

Original
article

Direct estimates of prevalent HIV infection in adults in England and Wales for 1991 and 1993: an improved method

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Objective: To estimate the number of prevalent HIV infections in England and Wales at the end of 1991 and 1993.

Method: A direct method was used whereby population estimates derived from the National Survey of Sexual Attitudes and Lifestyle (NATSAL) and prevalence data from the Unlinked Anonymous HIV Prevalence Monitoring Programme (UAPMP) were combined to produce estimates of the number of adults infected and alive in the population.

Results: In the population of England and Wales the numbers of prevalent infections for defined transmission categories, at the end of 1993, were as follows: 12 600 through sex between men, 2500 through injecting drug use, and 6900 through heterosexual intercourse. The overall estimate was 22 800 HIV seropositive individuals.

Conclusions: The direct method attempts to provide an estimate of the number of HIV infections using population based survey data. These estimates are consistent with other approaches using independent methods. Such methods are essential for inferring recent HIV incidence, projecting future AIDS cases, and for healthcare planning.

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Keywords: HIV; estimates; population

Introduction

Deriving the number of human immunodeficiency virus (HIV) seropositive people in different transmission categories in a defined population provides information that is essential for public health purposes. Such data characterise the HIV epidemic at a point in time¹; allow estimates to be made of the proportion of infections that have been diagnosed²; can be used to infer incidence; and improve estimates of future AIDS cases enabling the planning of future healthcare services.³ Reported HIV infections cannot be used for this purpose as they do not include undiagnosed infections. At least four methods have been developed to estimate the number of prevalent HIV infections⁴—the back calculation, diagnosis interval, test history, and the direct method. The direct method obtains the prevalence of infection in a defined population by estimating the proportions of population subgroups with defined risk behaviours, and applies estimates of the prevalence of infection in each subgroup to derive estimates of the total number of infections in the population. The method was used in an estimate of the size of the HIV epidemic in England and Wales by the Department of Health in 1988 (the "Cox report"), and 1991.^{5,6} For the Cox report the data sources available were few and generally based on highly selected samples. Since that time, the National Survey of Sexual Attitudes and Lifestyles (NATSAL) and the Unlinked Anonymous HIV Prevalence Monitoring Programme (UAPMP) have been undertaken to measure the distribution of behaviours in the population and to estimate the prevalence of HIV in defined populations, respectively.^{7,8} Using these and other recently available data, we provide revised estimates of

prevalent infection among adults, males and females aged 16-59, in England and Wales at the end of 1991 and 1993, respectively, using the direct method. This was undertaken as part of the work of a 1995 AIDS Projections Working Group.³ It was carried out independently of prevalence estimates derived by others using the back calculation, diagnosis interval, and test history methods.⁴

Methods

The method described is an extension of the work undertaken by Giesecke *et al.*,⁶ which in itself was a development of an earlier exercise.⁵

The direct method produces estimates of the number of adults infected (in this case with human immunodeficiency virus, HIV) and alive in the population. Estimates of the proportion of the population with particular risk behaviours (for example, homosexual sex, injecting drug use) are derived from population surveys. These categories form the denominators which are then multiplied by the best prevalence estimates of HIV infection specific to each category, producing an estimate of the number of likely HIV infected persons within each of these categories. The method requires that each category containing a non-zero prevalence can be identified and quantified, and that an estimate of prevalence can be derived. The following formula summarises the calculation:

$$\text{Estimated population, size} \times \text{HIV prevalence, estimates} = \text{estimated prevalence infection, (where } i \text{ indicates a specific category)}$$

For this exercise three developments of the earlier method were incorporated. To use the independent data on prevalent clinically diag-

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nosed infections from the National Survey of Prevalent Diagnosed HIV Infections⁹; to calculate prevalent undiagnosed infections using the direct method; and to carefully define denominators and prevalence data for injecting drug use.

Sources of data

NATIONAL UNLINKED ANONYMOUS HIV SEROPREVALENCE MONITORING PROGRAMME (UAPMP)

This is an ongoing programme of surveys which began in January 1990 with the primary aim of monitoring HIV prevalence in England and Wales avoiding the bias associated with diagnostic testing.^{8,10} The majority of the surveys focus on those whose behaviour makes them most vulnerable to infection with HIV, through surveys of homosexual or bisexual (referred to as homo/bisexual) men and heterosexual men and women attending sexually transmitted disease (STD) clinics and injecting drug users attending specialist treatment and support agencies or STD clinics. Levels of infection in those at lower risk of infection are monitored by surveys of pregnant women proceeding to birth or having terminations of pregnancy. The overall sample sizes were 351 049 and 503 623 in 1991 and 1993, respectively, with refusal rates of less than 0.2%.¹¹ Blood samples taken for clinical screening purposes in these populations were unlinked from personal identifiers before being tested for HIV antibody. In addition, one survey of injecting drug users employs saliva specimens collected voluntarily. Seroprevalence estimates from the following three surveys were used in the present study:

- (a) syphilis serology at STD clinics (estimates of seroprevalence excluded data from those known to inject drugs);
- (b) infant dried blood spots (conforms to seroprevalence in pregnant women having live births);
- (c) voluntary saliva samples from injecting drug users.

Detailed methodology of the surveys are available elsewhere.^{8,10}

NATIONAL SURVEY OF PREVALENT DIAGNOSED HIV INFECTIONS (PDI)

Since 1994 a mechanism has been established in all health districts in England and Wales whereby nominated HIV coordinators provide confidential anonymised reports of diagnosed HIV infected individuals currently alive and known to be receiving care at centres in their locality. This is coordinated by the Communicable Disease Surveillance Centre (CDSC—HIV and STD Division) and provides data which will be referred to as prevalent diagnosed infections (PDI).⁹ Reports are requested annually to exclude individuals who have died or left the country, and sufficient information is included (soundex (method of coding surnames to provide confidentiality and accuracy in national HIV databases), date of birth, and sex) to eliminate most duplicates. Because of the method of collection individuals may be classified into major behaviour risk

groups by age group and area of care and residence. The data were used to provide totals of adults with diagnosed prevalent infections in the categories current homo/bisexual men and heterosexual men and women. Data for 1991 were derived by reducing the 1993/94 totals by 10%, assuming that the number of known HIV infected adults would have increased by approximately 5% per year. This assumption was based on changes in the National Survey of Prevalent Diagnosed Infections observed since its inception. The direct method calculation within these two categories needed only to consider HIV infections that had not been clinically recognised. This overcomes a feature of the unlinked anonymous HIV prevalence monitoring programme survey of STD clinic attenders, whereby once a man or woman who attends an STD clinic has their infection diagnosed, they are more likely to receive much of their care in specialist services outside the normal STD clinics, thereby underestimating the prevalence of HIV.^{8,12}

THE NATIONAL SURVEY OF SEXUAL ATTITUDES AND LIFESTYLES (NATSAL)

The methods and results of the NATSAL survey have been published elsewhere.^{7,13} In summary, in 1990 and 1991 a population based stratified randomly selected sample of 18 876 men and women aged 16–59 years resident in England, Wales, and Scotland were interviewed about their sexual attitudes and lifestyles using a face to face questionnaire, administered by a trained interviewer, and a self completion booklet. The sampling unit was the household, and among households in which an eligible resident could be identified and selected a completed interview was achieved in 72%. The sample was broadly representative of the age, marital status, and ethnic structure of the population in the country.¹⁴ The information collected which was used in this exercise included age, sex, region of residence, sexual orientation, ever been to an STD clinic, sex of sexual partners during different time intervals, and injection of non-prescribed drugs. Only information on age, sex, and area of residence was collected for NATSAL non-responders.

BASE POPULATIONS

Mid year estimates of the sizes of the 1991 and 1993 male and female populations, projected from the 1991 Census for England and Wales, were supplied by the Office for National Statistics (ONS).¹⁵

ADULTS INFECTED WITH HIV THROUGH BLOOD TRANSFUSIONS OR FACTOR CONCENTRATES

Close surveillance of the outcome of infection is made for this group, among whom it is considered that infections had by 1991 been almost entirely recognised and reported (all blood products have been subject to donor deferral and anti-HIV screening since 1984). Therefore, actual data of HIV infected adults not known to have died or to have left the United Kingdom were used.

It was not always possible to achieve an exact match between the categories defined by the

datasets collected in the above surveys and therefore approximations and adjustments were made as follows.

Geographical areas

For the purposes of this study England and Wales were divided into three areas, inner London, outer London, and the rest of England and Wales, and UAPMP and PDI data from sampling sites within or outside London were taken to be representative of their entire respective areas. The data for England and Wales using NATSAL were accordingly analysed using these three areas. This geographical division is justified by the large differences in seroprevalence between inner and outer London, and the rest of England and Wales, with similar and low rates of reported HIV infection in areas beyond London.⁸

The unlinked programme gives information on the location of testing, whereas NATSAL gave data reported by the place of residence. An attempt to reduce this geographic discrepancy has been made by taking account of cross boundary flow, using the PDI data.

It has been shown that many people resident in outer London attend for treatment for HIV in inner London STD clinics.⁹ Therefore, in applying the direct method, adjustment was made to take account of the cross boundary flow for clinic attenders using weighted estimates of the greater London population based on attendance rather than residence derived from the PDI data. Table 1 shows the cross boundary flow for the risk group HIV infected homo/bisexual men, 94% were treated in inner London in 1993. Eighty four per cent and 85% of HIV infected heterosexual men and women, respectively, were treated in inner London.

Age groups

Age specific estimates, using the age bands 16–24, 25–34, 35–44, and 45–59 years, of the relative proportions of the defined risk groups resident in inner London, outer London, and the rest of England and Wales were derived using the National Survey of Sexual Attitudes and Lifestyles.⁷ These age specific survey proportions were then applied to the ONS population estimates to produce the denominators for the defined risk groups in 1991 and 1993.¹⁵ HIV seroprevalence estimates were derived from the National Unlinked Anonymous HIV Seroprevalence Monitoring Programme for many of the risk categories.⁸ Other related information came from the PDI data,⁹ from follow up of people infected through blood or coagulation factor (J Mortimer and P Rogers, personal communication), and from epidemio-

logical research among injecting drug users (G Stimson, personal communication). The prevalence estimates of HIV infection were applied to the age adjusted risk group denominators to produce an estimate of the number of likely HIV infected people. The total number of infections was derived by summing over the age specific groups.

Differences among populations attending STD clinics in inner and outer London

HIV prevalences among attenders at certain STD clinics in central London are higher than among those attending outer London clinics. This is observed in every major HIV exposure category but is more pronounced among homo/bisexual men.⁸ Seroprevalences observed for homo/bisexual men attending outer London clinics are more similar to those for men attending clinics in the rest of England and Wales than they are to those attending in the high prevalence inner London clinics.⁸

BEHAVIOURAL CATEGORIES

The estimates of the number of HIV seropositive people in England and Wales aged 16–59 were determined for the following 10 categories (risk groups).

1 Homo/bisexual men who are known clinically to be HIV infected and who are receiving care.

2 Current homo/bisexual men who have been to an STD clinic in the past 5 years and who are not known to be HIV infected (current defined as men reporting a male sexual partner in the past 5 years).

3 Current homo/bisexual men who have not been to an STD clinic in the past 5 years and who are not known to be infected.

4 Past homo/bisexual men not known to be infected (past defined as men reporting a male sexual partner more than 5 years ago).

5 Current injecting drug users (current defined as reporting injecting in the past 5 years).

6 Past injecting drug users (past defined as more than 5 years ago).

7 Heterosexual men and women known clinically to be HIV infected, transmission ascribed to heterosexual sex and who are currently receiving care.

8 Current non-injecting heterosexual men and women who have been to an STD clinic in the past 5 years and not known to be infected.

9 Low risk heterosexual men and women who have had a sexual partner and are not in any of the above categories.

10 Recipients of infected blood transfusions or factor concentrates.

1 Homo/bisexual men known clinically to be HIV infected and receiving care

Prevalent diagnosed infection data were classified into subcategories according to where the people attended for care (inner London, outer London, and rest of England and Wales).

2 Current homo/bisexual men attending STD clinics (not known to be HIV infected)

As stated above, the data were weighted to

Table 1 Movement for treatment of HIV infection in homosexual/bisexual men at STD clinics within London in 1993

Treated in:	London		Total resident (100%)
	Inner (%)	Outer (%)	
Resident in:			
Inner London	3234 (99)	37 (1)	3271
Outer London	1048 (83)	217 (17)	1265
Total treated	4282 (94)	254 (6)	4536

adjust for cross boundary flow using age specific populations derived from the 1993 survey of prevalent diagnosed infections (table 1). Cross boundary flow between London and elsewhere was negligible and therefore ignored (A Molesworth and J Mortimer, personal communication). Reported totals for those known to be infected, obtained from the PDI survey, were subtracted from the estimated age specific populations. HIV seroprevalences among those not known to be HIV infected from the UAPMP survey were applied to these new populations.

3 Current homo/bisexual men who have not attended STD clinics (not known to be HIV infected)

It is inappropriate to weight this population for any cross boundary flow because these men, by definition, have not attended an STD clinic. Estimates for this group had previously been derived using 1991 seroprevalences among clinic attenders divided by a factor of five on the premise that non-attenders have only a fraction of the risk of attenders.^{6,16} In the absence of additional information the same method was employed, but using the prevalences of those not known clinically to be infected and dividing by a factor of four which agrees more closely with previously observed data.¹⁶ In 1991 prevalence data for outer London clinics were not available so the data for clinics in the rest of England and Wales were used.

4 Previously homo/bisexually exposed men (not known to be HIV infected)

The denominator for this group is large and much of it is made up of individuals who have had only a limited number of homosexual contacts more than 5 years ago.⁷ It is inappropriate to assume the same level of risk of infection for this group as those current and continuing clinic attenders actively engaging in homosexual sex. The lowest prevalence (homosexual men not known clinically to be infected and not attending STD clinics in the rest of England and Wales in 1991 and 1993) were used for men resident in inner London and half these values for elsewhere.

5 Current injecting drug users

These estimates were calculated, adjusting and not adjusting for age, using UAPMP survey seroprevalence data. There was little difference between the two methods and therefore data shown were adjusted for age. Seroprevalences in London were based on small numbers of specimens and hence data were combined for the period 1991–4. During this period there was no evidence of a trend in prevalence.⁸

6 Past injecting drug users

It was considered likely that this group was at lower risk than those currently injecting drugs and seroprevalences for them were those derived for women outside London.

7 Heterosexual men and women known clinically to be HIV infected and receiving care

As for the homo/bisexual category (1), data

from the PDI survey were classified into subcategories according to where the people attended for care.

8 Current heterosexual STD clinic attenders (not known to be HIV infected)

The data were weighted in accordance with the cross boundary flow figures given earlier, using age specific populations derived from the 1993 PDI survey. Reported totals for those known to be HIV infected, using the PDI data, were subtracted from the estimated age specific populations. Age specific seroprevalences of those men and women not known to be infected from the UAPMP survey were applied to these new populations.

9 Low risk heterosexuals—allowing for higher fertility in ethnic African women compared with all other women

The prevalences for low risk heterosexuals were calculated using the seroprevalence observed among pregnant women obtained from unlinked anonymous dried blood spot testing.⁸

Women born in Africa, and of ethnic African origin, who are resident in England and Wales experience higher fertility (numbers of live births) than either women born in the United Kingdom or women in all other ethnic groups combined.¹⁷ These same women are also at increased risk of being HIV infected. Hence estimates of levels of HIV infection based on unlinked anonymous testing of samples related to pregnancies or live births, will tend to be biased upwards by the increased likelihood of inclusion of HIV infected African women compared with other women.⁸ The estimate of current infections in people at lower risk was adjusted, assuming conservatively that 80% of the HIV positive births born to women resident in London and 40% for the rest of England and Wales were to women probably exposed to infection in sub-Saharan Africa,⁸ and in the absence of further published data, that the fertility among women of African ethnic origin was twice that of the female population overall.

10 Recipients of infected blood transfusion or factor concentrates

Seroprevalence data were not used for this group. The number of HIV infected adults alive and living in the UK was used (J Mortimer and P Rogers, personal communication).

Table 2 shows a summary of the above behavioural categories, their definitions, and the sources of data used.

OVERLAPPING CATEGORIES

Adjustments were made to allow for a person appearing in more than one risk group.⁶ Using data from NATSAL it was considered possible that a woman could appear in one or more of the following categories: (a) having a child less than 5 years old; (b) STD clinic attendance during past 5 years; (c) injecting non-prescribed drugs during past 5 years.

Considering the overlap between these cate-

Table 2 Risk categories: denominator and seroprevalence definitions

Risk categories	Denominator definition	Seroprevalence definition
1 Homo/bisexual men known to be HIV infected and currently receiving care	Not applicable, data from PDI	Data from PDI
2 Current homo/bisexual men STD clinic attenders (not known to be HIV infected)	Men reporting a male sexual partner in the past 5 years and have been to an STD clinic in the past 5 years	HIV seroprevalence among people not already clinically identified
3 Current homo/bisexual men non-STD clinic attenders (not known to be HIV infected)	Men reporting a male sexual partner in the past 5 years and have not been to an STD clinic in the past 5 years	One quarter of HIV seroprevalence among people not already clinically identified
4 Past homo/bisexual men (not known to be HIV infected)	Men reporting a male sexual partner more than 5 years previously	See text
5 Current injecting drug user	People reporting injecting drug use in the past 5 years	Seroprevalence among people attending specialist centres for injecting drug users
6 Past injecting drug users	People reporting injecting drug use more than 5 years previously	See text
7 Heterosexual men and women known to be HIV infected and currently receiving care	Not applicable, data from PDI	Data from PDI
8 Current heterosexual STD clinic attenders (not known to be HIV infected)	People reporting having attended an STD clinic in the past 5 years, not reporting injecting drug use and (men only) not having had a sexual partner of the same sex	HIV seroprevalence among people not already clinically identified
9 Low risk heterosexual (not known to be HIV infected)	All people who have had a sexual partner and are not in any of the above categories	Dried blood spot seroprevalence (see text)
10 Blood or coagulation factor recipients	Reports of HIV infected people to PHLS AIDS centre	See text

gories reduced the estimate for the total number of infected low risk women by 13% because of the overlap with STD clinic attenders, and 7% because of the overlap with injecting drug users, leaving 80% of the original number calculated. It was assumed that the prevalence for low risk heterosexual men was the same as for low risk women.

Results

The resulting overall estimates for specific exposure categories, of the number of HIV infected adults, are presented in table 3 for

1991 and 1993. Those adults known to be infected and who are receiving care are incorporated into their respective exposure groups. These figures are marginally lower than those published in 1996 as a result of rounding.³ Overlap between categories was appropriately adjusted for as stated previously. Owing to the number of assumptions and the various datasets used to calculate an estimate, it seemed inappropriate to construct error bands giving a 95% confidence interval within which the true estimate would lie. Some of the prevalence estimates were too small to derive a reasonable sampling error.

Table 3 Estimated number of HIV infected adults in England and Wales at the end of 1991 and 1993

Exposure category	Geographic area	Estimated number infected		
		1991	1993	
Current homo/bisexual males	Inner London	7 100	7 000	
	Outer London	400	400	
	Rest of E & W	4 000	4 000	
Total		11 500	11 400	
Past homo/bisexual males	Inner London	400	300	
	Outer London	200	100	
	Rest of E & W	1 300	800	
Total		1 900	1 200	
Current injecting drug users	Men	London	1 000	1 400
		Rest of E & W	300	200
	Women	London	700	400
		Rest of E & W	100	100
Past injecting drug users	Men	600	300	
	Women	200	100	
	Total	2 900	2 500	
Heterosexual GUM attenders	Men	Inner London	1 100	1 400
		Outer London	100	100
		Rest of E & W	600	500
	Total	1 800	2 000	
	Women	Inner London	800	900
		Outer London	200	200
Rest of E & W		700	500	
Total	1 700	1 600		
Low risk heterosexuals	Men	1 300	1 600	
	Women	1 400	1 700	
	Total	2 700	3 300	
Blood or coagulation factor recipients		900	800	
Overall total		23 400	22 800	

E & W = England and Wales.

Table 4 A comparison of the estimates of the number of prevalent infections in adults at the end of 1991 using this updated calculation and Giesecke *et al.*'s method⁶

Exposure category	Updated 1991	Giesecke <i>et al.</i> 1991
Homo/bisexual males		
London	8 100	9 330
Elsewhere	5 300	5 560
Total	13 400	14 890
Injecting drug users	2 900	4 450
Heterosexual	6 200	6 340
Overall total	22 500	25 680

Discussion

Use of the direct method to estimate the prevalence of HIV infection in England and Wales suggests that the number of infected people in 1991 and 1993 was 23 400 and 22 800, respectively. These data have considerable implications for those concerned with HIV prevention and care. The numbers of homosexual and bisexual men living with HIV infection declined by only 6% from 13 400 (1991) to 12 600 (1993) (table 3) and when the known mortality of over 1000 per annum in this group is taken into account the decline actually translates into a substantial incidence of new homosexually acquired infections, an estimated rate of over 700 per annum.³ In contrast, the more significant 14% decline in prevalence among injecting drug users (table 3) is consistent with low rates of HIV transmission through needle sharing.³ These results are confirmed by other indicators of high rates of HIV transmission among homosexual men and low rates among injecting drug users.⁸

Six thousand of the total burden of around 23 000 prevalent HIV infections had progressed to AIDS or severe HIV disease by the end of 1993.³ The remaining 17 000 infections will present major future burdens to health and social services as they progress to disease.

POSSIBLE BIASES

The main sources of bias in the estimates derived in this study are the sampling errors in the UAPMP surveys and the response biases in the NATSAL survey. These issues of bias were discussed by Giesecke *et al.*, and are not further investigated.⁶ Improving the quality of the seroprevalence data has led to other issues of bias being encountered, specifically related to injecting drug use. The NATSAL survey did not collect data on the prison population. Various estimates have been proposed as to the number of the current prison population who injected drugs preceding imprisonment.^{18 19} There is also a problem of what HIV prevalence to apply to this population. The only available information for England suggests a very low prevalence of 0.3% in prisoners and in the absence of further data it was decided to exclude them from this study.⁸

The homeless and the institutionalised population were not surveyed in NATSAL either, although of the new episodes reported in 1994 to the North Thames Regional Drugs Misuse Database,²⁰ 37% lived in hostels, bed and breakfast hotels, squats, or were of no fixed abode, and a further 6.2% were resident in rehabilitation or treatment centres. This com-

plexity was thought to be too difficult to quantify.

There may be a time trend effect, and NATSAL was conducted in 1990/91. There are indications of an increase in injecting, at least insofar as reported in statistics of drug addicts notified to the Home Office.²¹ Between 1990 and 1993 there was a 53% increase in the number of new notifications where injecting was reported. It is unclear whether this increase represents an increase in injecting rates, an increase in the proportion of addicts seeking services, or both. There was no reason to believe that underreporting by NATSAL participants of injecting drug use behaviour occurred, and it was not found that questions on drugs generally had lower response rates than other items.¹³ There was also no reason to believe that NATSAL underrepresented areas of deprivation,⁷ where injecting drug use may be higher than elsewhere.

The North West Region was believed to be overrepresented in the outside London area for surveillance of injecting drug use, and that adjustment for its low HIV prevalence rate should be made accordingly. The low prevalence was however offset by a large injecting drug use population in that region and was thought to be of the correct magnitude and overall seroprevalence was not altered by leaving out this region. These points might indicate that this current calculation underestimates the prevalence of injecting and hence the number of HIV infections. On the other hand, HIV prevalence surveys are more likely to recruit longer standing injectors who are at increased risk of being HIV positive, and this may lead to an overestimate of HIV prevalence. Choosing the most appropriate prevalence is difficult. Estimates from the UAPMP have previously been lower than other studies and this improved method has resulted in an estimate that is closer to estimates derived by indirect methods.^{3 22 23}

The bias due to sampling errors still exists in the present calculations and is unlikely to be quantifiable owing to the increase in the number of assumptions made.

COMPARISON WITH PREVIOUS ESTIMATES

The revised estimates for 1991 of the number of HIV infected people in England and Wales are compared with those derived by Giesecke *et al.* in 1991 in table 4.⁶

The estimated number of HIV infected homosexual and bisexual men in 1991 is less than that estimated by Giesecke *et al.*⁶ This is the result of a number of factors including more reliable seroprevalence data and, especially, in quantifying those already known to be HIV infected. The estimate for infected injecting drug users is nearly halved, because a more stringent approach was used to define the denominator of current injecting drug users and prevalence estimates relied only on the UAPMP. Support for this approach is shown by the estimate of 2900 now coming close to those derived by indirect methods for 1991 of 2010 and 1800.⁴ Previously the estimates obtained from the direct method were outliers. The estimate for infected heterosexuals is slightly lower

than that estimated by Giesecke *et al.*⁶ Again, this may reflect the completeness of data on those clinically diagnosed with HIV and receiving care. The unlinked anonymous newborn infant dried blood spot survey was used to estimate the number of HIV infected low risk heterosexuals and adjustments were made to reduce the effect of higher fertility for women in countries where heterosexual transmission is common.

The 1993 estimates have been improved by a number of new developments which were not available previously. The introduction of the survey of prevalent diagnosed infections has enabled the actual number of men and women who have had their HIV infection diagnosed to be quantified. The cumulative data from the unlinked anonymous survey have been improved, and updated prevalences now exist for those not known to be HIV infected for inner and outer London, respectively, and for the rest of England and Wales. Cross boundary flow gives better estimates based on where people are treated rather than where they live. The unlinked anonymous newborn infant dried blood spot survey provides the best estimates of prevalence for the low risk heterosexuals and allowance has been made for differences in fertility for women who were at a higher risk of HIV infection than the rest of the population.

There are still areas of uncertainty and potential improvement. For example, for those whose exposure category does not give direct seroprevalence data, such as male homo/bisexual non-clinic attenders and those who had a homosexual relationship more than 5 years ago. Estimates of the effect of differential fertility will be improved by data on HIV infected women in England and Wales as international data suggest results vary between countries.^{24 25}

The Unlinked Anonymous HIV Prevalence Monitoring Programme and the National Survey of Sexual Attitudes and Lifestyles are the two main sources of information used to provide data on the HIV and AIDS epidemic and the behaviour patterns that underlie it, which complement the national system of AIDS case reporting. The estimates of the number of prevalent infections at the end of 1993 using the test history and diagnosis interval methods were 20 540 and 22 350, respectively.³ These estimates are similar to the direct method, and the accordancy is especially good for the homo/bisexual and heterosexual categories,³ although the other methods depend on the test behaviour of infected individuals, which is known to be influenced by external factors and vary with time.²⁶

However, it should be noted that the NAT-SAL survey on which most of this work was based, being the main source for the denominator information, was carried out in 1991. Although it is unlikely that the behavioural patterns of the population would have changed significantly by 1993, any future estimates using the survey may be subject to increasing error as behavioural data become outdated. Further information on the distribution of behaviour after 1990/1 will be particularly helpful for future applications of this method.

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- 1 Karon JM, Rosenberg PS, McQuillan G, Khare M, Gwinn M, Petersen LR. Prevalence of HIV infection in the United States, 1984 to 1992. *JAMA* 1996;276:126-31.
- 2 Holland FJ, Ades AE, Davison CF, Parker S, Berry T, Hjelm M, *et al.* Use of anonymous newborn serosurveys to evaluate antenatal HIV screening programmes. *J Med Screening* 1994;1:176-9.
- 3 Report of a working group convened by the Director of the Public Health Laboratory Service on behalf of the Chief Medical Officers. The incidence and prevalence of AIDS and prevalence of other severe HIV disease in England and Wales for 1995 to 1999: projections using data to the end of 1994. (Chairman: Professor N E Day.) *Communicable Disease Report* 1996;6:R1-24.
- 4 Report of a working group convened by the Director of the Public Health Laboratory on behalf of the Chief Medical Officers. The incidence and prevalence of AIDS and other severe HIV disease in England and Wales for 1992-1997: projections using data to the end of June 1992. (Chairman: Professor N E Day.) *Communicable Disease Report* 1993;3:S1-17.
- 5 Report of a working group for the Department of Health, Welsh Office. Short-term prediction of HIV infection and AIDS in England and Wales. (Cox report) London: HMSO 1988.
- 6 Giesecke J, Johnson A, Hawkins A, Noone A, Nicoll A, Wadsworth J, *et al.* An estimate of the prevalence of human immunodeficiency virus infection in England and Wales by using a direct method. *J R Statist Soc A* 1994; 157:89-103.
- 7 Johnson AM, Wadsworth J, Wellings K, Field J. *Sexual attitudes and lifestyles*. Oxford: Blackwell Scientific Press, 1994.
- 8 Unlinked Anonymous HIV Surveys Steering Group. Unlinked anonymous HIV seroprevalence monitoring programme in England and Wales—data to the end of 1995. London: Department of Health, PHLS, The Institute of Child Health, University of London, 1996.
- 9 Howitt DJ, Mortimer JY, Evans BG, Noone PA. People who travel to be treated for HIV infection: keeping track for care management. *Communicable Disease Report* 1995;5: R120-2.
- 10 Gill ON, Adler MW, Day NE. Monitoring the prevalence of HIV: foundations for a programme of unlinked anonymous testing in England and Wales. *BMJ* 1989;299: 1295-8.
- 11 Public Health Laboratory Services—Unlinked Anonymous HIV Prevalence Monitoring Programme. Reference Tables (unpublished).
- 12 Nardone A, Rogers P, Joyce C, Nicoll A, Mercey D. The interpretation of trends in HIV seroprevalence amongst homo/bisexual men attending a GUM clinic in central London. MRC AIDS Research Workshop, 1995 (abstract 29).
- 13 Johnson AM, Wadsworth J, Wellings K, Bradshaw S, Field J. Sexual lifestyles and HIV risk. *Nature* 1992;360:410-2.
- 14 Wadsworth J, Field J, Johnson AM, Bradshaw S, Wellings K. Methodology of the National Survey of Sexual Attitudes and Lifestyles. *J R Statist Soc* 1993;156:407-21.
- 15 Office of National Statistics. Mid 1991 and 1993 population estimates for England and Wales. ONS Monitor (PP1 94/2). London: HMSO, 1994.
- 16 Hunt AJ, Davies PM, McManus TJ, Weatherburn P, Hickson FC, Christofinis G, *et al.* HIV infection in a cohort of homosexual and bisexual men. *BMJ* 1992; 305:561-2.
- 17 Office of National Statistics. Birth Statistics 1992 (Series FM1 no 21, Table 9-1-9-6). London: HMSO, 1994.
- 18 Taylor A, Goldsberg D, Emslie J, Wrench J, Gruer L, Cameron S, *et al.* Outbreak of HIV in a Scottish prison. *BMJ* 1995;310:289-92.
- 19 Turnbull PJ, Stimson GV, Stillwell G. *Drug use in prison*. Horsham: AVERT, 1994.
- 20 Hayden DA, Stimson GV. *Drugs: the state of the region*. 3rd ed. *Issues in substance use and HIV/AIDS in North Thames Region*. London: Centre for Research on Drugs and Health Behaviour, 1995.
- 21 Research and Statistics Department. *Statistics of drug addicts notified to the Home office, United Kingdom, 1995*. Home Office Statistical Bulletin, Issue 15/96. London: Home Office, 1996.
- 22 Stimson GV, Hunter GM, Donoghoe MC, Rhodes T, Parry JV, Chalmers CP. HIV-1 prevalence in community-wide samples of injecting drug users in London, 1990-1993. *AIDS* 1996;10:657-66.
- 23 Strang J, Gossop M, Griffiths P, Powis B. HIV among south London heroin users in 1991. *Lancet* 1992;339:1060-1.
- 24 Stephenson JM, Griffioen A and the Study Group for the MRC Collaborative Study of women with HIV. The effect of HIV diagnosis on reproductive experience. *AIDS* 1996; 10:1683-7.
- 25 Boisson E, Nicoll A, Zaba B, Rodrigues LC. Interpreting HIV seroprevalence data from pregnant women. *J AIDS* 1996;13:434-9.
- 26 Waight PA, Rush AM, Miller E. Surveillance of HIV infection by voluntary testing in England. *Communicable Disease Report* 1992;2:R85-8.