S Ford, MB, FRCP, Departments of Medicine and Pathology, Queen’s University; PS Mistry, DSc; Director, Kingston Public Health Laboratory, Ontario Ministry of Health; P Connop, MB, FRCP, Prison Physician and Associate Professor, Departments of Community Health and Epidemiology, Queen’s University, Kingston, Ontario.

VOLUNTARY SCREENING FOR HEPATITIS C IN A CANADIAN FEDERAL PENITENTIARY FOR MEN

We recently carried out a voluntary linked, anonymous study of hepatitis C seroprevalence in the Federal Prison for Women at Kingston, Ontario (see second article in this issue). One hundred and thirteen inmates (86.9%) of the prison population volunteered to be tested and 39.8% were found positive for antibodies to hepatitis C.

An increasing awareness of hepatitis C among inmates of other penitentiaries in the area led to a rise in the number of prisoners requesting testing. It was therefore decided to offer hepatitis C testing on a voluntary nominal basis to the entire population of a male penitentiary. The penitentiary selected was Joyceville, a medium security federal penitentiary at Kingston. This penitentiary had been the site of a linked anonymous study of the seroprevalence of HIV(1) carried out in 1993. On this occasion, because of the concern that prisoners had who had heard of the results of the study at the women’s prison, and to avoid having to repeat the testing, inmates were tested on a nominal basis.

Methods
Prisoners were informed about the availability of testing at educational sessions where a physician addressed the prison population in groups, distributed educational materials and answered questions. In addition, an informational video program, made with the same physician by the inmate film unit, was shown on the prison television system. It was made clear that all prisoners who tested positive for hepatitis C would be further investigated, if they wished, and assessed as to their suitability for treatment. It was emphasized that the testing was voluntary.

For 2 days the prison was shut down and two teams, each comprised of a physician and two nurses, collected blood samples from volunteers. Each tube was labelled with the name and number of the volunteer.

Screening for hepatitis C antibodies was carried out by the Public Health Laboratory in Ottawa, and confirmatory testing was performed by the Central Public Health Laboratory, Ontario Ministry of Health in Toronto, as described in the second article.

As soon as they were available, the results were sent to the appropriate donors in sealed envelopes and all those who tested positive were invited to go to the prison health care facility for further testing, if they wished.

Results
The prison population on the day of testing was 592; blood samples were obtained from 408 prisoners for a response rate of 68.9%. On these 408 individuals, 114 (27.9%) were positive for hepatitis C antibodies.

Comment
The response rate of 68.9% was good. We feel that volunteer bias was, if anything, slanted towards high-risk individuals because a number of prisoners informed us that they were not going to give a blood sample because they had not been involved in any risk behaviour.

The seropositivity rate of 27.9% is somewhat lower than that found in the women’s prison. This may reflect a different exposure to risk prior to incarceration in female compared to male prisoners. Hepatitis C seropositivity in this population likely represents a marker for intravenous drug use. Infection may well have occurred prior to incarceration, but this finding does indicate a significant population with a propensity to high-risk behaviour. It also indicates a considerable burden of ill health which will fall, initially, on the prison medical services but, ultimately, on provincial health care systems.

These results would emphasize, yet again, the need to implement the harm-reduction strategies outlined in the report of the Expert Committee on AIDS and Prisons(2).

Follow-up of seropositives is currently being carried out.
References

Source: M Pearson, MD, CCFP, Prison Physician and Lecturer in the Department of Family Medicine, Queen’s University; PS Mistry, DSc, Director, Kingston Public Health Laboratory, Ontario Ministry of Health; PM Ford, MB, FRCP, Department of Medicine, Queen’s University, Kingston, Ontario.

Editorial Comment: These three articles add to the paucity of epidemiologic information available on hepatitis C in Canada. The major mode of transmission at present is injection drug use (IDU). The magnitude of the prevalence of hepatitis C in a high-risk population is confirmed by the studies carried out in Kingston. The previous study of male inmates carried out in British Columbia showed a prevalence of 28% with a relative risk of 3.4 for IDU[1]. The male inmates in Kingston show an identical rate. The high prevalence in women (39.8%) is probably indicative of the risk profile of the female inmate population. It will be necessary to explore further the specific circumstances of infection, primarily related to drug use and perhaps sexual activity, and the independent risk of tattooing and other skin piercing activities. The incidence of infection among inmates while in prison will also have to be examined. Those concerned about the issue of prisoners’ health should refer to the report on HIV/AIDS in prisons, as noted by the authors. Hepatitis C in high-risk populations will be a good indicator of the possibility of HIV transmission.

The burden of illness in Canada has yet to be clearly defined. An important unanswered question relates to the natural history of the disease, especially in those acquiring the infection as young adults through IDU. The severity of disease may depend on genotype and/or the virus load. The Montreal study adds to the evidence that the predominant genotype acquired in Canada is type 1. The significance of this with regard to the likely success of treatment and severity of disease in this country is not yet clear. However, it is interesting to note that the prevalence of type 1 in healthy blood donors is no different from that found in hepatology unit patients.

Reference