IN THE SUPREME COURT OF BELIZE A. D. 2012

Claim No. 668 of 2010

In the matter of the Constitution of Belize

And

In the matter of the alleged unconstitutionality of Section 53 of the Criminal Code

And in the matter of an application made pursuant to Section 20(1) of the said Constitution

BETWEEN

CALEB OROZCO
UNITED BELIZE ADVOCACY MOVEMENT

CLAIMANTS

AND

THE ATTORNEY GENERAL OF BELIZE

DEFENDANT

EXPERT REPORT OF BRENDAN COURTNEY BAIN

This report is prepared and submitted by Professor Brendan Courtney Bain.

Professional Qualifications and Experience

Professor Brendan Bain is one of the pioneers in Clinical Infectious Disease practice in the Caribbean and is a leading medical authority on the HIV epidemic in the Caribbean. Since 1983, he has provided clinical care to men and women living with HIV and AIDS, accepting patients of all sexual persuasions, regardless of their reported sexual practices. His specialist medical practice has been at the University Hospital of the West Indies (UHWI) as well as in small private clinics in Kingston, Jamaica.

In addition to his work as an HIV clinician, Professor Bain has been an active member of the national HIV response team organized by the Ministry of Health of Jamaica. He has served in several capacities, including educator, researcher and counselor, policy advisor, administrator and member of the Jamaica Country Coordinating Mechanism.

Between 1989 and 1992, he led the first HIV/AIDS training workshops for health care workers at the invitation of the Governments of the Cayman Islands, Jamaica and Belize. As an advocate for improvement of services to persons living with HIV (PLHIV), he persuaded the UHWI authorities to allow him to start an out-patient clinic dedicated to the care and treatment of PLHIV and to training of younger physicians and nurses in HIV care – the first in Jamaica. This initiative led to the commencement of a similar clinic at the Kingston Public Hospital in Jamaica, increasing access to HIV care for a larger number of patients.

In the year 2000, the Vice-Chancellor of the University of the West Indies (UWI) appointed him as the Focal Point for HIV/AIDS in a regional project aimed at strengthening the institutional response to HIV/AIDS and sexually transmitted diseases in the Caribbean. He has been endorsed by two successive Vice-Chancellors to lead Caribbean training programmes on behalf of the University. Between 2005 and 2010, he served as a member of the inaugural Technical Working Group on HIV/AIDS of the Pan-American Health Organisation.

In 2003, he was invited by a United States Government team to lead the Regional Coordinating Unit of the Caribbean HIV/AIDS Regional Training (CHART) Initiative, which became part of the International AIDS Education and Training Centre directed from the University of Washington at Seattle and funded via the US President's Emergency Plan for AIDS Relief (PEPFAR). The CHART initiative is also the recipient of two successive sub-awards that are part of regional grants to the Pan-Caribbean Partnership against HIV/AIDS from the Global Fund to fight AIDS, Tuberculosis and Malaria (rounds 3 and 9). Over the past nine years, the CHART programme has trained health care workers and lay counselors in the English and Dutch-speaking countries of the Caribbean as well as in parts of Haiti. Attitudinal training is a central part of the CHART curriculum, with anti-stigma and anti-discrimination training being paramount.

In 2006, Professor Bain was recognized by the Medical Association of Jamaica "for distinguished service in Medicine." The National AIDS Committee of Jamaica has honoured him twice; first in 2007 for "demonstrating visionary leadership in improving the quality of life for

persons living with or affected by HIV", and then in 2009 for "outstanding leadership in the response to HIV and AIDS" in the Academic Sector.

Professor Bain obtained his undergraduate degrees and post-graduate training in Internal Medicine from the University of the West Indies. He studied and conducted research in Infectious Diseases at St. George's Hospital Medical School with the aid of a Wellcome Trust Research Fellowship. He holds a Diploma in Medical Education from the University of Dundee, Scotland and a Masters Degree in Public Health summa cum laude from Boston University, U.S.A. He is an elected Fellow of the Royal College of Physicians of Edinburgh. He has published over 30 papers in peer-reviewed medical journals and is co-author of the book, Education and HIV/AIDS in the Caribbean published by UNESCO. His current academic appointment is as Professor of Community Health in the Faculty of Medical Sciences at the Mona campus at UWI in Jamaica. He is an Adjunct Professor in the Department of International Health at the Boston University School of Public Health.

Summary of key points

The focus of the present inquiry is how the law treats men who have sex with men who have anal sex in private. The specific request is for modification of the law to exclude the classification of "anal sex between two consenting male adults in private" as a criminal offense.

In this context, a major argument that has been posited by some experts is that the current law impedes access to HIV prevention, care and treatment services by men who have sex with other men (MSM), thus jeopardizing their health and threatening premature demise. Although it is not mentioned specifically by the claimant, I believe that the matter of access to HIV services is one of the considerations relevant to the current case.

The threat of illness and premature death from HIV infection has undoubtedly generated fear for persons in the general society and particularly for persons whose sexual choices put them at greater than average risk of acquiring HIV. Some spokespersons are making a case for special consideration and additional support to be given by the general public and by Public Health and legal authorities on behalf of MSM. This is understandable from a strategic and compassionate perspective. However, it behooves the members of the public as well as persons in authority to use all available evidence in considering how to effectively mitigate the threat posed by HIV.

As a physician and Public Health practitioner, one of my responsibilities is to assess behaviours for their impact on health and wellbeing. When something is beneficial, such as exercise, good nutrition, or adequate sleep, it is my duty to recommend it. Likewise, when something is harmful, such as smoking, overeating, alcohol or drug abuse, and unsafe sexual behavior, it is my duty to discourage it. Together with promoting individual responsibility, it is clear that environments that enable individuals to make and practice safe and healthy choices must be provided at family, community and governmental levels.

Another of my responsibilities as a Public Health practitioner is to assess the cost of behaviour, not just to the individual 'actor', but also to the community. There are some private behaviours, either carried out by individuals or between consenting adults, that may either be helpful or of little adverse consequence to other persons in the community. Behaviours that are helpful to individuals and to the community are to be encouraged. On the other hand, there are instances in which private behaviors result in considerable public cost due to illness, with accompanying loss of productivity and social disruption and the prospect of premature death. The public cost of these private behaviours must be acknowledged and actively reckoned with.

This report shows that the relative risk of contracting HIV is significantly higher among men who have sex with other men (MSM) in Belize than in the general population. This is also true in several other countries for which data are available, including countries that have repealed the law that criminalizes anal sex and countries where the law still applies.

Some Public Health practitioners and agencies have hypothesized that decriminalizing the practice of anal intercourse among consenting adults would lead to a reduction in the incidence rate of HIV infections among MSM. To date, published data have not substantiated this hypothesis.

This report also shows clearly that HIV should not be the only consideration in relation to the matter at hand. Available data from several parts of the world indicate that the relative risk of acquiring and spreading other sexually transmitted infections (STIs)[1] and cancers is unacceptably high among MSM when compared with other men and women.

Factors associated with the high relative risk of STIs and cancers in affected persons *are interactive* and include: (a) choosing a sexual partner whose sexual history is unknown; (b) being

[1] In this report, HIV infection is included among the group of sexually transmitted infections because in the Caribbean, including the country of Belize, the main mode of transmission of HIV is intimate genital sexual contact, including ano-genital contact.

part of a sexual network, including having multiple partners and a high rate of changing partners; (c) having unprotected sex; and (d) having a repertoire of sexual behaviours that includes actions that carry a significant risk either of causing physical trauma or of allowing contact with faecal material – these behaviours include, but are not confined to, penis-anus intercourse. Therefore, even when certain behaviours are done in private, they turn out to have serious deleterious public consequences.

The risk to MSM and their intimate sexual partners is not just to their physical health. The adverse physical and physiological consequences of STIs (including HIV) in MSM create significant and avoidable financial costs to individuals, households and governments. These important considerations must be included when considering whether to give public approval to risky behaviours such as are often practiced by MSM.

It is vital for each country affected by sexually transmitted infections to understand the epidemiology[2] of its epidemics and to devise evidence-based plans for prevention, care, treatment and rehabilitation of affected persons. Successful implementation of plans requires persons in the community to cooperate actively with the health authorities both in private and in public.

All sexually active persons must be urged to take responsibility for private and public behavior change as part of a comprehensive national approach that includes individuals delaying their sexual debut, reducing the number of their intimate sexual partners, getting tested for HIV and other STIs in relation to known risky exposure, learning and practising assertive skills in order to avoid coercive sex, disclosing the presence of an STI to prospective partners, using approved barrier protective devices, avoiding the use of mind-altering drugs – especially during or in temporal proximity to intimate sexual activity, and eliminating behaviours that carry the highest risk of coming into contact with infections. Successful programmes to stem the tide of HIV infections and other sexually transmissible illnesses must be comprehensive rather than piecemeal. In this approach, public and private health and education authorities ensure that everyone in the nation has accurate information and is supported and enabled to take responsibility for the health and safety of self and others.

A comprehensive approach calls for honest collaboration rather than confrontation.

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[2] Epidemiology is the study of the distribution and determinants of diseases in the human population.

MAIN REPORT

My responsibilities as a physician and Public Health Practitioner

I am persuaded that as a physician and Public Health practitioner, "one of my responsibilities is to assess behaviours for their impact on health and wellbeing. When something is beneficial, such as exercise, good nutrition, or adequate sleep, it is my duty to recommend it. Likewise, when something is harmful, such as smoking, overeating, alcohol or drug abuse, and unsafe sexual behavior, it is my duty to discourage it."

Another of my responsibilities as a Public Health practitioner is to assess the cost of behaviour, not just to the individual 'actor', but also to the community. There are some private behaviours, either carried out by individuals or between consenting adults, that may either be helpful or of little adverse consequence to other persons in the community. Behaviours that are helpful to individuals and to the community are to be encouraged. On the other hand, there are instances in which private behaviors result in considerable public cost due to illness, with accompanying loss of productivity and social disruption and the prospect of premature death. The public cost of these private behaviours must be acknowledged and actively reckoned with.

Defining sexual behaviours

Sexual behaviours are actions that are commonly interpreted as having a sexual intent and purpose. Some types of sexual behaviour do not involve the physical presence of another person. Examples of such types of sexual behavior are: reading sexually stimulating literature, listening to sexually explicit or sexually stimulating music, viewing sexually explicit films, masturbation, telephone sex and internet-based sex. In the world of sexuality, non-physical sexual behaviours often progress to physical contact.

Male-female and male-male sexual behaviours

In adult male-female sexual behavior, the prelude involves speech, setting of atmosphere and touching – either non-genital (e.g. kissing, fondling of different areas of the body) or touching and stimulation of the genital organs leading to an orgasm or climax. The usual climax of male-female intercourse involves penetration of the vagina by the penis with ejaculation by the male and an orgasm or series of orgasms experienced by the female. Some episodes end

without ejaculation or female orgasm. In some cases, intercourse ends without penetration of the vagina and there may be ejaculation into the mouth or into the anal passage.

The male-male physical sexual repertoire may begin in a similar way to the male-female process and can progress from kissing and fondling to placement of the fingers or hand into the anal passage (fisting), oro-anal contact (called 'rimming' or 'analingus'), and insertion of the penis into the anus. A variety of other actions have been reported in some cases of male-male sexual contact; these include mouth-anal contact, and golden showers (urination on another person). In a small proportion of reported cases, there is scat (defecation on another person) and in a few cases, felching (sucking or eating semen out of someone's anus).

High risk of transmission of infection is related to sexual repertoire, ignorance of partner's infection status and the reality of sexual networks

Several of the behaviours described in the preceding paragraphs are unsafe and therefore unhealthy because they create an unacceptable level of risk of acquiring and spreading infectious diseases that compromise the *health*, and in some instances the *life* of the infected person and the person's partners. As an example, a 1981 paper by R. R. Willcox of St. Mary's Hospital, London entitled, "Sexual behavior and sexually transmitted disease patterns in male homosexuals" published in the British Journal of Venereology, states in part that

> "Mouth-anal contact is the reason for the relatively high incidence of diseases caused by bowel pathogens in male homosexuals. Trauma [during anal penetration] may encourage the entry of microorganisms and thus lead to primary syphilitic lesions occurring in the anogenital area. Similarly, granuloma inguinale, condylomata acuminata, and amoebiasis may be spread from the bowel of the passive homosexual contact. In addition... trauma may be caused by foreign bodies, including stimulators of various kinds, penile adornments, and prostheses. (The phrase in parenthesis is my addition).

(A copy of the said journal article is now shown to me and exhibited hereto, marked B.B. #1.)

The risk of contracting sexually transmitted infections is multiplied when a sexual partner's infection status is unknown. In several instances, persons are not aware that they are harbouring infection because at the time that they are approached they are not experiencing symptoms. In addition, in my professional practice several persons who know that they are infected have told me that they do not disclose to their respective partners. When a person does not know his sexual partner's status, privacy is not sufficient to guarantee safety.

Another factor that increases the risk of transmission of sexually transmitted infections is intimate sexual contact with multiple partners. Privacy does not offer protection from this risk.

Information from Belize, Jamaica and other countries

Belize

According to a study entitled, "HIV seroprevalence and associated risk factors among male inmates at the Belize Central Prison", published in the Pan-American Journal of Public Health in 2009, co-authored by Drs. E Gough and Paul Edwards and based on blood testing among a group of volunteers in the Belize Central Prison, "of the 623 inmates in the sample, 25 tested positive for HIV-1/2 antibody for a seroprevalence of 4.0% (95% Confidence Interval 2.7, 6.0). After adjustment for confounding, HIV serostatus was positively associated with male-to-male sexual activity outside prison, age, and district of residence before current incarceration."

The article came to the following conclusions:

> "The seroprevalence in the Central Prison was almost twice that estimated for the adult population of Belize in 2004 (2.4%). However, the social variables of importance to inmates appeared to reflect the epidemic in the general population, with the exception that male-to-male sex outside prison is likely more important to the male inmate population in Belize. The findings suggest that HIV is likely contracted by most inmates before their incarceration, largely due to same-sex activity."

This article indicates that there is a higher relative risk of contracting HIV by men who have sex with men in Belize. (A copy of the said journal article is now shown to me and exhibited hereto, marked B.B. #2).

Jamaica

In 1993, a Master of Public Health thesis submitted to the University of the West Indies by Mr. Rossi Hassad, which I supervised, recorded the results of a questionnaire survey with 101 persons who identified themselves as men who have sex with men (MSM). Approximately 63% of the persons interviewed said that they engaged in insertive anal sex, while 56% indicated that they practiced receptive anal sex. Just over 39% reported practicing fingering or fisting in the anus, while just over 27% reported applying the mouth to their partners' anus. More than 12% practiced oral sex in which their partner swallows semen, while approximately 8% reported "self and mutual masturbation", and 3% mentioned "golden showers" (one person urinating on his sexual partner).

The most recent statistics available from Jamaica indicate that the rate of HIV seropositivity in a group of MSM who volunteered for testing was 32% compared to the estimated national average adult prevalence rate of 1.7% (data from Jamaica National HIV/STI Programme, 2010). This means that in this group of MSM, the prevalence rate is at least 18 times higher than in the general adult population.

Other countries

The Netherlands – increase in risky behavior in the era of anti-retroviral drugs

Recent data have indicated that consistent use of effective antiretroviral drugs reduces the rate of transmission of HIV. *The proviso is that risky sexual behavior is not increased.* The latter proviso is more than a speculative point, as shown by Daniela Bezemer and her colleagues from the HIV Monitoring Foundation in the Netherlands. They reported in the journal, AIDS, in 2009 that "the reproduction number R(t), a measure of the state of the [HIV] epidemic, declined among MSM in Holland 'early on' from initial values above two and was maintained below one from 1985 to 2000. [However], since 1996, when highly active antiretroviral therapy became widely used, the risk behaviour rate has increased 66%, resulting in an increase of R(t) to 1.04 in the latest period 2000-2004 (95% confidence interval 0.98-1.09), near or just above the threshold for a self-sustaining epidemic." According to the authors, "[their] hypothetical scenario analysis shows that the epidemiological benefits of highly active antiretroviral therapy and earlier diagnosis on incidence have been entirely offset by increases in the risk behaviour rate." They concluded: "We provide the first detailed quantitative analysis of the HIV epidemic in a well defined population and find a resurgent epidemic in the era of highly active antiretroviral therapy, most likely predominantly caused by increasing sexual risk behaviour." (A copy of the said journal article is now shown to me and exhibited hereto, marked B.B. #3).

The United States of America

In the United States of America, there is a significantly higher risk of HIV and syphilis among men who have sex with men compared to other men and compared to women. A Press Release issued by the National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention in the USA on March 10, 2010 stated in part that "Data presented at the U.S. Center for Disease Control and Prevention's (CDC) 2010 National STD Prevention Conference showed the rate of new HIV diagnoses among men who have sex with men (MSM) was over 44 times that of other

men and more than 40 times that of women. The range was 522-989 cases of new HIV diagnoses per 100,000 MSM vs. 12 per 100,000 other men and 13 per 100,000 women." The release also indicated "the rate of primary and secondary syphilis among MSM was over 46 times that of other men and more than 71 times that of women." (A copy of the said Press Release is now shown to me and exhibited hereto, marked B.B. #4).

France

In April 2011, Stéphane Le Vu and colleagues reported HIV surveillance data from France in the journal, Lancet Infectious Diseases. According to their data, in 2008 the rate of new HIV infections in MSM in France was over 100 times higher than in heterosexual men and over 14 times higher than in intravenous drug users (IDU) in that country. Their paper states in part: "After accounting for under-reporting, there were 6480 (95% Confidence Interval, 6190 - 6780) new diagnoses of HIV infection in France in 2008. We estimate that there were [actually] 6940 (6200 - 7690) new HIV infections in 2008, suggesting an HIV incidence of 17 per 100 000 person-years. In 2008, there were 3550 (3040 - 4050) new infections in heterosexuals (incidence of 9 per 100 000 person-years), 3320 (2830 - 3810) in MSM (incidence of 1006 per 100 000in person-years), and 70 (0 - 190) in IDUs (incidence of 86 per 100 000 person-years). Overall HIV incidence decreased between 2003 and 2008 ($p<0{\cdot}0001$), but remained comparatively high and stable in MSM." (A copy of an abstract of the said journal article, entitled, "Population-based HIV-1 incidence in France, 2003-08: a modelling analysis", is now shown to me and exhibited hereto marked B.B. #5).

A recent series of articles

An edition of the Lancet.com entitled, HIV infection in Men Who Have Sex with Men, was published on July 20, 2012. The executive summary of the series of papers reads as follows:

> "Despite great progress in tackling the HIV epidemic worldwide in the past two decades, there is one population in which the epidemic continues to grow in countries of all incomes: men who have sex with men (MSM). This Lancet series explores the unique aspects of the HIV epidemic in MSM, showing that it is factors such as the biology of anal sex, the characteristics of MSM networks, and known behavioural factors that are driving the epidemic in this population. The Series addresses the unique challenges faced by black MSM around the world, and discusses initiatives that reduce infectiousness of HIV — such as treatment-as-prevention and pre-exposure prophylaxis—that could have a huge impact in curbing the HIV epidemic in MSM and other populations."

This up-to-date summary identifies the factors that interact and that continue to create special risk of contracting and passing on HIV among men who have sex with men and others who have intimate sexual contact with them. Prominent among these factors are "the biology of anal sex", the characteristics of MSM networks", "known behavioural factors", and "the unique challenges faced by black MSM around the world."
(A copy of said executive summary is now shown to me and exhibited hereto, marked B.B. #6.)

The majority of sexually transmitted infections caused by viruses are still incurable

Due to advances in knowledge and greater availability of a range of anti-microbial drugs, the majority of bacterial, protozoal and parasitic infections associated with sexual behavior are curable. In contrast, the majority of sexually transmitted diseases that are caused by viruses still cannot be cured. These include infections with members of the herpes virus group, the hepatitis type B virus (hep B), the human papilloma virus (HPV), the human immunodeficiency virus (HIV) and the human T-lymphotropic virus type 1 (HTLV-1). Controlling some of these diseases is more possible than before, but requires long-term commitment and is expensive and inconvenient.

Risk of cancer associated with some sexually transmitted infections

Some sexually transmitted viral infections are now known to lead to cancer. Infection with hepatitis B can lead to cancer of the liver. Infection with some strains of HPV leads to cancer of the cervix in women, cancer of the penis in men and cancer of the mouth and cancer of the anus in men and women. In the latter case, the occurrence of cancer of the anus is much higher proportionally in men compared to women.

Preventing sexually transmitted infections

The search for vaccines to prevent STIs continues. Vaccines are now available against hepatitis B and human papilloma virus. However, to date, a reliable and effective vaccine against HIV has still not been found.

With or without effective vaccines, it is vital for each country affected by sexually transmitted infections to understand the epidemiology[3] of its epidemics and to devise evidence-

[3] Epidemiology is the study of the distribution and determinants of diseases in the human population.

based plans for prevention, care, treatment and rehabilitation of affected persons. Successful implementation of national plans requires persons in the community to cooperate actively with the health authorities both in private and in public. The optimal approach must be comprehensive and participatory.

A combination prevention approach is optimal with or without STI vaccines

As part of a comprehensive national approach, all sexually active persons, including MSM, must be urged to take responsibility for behavior change that includes individuals delaying their sexual debut, reducing the number of their intimate sexual partners, getting tested for HIV and other STIs in relation to known risky exposure, learning and practising assertive skills in order to avoid coercive sex, disclosing the presence of an STI to prospective partners, using protective devices such as condoms during intimate sexual contact in situations where the possibility of transmission of STIs cannot be excluded, avoiding the use of mind-altering drugs – especially during or in temporal proximity to intimate sexual encounters, and eliminating behaviours that carry the highest risk of coming into contact with infections.

Successful programmes to stem the tide of HIV infections and other sexually transmissible illnesses must be comprehensive rather than piecemeal. Together with promoting individual responsibility, it is clear that environments that enable individuals to make and practice safe and healthy choices must be provided at family, community and governmental levels.

Much attention and effort has been given to promoting the use of physical barriers during sexual intercourse to reduce the risk of acquiring some sexually transmitted infections. Protection of this kind depends on the integrity of the physical device and the ability of the person using it to follow a strict ritual before, during and after penetrative intercourse. In addition, the use of condoms or other physical barrier devices does not always prevent trauma during vigorous physical interaction and trauma increases the risk of transmission of infection.

When persons anticipate participating in any variety of anal sex, the use of water-based lubricants is recommended. The purpose of these lubricants is to reduce the risk of trauma to the delicate lining of the anus and lower rectum. Water-based lubricants are recommended instead of oil-based lubricants because the latter cause degradation of latex condoms.

In a comprehensive approach to prevention of STIs, cooperation rather than conflict is critically important.

"Treatment as prevention"

Antiretroviral drugs, when used appropriately, reduce the quantum of HIV (the viral load) in the blood and tissues of the infected person. In addition to the beneficial effect on the individual who is receiving treatment, the reduced viral load reduces the risk of passing on the virus to other persons. In this way, effective treatment of HIV contributes to prevention of further spread of the virus. Therefore, it is recommended that all infected persons know their status and that antiretroviral drugs be made available and used according to international guidelines. When these recommendations are practised consistently as part of a comprehensive approach outlined below, the application of appropriate treatment contributes to limiting ongoing spread of HIV, hence the concept of treatment as prevention.

The economic cost of sexually transmitted infections to the community and the Government

The direct and indirect financial costs of sexually transmitted infections from both a personal and a Public Health or community viewpoint are of significance. In order to measure the direct economic costs of these infections, in 2004, a team from the United States Centers for Disease Control and Prevention carried out a study using data from 2000. The study was published in the journal, Perspectives on Sexual and Reproductive Health and was entitled, "The Estimated Direct Medical Cost of Sexually Transmitted Diseases Among American Youth." The authors concluded that "the large number of [sexually transmitted] infections acquired by persons aged 15-24 and the high cost per case of viral STDs, particularly HIV, create a substantial economic burden." (A copy of the report of said journal article is now shown to me and exhibited hereto, marked B.B. #7). Outside of the USA, governments around the world are currently facing the high direct cost of care and treatment of persons living with HIV and other STIs.

The indirect economic costs associated with these diseases have to do with loss of productivity and other lost opportunities. Loss of productivity is typically measured either by rates of absenteeism or by tracking job loss statistics. What is more difficult to measure, but no

less real in the worst cases, is reduced productivity due to the tiredness and loss of energy that accompany these serious illnesses.

CERTIFICATION

I, Brendan Courtney Bain, attest and certify that I understand my duty to the Court as set forth in rules 32.2, 32.3 and 32.4; that I have complied with that duty; that this report includes all matters within my knowledge and area of expertise relevant to the issues on which the report is given.

I also certify that I have been given no instructions by any party, by any person representing a party, or by any other person with respect to this report. The report represents my own opinions based on my professional experience together with information from research literature related to the matter under consideration. The opinions expressed in the report are mine and should not be attributed to any institution with which I am associated.

Respectfully Submitted,

Brendan Courtney Bain

August 7, 2012

B.B. #1

This is a true copy of the Journal Article referred to in
The report of **BRENDAN COURTNEY BAIN**
Annexed hereto and marked B.B. #1

B.B. #1

Br J Vener Dis 1981;57:167-9

Sexual behaviour and sexually transmitted disease patterns in male homosexuals*

R R WILLCOX
From St Mary's Hospital, London

SUMMARY Male homosexual behaviour is not simply either "active" or "passive", since penile-anal, mouth-penile, and hand-anal sexual contact is usual for both partners, and mouth-anal contact is not infrequent. A simplified method for recording sexual behaviour—a "sexual behaviour record (SBR)"—can be of value in determining the sites to be investigated and as a basis for further epidemiological questioning.

Mouth-anal contact is the reason for the relatively high incidence of diseases caused by bowel pathogens in male homosexuals. Trauma may encourage the entry of micro-organisms and thus lead to primary syphilitic lesions occurring in the anogenital area. Similarly, granuloma inguinale, condylomata acuminata, and amoebiasis may be spread from the bowel of the passive homosexual contact. In addition to sodomy, trauma may be caused by foreign bodies, including stimulators of various kinds, penile adornments, and prostheses.

Introduction

The male homosexual is very likely to contract most of the sexually transmitted diseases, including gonorrhoea, chlamydial infections, a number of viral conditions—for example, condylomata acuminata and herpes simplex—and especially syphilis, which he may acquire during the diverse techniques of sexual intercourse. From such behaviour numerous bowel conditions, such as amoebiasis and shigellosis, and the viruses of hepatitis A or B are commonly spread within this group; indeed in some areas this is the predominant epidemiological pattern.[1 2] In certain districts—the West End of London—nearly four-fifths of early syphilitic infections in men result from the homosexual act.[3]

Sexual behaviour

Sexual behaviour is very varied and in male homosexuals may involve contact between the penis, anus, mouth, and hand of either or both partners. Sometimes two or more organs may be involved in one sexual act; for example, the anus and mouth of one partner[1] and the penis of the other. Penile-hand contact is common for both partners. The roles are often reversed during the same sexual act, and mouth-anal contact is not at all uncommon for both partners, with the consequent almost inevitable risk of transfer of bowel pathogens.

Although routine visual examination of the mouth, anus, and rectum will detect clinically obvious conditions like syphilis, condylomata acuminata, and the sores of herpes simplex, this is not true of rectal gonorrhoea, which is frequently asymptomatic, and of oral gonorrhoea, which is normally so. The routine investigation of male homosexuals for gonorrhoea should, therefore, include the culture of samples from the penis, anus, and mouth, but this is a time-consuming procedure under busy clinic conditions. While it may be desirable to test these three sites in all male homosexuals at least once, sampling can be confined subsequently to those sites which the patient admits have been exposed to infection.

SEXUAL BEHAVIOUR RECORD

It has been, and still is, common practice to record male homosexual behaviour as "active" or "passive", although many male homosexuals alternate these roles with different partners or play a double role with the same partner. Because of this a "sexual behaviour record (SBR)" has been devised (table I), which can act as a diagnostic guide to which

*Paper read at the 30th General Assembly of the International Union against the Venereal Diseases and Treponematoses, East Berlin, June 1980

Address for reprints: Dr R R Willcox, Tideway, Lonsdale Road, London SW13

Accepted for publication 24 November 1980

TABLE I *Sexual behaviour record (SBR)*

(Number of different sex contacts in past 3* months (indicate period))			
Male.....	Female.....	(State No)	
PA.....	AP.....	MP.....	HP.....
PM.....	AM	MA	HA.....
PH.....	AH.....	MM	HM .....
		MH	
	(Mark + or 0 as relevant)		

P = penis; A = anus; M = mouth; H = hand
*If gonorrhoea is the only condition suspected, a one-month period is adequate.

sites should be investigated (principally for the gonococcus) and how intensively; it can also serve as a basis for further epidemiological questioning and action.

The first letter (table I) applies to the relevant anatomical part of the patient and the second to the site of its application to any one of the sexual contacts in the period under review. The form may be simplified by the omission of hand and appear as in table II. Such a record is concise, can be obtained quickly by the examining doctor, and lends itself to its basic framework being incorporated on a rubber stamp or in handwritten notes.

The method may be unnecessarily elaborate for non-promiscuous male homosexuals, and its modification for female patients, although suitable for the very promiscuous, is not so for the majority who admit to only one contact during the given period.

TABLE II *Simplified version of the sexual behaviour record*

Period 3/12		
M 5	F 0	(State No)
PA +	AP +	MP +
PM +	AM 0	MA 0
		MM +

P = penis; A = anus; M = month
+ = Yes; 0 = no

Trauma in disease patterns

ANUS AND RECTUM

Some speculation still surrounds the specific mechanism of inoculation of the virus of hepatitis B among homosexuals. Likewise it has been suggested that the anal manifestations of granuloma inguinale result from self-inoculation of the area traumatised during sodomy or related practices with the organism, which was carried in the patient's bowel.[4] This has also been postulated for condylomata acuminata[5] and may apply to genital amoebiasis. It is also probable that anal chancres frequently invade the site of pre-existing traumatic fissures.

Apart from the trauma produced by the act of sodomy itself and from fingernails in hand-anal contact, a wide range of foreign bodies—inserted into the rectum for sexual stimulation and gratification—have caused serious trauma.[2] An extreme example is the human fist favoured by some more elderly experienced homosexuals under the influence of drugs.[6]

MALE EXTERNAL GENITALIA

Possible trauma to the ano-rectal region, the penis, or adjacent areas can be caused by the various penile adornments or prostheses used by some homosexuals who are influenced by sex magazines or catalogues (particularly those describing "leatherware") with a sado-masochistic bias. Examples include (fig 1): (1) the so-called "cock and ball" rings[7]; (2) the more traumatic "spiky cock ring"; (3) the "boilermaker" (two "cock" and one "ball" ring); (4) the "tenderiser"; (5) the "gates of hell" (in ground plan) showing its four leather straps and press studs; and (6) the same, with its added "slave lead".

Recently a homosexual male nurse well experienced in the contraction of sexually transmitted diseases presented an unusual appearance on routine examination for venereal disease (fig 2). The protrusion from his urethra proved to be a stainless-steel ring (the "Prince Albert"), which entered the terminal urethra to emerge adjacent to the frenum. The ring was removable like an earring and had a small perforated steel ball, which slid to and fro within its small compass of motion along the external portion. The patient, who had chosen this item from a catalogue, had had his urethra pierced under local anaesthetic by a doctor in Amsterdam at a cost of £15 (approx US $35 or DM62).

An advertisement in a male-orientated pornographic magazine obtained in Hamburg (West Germany) illustrated the following, which have not been seen in sex shops in London: (1) a ring through a nipple ("Brustwarze"); (2) a rod with ballpoint ends laterally through the glans penis ("Ampallang"); (3) a ring through the prepuce ("Vorhaut"); (4) a ring through the perineum ("Guiche"); (5) a rod with ballpoint ends vertically through the glans penis ("Apadravya"); and (6) a sketch of a naked man with his arms chained behind his back to his neck, rings in his ears, nipples, and

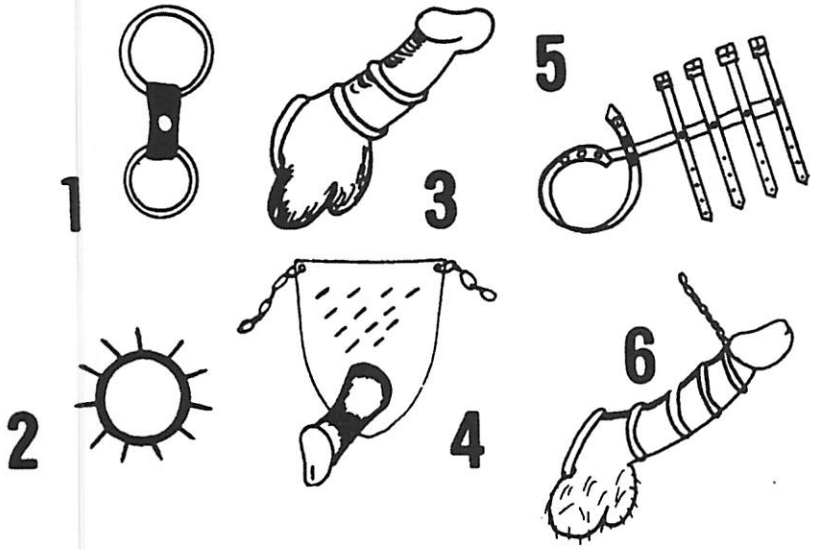

FIG 1 *Various penile accessories. See text.*

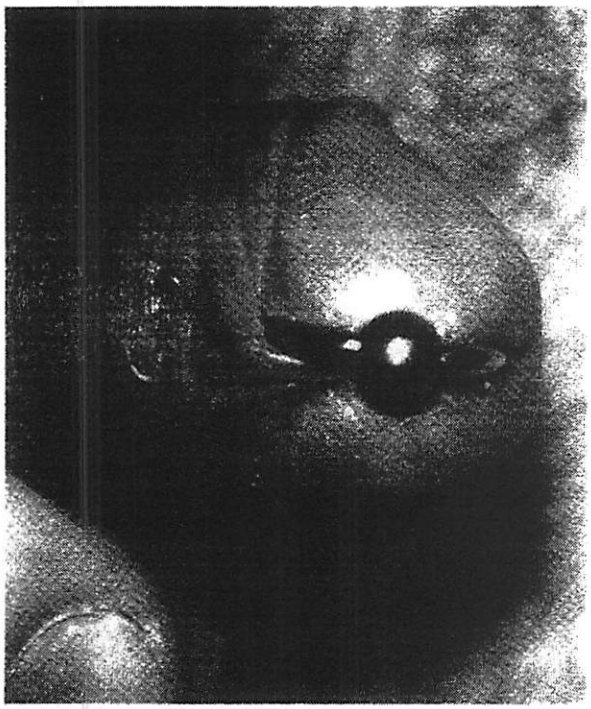

FIG 2 *The "Prince Albert" ring.*

perineum, and a padlock (with keyhole) entering and leaving the terminal urethra in the manner of a "Prince Albert" ring.

Discussion

Some of the examples described are more traumatic than others. It seems that at present they are used by only a small number of homosexuals (or that they are removed before the patients attend the clinics). Certainly in the large clinic at St Mary's Hospital, London, where there are many homosexuals, very few examples have been seen. Nevertheless, their use represents another method by which the rectum and anus can be injured and thus provide an entry for infection.

Thanks are expressed to Dr P N Cardew and the Department of Visual Communication, St Mary's Hospital, London, for the photograph, and to R M Coleman, director of Lydcare Ltd, for permission to use the drawings in fig 1.

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B.B. #2

This is a true copy of the Journal Article referred to in
The report of **BRENDAN COURTNEY BAIN**
Annexed hereto and marked B.B. #2

B.B.#2

HIV seroprevalence and associated risk factors among male inmates at the Belize Central Prison

Ethan Gough[1] *and Paul Edwards*[2]

Suggested citation Gough E, Edwards P. HIV seroprevalence and associated risk factors among male inmates at the Belize Central Prison. Rev Panam Salud Publica. 2009;25(4):292–9.

ABSTRACT **Objectives.** *To determine the seroprevalence of HIV and identify associated risk factors among inmates at the Belize Central Prison, managed by the Kolbe Foundation, Belize.*
Methods. *A voluntary sample of 623 participants was obtained from the male inmate population incarcerated during the period from 15 January to 5 March 2005. HIV serostatus was determined on location using the Abbott Determine Assay for HIV-1/2 for screening, and the MedMira MiraWell Rapid HIV-1/2 Test for confirmatory testing. Remaining serum was tested by ELISA at the Central Medical Laboratory, Belize. Demographic and risk behavior data were collected using an interviewer administered pre-tested questionnaire. A multivariate logistic regression was used to adjust for potential confounders and to identify independent associations with HIV seropositivity.*
Results. *Of the 623 inmates in the sample, 25 tested positive for HIV-1/2 antibody for a seroprevalence of 4.0% (95% Confidence Interval 2.7, 6.0). After adjustment for confounding, HIV serostatus was positively associated with male-to-male sexual activity outside prison, age, and district of residence before current incarceration.*
Conclusions. *The seroprevalence in the Central Prison was almost twice that estimated for the adult population of Belize in 2004 (2.4%). However, the social variables of importance to inmates appeared to reflect the epidemic in the general population, with the exception that male-to-male sex outside prison is likely more important to the male inmate population in Belize. The findings suggest that HIV is likely contracted by most inmates before their incarceration, largely due to same-sex activity.*

Key words Acquired immunodeficiency syndrome, HIV seroprevalence, prisons, Belize.

The HIV/AIDS epidemic in Latin America and the Caribbean is well established. Of the estimated 39.4 million people living with HIV/AIDS globally at the end of 2004, approximately 2.1 million were located in Latin America and the Caribbean (1). Contributing factors are diverse and include: unprotected sexual contact, multiple partners, early sexual initiation, male-to-male sex, intravenous drug use (IVDU), mother-to-child transmission, migration and mobility, population mixing, and bridging between high-risk subgroups and the general population (2).

An important fact about the epidemic in Latin America is that four of the six countries with the highest adult prevalence in 2004 were located in Central America. Belize was ranked first, with an estimated 2.4% of the adult population infected with HIV at the end of 2004 (1, 3). In Belize, the ninth leading cause of death in the year 2000 was AIDS-related. By 2004, AIDS was the third leading cause of death in the country and ranked as the first leading cause of death among the age groups 30–39 years and 40–49 years (4) Death related to AIDS also ranked third in the age group 20–29 years and was the only leading cause of death due to preventable illness in this group (4).

[1] Ministry of Health, Epidemiology Unit, Belmopan City, Belize. Send correspondence to: Ethan Gough, Epidemiology Unit, Ministry of Health, First Floor, East Block Building, Belmopan City, Belize, Central America; telephone: +501-822-2325; fax:+501-822-2942; email: egough@ghealth.gov.bz
[2] Central Health Region, Ministry of Health, Belize City, Belize.

In prisons, the prevalence of HIV varies worldwide (5–17), but HIV in prison populations has received much attention, and inmate populations are considered by many to be at greater risk of infection than the general population. Due to the high prevalence of behaviors conducive to transmission of HIV and other sexually-transmitted diseases (STDs), prisons may be viewed as reservoirs of HIV amplification and subsequent spreading in the community. These behaviors predominantly include unprotected sexual activity, tattooing, and in particular, injection drug use and its related needle/syringe sharing (6, 8, 17–21). Indeed, cases of HIV transmission within prison settings have been documented through epidemiologic and molecular investigation of prison outbreaks in Scotland (22–25) and Australia (26). Studies of HIV incidence in correctional facilities in the United States and Thailand provide further evidence of intraprison HIV transmission (17, 20, 27–30).

The Belize Central Prison is the country's only prison, and is currently under private management by the Kolbe Foundation, a private, Christian organization. Prior to this study, the Ministry of Health (MOH) worked very closely with the Central Prison Medical Center, particularly in the areas of tuberculosis and STDs, including HIV/AIDS, providing Voluntary Counseling and Testing (VCT), educational presentations, antiretroviral (ARV) therapy, case management, and training in clinical management. However, the seroprevalence of HIV among inmates of the Central Prison was unknown. From January–March 2005, the MOH, in collaboration with the Pan American Health Organization (PAHO), undertook a cross-sectional study of male inmates at the Belize Central Prison to determine the seroprevalence of HIV and to identify associated risk behaviors.

Approval for the study was obtained from the Ethics Committee of the Ministry of Health, Belize.

MATERIALS AND METHODS

Inmate sensitization

Prior to data collection, two visits were made to the Belize Central Prison to sensitize inmates to the project and to encourage participation. Sensitization included presentations on the benefits of knowing one's HIV status; the state of the epidemic in Belize; the National AIDS Program (sponsored by the MOH); pre- and post-test counseling for both HIV-positive and negative individuals; clinical management and referral of HIV positive patients; the research protocol; and a testimony by a former inmate living with HIV. Sixty-nine percent (713 / 1 028) of the eligible inmate population participated in sensitization sessions. The remainder of the population was inaccessible due to either being engaged in labor-related activities or a religious service, or an unwillingness to participate. Although participation in the sensitization sessions was not a prerequisite for study participation, the coverage achieved in sensitization likely contributed to better HIV-testing rates.

Pretest counseling and data collection

Nine one-day weekend visits were made to the Belize Central Prison from 29 January–5 March 2005 to offer VCT to inmates. Eligible inmates were those who had been sentenced or remanded and were at least 16 years of age. Illegal immigrants awaiting deportation were excluded because this transient population has minimal interaction with other inmates and can present communication barriers due to language and cultural differences. Also excluded were inmates less than 16 years of age, the minimum age of legal consent in Belize.

After verbal informed-consent, sociodemographic and risk behavior data were collected using a pretested, interviewer-administered questionnaire. The questionnaire was in part derived from others used in inmate HIV seroprevalence studies in the United Kingdom and Ireland (6, 8).

After written informed-consent was obtained, HIV serostatus was determined by a 2-step HIV rapid test algorithm employed by the MOH VCT program. This rapid test algorithm was modeled on same day VCT services utilized in Rwanda and Zambia (31). Specimens were screened utilizing the Abbott Determine Assay for HIV-1/2 (Abbott Laboratories, Abbott Japan Co. LTD, Minao-Ku, Tokyo, Japan), and reactive samples were confirmed by the MedMira MiraWell HIV-1/2 test (MedMira Laboratories Inc, Halifax, Nova Scotia, Canada). Both tests were performed on each sample, and reactive specimens were retested on location. Remaining serum was transported to the Central Medical Laboratory in Belize City for testing by Enzyme-Linked Immunosorbent Assay, Vironostika Uniform II PLUS 0 HIV-1/2 (Biomerieux, Biosiend, Boxtel, The Netherlands).

The algorithm was validated for use in the MOH VCT program prior to its use in this study. A total of 318 Abbott Determine Assays for HIV-1/2 and 30 confirmatory MedMira MiraWell HIV-1/2 tests were run against samples previously screened at the blood bank of the Central Medical Laboratory in Belize City. With the exception of one false-positive on the Abbott Determine Assay, all test results coincided with previously obtained ELISA test results.

Post-test counseling

On the Friday that followed each weekend visit, counselors from the VCT Center in Belize City returned to the Central Prison to provide the HIV test results and post-test counseling to those inmates who were interested. Results and post-test counseling were provided in a confidential manner.

Data analysis

Data on occupation before current incarceration were categorized using occupational groups and definitions developed in the 2002 *Living Standard Measurement Survey* (32). Major groups were identified; smaller groups and illegal occupations, such as drug dealing, were designated as "Other." Inmate age was grouped in 5-year intervals, and age at first sexual experience, by 3-year intervals.

Associations between HIV seropositivity and demographic or risk characteristics were determined using Odds Ratios (ORs). Large sample approximation was used to determine statistical significance. Multivariate logistic regression was performed to adjust for potential confounders. Predictors significantly ($P < 0.05$) associated with HIV by crude analysis were introduced into the multivariate model one at a time in order of magnitude. Those variables that produced a meaningful change in the magnitude of any association in the model, with statistical significance, were retained. Other variables known to be common confounders, or thought to be possible confounders based on a review of the literature were also introduced into the model and were retained or removed as described. Data entry and analysis were performed using Epi Info version 3.2.2.

TABLE 1. Demographic characteristics, incarceration information, HIV seroprevalence, and associated risk factors of 623 male inmates tested for anti-HIV-1/2 antibody at the Belize Central Prison, Belize, 2005

	Total		HIV positive			
	No.	%	No.	%	OR (95% CI)	*P* value
Country of birth						
Other[a]	80	12.8	2	2.5	Ref	—
Belize	543	87.2	23	4.2	1.73 (0.4, 7.5)	0.4624
Age in years						
< 25	214	34.5	4	1.9	Ref	—
25–29	137	22.1	9	6.6	3.69 (1.1, 12.2)	0.0326[b]
30–34	82	13.2	6	7.3	4.20 (1.2, 15.3)	0.0295[b]
35–39	63	10.1	3	4.8	2.67 (0.6, 12.3)	0.2068
≥ 40	125	20.1	3	2.4	1.29 (0.3, 5.9)	0.7408
Educational level completed						
< High school	486	78.3	21	4.3	Ref	—
≥ High school	135	21.7	4	3.0	0.67 (0.2, 2.0)	0.4753
Ethnicity						
Other[c]	309	49.7	6	1.9	Ref	—
Creole	313	50.3	19	6.1	3.29 (1.3, 8.3)	0.0123[b]
Marital status before current incarceration						
Married	62	10.0	1	1.6	Ref	—
Living with a partner	202	32.5	12	5.9	3.85 (0.5, 30.2)	0.1993
Non-union[d]	358	57.5	12	3.4	2.13 (0.3, 16.6)	0.4719
District of residence before current incarceration						
Belize[e]	238	38.3	15	6.3	Ref	—
Other	384	61.7	10	2.6	0.40 (0.2, 0.9)	0.0266[b]
Total time incarcerated in lifetime						
< 3 months	122	19.7	3	2.5	Ref	—
> 3 but < 12 months	132	21.3	2	1.5	0.61 (0.1, 3.7)	0.5919
1–3 years	186	30.0	10	5.4	2.25 (0.6, 8.4)	0.2244
> 3 years	180	29.0	10	5.6	2.36 (0.6, 8.8)	0.1991
Prison section where served most incarceration time						
Remands	130	21.0	5	3.8	Ref	—
Super max	11	1.8	1	9.1	2.50 0.3, 23.5)	0.4230
Medium/maximum security	190	30.6	7	3.7	0.96 (0.3, 3.1)	0.9476
Tango 1–6	253	40.8	12	4.7	1.25 (0.4, 3.6)	0.6814
Wagner's youth facility	36	5.8	0	0.0	Undef[f]	—
Total inmates per cell						
1 or 2	69	11.1	7	10.1	Ref	—
3 or 4	226	36.5	5	2.2	0.20 (0.1, 0.7)	0.0078[b]
> 4	324	52.3	13	4.0	0.37 (0.1, 1.0)	0.0428[b]
Offense						
Burglary/theft/robbery/stolen goods	245	39.6	8	3.3	Ref	—
Drug offenses	92	14.9	4	4.3	1.34 (0.4, 4.6)	0.6388
Murder/manslaughter	69	11.1	3	4.3	1.34 (0.3, 5.2)	0.6713
Disorder/assault/harm/damage to property	53	8.6	1	1.9	0.57 (0.1, 4.6)	0.5968
Other[g]	102	16.5	4	3.9	1.20 (0.4, 4.1)	0.7660
More than one offense	58	9.4	5	8.6	2.84 (0.9, 9.0)	0.0778

[a] El Salvador, England, Germany, Guatemala, Honduras, Mexico, Nicaragua, Romania, United States.
[b] Statistically significant at $\alpha = 0.05$.
[c] East Indian, Garifuna, Hispanic/latin, Maya, Mestizo.
[d] Divorced, separated, single/never married, widowed.
[e] Belize district.
[f] Undefined odds ratio.
[g] Attempted murder, fraud, indecent assault and other sexual offenses, owe the court, rape, unlicensed or unlawful possession.

RESULTS

During the study period, the estimated mid-period male inmate population was 1 144. Of the total, 114 did not meet eligibility criteria for participation. The majority of these were illegal immigrants awaiting deportation (75%). The remainder were either less than 16 years of age (3.5%), were recently arrested and were simply being held for processing (14.5%), or were in isolation (6.1%). One inmate was hospitalized for the duration of the study. A convenience sample of 623 eligible inmates was obtained, representing 54.5% of the eligible male population. An estimated 50% or more eligible inmates were sampled from each prison section.

The median age of inmates in the sample was 28 years, with a range of 16–64 years. Inmates were predominantly born in Belize (87.2%), of Creole ethnicity (50.3%), not involved in a monogamous relationship (57.5%) or had been living with a partner prior to incarceration (32.5%), and had less than a complete high school education (78.3%). Prior to incarceration, the majority of the inmates (61.7%) were residing outside of the Belize district, the largest administrative district of the country's six total districts. Most inmates had spent no more than three years incarcerated in their lifetime (71.0%), and were currently incarcerated for crimes having to do with attainment or possession of another person's property (39.6%), such as burglary, robbery, theft, or handling stolen goods (Table 1).

TABLE 2. Risk behaviors while incarcerated, HIV seroprevalence, and associated risk factors among 623 male inmates tested for anti-HIV-1/2 antibody at the Belize Central Prison, Belize, 2005

	Total		HIV positive			
	No.	%	No.	%	OR (95% CI)	*P* value
Shared tattoo equipment						
No	534	86.5	19	3.6	Ref	—
Yes	83	13.5	5	6.0	1.76 (0.6, 4.8)	0.2761
Ever sexually active in prison						
No	596	95.7	21	3.5	Ref	—
Yes	27	4.3	4	14.8	4.72 (1.3, 14.2)	0.0192[a]
Penetrative sex with condom in last 12 months[b]						
No	607	99.2	22	3.6	Ref	—
Yes	5	0.8	1	20.0	6.57 (0.3, 54.9)	0.1754
Penetrative sex without condom in last 12 months[b]						
No	608	97.6	22	3.6	Ref	—
Yes	15	2.4	3	20.0	6.59 (1.4, 23.8)	0.0191[a]
Penetrative sex partners in last 12 months[b]						
≤ 1	616	98.9	23	3.7	Ref	—
> 1	7	1.1	2	28.6	10.17 (1.3, 54.5)	0.0289[a]
Ever paid item(s) for sex in prison						
No	614	98.9	24	3.9	Ref	—
Yes	7	1.1	1	14.3	4.07 (0.2, 29.0)	0.2518
Ever accepted item(s) for sex in prison						
No	615	99.0	24	3.9	Ref	—
Yes	6	1.0	1	16.7	4.88 (0.2, 37.0)	0.2199
Used alcohol in last 12 months						
No	557	90.1	23	4.1	Ref	—
Yes	61	9.9	2	3.3	0.80 (0.2, 3.5)	0.7649
Used marijuana in last 12 months						
No	287	46.3	9	3.1	Ref	—
Yes	333	53.7	16	4.8	1.57 (0.7, 3.6)	0.2888
Used cocaine in last 12 months						
No	608	98.2	25	4.1	Ref	—
Yes	11	1.8	0	0.0	Undef[c]	—
Used crack in last 12 months						
No	603	97.7	25	4.1	Ref	—
Yes	14	2.3	0	0.0	Undef[c]	—
Ever shared needles/syringes						
No	619	99.4	25	4.0	Ref	—
Yes	4	0.6	0	0.0	Undef[c]	—
Tattoos						
No tattoos	119	19.2	5	4.2	Ref	—
Tattoos but none in prison	285	46.0	11	3.9	0.91 (0.3, 2.7)	0.8598
Tattoos in prison	216	34.8	9	4.2	0.99 (0.3, 3.0)	0.9822

[a] Statistically significant at $\alpha = 0.05$.
[b] Penetrative sex with both sexes.
[c] Undefined odds ratio.

Of the 623 inmates in the sample, 25 tested positive for HIV-1/2 antibody, for a seroprevalence of 4.0% (95% CI: 2.7, 6.0). Two inmates showed an indeterminate test result and were instructed to return to the Central Prison Medical Center in 3–6 months for a follow-up test.

Risk characteristics while incarcerated

Twenty-seven men (4.3%) reported ever being sexually active in prison. Fewer reported having penetrative sex without a condom in the last 12 months (2.4%), however these represented 88.2% of men who reported penetrative sex in that time. Only a few inmates (1.1%) reported penetrative sex with more than one partner in the last 12 months, however this was almost half (41.2%) of those who had engaged in penetrative sex in that period. Additionally, only a handful of inmates reported ever paying (1.1%) or accepting (1.0%) money or other items in exchange for sexual favors while incarcerated (Table 2).

Thirty-five percent of inmates had been tattooed in prison, with 38.4% of these reporting ever sharing tattoo equipment. Substance use while incarcerated was also common, but marijuana was the most common illicit drug reportedly used in the last 12 months. Only four inmates reported ever sharing needles or syringes to inject drugs while in incarcerated (Table 2).

Risk characteristics while not incarcerated

Most men reported having more than one partner of the opposite sex or exchanging items for sex during the two years prior to incarceration. However, only a few inmates reported always using condoms for any kind of heterosexual activity in that time (10.7%). Nineteen men (3.0%) reported ever engaging in male-to-male sex outside prison, with only eight reporting same sex activity in the last two years spent outside, and only one reporting always using condoms for same sex encounters in that period.

Alcohol and marijuana were the most common substances used outside prison, but a substantial number of inmates also

TABLE 3. Risk behaviours while not incarcerated, sexually transmitted disease (STD) history, HIV seroprevalence, and associated risk factors among 623 male inmates tested for anti-HIV-1/2 antibody at the Belize Central Prison, Belize, 2005

	Total		HIV positive			
	No.	%	No.	%	OR (95% CI)	*P* value
Number of partners of opposite sex in last two years outside prison						
≤ 1	227	38.2	10	4.4	Ref	—
> 1	367	61.8	15		4.1)0.93 (0.4, 2.1)	0.8619
Exchanged item(s) for sex in last two years outside prison						
No	442	71.6	20	4.5	Ref	—
Yes	175	28.4	5	2.9	0.62 (0.2, 1.7)	0.3512
Condom use in last two years outside prison[a]						
Not always	497	88.9	21	4.2	Ref	—
Always	62	11.1	2	3.2	0.75 (0.2, 3.3)	0.6973
Ever had sex with another man outside prison						
No	603	96.9	21	3.5	Ref	—
Yes	19	3.1	4	21.1	7.31 (1.9, 23.1)	0.0053[b]
Same sex partners in last two years outside prison						
≤ 1	619	99.5	23	3.7	Ref	—
> 1	3	0.5	2	66.7	50.25 (3.7, 1524.0)	0.0046[b]
Condom use with same sex partner(s) in last two years outside prison[c]						
Not always	7	87.5	2	28.6	Ref	—
Always	1	12.5	0	0.0	Undef[d]	—
Ever used alcohol						
No	78	12.5	5	6.4	Ref	—
Yes	544	87.5	20	3.7	0.56 (0.2, 1.5)	0.2597
Ever used marijuana						
No	134	21.6	2	1.5	Ref	—
Yes	487	78.4	23	4.7	3.29 (0.8, 14.1)	0.1095
Ever used cocaine						
No	483	78.8	20	4.1	Ref	—
Yes	130	21.2	5	3.8	0.94 (0.3, 2.6)	0.9052
Ever used crack						
No	431	69.6	17	3.9	Ref	—
Yes	188	30.4	8	4.3	1.09 (0.5, 2.6)	0.8366
Ever shared needles / syringes						
No	616	98.9	24	3.9	Ref	—
Yes	7	1.1	1	14.3	4.08 (0.2, 29.1)	0.2510
Ever diagnosed with an STD						
No	426	68.6	13	3.1	Ref	—
Yes	195	31.4	12	6.2	2.11 (0.9, 4.7)	0.0693
Pus or secretion from genitals in last three months						
No	581	93.3	23	4.0	Ref	—
Yes	42	6.7	2	4.8	1.24 (0.3, 5.5)	0.7743

[a] Subset of sexually active inmates in the last two years outside prison (n = 577).
[b] Statistically significant at α = 0.05.
[c] Subset of "Ever had sex with another man outside prison" (n = 19).
[d] Undefined odds ratio.

reported crack and cocaine use. Only seven inmates reported ever sharing needles or syringes outside prison (Table 3).

STD history

Thirty-one percent of men also reported ever being diagnosed with an STD, but many fewer reported STD symptoms in the last 3–12 months. The most common symptom reported was pus or secretion from the genitals in the last three months (6.7%) (Table 3).

Logistic regression

Several factors showed a statistically significant bivariate association with HIV seropositivity among inmates. However, after adjustment for confounding by multivariate logistic regression, only three factors remained significantly associated with HIV: (a) men reporting sex with another man outside prison were more likely to be HIV seropositive than men who reported no same sex partners (OR = 62.3); (b) inmates in the age groups 25–29 years (OR = 3.0) and 30–34 years (OR = 4.3) were more likely to have HIV compared to those less than 25 years of age; (c) inmates who had lived outside the Belize district before their current incarceration were less likely to be HIV seropositive than those who had lived within it (OR = 0.4) (Table 4). There were no statistically significant associations between IVDU or any other type of substance use and HIV infection, or between tattooing in prison and HIV. Also, no incarceration-specific characteristics showed any association with HIV infection with the exception of total number of inmates per cell (Table 1), but this association did not remain statistically significant after adjustment for confounding.

DISCUSSION

The seroprevalence of HIV in the male inmate population at the Central Prison in Belize was 4.0%, almost twice that estimated in the adult population in 2004 (2.4%). The main findings showed HIV

TABLE 4. Multivariate analysis of demographic and risk factors associated with HIV seropositivity among 623 male inmates tested for anti-HIV-1/2 antibody at the Belize Central Prison, Belize, 2005

	OR (95% CI)	*P* value
Ever had sex with another man outside prison		
Yes	62.3 (5.9, 662.9)	0.0006[a]
Ever sexually active in prison		
Yes	5.3 (0.7, 40.3)	0.1042
Age in years		
< 25	Ref	—
25–29	3.0 (1.0, 9.0)	0.0498[a]
30–34	4.3 (1.2, 15.9)	0.0289[a]
35–39	2.1 (0.5, 9.0)	0.3207
≥ 40	1.2 (0.4, 3.9)	0.7134
District of residence before current incarceration		
Belize[b]	Ref	—
Other	0.4 (0.2, 0.9)	0.0256[a]
Marital status before current incarceration		
Married	Ref	—
Living with a partner	2.1 (0.5, 9.1)	0.3334
Non-union[c]	1.3 (0.3, 5.2)	0.739

[a] Statistically significant at $\alpha = 0.05$.
[b] Belize district.
[c] Divorced, separated, single/never married, widowed.

seropositivity among inmates to be positively associated with male-to-male sex outside prison and being 25–29 or 30–34 years of age; and negatively associated with residing outside of the Belize district before current incarceration.

Although male-to-male sexual activity while incarcerated was found to be significantly associated with HIV infection by bivariate analysis (Table 2), only male-to-male sex outside prison showed a statistically significant association with HIV after adjustment for confounding (Table 4). This was the strongest association found in the study, but it is somewhat limited by poor precision as indicated by the width of the 95%CI: 5.9, 662.9. However, men who have sex with men (MSM) are a group known to be at particular risk of HIV infection and are also known to be a vulnerable subpopulation in some countries in Central America (2, 3). In prison populations, men who report having anal sex with other men have been found to be significantly more likely to be HIV-infected (8, 27), and being sexually active in prison has been identified as a significant contributing factor in syphilis (33) and hepatitis B (34) outbreaks in correctional facilities in the United States of America.

Although previous research shows the importance of male-to-male sex to HIV among inmate populations, there is only limited evidence for high rates of HIV transmission within prisons (17, 20, 27–30, 35). In addition, factors that increase the risk of contracting HIV in the general population—e.g., poverty and low socioeconomic status—also increase the risk for incarceration. A study of intravenous drug users in Bangkok, Thailand, found both HIV *and* a history of incarceration to be associated with injection drug use inside and outside prison, while a history of incarceration was associated with ever having a same-sex partner, and ever being tattooed, both of which are important routes of transmission within prisons (36). Thus the population at risk of HIV infection may often be the same population likely to be incarcerated, raising questions about whether incarceration or infection came first.

Regardless, the potential for intraprison transmission of HIV does exist; these findings are not an indication that transmission does not or cannot occur in the Belize Central Prison. Outbreaks are also of concern to correctional facilities. HIV outbreaks and outbreaks of other STDs have been documented in other countries (22–26, 33, 34).

Other risk factors of possible importance to HIV in prison populations (tattooing and IVDU) were not found to be associated with HIV infection in this group. With the exception of being tattooed in prison and sharing tattoo equipment, other risk behaviors that involve the sharing or use of unsterile needles and equipment were reportedly infrequent. Although cases of HIV transmission by contaminated tattoo needles have not been documented, the risk is believed to exist (19, 37), and although the evidence appears conflicting, tattooing has been implicated as a possible route of Hepatitis C transmission (6, 38, 39).

Demographic characteristics found to be associated with HIV were the age groups 25–29 years of age and 30–34 years, and having resided in the Belize district. The reproductive and productive age group (15–49 years of age) is the group most affected by HIV/AIDS in Belize, with 81.4% of the new infections reported to the MOH in 2004. AIDS-related deaths ranked first among those 25–29, 30–34, and 35–39 years of age in 2004 (4). Data from the MOH also indicate that the Belize district is the area most impacted by the epidemic (4). Since inmates 25–39 years of age were more likely to be HIV seropositive and inmates who had lived outside the Belize district were less likely to be seropositive, the demographic associations among inmates appear to reflect the epidemic in the general population.

A substantial number of inmates reported some form of transactional sex, more than one partner, inconsistent condom use, or alcohol or marijuana use with sex outside prison (*data not shown*). Crack and cocaine use outside prison were also reported by several inmates. These behaviors can place inmates or their partners at continued risk of infection if resumed after their release.

Study limitations

Although sexual activity while incarcerated was reported by only a few inmates, reports by prison staff and inmates themselves indicated that sexual activity is common, specifically in the Medium Security section. Also, if the counselor was female, some inmates indicated an unwillingness to report their sexual behavior. Those who did report were more likely to be HIV seropositive by crude analysis, and sexual risk behavior in the last 12 months in prison was reported by up to three inmates with HIV (Table 2). Underreporting of sexual risk behaviors could therefore have influenced the findings of this study, and the possibility of sexual transmission within the Central Prison can not be disregarded.

Due to the voluntary nature of this study, there was a potential for selection bias. It is possible that inmates who believed themselves to be at-risk for HIV refused to participate. Thus the characteristics of an unknown number of HIV

seropositive inmates were not identified, limiting the degree to which the results can be generalized. However, 72.4% of the sample either believed they were at risk for HIV or were not sure (*data not shown*), indicating that many inmates who believed they could be HIV seropositive did participate.

Conclusions

Cross-sectional studies should be interpreted with caution since they cannot directly identify risk factors for contracting HIV. However, risk factors of importance to this population were identified that provide a more complete picture of HIV among inmates in Belize. Overall, the major findings seem to reflect the epidemic in Belize's general population, with the exception that male-to-male sex outside prison may be of particular importance among Belize's inmate population. The findings suggest that HIV is likely contracted by most male inmates before their incarceration and is largely due to same-sex activity. To clarify the level of transmission within the Central Prison, a detuned ELISA assay could be used to further test specimens seropositive for HIV-1/2 antibody. This would identify infections that occurred, on average, within the last 129 days (40), providing an estimate of incidence that would help clarify the risk of contracting HIV within the correctional facility.

VCT should be continued and more actively promoted among inmates at the Central Prison to further identify HIV-infected individuals. Experience in the United States has shown substantial uptake of VCT services offered at correctional facilities, increasing by 194% over a six-year period (41). The Central Prison should be viewed as a public health opportunity for education, prevention, diagnosis, and treatment within a marginalized population that may be less effectively reached otherwise. In addition, the needs of inmates should be taken into account by those planning the National AIDS program. This should be done in collaboration with the prison authority. Since most inmates will eventually be released and many were serving sentences of three years or less, the public health impact of such efforts will extend beyond the prison and into the community.

Acknowledgements. This research would not have been possible without the financial support of the PAHO/WHO (TCR # 00076) and the Ministry of Health, Belize. Pedro Noya of the Caribbean Epidemiology Center and Sandra Jones of the PAHO/WHO Belize Country Office provided meaningful contributions to the conceptualization of this project. Marlon Skeen, Chief Executive Officer; Taheera Ahmad, Deputy Executive Officer; and staff of the Kolbe Foundation, Belize Central Prison, also contributed through their cooperation, advice in finalizing the logistics of field activities, and help in implementing field activities. In addition, this project would not have been possible without the valuable assistance of a number of MOH employees who contributed their time and expertise to the implementation of field work and data collection.

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Manuscript received on 14 January 2008. Revised version accepted for publication on 22 October 2008.

RESUMEN

Seroprevalencia al VIH y factores de riesgo asociados en hombres internados en la Prisión Central de Belice

Objetivos. Determinar la seroprevalencia al VIH e identificar los factores de riesgo asociados en hombres internados en la Prisión Central de Belice, administrada por la Fundación Kolbe.

Métodos. La muestra estuvo compuesta por 623 voluntarios hombres que se encontraban encarcelados entre el 15 de enero y el 5 de marzo de 2005. El estatus serológico con respecto al VIH se determinó en la prisión mediante la prueba de tamizaje Abbot Determine Assay y se confirmó con la prueba MedMira MiraWell Rapid, ambas para anticuerpos contra el VIH 1 y 2. El suero restante se analizó por ELISA en el Laboratorio Médico Central de Belice. Se recabaron los datos demográficos y sobre las conductas de riesgo mediante una encuesta preevaluada aplicada por un entrevistador. Se identificaron las asociaciones independientes con la seropositividad al VIH mediante análisis de regresión logística multifactorial ajustado por posibles factores de confusión.

Resultados. De los 623 prisioneros de la muestra, 25 resultaron positivos a anticuerpos contra el VIH-1/2, para una seroprevalencia de 4,0% (IC95%: 2,7% a 6,0%). Después de ajustar por los factores de confusión, la seropositividad se asoció con la actividad sexual con otros hombres fuera de la prisión, la edad y el distrito de residencia antes de su encarcelamiento actual.

Conclusiones. La seroprevalencia en la Prisión Central casi duplicó el estimado para la población adulta de Belice en 2004 (2,4%). Sin embargo, las variables sociales de importancia en los prisioneros parecieron reflejar la epidemia en la población general, aunque la relación sexual con hombres fuera de la prisión pareció tener mayor importancia en la población masculina encarcelada en Belice. Estos resultados indican que la mayoría de los prisioneros habría contraído la infección por el VIH antes de su encarcelamiento, en gran parte debido a prácticas homosexuales.

Palabras clave Síndrome de inmunodeficiencia adquirida, seroprevalencia de VIH, prisiones, Belice.

B.B. #3

This is a true copy of the Journal Article referred to in
The report of **BRENDAN COURTNEY BAIN**
Annexed hereto and marked B.B. #3

B.B.#3

A resurgent HIV-1 epidemic among men who have sex with men in the era of potent antiretroviral therapy

Daniela Bezemer[a], Frank de Wolf[a,b], Maarten C. Boerlijst[c], Ard van Sighem[a], T. Deirdre Hollingsworth[b], Maria Prins[d,e], Ronald B. Geskus[d,f], Luuk Gras[a], Roel A. Coutinho[g,h] and Christophe Fraser[b]

Objective: Reducing viral load, highly active antiretroviral therapy has the potential to limit onwards transmission of HIV-1 and thus help contain epidemic spread. However, increases in risk behaviour and resurgent epidemics have been widely reported post-highly active antiretroviral therapy. The aim of this study was to quantify the impact that highly active antiretroviral therapy had on the epidemic.

Design: We focus on the HIV-1 epidemic among men who have sex with men in the Netherlands, which has been well documented over the past 20 years within several long-standing national surveillance programs.

Methods: We used a mathematical model including highly active antiretroviral therapy use and estimated the changes in risk behaviour and diagnosis rate needed to explain annual data on HIV and AIDS diagnoses.

Results: We show that the reproduction number $R(t)$, a measure of the state of the epidemic, declined early on from initial values above two and was maintained below one from 1985 to 2000. Since 1996, when highly active antiretroviral therapy became widely used, the risk behaviour rate has increased 66%, resulting in an increase of $R(t)$ to 1.04 in the latest period 2000–2004 (95% confidence interval 0.98–1.09) near or just above the threshold for a self-sustaining epidemic. Hypothetical scenario analysis shows that the epidemiological benefits of highly active antiretroviral therapy and earlier diagnosis on incidence have been entirely offset by increases in the risk behaviour rate.

Conclusion: We provide the first detailed quantitative analysis of the HIV epidemic in a well defined population and find a resurgent epidemic in the era of highly active antiretroviral therapy, most likely predominantly caused by increasing sexual risk behaviour.

AIDS 2008, **22**:1071–1077

Keywords: antiretroviral therapy, homosexual men, infectious diseases, mathematical models, models/projections, sexual behaviour, surveillance

From the [a]HIV Monitoring Foundation, Amsterdam, The Netherlands, the [b]Department of Infectious Disease Epidemiology, Imperial College London, UK, the [c]Institute for Biodiversity and Ecosystem Dynamics, University of Amsterdam, the [d]Health Service Amsterdam, the [e]Center for Infection and Immunity Amsterdam (CINIMA), Academic Medical Center, University of Amsterdam, the [f]Department of Clinical Epidemiology Biostatistics and Bioinformatics, Academic Medical Center, the [g]Department of Human Retrovirology, Academic Medical Center, University of Amsterdam, and the [h]Center for Infectious Disease Control, National Institute of Public Health and the Environment, Bilthoven, The Netherlands.

Correspondence to Christophe Fraser, Department of Infectious Disease Epidemiology, Faculty of Medicine at St Mary's Campus, Imperial College London, London, W2 1PG. UK.

E-mail: c.fraser@imperial.ac.uk

Received: 9 May 2007; revised: 7 February 2008; accepted: 15 February 2008.

ISSN 0269-9370 © 2008 Wolters Kluwer Health | Lippincott Williams & Wilkins

Introduction

To determine the success of a decade of widespread intervention with highly active antiretroviral therapy (HAART) on controlling the human immunodeficiency virus type 1 (HIV-1) epidemic, we analysed the transmission dynamics of HIV-1 over the past 25 years among men having sex with men (MSM) in the Netherlands.

The first AIDS cases in the Netherlands among MSM were identified in 1981 [1]. HAART, consisting of a combination of drugs from three, and later four, different drug classes, became widely available from 1996 onwards. HAART dramatically reduced plasma and seminal viral load [2,3], resistance [4] and mortality rates [5,6]. As infectivity is shown to be strongly correlated to viral load [7,8], the widespread use of HAART might thus be expected to have reduced the incidence of HIV infections. Paradoxically, resurgent epidemics have been widely reported post-HAART [9,10]. Increases in risk behaviour [11–13] and syphilis and gonorrhoea diagnoses have also been documented in populations of MSM in several developed countries [13–15]. Earlier mathematical modelling studies have demonstrated that an increase in risk behaviour has the potential to counterbalance the beneficial effect of HAART [16–23].

In the present study, we aim to evaluate the separate impact of risk behaviour, HIV testing behaviour and HAART on the HIV epidemic in Dutch MSM by means of a mathematical model fitted to data recorded within several national databases, which provided extensive information on epidemic trends.

Methods

Model

A mathematical model describing HIV transmission and HAART use among MSM in the Netherlands was constructed. The model we used described natural (untreated) disease progression, diagnosis and subsequent use of HAART. The basic structure of the model is illustrated in Fig. 1. The modelling strategy was tailored to the task of analyzing annual HIV and AIDS diagnosis time series, and specifically to tracking changes in per capita transmission rates. The most important factor in this respect is a simultaneous estimation of the prevalence of infectious individuals, weighted by their relative infectiousness, which depends on stage of infection and treatment status, and the incidence of new infections. Mathematical details and analyses of the model, including sensitivity analyses, hypothetical scenarios and predictions, and further data are available on request from the authors.

Survival distribution

A method to increase realism in compartmental models is to include a unidirectional flow through several compartments, corresponding to an Erlang survival distribution By fitting such a distribution to data from 130 MSM seroconverters before the HAART era in the Amsterdam Cohort Studies [24], the maximum likelihood estimate corresponded to five compartments with mean stay in each of 1.89 years. Patients starting their disease progression first spend on average 0.24 year in an extra initial compartment that represents primary infection, and we equated the last stage of infection with AIDS, an approximation that seemed reasonable given the match with the estimated duration of high transmissibility that

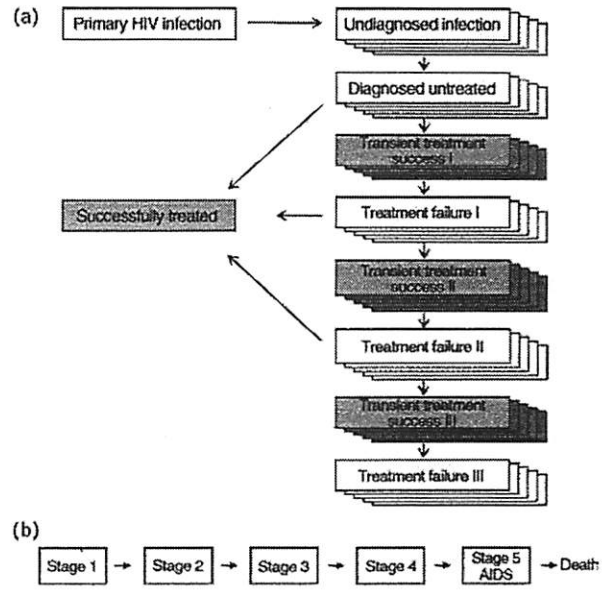

Fig. 1. Model structure. (a) Flow diagram of model of HIV-1 transmission among MSM. The model describes progression through different stages of natural history and treatment. Arrows depict the different flow rates between compartments. New infections start with primary HIV infection and then progress to death through stages of infection. Undiagnosed infections get diagnosed, after which risk behaviour can be reduced. The diagnosis rate varies over time. From 1996, antiretroviral treatment is available that can be long-term or transiently successful. Disease progression is represented by stacks: white stacks represent stages that are infectious and in which disease progression occurs. The nature of disease progression within a stack is shown in detail in (b). Grey stacks represent stages that are not infectious and in which disease progression does not occur as viral replication is suppressed by treatment. Infectiousness is highest during primary infection and AIDS, and lower during stages 1–4. All stages, weighted by their relative infectiousness and fitted by the risk behaviour rate parameter, contribute to the estimated annual new infections such that the annual data on HIV and AIDS diagnosis can be described. Imported infections flow into primary infection and undiagnosed compartments. (b) To enhance realism on survival distribution in the model, disease progression is represented by a unidirectional flow through five compartments with mean stay in each of 1.89 years.

has been observed prior to death [25]. The relative infectiousness of each stage is calculated from Wawer *et al.* [25], with primary and last stages of infection being more infectious than the other four stages. As 97% of the MSM population is infected with subtype B, imported infections are all assumed to be in the primary infection stage entering the Netherlands after short holidays, but this assumption was not critical (unpublished analysis available on request).

Highly active antiretroviral therapy

In the HAART era, patients start HAART after being diagnosed, and they will be either on successful treatment (no detectable viral load) or experience therapy failure, with a viral rebound and infectiousness [26]. During successful treatment, HAART is assumed to block both HIV transmission and disease progression [2–8,27,28], and viral blips are not taken into account [29]. Patients experiencing treatment failure are assumed to have periods of apparent successful treatment before failure [26]. After failure, patients go through the unidirectional stages of natural disease progression. We assume that there are three HAART treatment opportunities before patients fail completely and progress to death (representing the diversity of treatments available) [26]. The HAART era started in 1995 with clinical trials and compassionate use, and the mass treatment programme started in 1996 and was fully implemented by 1998. The influence of pre-HAART therapy on HIV viral load and transmission before 1995 is neglected. People start HAART with a rate irrespective of their stage of infection (as multistage disease progression is included in the model, this assumption approximately reproduces the observed pattern of HAART initiation), but at the AIDS stage people are set on HAART immediately. Disease progression is unidirectional. Parameters on HAART use and failure were obtained from the ATHENA national observational cohort [26].

Transmission rate and risk behaviour

The standardized per infectious capita transmission rate $\beta(t)$ is a time-varying function that measures the relative rate at which an HIV-positive infectious individual infects new individuals. It is standardized by setting it equal to 1.0 for untreated, undiagnosed individuals in the asymptomatic stage of infection during the first phase of the epidemic (1980–1983), so that all other values are measured relative to this. It is primarily intended as a measure of changes in risk behaviour that can be estimated in our study, and for convenience $\beta(t)$ will be referred to as risk behaviour rate. $\beta(t)$ is in fact a compound measure that is affected by changes in the partner change rate, by the rate and nature of risky sex acts within partnerships, by the effect of 'saturation' of the susceptible population (when new sexual partners are already previously infected) and by the effect of the changing prevalence of other sexually transmitted infections (STIs) in modulating HIV transmission.

Parameters in the model explicitly adjust for the effect of HAART in reducing infectiousness, for the increased infectiousness during primary and late (AIDS) stages of disease and for the effect of diagnosis in reducing risk behaviour. We assumed that MSM have a 50% reduction in risk behaviour after becoming aware of their seropositive status and implemented this into our model [30]. These assumptions were all encoded as disease-stage-specific scaling parameters of risk behaviour rate $\beta(t)$.

Reproduction number

We define the reproduction number $R(t)$ as the average number of people an infected person at time t would infect over his whole infectious lifespan if conditions remained the same as at time t [31,32]. It incorporates all factors including risk behaviour, effect of diagnosis and the effects of treatment with HAART in preventing infection. If the within-country $R(t)$ is greater than 1, then the epidemic will grow exponentially driven by local transmission, and conversely if this number is less than 1, the epidemic will contract down to a number proportional to the number of imported cases [31]. It is a key aim of public health interventions to avoid a locally driven epidemic and maintain $R(t)$ below one. The state of the epidemic can be characterized by $R(t)$ that can be calculated from the best fit parameters in the model.

Model fit

We fitted our model simultaneously to the observed time series of annual new diagnoses [32] and annual new AIDS cases (see below) [14,32,33], which are constrained by the diagnosis rate and the risk behaviour rate $\beta(t)$, and this made it feasible to estimate both these unknown parameters. Changing these independent parameters has different effects, which differently affect the goodness of fit of the model to the time series. Increasing risk behaviour increases both the number of diagnoses and AIDS cases, whereas increasing the diagnosis rate increases the number of diagnoses in the short term but leads to sustained long-term reductions in the number of diagnoses and AIDS cases.

The analysis was stratified into four distinct historical intervals: 1980–1983, the first AIDS cases were diagnosed [1]; 1984–1995, serological testing became available, increasing HIV awareness, introduction of first mono-antiretroviral and dual-antiretroviral therapies [3,6]; 1996–1999, early HAART era; and 2000–2004, current HAART era. The diagnosis rate during asymptomatic stages was estimated but was assumed to be zero during the first period (1980–1983). Diagnosis was assumed to be rapid (within 1 month) after AIDS, whereas zero during primary infection. The mean time to diagnosis, defined under conditions at time t, was calculated from the estimated diagnosis rate. The epidemic is assumed to have started with an import of cases in 1980. The model was solved numerically using Runge-Kutta 4 algorithm and

was fitted to data by a custom maximum likelihood method. All analyses were performed in Berkeley Madonna, version 8.0.1 (http://www.berkeleymadonna.com).

Annual new AIDS cases

To account for the effect of HAART in preventing progression to AIDS, we used different data sets to simultaneously fit to the following: before 1997, the model is fitted to annual data on AIDS diagnosis among MSM and collected by Statistics Netherlands from the beginning of the HIV epidemic [14,34]; from 1996, the model is fitted to annual data of number of MSM getting HIV diagnosed while having AIDS in the ATHENA national observational cohort [33].

Annual new diagnoses

From 1984 the model was fitted to data on annual diagnoses per year among MSM in the ATHENA national observational cohort [33]. Since 1998 all HIV patients in the Netherlands have been registered and monitored as part of the ATHENA national observational cohort. The year of first HIV diagnosis is recorded retrospectively at the point of registration into ATHENA. Patients who received HAART and died in the period 1996–1997 were included in the ATHENA database retrospectively. Although there is some uncertainty on the completeness of the retrospective inclusion, it is expected to have only minor bearing on our results. MSM who died before 1996 are not included in the ATHENA database. We explicitly accounted for this data truncation process in our model by implemented chance of surviving until 1996 for the respective stages of infection. In parallel, a prediction is made of the true (not truncated) curve of the number of new diagnoses (Fig. 2a). Data from 2005 are still incomplete, and they are thus not included in the current study.

Source of infection

By the start of 2005, 5516 MSM diagnosed with HIV had been included in the ATHENA observational cohort. Of these registered infections, 8% were reported to have acquired the infection while abroad and 62% from a partner within the Netherlands. Of those born in the Netherlands, 4% were infected abroad and of those born abroad, 41% were infected abroad. We assume that the remaining 30% of infections with an unknown country of infection are split according to these respective ratios respective to their country of birth. Thus, we estimate that overall 14% of diagnosed infections are imported.

For model verification, we compared the model number of prevalent cases with number of living HIV-positive MSM in the ATHENA database. Also, data on the predicted annual number of deaths with documented annual AIDS deaths in the Netherlands [14] were used for model outcome verification. These data contain

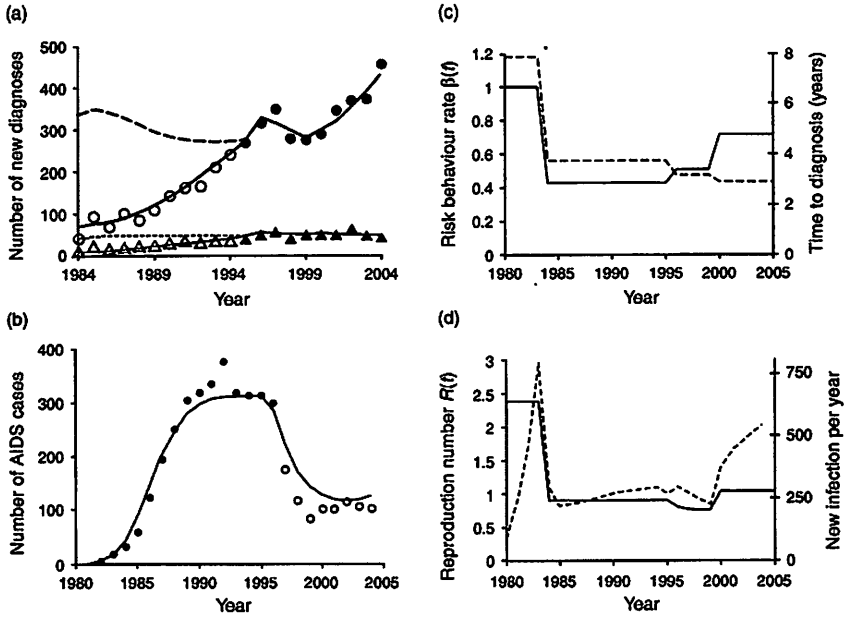

Fig. 2. Data and model fit. (a) Number of new diagnoses of HIV. Thick lines and dots, cases acquired within the Netherlands; thin lines and triangles, cases acquired abroad. Empty symbols represent years when data are only available for patients surviving until 1996, and dashed lines represent estimated actual number of diagnoses. (b) Number of new diagnoses of AIDS. Data from Dutch Health Inspectorate (black dots) used in model fit, and ATHENA (empty dots) for model verification (not fitted). (c) Estimates of the risk behaviour rate $\beta(t)$ (solid line, left axis; 1.30, 0.56, 0.66, 0.93) and the mean time between infection and diagnosis (dashed line, right axis; 7.88, 3.71, 3.16, 2.90). (d) Estimate of the reproduction number $R(t)$ (solid line, left axis; 2.39, 0.89, 0.76, 1.04) and of the number of new infections acquired within Netherlands (dashed line, right).

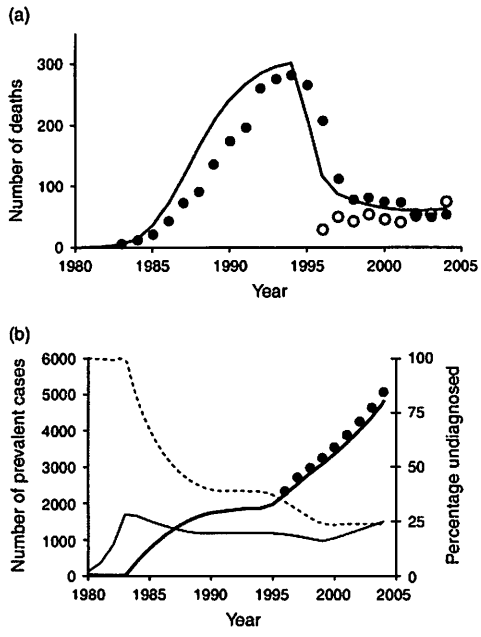

Fig. 3. Consistency of model fit. (a) Number of deaths caused by HIV. Seventy percent of number of AIDS deaths among male (black dots, see methods) and model prediction of AIDS deaths among MSM (thick line). Deaths among MSM in ATHENA (empty dots). (b) Number of prevalent cases. HIV+ MSM in ATHENA (black dots) and model prediction (thick line). Predicted number (thin line) and proportion (dashed line, right axis) of cases that are unaware of their infected status.

information only on sex and no more specific information on risk group. Hence, AIDS deaths among MSM were predicted using the percentage of MSM among male ATHENA participants in 1996 as an estimate, predicting that about 2000 MSM had died of AIDS before 1996 [14] (Fig. 3a). We also compared the estimated proportion of newly diagnosed patients in each disease stage as estimated by our best model fit, with data on CD4 cell count at diagnosis.

Results

Figure 2a and b shows the model curves that fitted best to the observed time series of annual new diagnoses and AIDS diagnoses (data on AIDS at diagnosis not shown). Figure 2d shows the estimated absolute number of new infections per year in the Netherlands. This peaked in 1983 with 802 new infections, and in 2004 with 554 new infections.

Estimates for the risk behaviour rate $\beta(t)$, the reproduction number $R(t)$ and the mean time to diagnosis are shown in Fig. 2c and d. Over the initial period (1980–1983), the estimate for the reproduction number $R(t)$ is 2.39 [95% CI (confidence interval) 2.17–2.76]. Between 1984 and 1995, the risk behaviour rate declined by 2.3-fold (95% CI 2.03–2.83), indicating large reductions in risk behaviour, and thereby reduced the reproduction number $R(t)$ below one to 0.89 (95% CI 0.85-0.93), that is, just below the epidemic threshold.

After 1995, when HAART was introduced, the reproduction number declined yet further to 0.76 (95% CI 0.7–0.86), but the reduction was not as great as it could have been due to a 18% (95% CI 3–34%) increase of the risk behaviour rate, $\beta(t)$. The risk behaviour rate is estimated to have increased yet further over the period 2000–2004 and returned to only 29% (95% CI 22–72%) below its value in the initial period 1980–1983. Reductions in the estimated mean time from infection to diagnosis [from 3.71 years (95% CI 3.49–3.97) in 1984–1995 to 2.90 years (95% CI. 2.84–3.03) in 2000–2004] with consecutive reductions in risk behaviour and widespread treatment with HAART resulted in the reproduction number being much lower than in the initial time period 1980-1983. Still, $R(t)$ for the last time period 2000–2004 is estimated to be 1.04 (95% CI 0.98–1.09), near or above the critical epidemic threshold, and thus indicating that HIV may once again be spreading epidemically among MSM in the Netherlands.

From the best fit model, we estimated that 24% of all living HIV-positive MSM were unaware of their HIV-positive status at the start of 2005 and that they account for 90% of new infections. Without both the increase of the risk behaviour rate and the decrease of time to diagnosis, the reproduction number $R(t)$ would have decreased by 24% from 0.89 to 0.68 due to the introduction of HAART. The risk behaviour rate would need to increase by 32% to offset this benefit, with 43% in order to offset the simultaneous benefits of the increase in testing behaviour and with 59% in order to get $R(t)$ equal to one, that is, to revert to epidemic growth. An increase of 66% was measured to have occurred. On the basis of these model estimates, we conclude that HAART has played an important role in limiting transmission but that any gains made have been more than offset by increases in the risk behaviour rate. Had these increases not occurred in the HAART era, the reproduction number $R(t)$ would have declined to 0.6, and the epidemic would have been in convinced decline.

We verified our predictions subjectively for consistency with approximated data on annual number of AIDS deaths in MSM (see Methods), and on the number of currently living diagnosed individuals in the national patient database ATHENA [33], shown in Fig. 3, and on the number of annual AIDS diagnoses after 1996 (Fig. 2b). We considered the quality of fit acceptable given that the model was not fitted to these data. A qualitative comparison of CD4 cell counts at diagnosis with model predictions in terms of disease stages shows similar trends.

In a sensitivity analysis, the results on the key outcomes $\beta(t)$ and $R(t)$ appear to be very robust to a wide range of model variants. In particular, model results were consistent when assumptions about the relative infectiousness of disease stages, effect of diagnosis on behaviour, and time from diagnosis to start of therapy were varied. In all model variants, $R(t)$ for 2000–2004 is estimated to be near or above the critical threshold ($R=1$), thus implying uncontrolled epidemic spread, with estimates of the current reproduction number ranging between 0.95 and 1.33, depending on the scenario (details available on request).

Discussion

The joint effect of HAART and risk behaviour on HIV incidence has been previously studied using mathematical models and empirical data [16–21,35]. Although based on different assumptions, all these studies come to the same conclusion regarding the potential for an increase in risk behaviour to offset the benefits of HAART in reducing transmission. Our study provides new evidence that this has actually occurred and quantifies its magnitude and timing within a well studied population of MSM.

A key feature of our study is the existence of several national databases recording diagnoses of HIV infection and AIDS, and deaths, allowing the diagnosis rate to be estimated reliably by simultaneously fitting to these time series within a robust inference framework. We were thus able to confirm that there has indeed been a recent increase in the diagnosis rate, reflecting a more frequent testing as was reported recently, but this was not sufficient to explain the recent increases in the number of people newly diagnosed. Rather, the recent increase in the number of new diagnoses reflects a substantial increase in transmission. Our estimates were corroborated by changing trends in CD4 cell count at diagnosis, where a recent increase in the proportion of newly diagnosed individuals with high CD4 cell counts is apparent.

Testing rates are low in the Netherlands when compared with other developed countries [36,37], and the potential of intervention by frequent testing with the rapid test is not yet fully explored [38]. Our model, however, suggests that the only way to reverse epidemic spread, and get R well below one, is to reduce the risk behaviour rate from current levels. The potential effects of routine use of new diagnostic methods that target primary HIV infection were not explored here and should be explored in future models [39].

The most likely factor driving changes in the risk behaviour rate parameter $\beta(t)$ is changing the sexual risk behaviour, both within partnerships and in partner change rates [12], though related factors such as other STIs acting to enhance transmission, saturation of the susceptible population or even evolution of infectivity could also play a role. Our analysis made it possible to compare the relative changes over time in risk behaviour rate between infectious and negative MSM, the 'hidden' information that cannot be measured by survey data, and our results indicate that whatever measures individuals are taking to 'serosort' [40] are not proving effective at the population level and have not offset epidemic spread.

The introduction of HAART was accompanied by a decrease in the percentage of resistant strains among new infections [33,41]. However, the recent increase in annual new infections could in turn result in an increasing absolute number of resistant infections [42].

The widespread use of HAART has led to large reductions in AIDS morbidity and mortality (Figs. 2 and 3). Sustaining these reductions into the future will require either further improvements in treatment efficacy or a response to limit resurgent epidemic spread.

In conclusion, there is an increase in HIV transmission among MSM in the Netherlands, in spite of earlier diagnosis and subsequent effective treatment. The most effective intervention is to bring risk behaviour back to pre-HAART levels.

Acknowledgements

D.B. was supported by grant 7014 from AIDS Fund Netherlands and by a travel grant from NWO (Netherlands Organisation for Scientific Research). C.F. is funded by the Royal Society. The funders had no role in study design, data collection and analysis, decision to publish or preparation of the manuscript.

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B.B. #4

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The report of **BRENDAN COURTNEY BAIN**
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B.B. #4
(2 pages)

http://www.cdc.gov/nchhstp/newsroom/msmpressrelease.html

Press Release

All Findings Embargoed Until: Wednesday, March 10, 2010 at 4:30pm EST Contact: NCHHSTPMediaTeam@cdc.gov (404) 639-8895

CDC Analysis Provides New Look at Disproportionate Impact of HIV and Syphilis Among U.S. Gay and Bisexual Men

A data analysis released today by the Centers for Disease Control and Prevention underscores the disproportionate impact of HIV and syphilis among gay and bisexual men in the United States.

The data, presented at CDC's 2010 National STD Prevention Conference, finds that the rate of new HIV diagnoses among men who have sex with men (MSM) is more than 44 times that of other men and more than 40 times that of women.

The range was 522-989 cases of new HIV diagnoses per 100,000 MSM vs. 12 per 100,000 other men and 13 per 100,000 women.

The rate of primary and secondary syphilis among MSM is more than 46 times that of other men and more than 71 times that of women, the analysis says. The range was 91-173 cases per 100,000 MSM vs. 2 per 100,000 other men and 1 per 100,000 women.

While CDC data have shown for several years that gay and bisexual men make up the majority of new HIV and new syphilis infections, CDC has estimated the rates of these diseases for the first time based on new estimates of the size of the U.S. population of MSM. Because disease rates account for differences in the size of populations being compared, rates provide a reliable method for assessing health disparities between populations.

"While the heavy toll of HIV and syphilis among gay and bisexual men has been long recognized, this analysis shows just how stark the health disparities are between this and other populations," said Kevin Fenton, M.D., director of CDC's National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention. "It is clear that we will not be able to stop the U.S. HIV epidemic until every affected community, along with health officials nationwide, prioritize the needs of gay and bisexual men with HIV prevention efforts."

For the purposes of determining rates of disease for MSM, CDC researchers first estimated the size of the gay and bisexual male population in the United States – defined as the proportion of men who reported engaging in same-sex behavior within the past five years. Based on an

analysis of nationally representative surveys, CDC estimated that MSM comprise 2.0 percent (range: 1.4-2.7 percent) of the overall U.S. population aged 13 and older, or 4 percent of the U.S. male population (range: 2.8-5.3 percent). Disease rates per 100,000 population were then calculated using 2007 surveillance data on HIV and primary/secondary syphilis diagnoses and U.S. Census data for the total U.S. population.

The new analysis is the first step in more fully assessing the impact of HIV among MSM and other populations significantly affected by the disease. CDC is developing more detailed estimates of infection rates among MSM by race and age, as well as among injection drug users. CDC is also in the early stages of planning for estimates among heterosexuals. Ultimately, these data can be used to better inform national and local approaches to HIV and STD prevention to ensure that efforts are reaching the populations in greatest need.

Research shows that a range of complex factors contribute to the high rates of HIV and syphilis among gay and bisexual men. These factors include high prevalence of HIV and other STDs among MSM, which increases the risk of disease exposure, and limited access to prevention services. Other factors are complacency about HIV risk, particularly among young gay and bisexual men; difficulty of consistently maintaining safe behaviors with every sexual encounter over the course of a lifetime; and lack of awareness of syphilis symptoms and how it can be transmitted (e.g., oral sex). Additionally, factors such as homophobia and stigma can prevent MSM from seeking prevention, testing, and treatment services.

Also, the risk of HIV transmission through receptive anal sex is much greater than the risk of transmission via other sexual activities, and some gay and bisexual men are relying on prevention strategies that may be less effective than consistent condom use.

"There is no single or simple solution for reducing HIV and syphilis rates among gay and bisexual men," said Fenton. "We need intensified prevention efforts that are as diverse as the gay community itself. Solutions for young gay and bisexual men are especially critical, so that HIV does not inadvertently become a rite of passage for each new generation of gay men."

Preventing HIV and STDs among gay and bisexual men is a top CDC priority. CDC provides funding to health departments and community-based organizations throughout the nation to implement proven behavior-change programs for MSM and will soon expand a successful HIV testing initiative to reach more gay and bisexual men. Additionally, CDC is implementing an updated National Syphilis Elimination Plan in cities where MSM have been hardest hit by the disease, and will release an updated HIV prevention strategic plan within the next year to support the President's upcoming National HIV/AIDS Strategy. CDC officials note that the new analysis released today underscores the importance of the HIV and STD prevention efforts targeting gay and bisexual men recently announced as part of the President's fiscal year 2011 budget proposal.

For more information on HIV or syphilis, please visit www.cdc.gov/hiv or www.cdc.gov/std.

B.B. #5

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B. B. #5

Lancet Infect Dis. 2010 Oct;10(10):682-7. Epub 2010 Sep 9.

Population-based HIV-1 incidence in France, 2003-08: a modelling analysis.

Le Vu S, Le Strat Y, Barin F, Pillonel J, Cazein F, Bousquet V, Brunet S, Thierry D, Semaille C, Meyer L, Desenclos JC.

Source

Institut de Veille Sanitaire, Saint-Maurice, France. s.levu@invs.sante.fr

Erratum in

- Lancet Infect Dis. 2011 Mar;11(3):159.

Abstract

BACKGROUND:
Routine national incidence testing with enzyme immunoassay for recent HIV-1 infections (EIA-RI) has been done in France since January, 2003. From the reported number of HIV infections diagnosed as recent, and accounting for testing patterns and under-reporting, we aimed to estimate the incidence of HIV infection in France in 2003-08.

METHODS:
We analysed reports from the French National Institute for Public Health Surveillance for patients who were newly diagnosed with HIV between January, 2003, and December, 2008. Missing data were imputed with multiple imputation. Patients were classified with non-recent or recent infection on the basis of an EIA-RI test, which was calibrated with serial measurements from HIV seroconverters from the French ANRS-PRIMO cohort. We used an adapted stratified extrapolation approach to calculate the number of new HIV infections in men who have sex with men (MSM), injecting drug users (IDUs), and heterosexual men and women by nationality. Population sizes were obtained from the national census and national behavioural studies.

FINDINGS:
After accounting for under-reporting, there were 6480 (95% CI 6190-6780) new diagnoses of HIV infection in France in 2008. We estimate that there were 6940 (6200-7690) new HIV infections in 2008, suggesting an HIV incidence of 17 per 100 000 person-years. In 2008, there were 3550 (3040-4050) new infections in heterosexuals (incidence of 9 per 100 000 person-years), 3320 (2830-3810) in MSM (incidence of 1006 per 100 000 person-years), and 70 (0-190) in IDUs (incidence of 86 per 100 000 person-years). Overall HIV incidence decreased between 2003 and 2008 ($p<0{\cdot}0001$), but remained comparatively high and stable in MSM.

INTERPRETATION:
In France, HIV transmission disproportionately affects certain risk groups and seems to be out of control in the MSM population. Incidence should be tracked to monitor transmission dynamics in the various population risk groups and to help to target and assess prevention strategies.

FUNDING:
French National Institute for Public Health Surveillance (InVS) and French National Agency for Research on AIDS and Viral Hepatitis (ANRS).

B.B. #6

This is a true copy of the Executive Summary referred to in
The report of **BRENDAN COURTNEY BAIN**
Annexed hereto and marked B.B. #6

B.B. #6

Executive summary from Lancet.com series entitled, HIV in Men Who Have Sex with Men.
Source: http://www.thelancet.com/series/hiv-in-men-who-have-sex-with-men
Published July 20, 2012. Accessed August 6, 2012.

"Despite great progress in tackling the HIV epidemic worldwide in the past two decades, there is one population in which the epidemic continues to grow in countries of all incomes: men who have sex with men (MSM). This Lancet series explores the unique aspects of the HIV epidemic in MSM, showing that it is factors such as the biology of anal sex, the characteristics of MSM networks, and known behavioural factors that are driving the epidemic in this population. The Series addresses the unique challenges faced by black MSM around the world, and discusses initiatives that reduce infectiousness of HIV — such as treatment-as-prevention and pre-exposure prophylaxis—that could have a huge impact in curbing the HIV epidemic in MSM and other populations."

B.B. #7

This is a true copy of the Journal Article referred to in
The report of **BRENDAN COURTNEY BAIN**
Annexed hereto and marked B.B. #7

B.B. #7

The Estimated Direct Medical Cost of Sexually Transmitted Diseases Among American Youth, 2000

CONTEXT: *Each year, millions of U.S. youth acquire sexually transmitted diseases (STDs). Estimates of the economic burden of STDs can help to quantify the impact of STDs on the nation's youth and on the payers of the cost of their medical care.*

METHODS: *We synthesized the existing literature on STD costs to estimate the lifetime medical cost per case of eight major STDs—HIV, human papillomavirus (HPV), genital herpes simplex virus type 2, hepatitis B, chlamydia, gonorrhea, trichomoniasis and syphilis. We then estimated the total burden of disease by multiplying these cost-per-case estimates by the approximate number of new cases of STDs acquired by youth aged 15–24.*

RESULTS: *The total estimated burden of the nine million new cases of these STDs that occurred among 15–24-year-olds in 2000 was $6.5 billion (in year 2000 dollars). Viral STDs accounted for 94% of the total burden ($6.2 billion), and nonviral STDs accounted for 6% of the total burden ($0.4 billion). HIV and HPV were by far the most costly STDs in terms of total estimated direct medical costs, accounting for 90% of the total burden ($5.9 billion).*

CONCLUSIONS: *The large number of infections acquired by persons aged 15–24 and the high cost per case of viral STDs, particularly HIV, create a substantial economic burden.*

Perspectives on Sexual and Reproductive Health, 2004, 36(1):11–19

By Harrell W. Chesson, John M. Blandford, Thomas L. Gift, Guoyu Tao and Kathleen L. Irwin

Harrell W. Chesson, John M. Blandford and Thomas L. Gift are economists, Guoyu Tao is a health services researcher and Kathleen L. Irwin is chief, Health Services Research and Evaluation Branch, Division of STD Prevention, Centers for Disease Control and Prevention, Atlanta.

Sexually transmitted diseases (STDs) have a considerable impact on the health of adolescents and young adults in the United States. In 2000, an estimated nine million cases of STDs occurred among persons aged 15–24.[1] In addition, STDs impose a substantial economic burden: The direct cost of STDs, including HIV, among all age-groups was estimated to be $9.3–15.5 billion in the United States in the mid-1990s, adjusted to year 2000 dollars.[2]

Assessing the economic burden of STDs is important for two main reasons. First, estimates of the cost of treating STDs among adolescents and young adults can help quantify the impact of STDs on the nation's youth and on those who pay for their medical care. In many cases, the payers are public programs; for example, one study of patients receiving care for HIV found that 47% were covered by Medicaid or Medicare, 33% had private insurance and 20% were uninsured.[3] Second, information on the medical expenses involved in treating STDs is needed for cost-effectiveness evaluations of prevention programs.

The costs associated with STDs can be divided into three main categories: direct, indirect and intangible.[4] Direct costs may be either medical or nonmedical. Direct medical costs of STDs generally refer to the expenses of treating acute STDs and the sequelae of untreated or inadequately treated acute STDs. Examples are the cost of clinician visits, hospitalization, diagnostic testing, drug treatments and therapeutic procedures. Other expenses associated with receiving medical treatment, such as the cost of transportation to and from medical services, are classified as direct nonmedical costs. Indirect costs of STDs generally refer to productivity losses (lost wages) attributable to STD-related illness. Intangible costs of STDs are related to the pain and suffering associated with STDs.

In this article, we present estimates of the direct medical costs of STDs, including HIV. We synthesize the existing literature to estimate the lifetime cost of STDs that were acquired in 2000 by Americans aged 15–24. To our knowledge, this is the first study of the economic burden of STDs among youth in the United States.

METHODS AND RESULTS

We focused on eight major STDs—HIV, human papillomavirus (HPV), genital herpes simplex virus type 2 (HSV-2), hepatitis B virus, chlamydia, gonorrhea, trichomoniasis and syphilis. Although we used common guidelines in estimating the cost of each of these STDs, our methods varied because of STD-specific differences in the probability and cost of long-term sequelae and in the availability of cost estimates.

All costs (including those obtained from previous studies) were adjusted for inflation to year 2000 dollars, using the medical care component of the Consumer Price Index for All Urban Consumers.[5] We examined the lifetime cost of new STD cases occurring among young Americans in 2000 (incidence costs) rather than the total cost in 2000 of existing cases of STDs and their sequelae among persons who were 15–24 years old at the time of infection (prevalence costs).

Estimates of incidence costs, based on information available in the literature, include the more immediate expenses of treating acute infections as well as the future costs of sequelae, such as pelvic inflammatory disease (PID), that might develop if an infection is not treated or if treatment is delayed or inappropriate. Following conventional methods of cost analysis, we used discounting to convert future costs into present value equivalents.[6] Future costs were discounted by 3% annually.[7]

When cost-per-case estimates were not available in the literature or could not be derived readily from published data, we describe our methods in more detail. We calculated sex-specific estimates when sex-specific data on cost per case were available or could be derived from existing data and when sex-specific costs differed substantially. Costs of neonatal complications attributable to STDs were not included in this analysis, because available cost data were limited and the inclusion of neonatal complications would have added complexity to the analysis.

To calculate the total direct medical cost for each STD, we multiplied the estimated cost per case by the estimated number of new cases that occurred in 2000 among persons aged 15–24 (Table 1).[8]

TABLE 1. Estimated lifetime cost per case, number of new cases among persons aged 15–24 and total direct medical costs of eight major STDs, United States, 2000

STD	Average lifetime cost per case* ($)	No. of new cases in 2000†	Total direct medical cost* ($)
Total	**na**	**9.1 million**	**6.5 billion**
HIV	199,800	15,000	3.0 billion
HPV	1,228 (women) 27 (men)	4.6 million	2.9 billion
Genital herpes	417 (women) 511 (men)	640,000	292.7 million
Hepatitis B	779	7,500	5.8 million
Chlamydia	244 (women) 20 (men)	1.5 million	248.4 million
Gonorrhea	266 (women) 53 (men)	431,000	77.0 million
Trichomoniasis	18	1.9 million	34.2 million
Syphilis	444	8,200	3.6 million

*In year 2000 dollars. †Excludes infections that were not sexually acquired. *Notes:* To calculate total costs, we assumed that men accounted for 50% of new HPV infections, 43% of new cases of genital herpes, 35% of new chlamydial infections and 41% of new cases of gonorrhea in this age-group (references 1, 2, 26 and 58). Totals may not match sum of individual items because of rounding. na=not applicable. *Source:* For incidence estimates, see reference 1.

HIV

Estimates of the discounted lifetime medical cost per new case of HIV were obtained from an existing study.[9] We applied the midpoint ($199,800) of the two estimates ($176,500 and $223,300) from that study's intermediate cost scenario, which included the following assumptions: Persons with HIV live for 16 years after becoming infected; each infected person is unaware of his or her infection in the first two years and begins viral load monitoring (but not treatment) in the third year; and in years 4–16 after infection, the person receives antiretroviral therapy, prophylaxis and treatment for opportunistic infections, as well as other medical care associated with progression to AIDS.

This estimated lifetime cost ($199,800) is consistent with the findings of a study that indicated that the average annual cost of care was approximately $20,900 for adults receiving care for HIV in 1998.[10] For example, when a 3% annual discount rate is applied, the cost of 12 years of care at $20,900 per year would be about $214,000 if care began immediately after infection, and would be about $174,000 if care began seven years after infection. This example is conservative, however, in assuming that only 12 years of care would be required; estimated life expectancy following HIV infection is 22–26 years for persons receiving antiretroviral treatment.[11] Thus, the estimated cost per case of HIV that we apply may be a lower-bound estimate of the true cost.

HPV

Our estimate of the total medical cost attributable to an HPV infection in youth focused on costs associated with cervical abnormalities in women and external anogenital warts in both men and women.* We first calculated the average cost of a new HPV infection in the general population, then made an adjustment based on the likelihood that the infection occurred by the age of 24.

• *Cervical abnormalities.* For adolescent and young adult women, we based the analysis on reported costs associated with diagnosis and management of cytologic abnormalities, preinvasive cervical neoplasia and invasive cervical cancer, and then retrospectively estimated the portion of the costs of these conditions attributable to HPV.†

Because published estimates of the cost per case were not available, we constructed a decision analysis model to calculate the expected cost of an abnormal cervical cytology finding in women. Potential management strategies following an abnormal Pap test result were based on the 2001 Bethesda guidelines, a set of evidence-based recommendations developed in a consensus conference sponsored by the American Society for Colposcopy and Cervical Pathology.[12] For all atypical Pap test findings, we attributed fully to HPV the costs associated with the diagnosis and treatment of histologically confirmed findings of cervical intraepithelial neoplasia grades 1–3 and of invasive cervical cancer (details available from the author).

We drew cost estimates for physician visits, follow-up Pap and HPV tests, colposcopy and treatment of cervical neoplasia from a previous study,[13] subtracting indirect costs

*Other medical costs that may be attributable to HPV infection—such as those associated with cancers of the anus, penis, vulva and vagina—are not included, because the proportion of these cancers that may be attributed to HPV has not been well established.

†We used this approach because of the high rate of clearance of incident HPV infection without treatment and the difficulty of predicting the likelihood of progression from incident infection to particular manifestations of disease (sources: Ho GY et al., Natural history of cervicovaginal papillomavirus infection in young women, *New England Journal of Medicine*, 1998, 338(7):423–428; Moscicki AB et al., The natural history of human papillomavirus infection as measured by repeated DNA testing in adolescent and young women, *Journal of Pediatrics*, 1998, 132(2):277–284; and Woodman CB et al., Natural history of cervical human papillomavirus infection in young women: a longitudinal cohort study, *Lancet*, 2001, 357(9271):1831–1836).

for patient time.[14] We assumed that cervical intraepithelial neoplasia occurs, on average, three years after initial HPV infection, and discounted treatment costs accordingly.[15] The decision analysis model estimated the discounted HPV-attributable cost per abnormal Pap test at $1,281. With the estimated 2.8 million abnormal Pap test results per year, direct HPV-attributable costs of recommended follow-up to abnormal cervical cytology and treatment of related neoplasia totaled $3.6 billion among women of all ages.

We projected 12,800 cases of invasive cervical cancer annually, distributed as 57.5% localized to the cervix, 34.0% with pelvic involvement and 8.5% with more distant spread.[16] When the costs of patient time were excluded, estimated invasive cervical cancer costs were $20,255 for localized disease, $21,678 for pelvic disease and $36,912 for distant disease.[17] We discounted the cost estimates based on the assumption that diagnosis of invasive cancer occurs, depending on stage, 21–25 years after initial HPV infection.[18] On the basis of these figures, the total discounted annual cost of invasive cervical cancer among all age-groups in the United States (i.e., including women aged 25 or older) was estimated at $146.4 million.

• *HPV and anogenital warts.* The average cost of treatment after a new diagnosis of external anogenital warts was $446 (details available from the author). Approximately 20–30% of episodes of anogenital warts resolve without treatment.[19] Because not all persons with such warts seek or require therapy to remove them, we adjusted our estimates according to the assumption that 25% of cases resolve without treatment. Estimates of annual incidence of anogenital warts vary widely, from 250,000–500,000 to 500,000–1,000,000.[20] To estimate the economic burden of HPV, we assumed an incidence of 500,000. Given these assumptions, the annual total direct cost associated with anogenital warts for all age-groups is $167.4 million.

• *Economic burden of infection acquired during youth.* To estimate the burden of HPV infection in adolescents and young adults, we adjusted total cost figures to reflect the proportion of persons infected between ages 15 and 24. The attributable total costs of HPV infection among women were adjusted to reflect the results of a model of the natural history of HPV infection and progression, which found that 74% of incident cervical HPV infections occur among women in this age-group.[21] We assumed that the cumulative incidence of HPV infection was comparable among young men[22] and assigned the economic burden of treatment for anogenital warts accordingly.

This adjustment implies that costs attributable to HPV infection in youth include $2.7 billion for the follow-up of abnormal Pap results and treatment of cervical neoplasia, $108.3 million for direct medical costs associated with invasive cervical cancer and $123.9 million for the treatment of external anogenital warts. The total annual cost of HPV infection attributable to infections acquired through age 24 is $2.8 billion for women and $62 million for men. This total cost estimate is more than twice that of an earlier study;[23] much of the difference results from the incorporation of costs linked to diagnosis and management of cytologic abnormalities. Assuming 4.6 million infections among those aged 15–24, distributed equally between the sexes,[24] the expected cost per HPV infection is $1,228 for women and $27 for men.

Genital Herpes

Estimates of the annual prevalence cost of genital herpes (excluding neonatal herpes) among persons who were aged 15–24 at the time of infection have ranged from $78–112 million (based on medical claims data) to $450 million (based on expert opinion), assuming that roughly 40% of HSV-2 infections occur between ages 15 and 24.[25]

To estimate the incident cost of genital herpes, we needed estimates of the discounted, lifetime cost per new case. These estimates were based on a study of the direct and indirect costs of HSV-2 infection.[26] We obtained the estimates of direct costs per case ($417 for women and $511 for men, including suppressive therapy for some patients) from the study's lead author.[27] In that study, the author assumed that 17% of infected individuals would develop symptomatic genital herpes, and estimated that infected men and women would experience an average of 19 and 16 lifetime symptom days, respectively.[28]

Hepatitis B

The estimated cost per case was based on an existing study of the costs of treatment for acute hepatitis B infection and its sequelae.[29] In that study, the investigators estimated that 60% of initial infections in adults or adolescents were asymptomatic and did not require treatment. Among symptomatic infections, an estimated 88% would require outpatient treatment at a cost of $272 per occurrence, and 12% would require hospitalization at a cost of $8,080 per hospitalization. The investigators estimated that 0.9% of all infections would result in chronic liver disease, with related costs averaging $59,308 before discounting.[30] When we conservatively assumed that the average latent period before onset is 20 years,[31] the discounted cost per case of chronic liver disease was $32,837. These assumptions yielded an average cost per case of $779.

Chlamydia

The average cost per case of chlamydia was based on costs of diagnosis and treatment of acute infections, screening tests that yielded positive test results and sequelae resulting from untreated acute infections or from delayed or improper treatment.

• *Diagnostic and treatment costs of acute infection.* The estimated costs of acute care per case, which were drawn from four sources, ranged from $23 to $109.[32] These expenses include costs for office visits (including treatment visits, where appropriate), diagnostic testing and treatment.[33] The low end represented case detection through urine-based nucleic acid amplification testing (NAAT) in men in a correctional setting; the high end was for cases in women detected using NAAT on cervical specimens during diagnostic

visits in a privately insured population. Intermediate estimates reflected the cost per case detected through diagnostic visits or screening in publicly funded family planning clinics ($37–53) and STD clinics ($48–73).[34]

An estimate of $73, close to the midpoint of the range of estimates (excluding those for cases detected in correctional settings), reflects the fact that chlamydia is detected and treated in a variety of settings. This estimate includes treatment with single-dose therapy, which may be preferred for adolescents because it avoids the compliance problems associated with multidose therapies.[35] In women, cases detected by urine NAAT may be less costly because pelvic exams are not needed.

A proportion of acute chlamydial infections are asymptomatic. Estimates of the proportion of acute infections in men that are asymptomatic or that lack recognized symptoms range from 82% to 98%; rates of asymptomatic infection in women range from 74% to 92%.[36] Without screening, asymptomatic infections are unlikely to be treated. Because screening of women is far more common than screening of men, the proportion of asymptomatic, infected persons treated is higher among women than among men.[37]

• *Costs of sequelae.* We included the possible costs of epididymitis in men and PID in women, two of the primary sequelae of acute chlamydial infection. Estimated rates of progression to epididymitis vary from 1% to 5%,[38] and published estimates of the cost per case range from $144 to $684.[39] Because the lowest estimate was based on the most recent data and may best reflect current care practices, we used it as the cost per case. The expected expense of epididymitis for each acute chlamydial infection in men was calculated by multiplying the cost per case by the midpoint of the range of rates of progression (3%).

The rate of progression to PID following acute chlamydial infection in women varies, depending on whether the initial infection is successfully treated. When an acute chlamydial infection is not diagnosed or treated, PID develops in an estimated 10–40% of cases.[40] PID may also develop in 3–6% of acute cases that are treated, in part because it can occur before treatment is received.[41] On the basis of these estimates, we used rates of 20% in untreated cases and 4% in treated cases to generate our estimate of PID-associated costs per case of chlamydia in women.

Estimated costs per case of PID, including those associated with acute PID, chronic pelvic pain, ectopic pregnancy and treated infertility, range from $1,060 to $3,626.[42] Using insurance claims taken from a national database, we applied a conservative estimate of $1,334 for the cost per case of PID.[43]

• *Average cost per case of chlamydia.* The expected costs per case for men ($20) and women ($244) were calculated by assuming that acute infections were asymptomatic or untreated in 78% of men and 32% of women.[44] In women, 82% of the estimated cost per case is attributable to sequelae, whereas in men, 78% of the estimated cost per case is attributable to acute infection.

Gonorrhea

The average cost per case of gonorrhea was based on costs of diagnosis and treatment of acute infections, screening tests that yielded positive test results and sequelae resulting from untreated acute infections or from delayed or improper treatment.

• *Diagnostic and treatment costs of acute infection.* The estimated cost of care per acute case was drawn from three sources.[45] As with the cost of chlamydia, the cost of gonorrhea depends on the care setting, on the type of specimen used for testing and on whether the case is detected through a diagnostic visit initiated by patients with symptoms or through visits for non–gonorrhea-related issues in which gonorrhea screening is provided. The costs for cases detected through screening, covering expenses for office visits (including treatment visits, where appropriate), diagnostic testing and treatment, range from $36 to $69.[46] The lower estimate is for screening in a correctional setting, and the higher estimate reflects a private setting. For cases detected through diagnostic visits, the costs range from $69 to $125.[47] The cost per case would be lower if most symptomatic men were treated on the basis of symptoms or a clinic-performed gram stain (without laboratory-based testing), but research has found high rates (83–92%) of diagnostic testing among private providers.[48] We used $69 as an estimate of the average cost per acute asymptomatic or symptomatic case treated.

Untreated acute infections for which patients never seek care entail no direct costs (although treating their sequelae can be costly). Data on the proportion of gonorrheal infections that are asymptomatic or that do not have recognized symptoms vary. Women are generally more likely than men to have asymptomatic infections, but even among men, asymptomatic infections and infections without recognized symptoms are estimated at 34–100% of all infections.[49]

• *Costs of sequelae.* We included the costs of treating epididymitis in men and PID in women. Because there is no evidence that epididymitis costs vary significantly according to the organism involved, we used the data for chlamydia to estimate epididymitis costs attributable to gonorrhea.[50] We also used the estimated rates of progression from chlamydial infection to epididymitis to calculate those for acute gonorrhea.

PID develops an estimated 10–40% of the time following cervical gonococcal infection.[51] One study found that 4% of women with incident gonococcal infections of less than six months' duration developed symptomatic PID, but 9% had lower abdominal tenderness, a symptom consistent with PID.[52] We estimated that PID develops in 20% of women with untreated acute gonococcal infections and in 6% of those with successfully treated infections.[53] The estimates of the cost per case of PID resulting from chlamydial infection were used to calculate the cost per case of gonococcal PID.

• *Average cost per case of gonorrhea.* The expected costs per case for men ($53) and women ($266) were calculated by

assuming that acute infections were asymptomatic or untreated in 29% of men and 27% of women.[54] In women, 81% of the cost per case is attributable to sequelae, whereas in men, 92% of the cost per case is attributable to acute infection.

Trichomonas vaginalis

The literature related to the costs of infection with *Trichomonas vaginalis* is minimal. Therefore, the estimated cost per case was based on the treatment estimates for gonorrhea and chlamydia, adjusted for the expected differences in medication and laboratory costs. We assumed that the vast majority (90%) of diagnostic testing relied on wet-mount preparation conducted during the patient visit, because reliable data were not found on use of the InPouch™ diagnostic culture, a relatively new test for trichomoniasis. Assuming the cost of a diagnostic visit that includes wet-mount materials, preparation and reading during the patient visit is similar to that for gonorrhea or chlamydia, we estimated the visit cost at $40, exclusive of medications.[55] Treatment with the recommended regimen of a single 2 g dose of metronidazole (average wholesale price of $2) yields a total diagnosis and treatment cost of $42. Use of the InPouch kit adds $2.40 per test, plus the costs of laboratory time for multiple readings of the specimen and a return treatment visit for those with positive results. The estimated additional cost of InPouch culture is $44. Given a weighted average of diagnosis by 90% wet-mount and 10% InPouch culture, we estimated the cost per treated case of trichomoniasis at $46. An estimated 20–50% of infections are symptomatic; we assumed that 40% would be treated, and that 60% would not be treated and would incur no costs, thus leading to an average cost per case of $18.[56]

Syphilis

Syphilis cost estimates were based on an earlier decision analysis of the natural course of syphilis infection.[57] We assumed that each new case of syphilis would first be detected and treated in the primary, secondary or early latent stage; first be detected and treated in the late latent stage; be treated inadvertently by antibiotics taken for reasons unrelated to syphilis; or lead to long-term sequelae such as late benign syphilis, cardiovascular syphilis or neurosyphilis. Our estimates reflect the probability of and costs associated with each of these scenarios.

We made three adjustments to the probabilities and costs from the previous analysis. First, we assigned a higher value (0.61 rather than 0.49) to the probability of receiving treatment in the primary, secondary or early latent stage of syphilis. This choice ensured that the ratio of treated primary, secondary and early latent cases to the treated late latent cases in the decision tree model would be consistent with the ratio reported to the national surveillance system of the Centers for Disease Control and Prevention (CDC) from 1980 to 1999. Second, we used a lower cost of treatment of primary, secondary or early latent syphilis ($53 rather than $380). The difference arises because we used a more conservative estimate of the cost of screening and CDC-recommended treatment, and excluded the costs of possible follow-up visits.[58] Third, a lower cost of neurosyphilis ($56,806 rather than $166,374) was applied, assuming that initial treatment would cost $4,857, long-term care would cost $51,949 and 25 years would elapse between infection and initial treatment.[59] Because information about the long-term cost of neurosyphilis is scarce, we used the average cost of care for Alzheimer's patients over a 10-year period (including the costs of informal care)[60] as an approximation. These adjustments to the probability of treatment and costs of treatment for early syphilis and neurosyphilis resulted in a more conservative cost estimate than the one previously reported.[61] The other inputs used in this decision analysis model were quite similar to those used in recent evaluations of syphilis screening programs in the United States.[62] The estimated cost per case of syphilis was $444.*

Total Economic Burden

For the eight STDs considered here, the total estimated cost of the nine million cases that occurred among 15–24-year-olds in 2000 is $6.5 billion (Table 1). Viral STDs accounted for 94% of the total burden ($6.2 billion), and nonviral STDs for 6% ($0.4 billion). HIV and HPV were by far the most costly STDs in terms of total estimated direct medical costs, accounting for 90% of the total burden ($5.9 billion). Genital herpes and chlamydia were the third and fourth most costly STDs, accounting for total costs of $293 million and $248 million, respectively.

DISCUSSION AND CONCLUSIONS

The estimated economic burden of STDs among youth is substantial, both because of the large number of infections acquired by persons aged 15–24 and because of the high cost per case of viral STDs, particularly HIV. Without existing STD prevention efforts, the incidence cost of STDs would be even greater than our estimate of $6.5 billion. Additional STD prevention activities may avert some of the cost of treating STDs among the nation's adolescents and young adults.

The overall cost burden of STDs is so great that even small reductions in incidence could lead to considerable reductions in treatment costs. However, prevention activities (such as HIV counseling and testing, STD screening and treatment, and sex partner notification) also have economic costs. Cost-effectiveness studies of STD prevention programs for adolescents and young adults can help determine the best use of limited STD and HIV prevention resources.[63]

*This cost per case was estimated as the expected cost of the following clinical outcomes of syphilis: primary, secondary or early latent stage syphilis (probability, 0.61; treatment cost, $53); late latent stage syphilis with no lumbar puncture (probability, 0.199; treatment cost, $467); late latent stage syphilis, including a lumbar puncture (probability, 0.041; treatment cost, $675); inadvertent treatment (probability, 0.134; treatment cost, $0); late benign syphilis (probability, 0.007, treatment cost, $1,094); cardiovascular syphilis, including the need for cardiac surgery in some cases (probability, 0.005; treatment cost, $13,931); and neurosyphilis, including the need for long-term nursing home care (probability, 0.004; treatment cost, $56,806).

Certain bacterial and viral STDs can facilitate the transmission of HIV, and HIV costs can be an important component of their cost.[64] Because we included HIV costs as a separate category, however, we did not include them as a cost component for other STDs. Prevention of STDs other than HIV might result in reductions in HIV and its associated costs. For example, a published mathematical model[65] of the effects of STDs on HIV transmission suggests that about 2,100 of the estimated 15,000 new HIV infections among young Americans in 2000 might be attributable to coinfection with syphilis, gonorrhea or chlamydia.

Limitations

These estimated lifetime costs per case are subject to considerable uncertainty and should be viewed as ballpark figures rather than precise calculations. Our estimates depend on the numerous assumptions we made in our analysis. In calculating HPV costs, for example, we assumed that patients with atypical Pap test results would be managed in strict adherence to the Bethesda Guidelines. If management is less rigorous, the expected cost per abnormal Pap result will be lower, though this reduction might be offset in part by increased costs of treating invasive cancer in later years. The estimated total burden of STDs ($6.5 billion) is based on the cost-per-case estimates as well the estimated number of cases of each STD. As with the cost-per-case estimates, the incidence estimates are subject to considerable uncertainty.

The estimated cost per case of HIV (the most costly STD in our analysis) is based on a 1997 study, and the lifetime cost may have changed substantially since then. Nonetheless, the estimate we used is the most current one available, and is widely used in cost-effectiveness evaluations of HIV prevention programs. In addition, the lifetime cost ($199,800) we applied appears to be consistent with a more recent estimate of the annual cost of care for persons with HIV.[66]

As with our estimates for HIV, our cost estimates for other STDs are affected by the limitations of the studies on which our estimates are based. For example, cost estimates used in the decision analyses might be from one clinical setting where costs are not readily applicable to other settings. Drug treatment costs based on wholesale prices might underestimate the actual cost of treatment for some purchasers of these drugs. Furthermore, the cost of STDs can change over time. Although we adjusted existing cost estimates for inflation, such adjustment might not fully capture changes in diagnosis, treatment and management in recent years or future years. Such changes might include broader use of urine-based amplification testing for gonorrhea and chlamydia, new guidelines for cervical neoplasia and cancer screening, HPV DNA testing, new treatments for HIV and trichomoniasis, herpes type-specific serology testing and its potential influence on the proportion of persons with genital herpes who receive treatment, and modification of treatment regimens in the face of changing antimicrobial resistance patterns.[67]

With some exceptions, our cost-per-case estimates are not age-specific. Rather, we based them on existing studies that typically reflect STD costs among adults rather than adolescents. For example, we assumed that the distribution of high- and low-risk HPV types is independent of the age at infection. If the distribution of HPV types varies by age, we may have overestimated or underestimated the true cost of HPV infection in adolescents and young adults. In addition, the estimated costs of HIV and HSV include long-term drug therapy. If young people require more years of such treatment than was estimated for the adult populations on which our sources are based, the actual cost of HIV and HSV among youth could exceed our estimates.

In calculating the costs by STD, we may have double-counted certain costs in instances in which a person was infected with more than one STD at a given time. For example, a person infected with both gonorrhea and chlamydia might have both infections diagnosed at the same doctor visit. However, some patients presenting with gonorrhea alone (or chlamydia alone) may be presumptively treated for the other infection as well because coinfection is common. Thus, any overestimation of the cost of diagnostic visits for a person infected with both chlamydia and gonorrhea would be offset, at least in part, by the added costs of presumptive dual treatment for persons who are not infected with both organisms. Data are not available to determine the net effect of these two possibilities on our cost estimates for gonorrhea and chlamydia; it likely is far less than the impact of our use of conservative estimates of the rates of progression to PID and cost of PID attributable to gonorrhea and chlamydia.

We did not consider every possible direct medical cost of each STD. For example, we limited estimates of the economic burden of HPV among youth to management of cervical manifestations among women and anogenital warts among both sexes. To the extent that HPV is an important factor in other male and female genital cancers and internal genital warts, we underestimated the economic burden of HPV infection. STD infections in pregnant women can cause pregnancy complications and medical problems for infants who are infected during the perinatal period. Because we did not include these costs, we likely underestimated the cost of STDs among young women.

We did not include the cost of primary STD and HIV prevention activities (for example, finding and notifying partners of infected persons) or the cost of protecting the nation's blood supply from these diseases. Similarly, we did not include the cost of large-scale screening for STDs that often lack symptoms or have symptoms or signs that are not easily recognized. For example, the costs of routine prenatal syphilis and HIV screening programs and routine chlamydia screening programs for sexually active adolescent and young adult women were not included. However, costs associated with screening tests that yield a positive result, as well as subsequent diagnostic tests required because of the positive screening result, were included because these costs must be incurred to detect and treat

infection. Although these screening costs would have been incurred regardless of test outcome, the inclusion of these costs for positive tests has little effect on the estimated burden of STDs.

Our cost estimates did not include either the indirect costs or the intangible costs associated with STDs; the estimated burden of STDs would be substantially higher if these costs were included. Even though we included eight major STDs, we excluded other important STDs, such as hepatitis C, human cytomegalovirus and bacterial vaginosis, because of limited cost information. We did not include the cost of genital herpes attributable to HSV-1.

These numerous limitations likely result in an underestimation of the cost of STDs among adolescents and young adults. If we included every known STD and every possible associated cost, the estimated cost burden of STDs would be greater. Furthermore, the estimated cost would be about 10% higher if expressed in current dollars rather than year 2000 dollars. And prevalence costs of STDs could be even higher than the incidence costs we estimated here, because prevalence costs include current costs of STDs acquired in previous years and are not discounted.

Our analysis provides only point estimates of the cost of eight major STDs. Although this is an important first step in examining the cost of STDs among adolescents, more research is needed. Most important, future studies should include detailed sensitivity analyses to examine how the cost-per-case estimates change when key inputs (cost of treatment, probability of long-term sequelae, etc.) are varied. Incorporating sensitivity analyses was beyond the scope of this study, and any subsequent users of the point estimates we have provided should address the inherent uncertainty in these estimates.

Despite its limitations, our cost analysis provides practical estimates of the direct medical costs of STDs among America's youth. These figures underscore the enormous burden of STDs and illustrate the potential savings that could be achieved through successful STD prevention activities.

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Acknowledgments

The authors thank J. Thomas Cox, Eileen Dunne, David N. Fisman, Sue J. Goldie, Shalini Kulasingam, Herschel W. Lawson, Evan Myers, Katherine M. Stone, James Trussell and Hillard Weinstock for helpful suggestions and additional information. We are also grateful for recommendations and comments from the following members of the University of North Carolina School of Journalism and Mass Communication Panel on Youth, Sexually Transmitted Diseases and the Media, which was supported by the William T. Grant Foundation: Tracey A. Adams, Jane D. Brown, Virginia Caine, Joan R. Cates, Willard Cates, Jr., Richard A. Crosby, Jacqueline E. Darroch, Ralph DiClemente, Nancy Herndon, Lloyd J. Kolbe, Felicia E. Mebane, Susan L. Rosenthal, Laura F. Salazar, Susan Schulz, Jonathan Stacks and Felicia Stewart.

Author contact: *hbc7@cdc.gov*