SEXUALLY TRANSMITTED INFECTIONS IN CANADA: RECENT RESURGENCE THREATENS NATIONAL GOALS

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Abstract: *This paper presents recent data on sexually transmitted infections (STI) in Canada and analyzes the current situation in relation to national goals for STI prevention set in 1997. While epidemiological trends at that time indicated that, with the exception of HIV, most of the reportable STIs were either slowly declining or close to elimination, recent trends are less favourable. The rate of decline in new HIV infections among adults appears to have levelled off. Similarly the number of reports of new HIV infections among men who have sex with men, which declined rapidly between 1995 and 1998 has also plateaued with a slight increase in 2000. The period since 1997 has also seen broadly-based increases in the rates of chlamydia and gonorrhea and new localized outbreaks of infectious syphilis. In addition, recent data for the nonreportable STIs suggest that large numbers of Canadians are infected with herpes simplex virus or human papilloma virus. Although STI vaccine research holds promise for the future, evidence-based primary prevention programs to promote and facilitate condom use and other safer sex practices remain key to STI reduction in Canada.*

Key words: Canada STI HIV Chlamydia Gonorrhea Syphilis Human Papilloma Virus Herpes Simplex Virus

INTRODUCTION

It took Odysseus years to reach his simple goal of sailing home to Ithaca. Like the ancient hero, Canadians need both persistence and patience in pursuit of our national goals for control of sexually transmitted infections (STI). We must also remind ourselves that the voyage may be anything but smooth.

In 1997, the authors of a review of Canada's goals for STI prevention (SIECCAN, 1997) painted a generally optimistic picture of the state of the nation with respect to the then current and anticipated trends for sexually transmitted infections (for summary see Patrick, 1997). With the exception of HIV, most of the reportable STIs appeared to be either slowly declining or close to elimination. We emphasized that through the "common pathway" of promoting safer sexual behaviour, we might continue to accrue the benefits of reductions in unwanted pregnancy, cancer of the cervix, HIV as well as other STI (Wasserheit, 1992). At the time, our editor urged us to be cautious in our optimism. This was prescient advice!

In 2001, the trends are anything but as favourable. The rate of decline of newly acquired HIV infections has slowed to the point of having almost levelled off between 1999 and 2000 (Health Canada, 2001). Since 1997 we have also seen gradual but broadly-based increases in the rates of chlamydia and gonorrhea plus troublesome outbreaks of infectious syphilis and a rise in both new HIV diagnoses and in HIV incidence estimates for men who have sex with men (MSM) (Geduld & Archibald, 2000; Health Canada, 2000; Health Canada, 2001; Remis, 2000; Wong &

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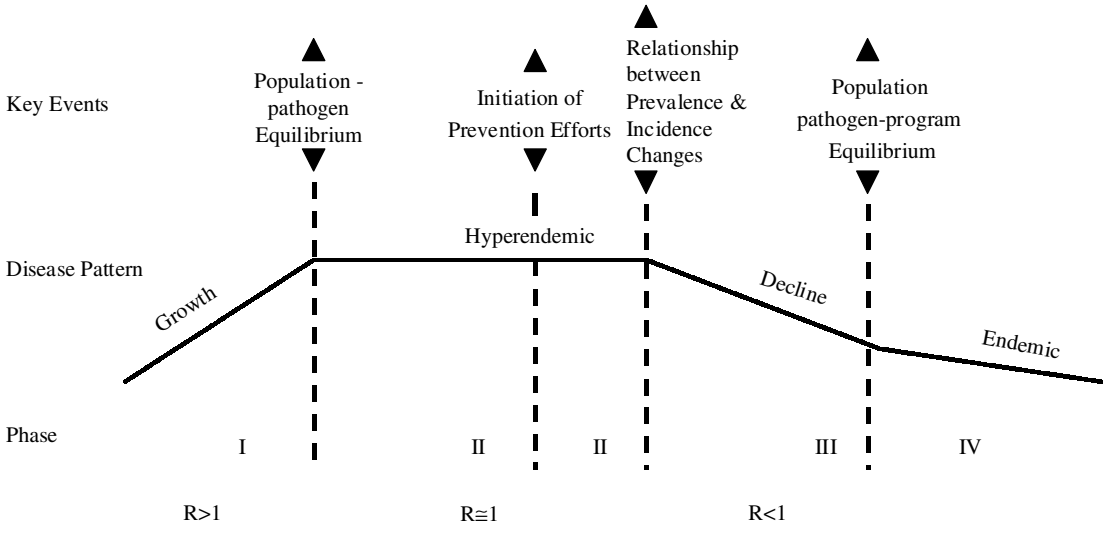
Jordan, 2001). In addition, the findings of new studies on the prevalence of Herpes simplex virus (HSV) indicate how widespread some viral STIs have become (Howard et al., 2001; Patrick et al., 2000a). Whether these patterns are the result of a resurgence of unprotected sexual activity or a combination of social/behavioural circumstances, the evidence presented in this paper demonstrates that STI rates have not continued to fall as expected and that we need more than a reliance on secular trends to achieve our STI goals for Canada. It would appear that our "common pathway" can work in reverse.

The goal of this paper is to document the current STI situation in Canada in relation to previously published national goals for prevention of STIs and associated reproductive health concerns. In order to put the current situation in perspective, it may be helpful to review the conceptual approach to understanding and preventing STI epidemics that influenced our goal setting exercise in 1997 (for a detailed analysis of this conceptual approach see Health Canada, 1997; Maticka-Tyndale, 1997; Patrick, 1997a). In the model put forward by Anderson and May (1986), the reproductive rate, or reproductive number (Ro), for a particular sexually transmitted infection is the mean number of secondary infections produced in a specified period of time by individuals infected with that STI. If the number is greater than one, the prevalence of the STI (i.e., the percentage of the population infected) increases and the epidemic propagates. If the number is approximately one, prevalence remains roughly at steady state. If the reproductive number is consistently less than one, prevalence declines and the trend will be toward control or elimination.

Conceptually, the factors that determine the reproductive rate of an STI (R_0 = BcD) are:
B (the probability of transmission for each sexual contact between an infected and uninfected individual);
c (the number of sexual contacts per unit time between infected and uninfected individuals); and
D (the average duration of infectivity of an individual who has acquired the STI).

Successful interventions may target one or more of these parameters. For example, condom use reduces B (risk of transmission) for many STIs whereas treatment can reduce both B and D. Maticka-Tyndale (1997) used this type of analysis to identify the behavioural and social interventions most likely to have an impact on STI and concluded that increasing

Figure 1 Dynamic Typology of STD Epidemics.*



History of a STI epidemic illustrating events that mark transitions into new phase. R – the reproductive number. Adapted from *Wasserheit and Aral (1996).

condom use and improved access to STI diagnosis and treatment were probably the most effective targets for reducing STIs.

A Dynamic Topology of STI Epidemics

In recent years, Anderson and May's (1986) conception of STI control has been modified to take into account the dynamic nature of STI epidemics and the non-constant nature of the component parameters that determine the reproductive number. Wasserheit and Aral (1996) have described STI epidemics as dynamic interactions among the pathogen, behaviour and prevention efforts which evolve through predictable phases (see Fig. 1 for a dynamic topology of these phases). Since the phase of the epidemic for an STI determines to some extent the types of interventions that will be most efficacious (Table 1), an understanding of the topology in Fig. 1 will be useful for identifying phases and strategies to deal with current trends in different STIs in Canada.

When a STI is newly introduced into a population that is susceptible and that has sexual networking supportive of propagation, the STI may not, at first, be recognized. The reproductive number will exceed 1 and prevalence will increase (Phase I, Fig.1). This first phase of an epidemic concludes when a stable but often high prevalence of the STI is reached and the reproductive number more closely approximates one. At this point (early phase II, Fig.1), an STI epidemic will be broadly distributed in the general population (i.e., it will not be confined solely within sexual networks with high rates of partner exchange and connectivity). It is generally in the initial part of the hyperendemic phase (IIa) of an epidemic when the infection is recognized and scientific inquiry may identify responsible agents. Following recognition, we move into phase IIb during which modes of diagnosis and control are researched and defined. If these are deployed and are successful in reducing the reproductive number below 1, we move into phase III during which the prevalence of the STI may gradually decline. As prevalence declines, remaining infections move again into progressively more marginalized populations in which control measures may prove less effective. In this endemic phase (phase IV, Fig.1), overall prevalence is lower but the reproductive number again approaches 1.

Although this dynamic topology is often drawn as a linear continuum, it is clear that some infections have the potential to regress to earlier phases if control measures are either inappropriately removed or lose efficacy. Public health policy and practice must consider the fact that interventions that may be maximally beneficial for one phase of an STI epidemic may have less impact in other phases of the epidemic for that STI. Control programs may have to be modified as epidemics progress through various phases (Table 1). For example, in early phase III widespread screening strategies may yield a sizeable number of infections because of the high prevalence of infection

Table 1 Phase Appropriate STI Prevention Strategies*

Phase II - Hyperendemic	Phase III - Decline	Phase IV – Endemic
· Mass media campaigns · Widespread screening programs · Detection and treatment service · Provide risk-reduction counseling · Client-initiated partner notification · Some targeted health promotion to higher risk groups · Outreach for screening and treatment	· Maintain screening programs (do not stop prematurely) · Detection and treatment service · Provide risk-reduction counseling · Client and Health department initiated partner notification · More targeted health promotion to higher risk groups · Increase outreach for screening and treatment · Peer-risk-reduction counseling · Community-level behavioural intervention	· Detection and treatment service · Provide risk-reduction counseling · Health department assisted partner notification · Intensive targeted health promotion to high risk groups · Intensive outreach for screening and treatment for high risk groups · Peer-risk-reduction counseling · Community-level behavioural intervention · ± Vaccines or selective mass treatment

*Adapted from Wasserheit and Aral (1996). See Fig. 1 for phases.

in this initial phase of the epidemic. However, as prevalence declines, the benefits of screening diminish. Gonorrhea has posed this challenge in may parts of the country. While two decades ago, widespread screening found a large number of cases, many practitioners may now go years without seeing a positive gonorrhea test from screening. Strategies such as partner notification and focused outreach to higher risk groups have become increasingly important. During phase IV, partner notification itself may become less effective as remaining pockets of infection move increasingly into marginalized and chaotic populations. The recent outbreak of infectious syphilis among core groups in Vancouver is a characteristic example of phase IV of an STI epidemic.

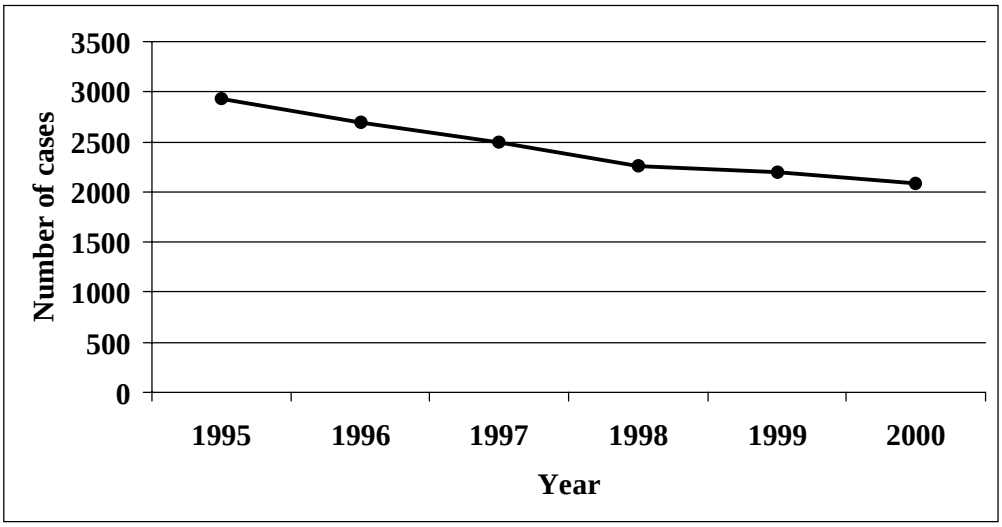
The implications of the phase of a STI epidemic (Fig.1) for optimal prevention strategies (Table 1) will be an implicit and explicit consideration in the following review of the current status of key STIs and their sequelae in Canada.

HIV/AIDS

The trend toward a gradual decline in the number of new diagnoses of HIV infection in adults in Canada from 1995 to 1998 has not continued. The rate of decline appears to have levelled off between 1998 and 2000 (Fig. 2) (Health Canada, 2001). However trends in new HIV infection vary noticeably between different subgroups in the population (Fig. 3) and explanations for the trends may differ between groups as well. For example, among injection drug users (IDUs), the highest rates of reporting and of incidence in some major cities (about 500 new cases in 1996) appear to be behind us for the time being (about 300 new cases in 2000) (Fig. 3) (Health Canada, 2001; Patrick et al., 2001). However, this decline in the number of HIV diagnoses among IDUs may have as much to do with saturation of the highest risk populations as with the specific successes of public policy.

In contrast, positive HIV reports among MSM were declining until 1998, almost levelled off in 1999, and appear to have increased in 2000. This is the first time since the 1980s that there have been signs of a reversal of the trend toward declining numbers of positive HIV reports among MSM (Fig. 3) (Health Canada, 2001; Remis, 2000). This phenomenon has also been documented within the Vanguard cohort in Vancouver, but not yet in the OMEGA cohort in Montreal (Martindale et al., 2001; Remis et al., 2001). Recent surveys of these cohorts are mixed with

Figure 2 Adult Cases of Newly Diagnosed HIV in Canada 1995-2000.



Health Canada. HIV and AIDS in Canada. Surveillance Report to December 31, 2000. Division of HIV/AIDS Epidemiology and Surveillance, Bureau of HIV/AIDS, STD & TB, Health Canada, 2001.

respect to trends in the practice of safer sex (Craig et al., 2000; Dufour et al., 2000; Strathdee et al., 2000). Overall, reasons for changes in sexual behaviour may include: safer sex fatigue; complacency because of the availability of potent antiretroviral therapy (see Misovich, Fisher & Fisher, 1999); and a new generation of young MSM who have not witnessed the full devastation of AIDS.

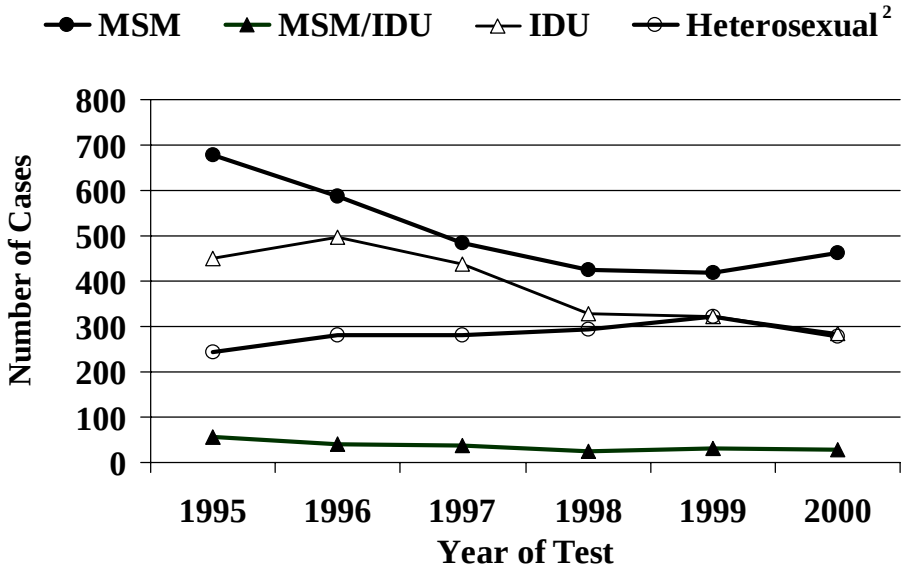
While females still represent a minority of those with newly acquired HIV infection, the absolute number of new positive HIV test reports among all females which showed a decline through 1995, 1996 and 1997 (528, 541 and 456 cases respectively) has not continued to do so in 1998, 1999, and 2000 (493, 544 and 544 cases respectively) (Health Canada, 2001).

Because of the impact of antiretroviral therapy in preventing development of AIDS among those living with HIV, the trend has been for new AIDS case reports to be increasingly removed in time from the initial HIV infection that was their source. For example, the number of new reported cases of AIDS (adjusted for reporting delay) peaked in the early 1990s (1,859 new cases in 1993) and declined to 644 in 2000. The rate of this decline has been much greater than the rate of decline of new HIV reports over the same period (Health Canada, 2001).

Chlamydia

Chlamydia is the most frequently reported communicable disease in Canada. It is also the most broadly distributed bacterial STI in the general population. In the dynamic topology model, the chlamydia epidemic might be considered in early phase III—the early decline phases. Chlamydia rates for Canada as a whole declined from 1992 to 1997 but since then, this declining trend has reversed in both males and females. The preliminary rate for 2000 of 146/100,000, an increase of 30% since 1997, (Fig. 4; Table 2) is well above the national goal of 80 per 100,000 in the general population by the year 2000

Figure 3 Positive HIV Test Reports[1] Among Adults by Exposure Category in Canada.

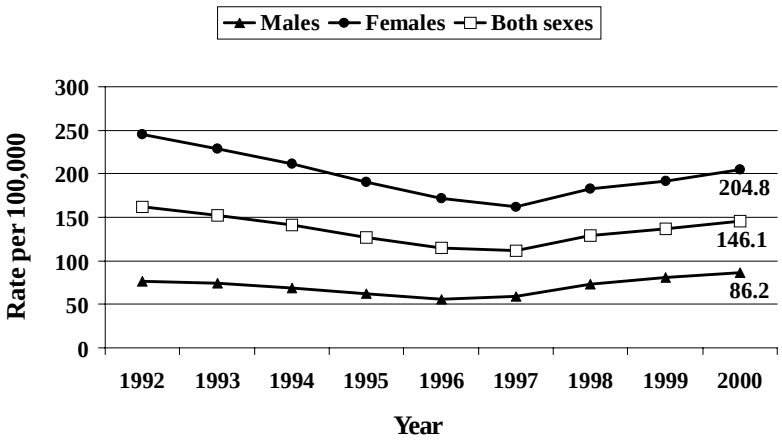


[1] This figure presents only HIV test reports where exposure category is reported. The totals in Figure 3 are much lower than the overall totals due to the large number of test reports that lack information on exposure category.

[2] Heterosexual: Includes the subcategories: heterosexual contact with a person at risk for HIV, origin in a country where HIV is endemic and heterosexual as the only identified risk

Health Canada. HIV and AIDS in Canada. Surveillance Report to December 31, 2000. Division of HIV/AIDS Epidemiology and Surveillance, Bureau of HIV/AIDS, STD & TB, Health Canada, 2001.

Figure 4 Reported Genital Chlamydia Rate[1] in Canada 1991 to 2000[2].



[1] Rate per 100,000 population. Population estimates provided by Statistics Canada.
[2] 2000 numbers are preliminary and changes are anticipated.
Source: Health Canada, Centre for Infectious Disease Prevention & Control, Bureau of HIV/AIDS, STD & TB, 2001.

Table 2 Number of Cases and Rates for Genital Chlamydia by Age Group and Sex in Canada, 1995-2000.

		Age Group											
		15-19		20-24		25-29		30-39		40-59		Total Canada	
Year		Cases	(Rate[1])	Cases	(Rate*)	Cases	(Rate*)	Cases	(Rate*)	Cases	(Rate*)	Cases	(Rate*)
1995	Male	1721	(169.6)	3478	(335.6)	1848	(163.1)	1484	(55.7)	398	(10.9)	9085	(61.9)
	Female	10704	(1109.1)	10496	(1041.7)	3745	(336.8)	2312	(88.5)	459	(12.6)	28451	(190.4)
	Total[2]	12427	(627.6)	13976	(683.7)	5594	(249.2)	3796	(72.0)	858	(11.8)	37551	(126.8)
1996	Male	1524	(148.5)	3128	(302.7)	1745	(155.6)	1372	(51.2)	436	(11.5)	8317	(56.0)
	Female	9752	(998.6)	9439	(941.2)	3549	(322.0)	2134	(81.5)	530	(14.0)	26062	(172.4)
	Total	11282	(563.3)	12572	(617.4)	5295	(238.1)	3508	(66.2)	966	(12.8)	34399	(114.8)
1997	Male	1510	(145.6)	3260	(315.9)	1783	(160.6)	1559	(58.5)	484	(12.4)	8714	(58.1)
	Female	9588	(971.6)	9170	(914.9)	3458	(316.5)	2103	(80.7)	512	(13.1)	25406	(166.2)
	Total	11102	(548.5)	12434	(611.2)	5242	(237.9)	3662	(69.5)	997	(12.7)	34144	(112.7)
1998	Male	1934	(184.0)	4094	(394.1)	2338	(217.2)	1934	(75.0)	609	(15.2)	11041	(73.6)
	Female	10599	(1063.4)	10087	(1011.0)	3857	(366.3)	2299	(90.4)	509	(12.6)	27956	(182.9)
	Total	12537	(612.2)	14185	(696.5)	6199	(291.1)	4235	(82.7)	1118	(13.9)	39034	(128.8)
1999	Male	1954	(184.6)	4632	(440.2)	2510	(234.7)	2197	(86.4)	713	(17.3)	12156	(80.5)
	Female	11257	(1121.8)	10621	(1054.1)	4005	(383.8)	2364	(94.6)	606	(14.6)	29486	(191.6)
	Total	13223	(641.3)	15259	(740.8)	6517	(308.4)	4561	(90.5)	1320	(16.0)	41676	(136.7)
2000*	Male	2260	(212.5)	4862	(458.2)	2725	(256.2)	2273	(90.6)	838	(19.7)	13116	(86.2)
	Female	12092	(1200.4)	11586	(1140.6)	4202	(405.1)	2586	(105.1)	666	(15.6)	31769	(204.8)
	Total	14356	(693.3)	16458	(792.5)	6931	(329.9)	4861	(28.4)	1505	(17.6)	44915	(146.1)

[1] Rate per 100,000 population. Population estimates provided by Statistics Canada.
[2] Totals include cases not specified for sex.
*2000 cases are incomplete and changes are anticipated. Refer to Division below for current updates.
Source and contact: Division of Sexual Health Promotion and STD Prevention & Control, Health Canada, 2001

(Health Canada, 1997; Patrick, 1997b).

The annual reported infection rate is greatest among 15- to 24-year-olds and particularly so among young women in these age cohorts (Table 2). Canada's goal for chlamydia prevention in this vulnerable 15- to 24-year-old female demographic group was to reduce the rate of infection to 500 per 100,000 by 2000 (Health Canada, 1997; Patrick, 1997b). Even though the reported female rate has increased less than the male rate, in 2000 the female rate in this age group is more than twice this national goal level (Table 2). Collectively 15- to 24-year-olds of both sexes accounted for 68.6% of all reported cases of chlamydia in Canada in 2000; 25- to 29-year-olds accounted for an additional 15.5%.

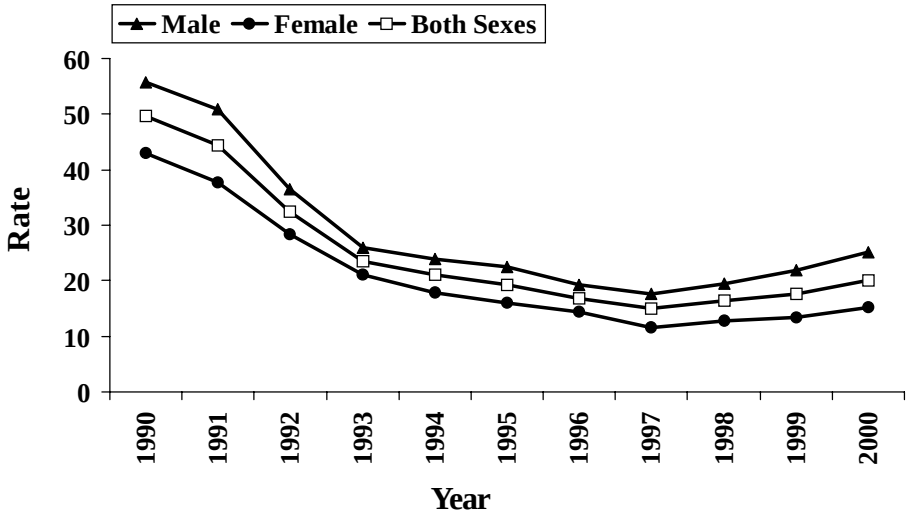
A small increase in the chlamydia rate had been anticipated as a result of improved detection made possible by the introduction in most regions of more sensitive and non-invasive Nucleic Acid Amplification Technology (NAAT) in place of enzyme immunoassay for diagnosis. However, NAAT testing has now been in relatively constant use in some areas of the country for over 4 years yet rates are continuing to increase in those regions.

As a true phase III epidemic, chlamydia is logically managed by the combination of widespread screening and treatment of those at risk, partner notification and treatment, and health promotion efforts directed at the 15- to 24-year-olds who accounted for over two thirds of reported cases in 2000. On its own, the recent increase in the reported rate of chlamydia might not lead to high anxiety about the state of STI epidemics in Canada. However, this trend with chlamydia has been mirrored by the other bacterial STIs and it is thus reasonable to conclude that we may be stumbling on our journey toward improved control.

GONORRHEA

The firmest evidence for a rebounding problem with STI in Canada is the trend in the reported rate of gonorrhea (Health Canada, 2000). The declining trend seen for the past two decades started to reverse in both sexes in 1997 so that Canada in 2000 was back to a rate of 20.1 per 100,000 population, an increase of 35% since 1997 (Fig. 5; Table 2). This leaves Canada well off course to its target of eliminating endemically transmitted gonorrhea by 2010 or at a minimum reducing the annual rate to 5 per 100,000 population (Alary, 1997; Health Canada, 1997). As is the case with chlamydia, gonorrhea rates are high in

Figure 5 Reported Gonorrhea Rates[1] in Canada 1990 to 2000[2].



[1] Rate per 100,000 population. Population estimates provided by Statistics Canada.
[2] 2000 numbers are preliminary and changes are anticipated.
Source: Health Canada, Centre for Infectious Disease Prevention & Control, Bureau of HIV/AIDS, STD & TB, 2001.

the 15- to 24-year-old age groups although less heavily biased toward females than is the case with chlamydia (Table 3). Indeed in the older age cohorts, gonorrhea rates among males are 2-8 times those for females. In 2000, 15- to 24-year-olds accounted for almost half of all reported cases of gonorrhea with 25- to 29-year-olds adding another 15.5% (Table 3).

NAAT testing for gonorrhea has been deployed in many regions in Canada and improved detection could thus account for some of the increase in reported infections that began in all age groups and both sexes from 1997-1998. However, gonorrhea rates have continued to rise in some jurisdictions, reaching outbreak threshold in areas where the NAAT technology has not been introduced (BCCDC, 1999). In an ad hoc survey conducted by Health Canada in 1999, officials of only one province felt that their observed increase in gonorrhea incidence was attributable to the earlier introduction of NAAT.

At present, gonorrhea might be considered as being in late phase III or early phase IV on the dynamic topology continuum. It is becoming increasingly focused in marginalized populations, a trend which may account for a broad and even divergent pattern in rates by region (Blanchard et al., 1998). There is a need to look carefully at crafting our provincial and local public health control efforts to cater to increasingly marginalized populations in which remaining cases are concentrated. But the apparently easy return of higher rates of gonorrhea in some regions suggests that it would be premature for many regions to consider deleting gonorrhea screening of individuals at risk of STI.

We should also remain vigilant to the fact that *Neisseria gonorrhoeae* can continue to challenge

Table 3 Number of Cases and Rates of Gonorrhea by Age Group and Sex in Canada, 1995-2000.

		Age Group											
		15-19		20-24		25-29		30-39		40-59		Total Canada	
Year		Cases	(Rate[1])	Cases	(Rate*)	Cases	(Rate*)	Cases	(Rate*)	Cases	(Rate*)	Cases	(Rate*)
1995	Male	425	(41.8)	769	(74.1)	710	(62.5)	980	(36.7)	360	(9.9)	3322	(22.6)
	Female	888	(91.9)	761	(75.4)	347	(31.2)	243	(9.3)	51	(1.4)	2385	(16.0)
	Total[2]	1315	(66.4)	1530	(74.8)	1059	(47.1)	1224	(23.2)	412	(5.6)	5715	(19.3)
1996	Male	345	(33.6)	688	(66.6)	614	(54.8)	820	(30.6)	320	(8.5)	2845	(19.2)
	Female	844	(86.4)	652	(65.0)	320	(29.0)	210	(8.0)	60	(1.6)	2168	(14.3)
	Total	1189	(59.4)	1341	(65.8)	934	(42.0)	1034	(19.5)	380	(5.0)	5023	(16.8)
1997	Male	333	(31.5)	594	(57.4)	570	(51.4)	777	(29.2)	338	(8.5)	2657	(17.7)
	Female	725	(69.7)	588	(56.9)	242	(21.0)	194	(7.1)	43	(1.3)	1855	(11.6)
	Total	1058	(52.3)	1184	(58.2)	812	(36.9)	972	(18.4)	381	(4.9)	4522	(14.9)
1998	Male	327	(31.1)	665	(64.0)	571	(53.0)	898	(34.8)	406	(10.2)	2921	(19.5)
	Female	799	(80.2)	575	(57.6)	245	(23.3)	196	(7.7)	53	(1.3)	1938	(12.7)
	Total	1126	(55.0)	1242	(60.9)	816	(38.3)	1094	(21.4)	459	(5.7)	4868	(16.4)
1999	Male	336	(31.7)	745	(70.8)	597	(55.8)	1066	(41.9)	512	(12.4)	3311	(21.9)
	Female	806	(80.3)	637	(63.2)	288	(27.6)	202	(8.1)	72	(1.7)	2067	(13.4)
	Total	1143	(55.4)	1382	(67.1)	885	(41.9)	1268	(25.1)	584	(7.1)	5380	(17.6)
2000*	Male	423	(39.8)	812	(76.5)	651	(61.2)	1252	(49.9)	614	(14.4)	3813	(25.1)
	Female	960	(95.3)	736	(72.5)	303	(29.2)	224	(9.1)	72	(1.7)	2353	(15.2)
	Total	1384	(67.1)	1548	(74.3)	954	(45.7)	1476	(8.6)	689	(8.0)	6173	(20.1)

[1] Rate per 100,000 population. Population estimates provided by Statistics Canada

[2] Totals include cases not specified for sex.

***2000 cases are incomplete and changes are anticipated. Refer to Division below for current updates.**

Source and contact: Division of Sexual Health Promotion and STD Prevention & Control, Health Canada, 2001

us with respect to its ability to adapt genetic mechanisms that produce resistance to antimicrobial therapy. Non-culture gonorrhea tests are not able to provide resistance information at present and the increasing use of such tests will reduce our ability to track GC resistance. Until standardized genotype resistance technology is available, it is important for us to maintain sentinel sites across the country that will continue to do gonorrhea cultures. In 1998, 4001 isolates of *Neisseria gonorrhoeae* were tested in Canada for antibiotic resistance (Table 4). The largest group (24%) were resistant to tetracycline, followed by penicillin (11%). A ciprofloxacin resistance rate of 1% may escalate with increasing international travel, as high levels of ciprofloxacin resistance have recently extended from Asia to Hawaii (CDC, 2000). Trends in gonorrhea rates in regions such as British Columbia serve to remind us that progress in STI control is not inevitable. Rather, it is possible to move in reverse or even in a cycle with respect to some epidemic phases.

Pelvic Inflammatory Disease

Pelvic inflammatory disease (PID) may result from invasion of the fallopian tubes by classic STI pathogens such as *Chlamydia trachomatis* and *Neisseria gonorrhoeae* but also from ascending infection with mixed genital tract organisms often associated with genital tract surgery (e.g., D & C, therapeutic abortion, etc.) or other procedures (e.g. insertion of an IUD). Many cases are silent and most do not result in hospitalization. It is somewhat encouraging to see a decline in the rate of hospitalization for PID in Canada from 282 episodes per 100,000 women aged 15-44 in 1983/84 to 78.9 per 100,000 women in 1996/97. This trend needs to be interpreted cautiously since over this time period we have also have also seen improvements in outpatient antimicrobial therapy as well as a significant decrease in the availability of hospital beds.

Since well over half of all cases tubal infertility and ectopic pregnancy are sequelae of PID, Canada's goal for a 50% reduction in PID and ectopic pregnancy by the year 2007 (MacDonald & Brunham, 1997) was predicated on a 25% reduction in endemic chlamydial infection by 2002 and a 50% reduction by 2007 and elimination of endemic gonorrhea by 2002. Those goals are currently not in reach and continued reduction in the incidence of pelvic inflammatory disease will clearly require sustained efforts to control chlamydia and gonorrhea coupled with increased attention to methods to reduce the risk of infection associated with surgical and other medical procedures.

Infectious Syphilis

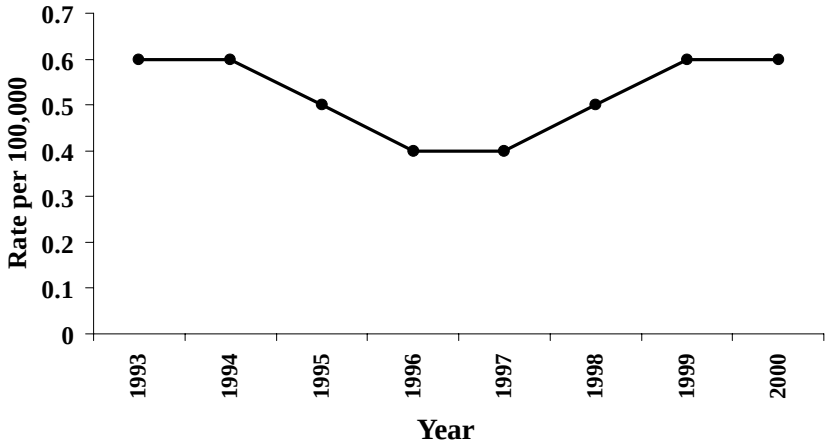
Infectious syphilis provides a classic example of a late phase STI epidemic. Canadian rates have declined almost consistently since the early 1980s and syphilis reached the brink of elimination in 1997 with a total of 116 cases reported and an overall infection rate at 0.4 per 100,000 population (Fig. 6; Table 5). Given these low levels, localized outbreaks can have an appreciable effect on rates as reflected by the upswing since 1997 (Wong & Jordan, 2001) (Fig. 6).

Table 4 Proportion of Canadian *Neisseria gonorrhoeae* Isolates Resistant to Various Antimicrobials.

Antibiotic	Number of Strains Resistant to Antibiotics (*N* = 4001*)	Resistance (%) of All Cultured Strains in Canada
Penicillin	441	11.0
Tetracycline	954	23.8
Erythromycin	381	9.5
Spectinomycin	2	0.05
Ciprofloxacin	44	1.1
Azithromycin	25	0.6

*** 4,001 strains were tested by the Canadian *Neisseria gonorrhoeae* Antimicrobial Susceptibility Surveillance Network for 1998. The network is listed in Appendix 2.**
(1998/99 STD Surveillance Report data is from the National Laboratory for STD in Canada.)
Source: Health Canada (2000a)

Figure 6 Reported Infectious Syphilis (Primary, Secondary Early Latent) Rates[1] in Canada 1993 - 2000[2].



[1] Rate per 100,000 population. Population estimates provided by Statistics Canada.
[2] 2000 numbers are preliminary and changes are anticipated.
Source: Health Canada, Centre for Infectious Disease Prevention & Control, Bureau of HIV/AIDS, STD & TB, 2001

Table 5 Number of Cases and Rates for Infectious Syphilis by Age Group and Sex in Canada, 1995-2000.

		Age Group											
		15-19		20-24		25-29		30-39		40-59		Total Canada	
Year		Cases	(Rate[1])	Cases	(Rate*)	Cases	(Rate*)	Cases	(Rate*)	Cases	(Rate*)	Cases	(Rate*)
1995	Male	2	(0.2)	14	(1.4)	14	(1.2)	30	(1.1)	24	(0.7)	90	(0.6)
	Female	11	(1.0)	12	(1.2)	12	(1.1)	11	(0.4)	9	(0.2)	55	(0.4)
	Total[2]	13	(0.6)	26	(1.3)	26	(1.2)	41	(0.8)	33	(0.5)	145	(0.5)
1996	Male	3	(0.3)	7	(0.7)	13	(1.2)	27	(1.0)	21	(0.6)	74	(0.5)
	Female	9	(0.9)	9	(0.9)	14	(1.3)	11	(0.4)	5	(0.1)	49	(0.3)
	Total	12	(0.6)	16	(0.8)	27	(1.2)	38	(0.7)	26	(0.3)	123	(0.4)
1997	Male	1	(0.1)	4	(0.4)	8	(0.7)	27	(1.0)	26	(0.7)	67	(0.4)
	Female	2	(0.2)	6	(0.6)	14	(1.3)	18	(0.7)	7	(0.2)	49	(0.3)
	Total	3	(0.1)	10	(0.5)	22	(1.0)	45	(0.9)	33	(0.4)	116	(0.4)
1998	Male	2	(0.2)	4	(0.4)	10	(0.9)	41	(1.6)	32	(0.8)	100	(0.7)
	Female	5	(0.5)	10	(1.0)	11	(1.0)	25	(1.0)	12	(0.3)	66	(0.4)
	Total	7	(0.3)	14	(0.7)	21	(1.0)	66	(1.3)	44	(0.5)	166	(0.5)
1999	Male	1	(0.1)	12	(1.1)	12	(1.1)	37	(1.5)	39	(0.9)	113	(0.7)
	Female	8	(0.8)	12	(1.2)	14	(1.3)	17	(0.7)	16	(0.4)	74	(0.5)
	Total	9	(0.4)	24	(1.2)	26	(1.2)	54	(1.1)	55	(0.7)	187	(0.6)
2000*	Male	0	(0.0)	3	(0.3)	11	(1.0)	42	(1.7)	45	(1.1)	111	(0.7)
	Female	7	(0.7)	10	(1.0)	10	(1.0)	23	(0.9)	14	(0.3)	65	(0.4)
	Total	7	(0.3)	13	(0.6)	21	(1.0)	65	(1.3)	59	(0.7)	176	(0.6)

[1] Rate per 100,000 population. Population estimates provided by Statistics Canada
[2] Totals include cases not specified for sex.
*2000 cases are incomplete and changes are anticipated. Refer to Division below for current updates.
Source and contact: Division of Sexual Health Promotion and STD Prevention & Control, Health Canada, 2001

A sustained outbreak began in Vancouver in 1997 and has proved refractory to interventions aimed at ending it (Rekart et al., 2000). Between 1996 and 1999, the rate of infectious syphilis increased from 0.5 per 100,000 to 3.4 per 100,000 population in British Columbia. The impact on annual case count is depicted in Fig. 7. Overall, 277 cases were reported in the 30 months between July 1997 and December 1999. In the Downtown Eastside neighbourhood of Vancouver, the rate reached 126 per 100,000 population, a striking contrast from the highest national rate (1.7/100,000) seen for males or females in any of the age categories or years depicted in Table 5. Of interest is the degree to which the outbreak is occurring in a highly marginalized population in which traditional public health interventions (partner notification and treatment, screening, health promotion) are less effective. Four other jurisdictions across Canada have also experienced outbreaks since 1999. The year 2000 goal for infectious syphilis was to maintain the rate at or below 0.5 per 100,000 population (Health Canada, 1997; Romanowski, 1997). The presence of even one sustained outbreak has been enough to imperil this goal.

The control of syphilis will depend on efforts to expediently identify remaining cases and to locate, test and treat potentially infected partners. Sustained community outreach to high-risk groups will be necessary and some forms of peer-based intervention may also be employed. Because syphilis could be reintroduced at any time from overseas, maintaining control of syphilis will remain a challenge unless there is a fundamental change in the social fabric that promotes the existence of sexual networks with high rates of partner exchange, concurrent partnership and high risk sexual and IDU behaviours.

Genital Human Papillomavirus Infections

While many types of human papillomavirus (HPV) are responsible only for condylomata (wart-like growths around the genitals or anus), some sub-types have been linked closely to cancer of the cervix (Bosch et al.,1995). Unfortunately, sub-clinical HPV infections are rarely diagnosed. However, recent data from prospective Canadian studies in Ontario and Newfoundland have elucidated the prevalence of oncogenic HPV infection in specific age groups. Based on testing of women appearing at clinics for Pap smears, the highest prevalence of HPV infections (about 16-21%) was found in women under 25 (Fig. 8) (Ratnam et al., 2000; Sellors et al., 2000). At any point in time, one in seven young sexually active women may carry detectable oncogenic HPV. This worrisome rate is mitigated to a certain extent by the knowledge that a high proportion of those infected will clear the virus and that only the persistently infected seem to be at risk of progressing to cancer of the cervix. The role of HPV testing in cervical cancer screening has yet to be established.

Figure 7 Infectious Syphilis in British Columbia, 1983-1999.

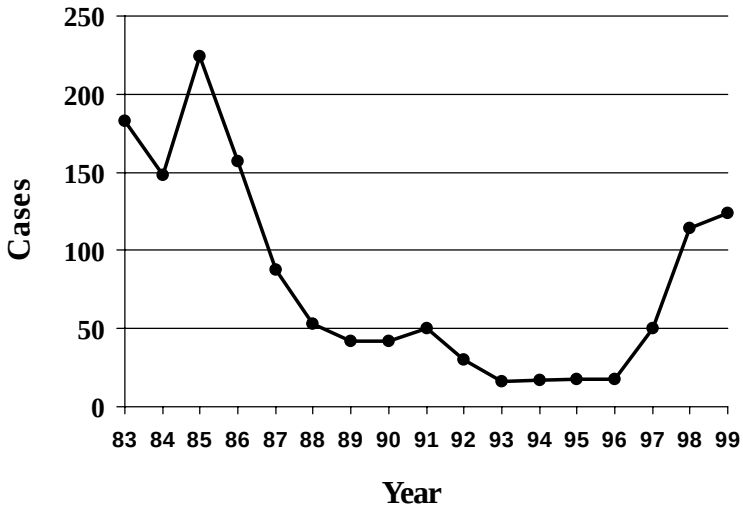
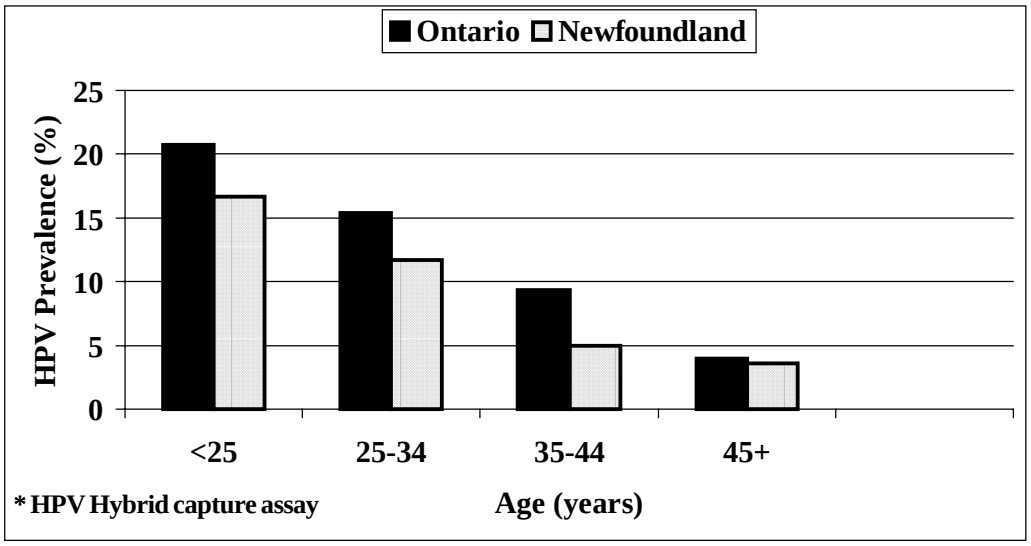


Figure 8 Oncogenic HPV Prevalence in Ontario and Newfoundland Women*.



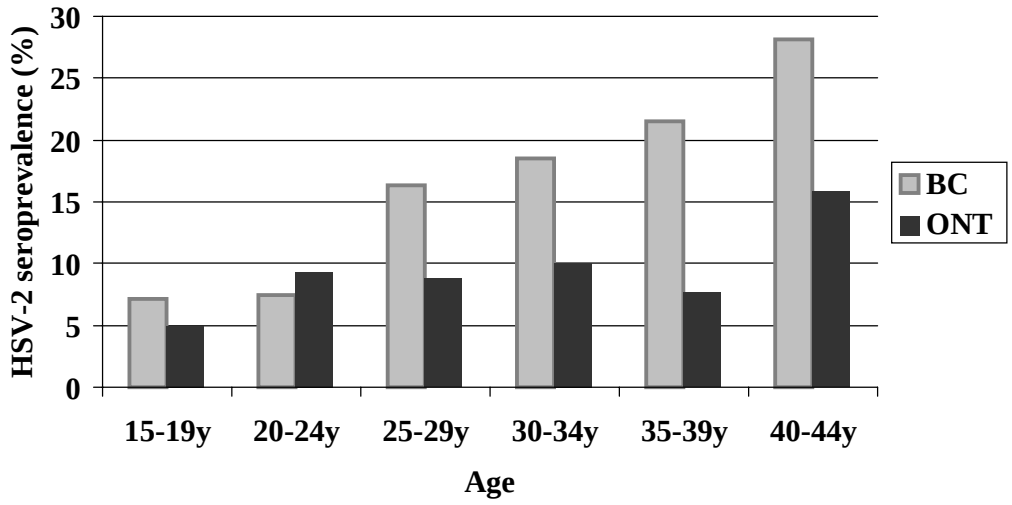
Source: Sellors et al. (2000)
Ratnam et al. (2000)

Oncogenic HPV infections in Canada are on the cusp of transition between Phase II and Phase III of the epidemic topology shown in Fig. 1. We are thus at the stage of doing the research to clarify the epidemiology and natural history of HPV (this was one of Canada's goals for HPV cited by Health Canada, 1997; Lytwyn & Sellors, 1997) but we have not yet developed and implemented interventions to reduce the incidence and prevalence of HPV infection. Such interventions are crucial to reducing the rates of diseases caused by HPV such as invasive cervical cancer. Lytwyn and Sellors (1997) identified a number of research needs and goals that might reverse this trend including development of a vaccine for HPV, development of new topical agents against HPV, and development of effective barrier methods (condoms appear to reduce the risk of infection but do not protect all infected or infectable skin areas). HPV is a genetically stable DNA virus and may well prove to be a target for antiviral vaccines currently under development. Although topical agents such as spermicides with nonoxynol-9 appear to be ineffective against HPV, the detergent sodium dodecyl sulphate (SDS) has been reported to block the infectivity of HPV, presumably by inactivating key proteins (Howett et al., 1999). Until these new modalities are available, cervical cancer reduction will best be accomplished by promotion of regular pap tests, smoking cessation, barrier methods, and negotiation of safer sex practices among partners with known infection.

Herpes Simplex Virus Infections

Herpes simplex virus (HSV) is the second most prevalent viral sexually transmitted infection worldwide and the most common cause of genital ulceration in the developed world (Mindel, 1998). Many cases of genital herpes are so subtle that up to 75% of people with serologic markers of HSV-2 infection remain undiagnosed (Lafferty, Coombs, Benedetti, Crithlow, & Corey, 1987). Viral shedding from the genital tract occurs in both symptomatic and asymptomatic individuals (Wald et al., 2000). In addition to concerns about direct morbidity, genital herpes infections have three important public health implications. Undiagnosed cases contribute to the population reservoir and transmission of the virus. In addition, perinatal transmission to the neonate may result in disseminated disease, neurological damage and high mortality. Finally, herpetic ulcers facilitate the transmission of HIV (Wald et al., 2000; Lafferty et al., 1987).

Figure 9 HSV-2 Seroprevalence in Antenatal Women in BC and Ontario 2000.



Source: Patrick et al. (2000a)
Howard et al. (2001)

The prevalence of HSV-2 among adults in the United States increased 30% in a decade from 16.4% in the late 1970s to 21.7% in 1989-94 (Rosenthal et al., 1997). Several recent studies have now clarified the picture in Canada. Fig. 9 shows the age-specific seroprevalence of HSV-2 in women in British Columbia and Ontario (Patrick et al., 2000a; Howard et al., 2001). In B.C., the overall age adjusted seroprevalence for HSV-1 was 58.9% and for HSV-2 17.3%. However, the prevalence of HSV-2 started to increase after age 25, reaching 28% by age 44 (Chi square for trend <0.001). Compared to BC, antenatal women in Ontario had a lower HSV-2 seroprevalence and age-specific prevalence did not rise until age 40.

HSV is perhaps one of the best examples of a hyperendemic Phase II infection and it is therefore not surprising the Canada's goals for prevention of genital herpes (Health Canada, 1997; Steben & Sacks, 1997) focused on surveillance needs, research needs, control strategies, and vaccine preparedness rather than on setting targeted rates for different risk groups. While the number of strategies for public health interventions is indeed small, we should not be defeatist about the prospects for improvement. While consistent condom use will not prevent all HSV transmission, data from a recent study of discordant couples suggests that condom use still has an appreciable protective effect (Wald et al., 2001).

Hepatitis B Infections

In 1998 there were 970 new cases of Hepatitis B (HBV) reported in Canada. This represents a substantial drop from the 1989 peak of 3378 cases. Some of this decline is attributable to more accurate identification of acute cases by the provinces and territories. A recent review by Zhang, Zou and Giulivi (2001) placed the estimated incidence rate of clinically recognised newly reported acute HBV infections in 1998-99 at 2.3 per 100,000 of population which suggests a decline from the estimated rates of 3-5 per 100,000 between 1992-1995. Recent Canadian seroprevalence studies also indicated marked declines in anti-hepatitis B core prevalence (a marker of cumulative infection). Zhang, Zou and Giulivi (2001) estimate that 0.5% to 1.0% of the population may be HBsAg positive (i.e., carriers of HBV) although this overall figure obscures considerably rates in specific sub-groups within the population.

A recent study found that among individuals who had been immunized, effectively none were HBV carriers and all exhibited a high level of reactivity and titres for antibodies against HBs (Patrick et al., 2000b).

The Hepatitis B epidemic is an example of a Phase III epidemic in decline. However the introduction of immunization makes this a special case. Immunization reduces the risk of transmission for each sexual contact (B) and could thus drive the reproductive number for the epidemic practically to zero. Success on this front requires both public health strategies to immunize high risk populations, a point made by Tepper and Gully (1997) in the initial report on Canada's goals for STI prevention, along with broadly based immunization programs. Zhang et al. (2001) note that the universal school-based vaccination of 9- to 13-year-olds adopted across Canada in the early 1990s could, over time, prevent 63% of all acute infections and 47% of chronic infections. Provinces and territories that have universal programs that combine infant and preadolescent vaccination are likely to reduce both the costs of the programs and the occurrence of the 10-15% of chronic HBV infections acquired in early childhood.

CONCLUDING OBSERVATIONS

Because the effect size of vaccination can be so large, it is tempting to see vaccines as the key to STI prevention. At present, the anti-HBV vaccine is the sole example available for widespread use against any STI. However, vaccine research is currently underway and reasonably advanced for oncogenic HPV, and herpes simplex and promising strategies are also emerging for chlamydia. Although recent history suggests caution in our optimism, it seems likely that we can look forward to the first part of the 21st century as an era in which at least one more STI may become vaccine preventable.

However, primary prevention programs that include conceptually sound, evidence-based interventions to promote and facilitate condom use and other safer sex practices remain key to STI reduction in Canada. In a recent review of STI prevention programs that had been evaluated based on defined outcomes, McKay (2000) identified the characteristics of effective interventions and gave examples of the behavioural impact of programs designed to meet the needs of diverse groups at high risk of STI/HIV infection. The initial report on Canada's goals for STI prevention included a theory based framework for such interventions (Fisher, 1997) and we must continue to develop and foster the kinds of programs that can further these goals.

In Canada, we also need more and better national data on sexual behaviour to guide the design of such interventions and to provide baseline information against which to assess their impact. A recent review by Maticka-Tyndale, Barrett, and McKay (2000) pointed out the limitations in our longitudinal data on sexual behaviour in Canada and showed how available information (from the 1996 National Population Health Survey and the 1995 General Social Survey) could be used to identify how the links between social factors (family income, school attendance, work status) and sexual health behaviour (age of first intercourse, number of partners in past year, contraception, and condom use) impact on STI prevention. An understanding of trends and associations among these parameters is another necessary aspect of national efforts to reset our course to declining STI rates in Canada.

Unlike Odysseus, young Canadians need not necessarily lash themselves to the mast when they hear the siren call to love. The vast majority of teens and young adults will eventually hear that call and we thus need to redouble our efforts to ensure that they have the motivation and skills to navigate the potentially stormy waters of STI by consistent use of condoms, other safer sex practices, and communication. It is time to take a renewed and energetic approach to the promotion of barrier methods for protection during sexual intercourse, to re-equip the crew, and to sail on toward our stated goals for STI prevention.

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