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Using STD occurrence to monitor AIDS prevention*

Summary

Monitoring the effects of AIDS prevention programmes is increasingly important but methodologically difficult. The use of surveillance derived measures of the occurrence of sexually transmitted diseases as indicators of high risk sexual behaviour, or of HIV incidence, has been widely recognised as a possible approach. This paper first examines the theoretical and empirical basis for this strategy, and highlights, using examples, some of the pitfalls in the interpretation of trends in sexually transmitted disease occurrence. Problems arising in the interpretation of the types of STD surveillance data currently available in countries in Western Europe are discussed. Ways in which STD surveillance systems might be developed so as to enhance their value in monitoring AIDS prevention are proposed. The paper goes on to identify areas of clinical and epidemiological research which might improve our ability to interpret such enhanced STD surveillance data.

AIDS prevention programmes have attempted to bring about changes in behaviour relating to the various modes of HIV transmission, through health education. Awareness of the need to assess the effectiveness of these programmes has been growing. Knowledge-Attitude-Practice (KAP) studies provide a popular approach to assessment, but their interpretation is frequently plagued by problems concerning the validity of the measures used, and the extent to which results might be generalised[1]. Furthermore, experience teaches that changes in behaviour to match changes in knowledge and attitudes are far from automatic[2]. The measurement of programme impact on HIV occurrence through prospective serological studies offers a more direct approach. Such studies can provide an accurate picture of secular trends in HIV seroprevalence[3], but, without controlled trials, we cannot know what these trends would have been without the intervention of prevention programmes.

Against this background the possibility of using the occurrence of sexually transmitted disease (STD) as a measure of programme impact become attractive. There are three ways in which STD occurrence bears on the problem of HIV infection. Firstly STDs may influence the susceptibility of individuals to infection[4]. Secondly STDs may influence the natural history or course of the disease process in those infected with HIV[5]. Thirdly, because sexually transmitted pathogens share with HIV a predominant mode of transmission through sexual intercourse, the frequency of occurrence of these diseases might tell us something which is relevant to the transmission of HIV.

In what follows we will focus on the third of these. We will consider the extent to which measures of STD occurrence can usefully be employed as indicators of the effectiveness of AIDS/HIV prevention programmes, and describe some of the pitfalls and practical problems encountered. We will desribe the types of STD surveillance currently in operation in Western Europe, and consider the extent to which the shortcomings of these systems limit our ability to infer changes in sexual behaviour from trends in STD occurrence. We will suggest how basic epidemiological research in conjunction with the further development of STD surveillance systems might enhance our ability interpret the data in this way.

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Which diseases?

Direct and indirect indicators

There are two distinct ways in which STD occurrence might be used as an indicator of the occurrence of HIV infection. Where the incidence of an STD within a population changes in a predictable way with changes in *HIV incidence,* then trends in the incidence of that disease may be used as a direct measure of trends in HIV incidence. For the purposes of the ensuing discussion we refer to such notional STDs as *direct indicators.*

Where the incidence of an STD within a population changes in a predictable way with changes in *sexual behaviour,* then trends in the incidence of that disease may be used as a direct measure of trends in that sexual behaviour. If the relationship between the same sexual behaviour pattern and HIV incidence is also known and predictable, we can infer trends in HIV incidence *indirectly* from observed trends in the incidence of the STD. We refer to such notional STDs as *indirect indicators* for the purposes of discussion.

The distinction made is an important one, because an STD whose incidence is rapidly sensitive to changes in sexual behaviour, is likely show quite different overal epidemiological characteristics to those of HIV infection.

Theoretical and empirical approaches

The sexually transmitted diseases are a diverse group of viral bacterial, protozoa, fungal and ectoparasitic infections which share with HIV a common route of transmission through sexual intercourse. Infection with each of these organism presents its own pattern of clinical features, prognosis, and transmisi-on dynamics, determined by the biological features of the organism, the host response to infection and patterns of sexual contact. We can use both theoretical and empirical approaches to identify STDs whose changes in incidence over time might closely reflect changes in sexual behaviour, or in incidence of HIV infection. What we mean by this can be summarized as follows:

Theoretical approach

- Use our knowledge of the organism, its mode of transmission, and host response to exposure, to predict its likely transmission dynamics and thus suitability as an indicator.

Empirical approach

- Use available information on the observed association between occurrence of the infection and sexual behaviour of HIV incidence to establish its suitability as an indicator.

We will deal with each in turn.

Theoretical approach

Transmission models of infectious diseases enable us to identify several factors which are likely to exert an important influence on the incidence rate of a sexually transmitted infection. These are summarized in table 1.

'Biological'	'Behavioural'
– Infectivity – Protective Immunity – Period of infectiousness – Incubation period – Fatality	– Sexual contact rate – Type of contact

Table 1. *Transmission parameters determining incidence rates of sexually transmitted diseases and HIV.*

Features of a sexually transmitted infection which lead its incidence to change rapidly with changing sexual contact rate

- high infectivity
- short period of infectiousness
- short incubation period
- absence of conferred immunity

Table 2. *Features of a sexually transmitted infection which lead its incidence to change rapidly with changing sexual contact rate.*

While HIV infection and the other STDs share type and rate of sexual contact as an important determinant of incidence, biological factors vary considerably between different infections, and exert a significant and perhaps dominant influence on incidence. Using disease specific knowledge of the transmission factors, is it possible, a priori, to identify which disease might be good indicators either for type and rate of sexual contact, or for HIV incidence?

a) An indicator for type and rate of sexual contact

A good indicator for type and rate of sexual contact will be an endemic disease whose incidence in a population moves rapidly and predictably to a new level with changes in sexual behaviour. Simple models enable us to identify likely transmission factors for such a disease[6]. These are summarized in table 2.

High infectivity means that secondary cases from an infectious individual will arise quickly. Hence an increase in sexual activity will rapidly generate new cases that would otherwise not have occurred. Similarly, a decrease in sexual activity will rapidly incur a large

	Infectivity	Period of infectiousness	Incubation Period	Immunity
Neiserria Gonorrhoea	+++	weeks (Rx dependant)	days	–
Chlamydia Trachomatis	+	years (Rx dependant)	weeks	?
Treponema Pallidum	+	years (Rx dependant)	months	±
Herpes Simplex Viruses	++	years (intermittent)	days	±
Hepatitis B Virus	++	years (if s/e ag+)	months	+
Human Papillomavirus	+	years (intermittent)	weeks	?
Molluscum Contagiosum	++	while lesions present	weeks	?
HIV	+	years (intermittent?)	months	–

Table 3. *Transmission parameters of some sexually transmitted pathogens.*

deficit of cases that would have occurred if the change in activity had not happened. The duration of infectiousness should be short, so that the members of the infected class 'turn over' rapidly. If the duration is long, then inertia is introduced into the system, and the number of infectious individuals is large relative to the inflow and outflow from the class. In these circumstances the number of individuals available to cause secondary infections will remain fairly constant despite short term changes in sexual activity.

The incubation period should be short for similar reasons. A long incubation period will cause an appreciable lag to occur between change in sexual activity, and the concomitant change in the size of the pool available to cause secondary infection. The importance of an absence of conferred immunity is harder to grasp. The absence of "herd immunity" removes the periodic oscillations in incidence rate which are so characteristic of the bacterial and viral diseases of childhood. This is important because these periodic oscillations, if large, may obscure trends in incidence resulting from changes in sexual contact rate, especially when such trends are considered over short time periods.

For the majority of the STDs it is difficult to quantify these transmission factors. Perhaps the best that current knowledge will allow, is a broad description of the relative size of the parameters. Our attempt to do this for some of the STDs is shown in table 3.

Tables 2 and 3 suggest that sexually transmitted gonorrhoea infection might satisfy our requirements for an indicator of sexual contact rate. The infectivity (defined as probability of transmission of infection during an episode of sexual contact) has been estimated at between 0.4 and 0.9[7]. The time to become infectious is estimated at one to two days.

Hethcote & Yorke have used a simple mathematical model with sexual activity evenly distributed in the population, to estimate that, given a change in sexual contact rate, the incidence of gonorrhoea in the population would approach its new equilibrium level with a *half life* of 1.7 months[8]. A brief examination of the properties of this model will provide important insights.

Figure 1 shows a plot of equilibrium incidence rate against duration of infection and sexual contact rate assuming an infectivity of 0.5. Sexual contact rate is defined as the average number of sexual contacts per year, for an individual in the population. The model assumes that a sexual contact is equally likely to be with any member of the population. Clearly this is not the case in reality for heterosexuals, and where individuals are in serial monogamous relationships. However, such individuals may be considered to have an effective contact rate roughly proportional to their rate of acquisition of new partners. The figure reveals two interesting phenomena. Firstly, both duration of infectiousness and sexual contact rate are important in determining incidence. Because duration of infection is primarily determined by treatment, a modern STD service may be expected to exert a considerable influence on gonorrhoea incidence by reducing the average period of inectiousness. Secondly using our best estimates of the values of the parameters concerned, the model predicts that gonorrhoea should have died out all together. Clearly this has not occurred. The model assumes that infected individuals are distributed evenly throughout the population and that every individual has the same expected number of sexual partners, and an equal probability of having sex with any other person. This does not reflect the real situation.

More complex models have attempted to describe the real situation more closely by dividing the population into discreet groups of individuals, defined by type and rate and sexual contact. The simplest of these postulates a core

group of highly sexually active individuals and a non-core group comprising those less sexually active[8]. Figures 2 shows the overall incidence of gonorrhoea predicted by this model, for various levels of sexual contact in the core and non-core groups. The average duration of infectiousness is taken as 25 days, with the core group representing 5% of the total population, and having a mean number of partners an order of magnitude greater than that of the non-core group.

The figure again highlights two important points. Firstly, the equilibrium incidence of gonorrhoea is mainly determined by the average contact rate in the core group, while changes in contact rate in the non-core group exert a smaller effect. Secondly, for certain rates of core contact, an increase in sexual contact rate in the non-core group can lead, paradoxically, to a decrease in the incidence of the disease. The crux of this effect is the assumed independence of sexual contact rate between the core and non-core groups. If the two rates are independent, then an increase in the rate of the non-core group (while the core group rate ramains constant) results in a larger proportion of core group contacts being with members of the non-core group. This is because there are more non-core group members available to have sex with. At low levels of sexual contact rate in the non-core group, new infectious in this group do not tend to propagate. The net effect is therefore a reduction in incidence.

We cannot say whether the independence of sexual contact rate in the core and non-core groups is simply a mathematical assumption or a sociological reality, and we should clearly be cautious in our interpretation of the predictions of simple models. However, the models does emphasises that changes in gonorrhoea incidence are likely principally to reflect changes in behaviour among a small number of highly sexually active individuals. Thus gonorrhoea infections occurring in individuals with low activity will not generate many secondary infections, given the short infectious period. In contrast, because people with HIV may be infectious for many years, those with low levels of sexual activity may still contribute significantly to the overall incidence rate of infection in the long term.

It has been argued[9] that gonorrhoea infection may be acquired in circumstances unlikely to permit the transmission of HIV. This is to say that the types of sexual behaviour for which gonorrhoea infection is an indicator may not be those which are relevant to HIV transmission. This problem may be overcome in part by excluding oropharyngeal infections from the analysis. We cannot therefore assume that changes in sexual behaviour which lead to a decline in gonorrhoea incidence remove the conditions which permit the continued dissemination of HIV in the wider population. Similarly an increase in the observed occurrence of gonorrhoea may tell us little about sexual behaviour which is relevant to the dissemination of HIV in the population[9].

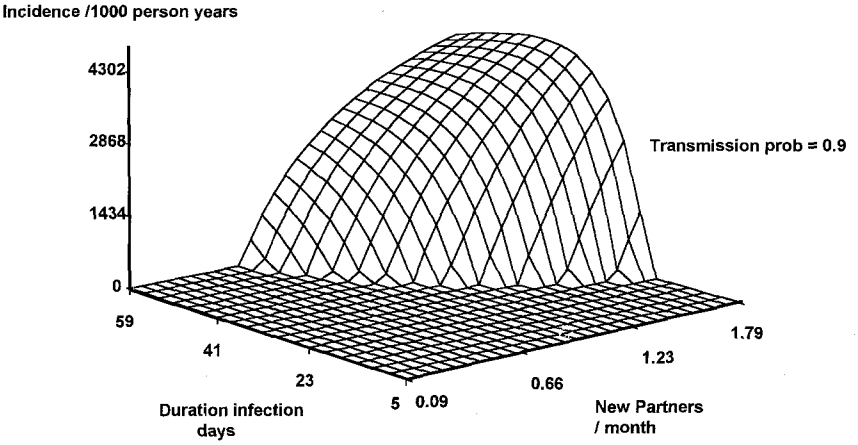

Figure 1. *Endemic equilibrium incidence of gonococcal infection by duration of infection and sexual contact rate.*

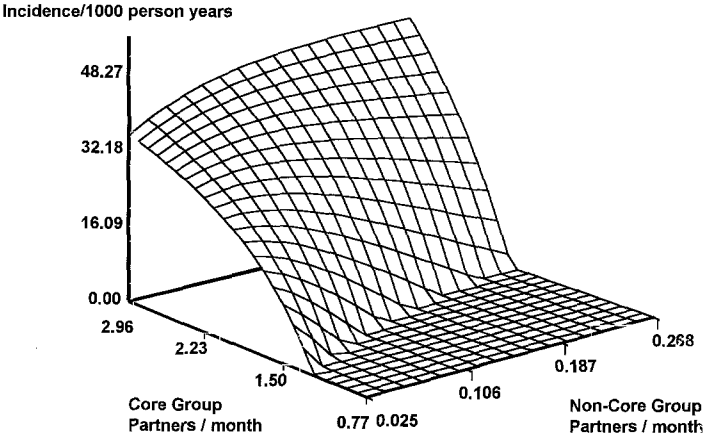

Figure 2. *Endemic equilibrium incidence of gonococcal infection core/non-core model.*

b) An indicator of HIV Incidence

If gonorrhoea incidence is unlikely to be a good indicator of HIV incidence, can our theoretical approach suggest an alternative candidate? The short answer is no, for two reasons. The first is that HIV infection in contrast to gonorrhoea and many other STDs is in an epidemic phase. That is to say it has not yet reached a level of stable endemic equilibrium. Even if there were no change in patterns of sexual activity, or duration of infectiousness, one might anticipate that it would take many years for HIV incidence to reach such a point of equilibrium. The second is that many of the transmission factors and the ways in which they interact to determine the incidence of disease are not known with sufficient accuracy either for HIV or the other STDs.

Empirical approach

We want now to move on to examine the evidence which might provide empirical support to our theoretical insights. The broad distinction drawn between an indicator of sexual behaviour, and an indicator of HIV incidence will again prove useful, and we will consider each in turn.

a) An indicator for type and rate of sexual contact

The relationship between patterns of sexual behaviour in a population and the incidence of the classical sexually transmitted diseases has never been fully investigated. This is perhaps because many STDs have been treatable, and their control can be effected by implementing programmes designed to achieve rapid diagnosis and treatment. There is thus little empirical evidence which we can use to choose an STD indicator of sexual behaviour. Ways in which we might set about obtaining such information are discussed in the final section.

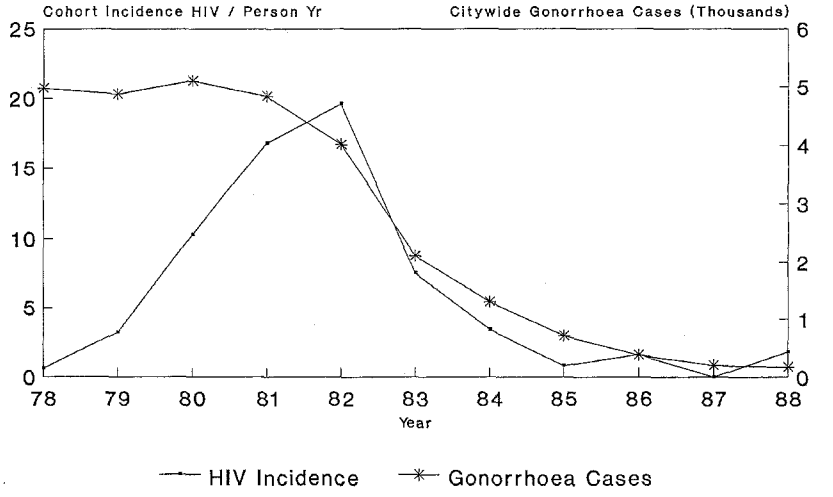

Figure 3. *Cohort incidence of HIV and city-wide cases of gonorrhoea San Francisco 1978–1988.*

b) An indicator of HIV Incidence

Prospective studies might provide the best means of identifying a suitable STD to act as an indicator of HIV incidence, as they allow direct comparison of time trends. Both prospective surveillance data and special cohort studies yield such information. HIV incidence rates in cohorts of homosexual men have been calculated for successive years during the 1980s. Figure 3 shows the results of one such study carried out in a cohort of 313 homosexual men in San Francisco[10]. HIV incidence and number of cases of rectal gonorrhoea reported in the whole city are shown for each year between 1978 and 1988. The figure shows a rapid increase in HIV incidence in the cohort up to 1982, followed by a sharp decline. A decline in city-wide notifications of gonorrhoea is also shown. On the face of it these data might be interpreted as providing empirical support for the notion that gonorrhoea incidence closely reflects HIV incidence, in a situation where HIV is endemic. There are two important reasons why we should not rush to accept this view. Firstly, while the frequency of rectal gonorrhoea is measured in the whole city population, that of HIV is only measured in the cohort. Because the peak incidence of gonorrhoea in homosexual men is in 20–24 year olds, the city based figures are likely to reflect cases in this highly sexually active age range throughout the period under study. On the other hand members of the cohort are ten years older by the end of the period, a fact which is likely to be reflected in their levels of sexual activity. Any valid comparison of time trends in STD and HIV incidence must therefore be made between groups whose age structure is comparable over the period of observation[11]. Secondly, as figure 4 shows, the prevalence of HIV in the cohort had already reached 40% by 1982.
If, as seems likely, there was considerable heterogeneity in the cohort as regards sexual partner change, the decline in incidence after 1983 might merely reflect the fact that those whose behaviour put them at risk had already been infected by that time.
The second source of prospective data is routine surveillance. While these data can provide useful in-

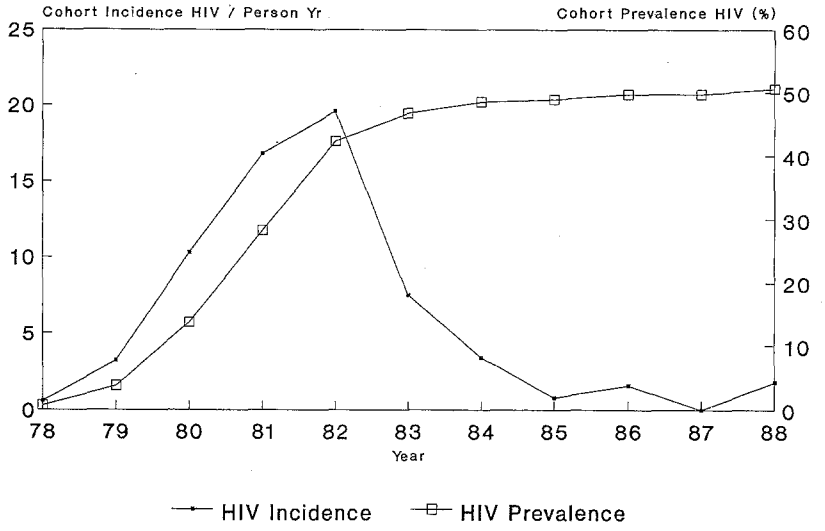

Figure 4. *Cohort incidence and prevalence of HIV San Francisco 1978–1988.*

formation on time trends in STD incidence, corresponding information on trends in HIV incidence has seldom been collected in a way which allows valid comparisons to be made. However, as data generated by new HIV surveillance programmes become available many of the problems of validity may be overcome.

Using the 'newer STDs' as indicators'

So far we have tried to understand the theoretical and empirical grounds which exist to support our common-sense notion that STD occurrence can help us to monitor AIDS prevention. Our main conclusion has been that there are good theoretical reasons for supposing gonorrhoea to be a rapid and sensitive marker for type and rate of sexual contact in highly active sections of the population. We have not found any substantial basis for thinking that any of the STDs will provide a reliable marker for HIV incidence. But what of the other 'newer STD' which appear to have become so much more common over recent years while syphilis and gonorrhoea have declined in importance? Throughout history some established infections have virtually disappeared and new diseases have emerged. The reasons for these changes are generally unknown. Because in our knowledge of sexual behaviour we find an explanatory framework in which we can understand secular trends in STD incidence, we may be tempted to see changes in this behaviour as the whole cause of such trends. If we succumb to this temptation it leads us to a paradox. The figures shows numbers of men attending STD clinics in England and Wales between 1976 and 1988 [12,13,14].

The data show two distinct patterns. Firstly there appears to be a sharp decline in attendances at which gonorrhoea and syphilis where diagnosed. It seem unlikely that these can be wholly explained by earlier treatment, improved contact tracing or epidemiological treatment. Warts, herpes and pediculosis show a marked increase to the mid 1980s followed by a suggestion of decline. Treated non-STD cases show a similar pattern, suggesting that, at least for some of these diseases, the increase might be accounted for by the incidental ascertainment of asymptomatic disease among the increasing overall number of attenders. The numbers of attenders in whom no disease was found show very similar trends, with increases of around 50% over the period. One might argue that an increase in overall attendance of the order of 50–75% would be unlikely to account for the 4–5 fold increase in genital warts or the rise in genital herpes seen over the period, although it might more easily explain the increase in non gonococcal urethritis. However, one should remember that a considerable proportion of these reported infections may have occured as multiple infections in the same persons.

Using our sexual behaviour framework how can we explain increases in some sexually transmitted disease while others are declining? One hypothesis might be that the different STDs are associated with different types of sexual behaviour. Changes in such sexual behaviour would then engender changes in the occurrence of the associated disease, without having any significant effect on the occurrence of other STDs. One might attempt a preliminary test of this hypothesis by looking for changes in the proportions of cases which the different diseases contribute to the total burden of STD diagnosed among homosexual and heterosexual men over time. Generally however breakdown by sexual orientation of cases of STD other than gonorrhoea and syphilis are not available.

Another explanation might be that the newer diseases are in an epidemic phase, and have not yet reached a stable endemic equilibrium incidence. If this is the case, then they will probably be of little value as indicators of sexual behaviour within populations. This is not however to say that they are not worthy of surveillance.

A further problem with using the 'newer diseases' as direct or indirect indicators is that there is little quantitative information concerning the relationship between sexual behaviour and disease incidence. We are therefore not in a position to know in what ways their incidence will change with changes in sexual behaviour within a population.

STD surveillance systems

STD surveillance systems were originally set up, in an era without modern antibiotics, for the primary purpose of containment and control of a limited number of venereal diseases. Clinician-based compulsory notification systems therefore dominated the scene until comparatively recently. Multiple notification of cases within these systems was quite logically considered acceptable and even desirable for control purposes. With the growth of interest in STD epidemiology which accompanied the rise in public health importance of these diseases during the 1960 and 1970s, the limited value of this data for epidemiological purposes was noted in several countries and the objectives of such systems redefined. Current objectives include obtaining information which can be used to estimate the size of the STD problem, to inform the design and evaluation of prevention and treatment programmes, and the management of services.

Many countries in Western Europe have attempted to develop STD surveillance either by enhancing existing systems, or by the implementation of new schemes [21,22]. The ways in which the various countries have attempted this, and the extent to which they have succeeded has been determined by a wide range of organisational, social and political factors peculiar to their individual circumstances. Among the more important of these factors have been the nature and structure of health care delivery for STDs, the general political acceptability of public health surveillance, and the extent to which the public and governments have regarded STDs as an important problem. STD surveillance systems may be usefully classified both by the approach taken to the ascertainment of cases, and by the extent of surveillance [21].

Cases of STD may be ascertained by

- *Diagnosis:* where cases are ascertained in patients presenting themselves for treatment of STD related symptoms. Diagnosis may be by detection of the causative organism or by clinical syndrome.
- *Case-finding:* where cases are sought by clinical or laboratory tests to detect STDs in those seeking treatment for other reasons.
- *Screening:* testing for STD in defined populations who are not seeking care.
- *Epidemiological studies:* usually prevalence surveys (cross-sectional studies) in defined population samples.

Extent of surveillance

- *National surveillance.* National surveillance schemes attempt to identify all cases reaching medical care occurring within a country.
- *Sentinel surveillance.* Sentinel surveillance schemes generally focus on identifying cases occurring within the catchment populations of particular units delivering health care.
- *Surveillance in special populations.* Surveillance in easily accessible, or epidemiologically relevant subgroups of the population such as military recruits and pregnant women.

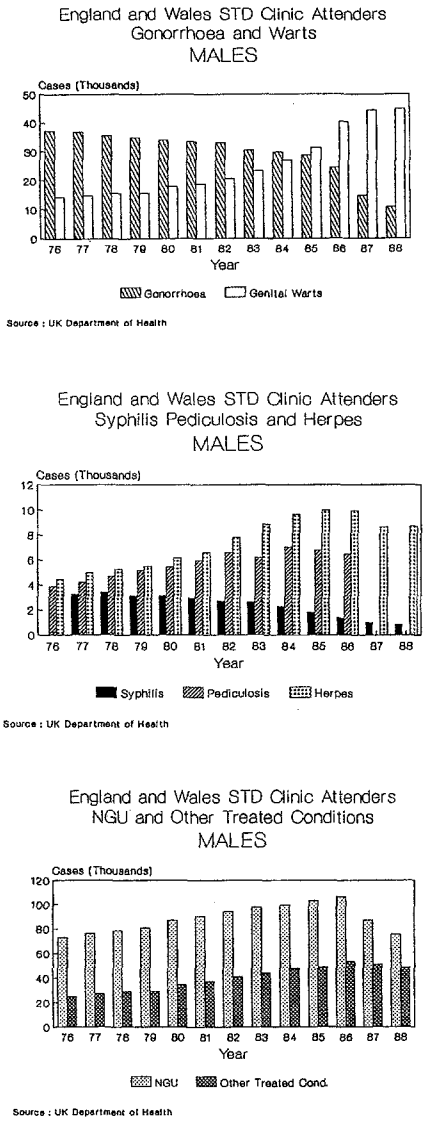

Figure 5. *England and Wales STD clinic attenders gonorrhoea and warts males.*

The types of surveillance commonly used in Western Europe described below.

a) National reporting by individual clinicians

The principle is that clinicians should report all cases of specific diseases which they see to a central authority. Reporting may be compulsory or voluntary or a combination of these. Diseases included

vary from country to country. Generally the 'classical' STDs: syphilis, gonorrhoea, chancroid and Lymphgranuloma venereum (LGV) are covered. Usually, notification is anonymous, and attached information includes age, sex district of residence and sometimes details of sexual contacts. National clinician based reporting systems potentially allow the widest coverage of cases of STD.

b) Reporting by sentinel clinician

Sentinel clinician reporting systems take notifications from defined subgroup of practitioners, chosen for their clinical speciality or interest in STDs, on the basis of the population that they serve, or because of their ability and willingness to participate. STDs may represent only a small proportion of all diseases included in the system. The possibility of obtaining a high level of commitment, coverage of a wider range of STDs and better epidemiological information through such systems has made them popular in Western Europe in recent years[17]. The consistency of reporting enables an accurate picture of time trends to be obtained. These systems are also flexible, and new diseases can be included with minimal disruption.

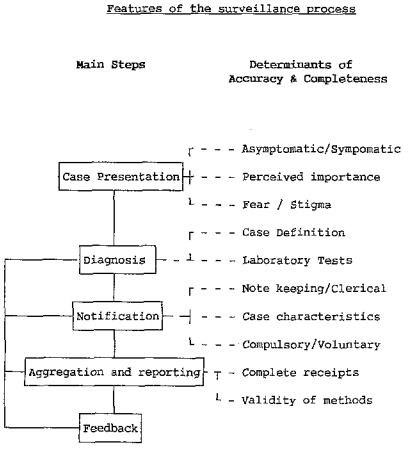

Figure 6. *Features of the surveillance process.*

c) National laboratory reporting

The general principle is that laboratories should report all positive tests for STDs which they carry out and where appropriate antibiotic sensitivities. Generally laboratories report a wide number of infectious diseases among which STDs number but a few. Laboratory reporting of STDs has been developed in a number of countries and complements clinical reporting systems. Reporting may be voluntary or compulsory.

d) Sentinel laboratory reporting

Sentinel laboratory reporting systems take notifications from defined subgroup of laboratories and national reference laboratories, chosen for their interest in STDs, on the basis of the population that they serve, or because of their ability and willingness to participate. Sentinel laboratories may be selected in conjunction with sentinel clinicians. STDs may represent only a small proportion of all diseases included in the system.

e) Screening and case finding

Much information on the prevalence of STDs within certain subgroups of the population is obtained from routine screening programmes. Hepatitis B, HIV and syphilis may be routinely screened for among blood donors, women attending for ante-natal tests, and other groups such as military recruits and prisoners. Screening programmes for chlamydia are also in vogue.

f) Special studies

Valuable and in some cases, unique surveillance data have been obtained from special studies of STD prevalence and antimicrobial sensitivity, and surveys of pharmaceutical prescribing. These surveys can provide new insight into the epidemiology of a disease or may serve to supplement routine surveillance systems. Unlinked anonymous screening studies for HIV[3,18] are a recent example of the use of this approach. Special studies are often the only method of obtaining information on the sequelae of STDs, such as the frequency of pelvic inflammatory disease after chlamydial infection or the frequency of carcinoma of the cervix after human papillomavirus infection.

Using STD surveillance data as an indicator of sexual behaviour

We have dealt at some length with questions concerning the adequacy of measures of STD occurrence as indicators of sexual behaviour, given that the measures were themselves accurate. In attempting to interpret real data generated by real surveillance systems we musk ask ourselves four additional questions. Firstly, are the estimates of the rates or trends in occurrence sufficiently accurate or consistent to allow any conclusions to be drawn? Secondly, are data available for long enough periods to allow the analysis of trends? Thirdly, is sufficient information available on the pertinent characteristcs of cases to allow meaningful interpretation, given the behavioural and sociodemographic heterogeneity of the population surveyed? And fourthly, what influences other than sexual behaviour patterns might have influenced occurrence?

Accuracy and consistency of estimates of level and trends in occurence?

Some of the factors which determine the accuracy and consistency of these estimates are common to all surveillance systems while others are peculiar to particular types of system, or the context in they operate. The common factors can be identified using the idealized scheme shown in Table 6, which emphasises that they arise at each stage of the surveillance process.

a) Case presentation

Whether or not a person with an STD ever comes to see a doctor will depend on the presence or absence of symptoms, their perceived importance, and the accessibility of medical care. Of these, the first two are likely to vary significantly with the specific clinical features of the disease in question. All of the factors are likely to vary substantially with gender, social class, ethnicity and other demographic characteristics.

b) Diagnosis

Where case reports are based on clinical diagnoses, diagnostic criteria may vary, and those cases reported may not be confirmed by laboratory tests. Furthermore laboratories may vary in the sensitivity and specificity of their diagnostic tests and testing patterns may change.

c) Case notification

The proportion of diagnosed cases which are notified will depend on whether the notification is compulsory, the existence of incentives, and the complexity of the notification process. This latter is particularly important. If we try to enhance our ability to interpret surveillance data by including more comprehensive details of cases, the complexity of the process is increased. This in turn may lead to the lowering of notification rates.

e) Aggregation and reporting

Major problems of interpretation of notification based data relate to the determination of the size of the at risk population. For crude incidence estimates this is especially a problem where surveillance is health care facility based. Where attempts are made to break down incidence rates by variables such as sexual orientation, injecting drug use, or involvement in commercial sex, the problems of assessing the size of these populations will be considerable at what ever level surveillance is being carried out.

f) Features of specific types of system which limit interpretation

Surveillance through national reporting by individual clinicians aims to record all cases of STD in a country which reach medical care. The important factor limiting interpretation is under-reporting. The proportion of STD cases which are notified varies considerably from country to country but may less than 5% [19] in some countries. In addition the lack of availability of laboratory diagnostic systems to many clinicians treating patients with STDs may also be important, especially where the majority of cases of STD are seen by general practitioners.

For most sentinel clinician networks it is very difficult to evaluate the size and characteristics of the population which participatns serve, or changes in this population or its characteristics over time. This problem limits ability both to interpret trends, and to generalise of results of countries as a whole.

Furthermore the relatively small number of participants will restrict the power of the system, particularly in the surveillance of STDs of low incidence.

Several of the common STDs are not amenable to surveillance through laboratory reports because routine diagnostic tests are not widely available. In addition any changes in the frequency with which diagnostics tests are used, such as the recent widespread and rapid increase in the use of ELISA for chlamydia trachomatis may produce major artefacts in the observed trends in occurrence derived from laboratory notifications. Laboratory reporting can only rarely provide epidemiological information beyond the age and sex of patients and, in some cases, the site of infection.

Although the problems outlined above hamper our attempts to obtain accurate measures of STD occurrence, they are less of a handicap in assessing trends in occurrence. If the influences determining case presentation, diagnosis and notification have remained fairly constant over time, then proportional changes in real incidence will be reflected in reported incidence. Conversely, artefactual trends in reported incidence are likely to appear where changes have occurred in any element of the notification system. The likelihood of cases presenting may have been a particulary important bias in recent years with attempts to focus public attention on AIDS and sexual hygiene.

Are data available for long enough periods to allow the analysis of trends?

In many countries data from STD surveillance systems are only available for recent years. The experience of countries which have collected data for decades emphasis the importance of long term information. Long term trends probably arise from a complex interaction of social, behaviour and biological factors [7]. Figure 7 shows

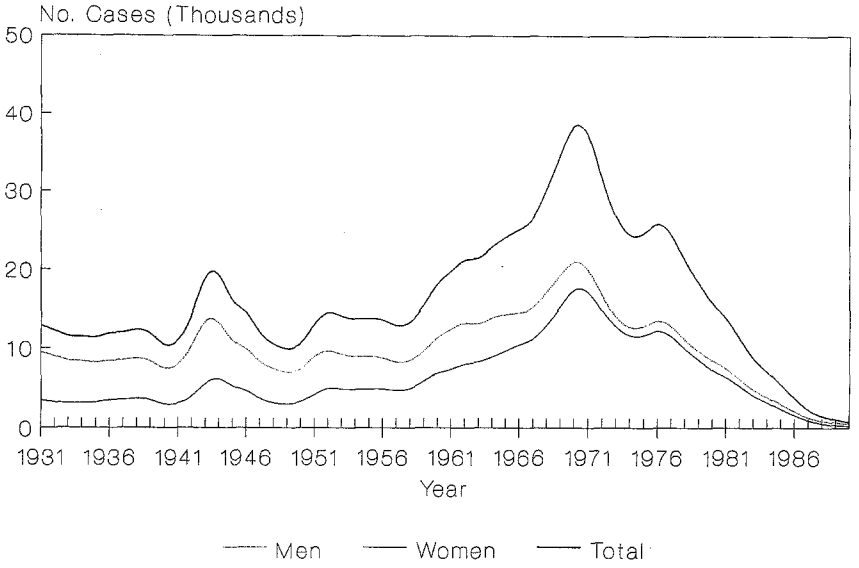

Figure 7. *Notified cases of gonorrhoea in Sweden 1931–1990.*

annual case reports for gonorrhoea in Sweden between 1912 and 1990[20]. Numbers of reported cases are shown combined for both sexes, and for men and women individually.

The figure shows interesting peaks around both the first and second world wars, perhaps resulting from changes in the stable patterns of sexual behaviour during socially disrupted times. A sharp increase begins in the early 1960s reaching a peak in 1970, and then declining sharply to reach, by 1982, its lowest level at any time since 1915. The decline then continues to 1987. The figure is intended to demonstrate the magnitude of the trends which have occurred over the last 85 years, against which backdrop we must assess the influence of AIDS prevention programmes in recent years and in the future. Failing to take this longer view may lead to misinterpretation. An example will again serve to illustrate the point.

Figure 8 shows the total number of positive gonococcal isolates obtained from male patients attending the Genitourinary Medicine Clinic at St Mary's Hospital, Paddington, UK in the first six months of 1983, 1984, 1985 and 1986. The data were published in a letter, the final line which is quoted at the bottom of the figure[21].

Figure 9 shows the same data plotted together with the number of cases of gonorrhoea notified to the Department of Health by the same clinic between 1976 and 1986[22].

The figure suggests that the decline in number of gonococcal isolates from men was actually the continuation of a trend which had been occurring since at latest 1977 and was therefore not due to fear of AIDS. While it is certainly possible that in the absence of AIDS, the number of gonococcal isolates might have remained steady or increased, the need for caution in the interpretation of short term trends is emphasised.

Is sufficient information available on the pertinent characteristics of cases to allow meaningful interpretation?

While existing surveillance systems can provide a broad impression of the trends in STD incidence, very often age and sex are the only case characteristics notified. The absence of more detailed information limits the value of the data as a measure of the success of AIDS prevention programmes. Three types of information which are frequently lacking would be particularly useful. Whether of not a case is a reinfection, and details of a case's STD history would be valuable in assessing trends, and distribution of cases. HIV transmission *risk category* attached to each notification would enable an assessment of adoption of *safer sex* practices within particular transmission groups. Details of the recent sexual history of cases would allow more accurate assessment of the relationship between sexual behaviour and STD risk.

What influences other than sexual behaviour patterns might have influenced occurrence?

a) Effects of treatment and contact tracing programmes

Clearly these are importance for diseases where treatment is available. The mean duration of infectiousness is major factor influencing the incidence of gonorrhoea[8]. Treatment of cases and sexual contacts will tend to reduce the average duration substantially. We must therefore be alert to the possibility that changes in the incidence of treatable sexually transmitted diseases may result as much from the success or failure of our treatment and secondary prevention programmes as from changes in sexual behaviour. The size of the effect on reported occurrence of STD may be very difficult to assess.

b) Effects of widespread antibiotic prescribing

It is possible that the widespread use of antibiotics for the treatment of other illnesses might have significantly reduced the occurrence of syphilis and gonorrhoea by treating asymptomatic cases in the population serendipitously.

c) Biological changes in the organisms

These must always be considered in interpreting time trends in the occurrence of STDs. It is noteworthy that in several countries the decline in gonorrhoea occurrence has been observed only in non PPNG strains [23].

d) Demographic changes

Migration of individuals from countries having a high prevalence of a particular STD to one having a low prevalence can considerably increase the incidence of the disease in the receiving country [24].

How might we enhance the value of STD surveillance data for monitoring AIDS prevention?

The factors which limit the extent to which STD surveillance data can be used to assess trends in sexual behaviour arise both from our lack of a quantitative measure of the relationship between sexual behaviour and STD risk, and from the inaccuracy and questionable validity of measures our STD occurrence. An expansion of basic research into sexual behaviour and STD risk, carried out in parallel to attempts to improve surveillance systems themselves is therefore required.

Basic Research

For trends in estimates of STD incidence surveillance these estimates to be used as measures of changes in sexual behaviour however, we need to know far more about quantitative aspects of the relationship between the occurrence of the various STDs and sexual behaviour. While the collection of more information on parameters of sexual behaviour in STD cases through improved surveillance will provide new information about the distribution of the STDs in relation to these parameters, there remains a pressing need for a programme of both empirical and theoretical research directed towards the further elucidation of the relationship. This might include:

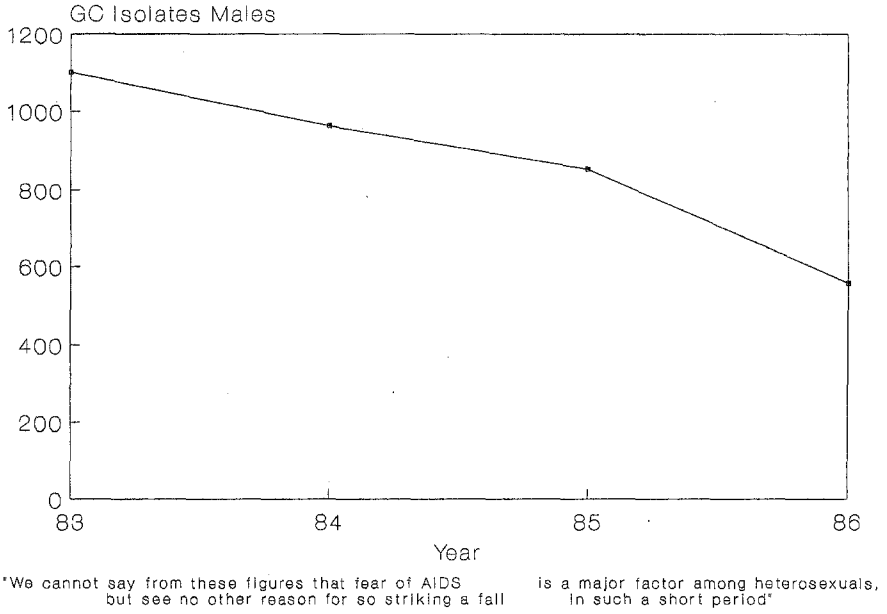

Figure 8. *Total gonorrhoea isolates in males Praed St Clinic 1976–1986 (six month samples).*

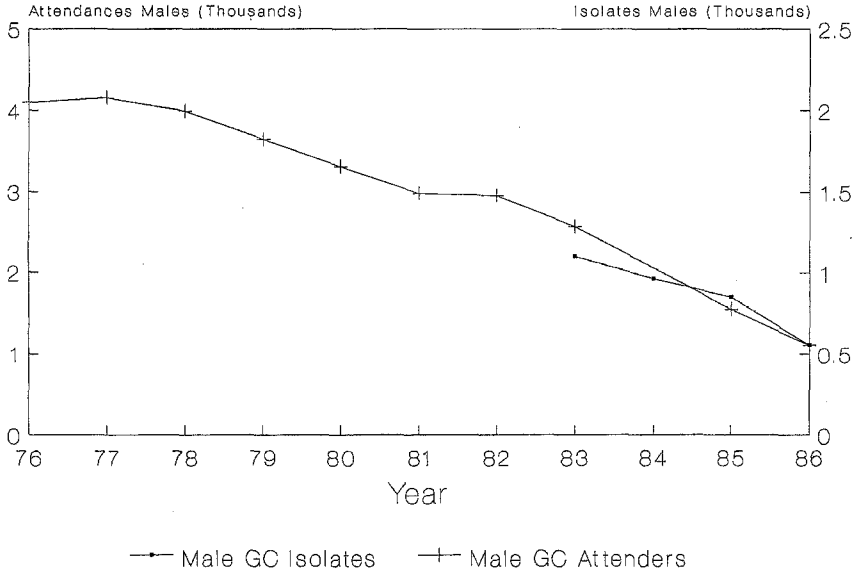

Figure 9. *Total male gonorrhoea cases and isolates in males Pread St Clinic 1976–1986.*

a) Empirical work

– Transmission parameters of organisms

Attempts should be made to measure infective, incubation period, duration of infectiousness, immunity and individual non-sexual risk

factors for acquisition of infection with the STD pathogens, through both clinical and epidemiological studies of individuals with STDs, and their sexual partners.

– *Relationship between sexual lifestyle and risk of STD*

There is need to extent and refine the ways in which we measure sexual behaviour for this purpose. It will then be of central importance to identify the parameters of sexual behaviour which determine risk of acquisition of the STDs and to describe their effects quantitatively. This may be achieved through case-control, follow-up studies, and intervention studies in suitable populations. In addition it will be necessary to characterise the distributions of these parameters of sexual behaviour through special surveys in the general population and in groups of particular interest. Studies of sexual mixing patterns are also urgently reeded.

b) Theoretical work

Stochastic and deterministic mathematical models of STD dynamics provide formal specifications of the intuitions and assumptions which we use throughout our work on STD epidemiology. For this reason their elaboration allows us to bring greater clarity to our thinking on the subject. Virtually all the recent STD epidemiological modelling work has been concerned with HIV infection. Models incorporating sophisticated population mixing assumptions have now been developed. The construction of similar models for other STDs will assist us in two principle ways. Firstly, it will inform empirical work through the a priori identification of aspects of sexual behaviour likely to be important in determining risk of acquisition of STDs. Secondly it will provide us with a framework within which we can achieve a quantitative appreciation of the relationship between trends in STD occurrence and underlying changes in sexual behaviour which explain these trends.

Improvements to surveillance systems

In our previous discussion we noted that the generation of information of use in monitoring sexual behaviour is only one among the several objectives of STD surveillance. Improving the quality of the data will however serve all of these objectives. It is not possible, to identify any combination of the approaches to surveillance outlined above which will provide optimum results in all countries. What is appropriate for future development will depend on the nature of existing systems and a number of wider factors. The nature of the relevant legislation, the structure of health care delivery and laboratory services, the nature and extent of the Public Health 'culture' among clinicians and laboratories, and the particular epidemiological and clinical profile of STDs which is found within a particular country must all be taken into consideration. The evolution of STD surveillance in Western Europe has therefore been, and is likely to remain incremental and pragmatic, in the face of rapidly shifting objectives, resourcing, and political and cultural imperatives. Notwithstanding this, certain objectives can be defined towards which surveillance systems might develop:

a) Extend the range of diseases covered by surveillance

This will allow both a wider characterisation of trends in STD and the identification of new markers for sexual behaviour in various populations.

b) Extend range of epidemiological variables to be attached to cases

The availability through surveillance systems of information concerning the sociodemographic and sexual behavioural characteristics, and STD histories of patients, together with an increase in the number of diseases covered, will enable a clearer picture to emerge of trends in STD occurrence within different groups in the population. In addition it will provide useful information on the relationship between reported characteristics and the risk of acquisition of STDs, particularly where population based information on the distribution of such characteristics over representative population samples is known.

c) Measurement of HIV prevalence among STD attenders

Availability of information concerning HIV prevalence among people with STDs will make possible analysis of the influence of STDs on susceptibility to HIV infection, and a direct estimates of the relationship between STD risk and HIV risk.

d) Upwards compatibility

As countries develop their surveillance systems it is crucial that useful elements in existing systems should be preserved. As we suggested above, the analysis of secular trends in STDs requires a timeframe of many years. Because new surveillance systems will only generate data prospectively, it is essential that this new data should be comparable with that which has been generated by the old systems.

e) Patterns of service utilisation

Where surveillance systems based upon sentinel clinical or laboratory networks are developed, informa-

tion on the size, characteristics and service utilisation patterns of catchment populations should be collected in parallel through special studies. This will facilitate the interpretation of the data and identify new options for surveillance in the future.
To achieve these goals and to allow comparison between countries of the frequency of STD occurrence in the future, the WHO Regional Office for Europe has provided a broad framework within which the surveillance of STDs might be developed. The proposals are summarized in the Table 4.

Practical considerations

A number of wider issues must be taken into account in attempting to develop new and better STD surveillance systems. Legal problems may be encountered within individual countries where development of STD surveillance is attempted. There may be a need for changes in the law where modifications to statutory notification systems are proposed. In addition the disclosure of information obtained by a physician from his patient raises legal and ethical difficulties, especially where the information is disclosed in a form which allows the identification of the patient. Where surveillance systems entail performing tests on people purely for surveillance purposes or without their consent, extremely complex legal and ethical problems are likely to be encountered.
The cultural acceptability of health surveillance and Public Health, both to health professionals and to the general public, varies considerably between countries. The extent to which State authorities can legitimately require access to detailed information about the affairs of citizens, is in general an issue which arouses strong feelings. This may be particularly true in countries which have recently experienced centralised authoritarian government[25]. Attempts to enhance STD surveillance systems by collecting more extensive and detailed information about disease occurrence, and the characteristics of cases may therefore meet with resistance from both the public and health professionals.

Conclusions

AIDS prevention activity has focussed on attempts to bring about changes in behaviour relating to the various modes of HIV transmission, through health education programmes. Attempts to assess the effect of such interventions through 'Knowledge-Attitude-Behaviour' studies or serial estimation of HIV seroprevalence face major problems. Against this background the possibility of using STD occurrence as a measure of programme impact becomes attractive.
STD occurrence might be used as an indicator of the effect of AIDS prevention programmes in two ways: directly as an indicator of HIV incidence, and indirectly as an indicator of sexual behaviour. Because HIV infection in contrast to some other STDs is in an epidemic phase, it is very difficult to envisage a reliable relationship between HIV incidence and that of any STD. An indirect approach therefore seems more promising.
Simple transmission models suggest that gonorrhoea infection might provide a rapid and sensitive indicator of changes in sexual behaviour within populations. The disease also has the advantage that historical data on its occurrence are available in many countries. The major drawback is the dependence of the incidence of the disease on how early in the infection treatment is carried out. The models also suggest that changes in gonorrhoea incidence are likely principally to reflect changes in behaviour among a small number of highly sexually active individuals. Furthermore types of sexual act which permit the transmission of gonorrhoea do not necessarily permit the transmission of HIV. We cannot assume that changes in sexual behaviour which lead to a decline in gonorrhoea incidence remove the conditions which permit the continued dissemination of HIV in the population or vice versa.
The occurrence of gonorrhoea and syphilis appears to have been decreasing while that of several other STDs has been increasing. This may be partly explained by more timely treatment of gonorrhoea and syphilis index cases and contacts, and increased ascertainment of cases of other STDs. However the possibility that some of these latter diseases are, like HIV, in an epidemic phase should be considered. At present insufficient is known about the descriptive epidemiology of these diseases, their biologically determined transmission parameters or the quantitative nature of the relationship between their incidence and patterns of sexual behaviour for them to be reliably used as direct or indirect indicators.
STD surveillance systems have been in operation in many countries for several years, and the analysis of the estimates of STD occurrence which can be derived from them represents an attractive approach to assessing the impact of AIDS prevention programmes on sexual behaviour. Interpreting surveillance data in this way requires a proper understanding both of the limitations of the data themselves, and the factors which might confound the relationship between sexual behaviour and STD incidence.
In many countries, STD surveillance systems were set up before the advent of modern antimicrobial therapy, for the purpose of control and containment of venere-

		Surveillance system					
Disease/ Syndrome	**Reporting Categories**	**Indiv Clin**	**Sent Clin**	**Lab**	**STD Clin**	**Scrn CF**	**Surv**
SYPHILIS	Total Syphilis	+	*	*	*	a/b/c/d	
	Early symptomatic				*		
	Latent				*		
	Congenital	*	(*)				
	Age/Sex	*	*	*	*		
	Sexual preference		*		*		
	Travel associated		*		*		
GONORRHEA	Total gonorrhoea	*	*	*	*	d	f
	Post-pubertal	*			*		
	Neonatal	*	(*)				
	Age/Sex	*	*	*	*		
	Sexual preference		*		*		
	Travel associated		*		*		
	Site of infection		*	*	*		
	Antibiotic resist			*	+		h
NON GON GENITAL INFECT'N	Total NGGI	*	*		*		
	Chlamydia			+	*	e	
	Age/Sex	*	*	+	*		
	Sexual preference		*		*		
	Travel associated		*		*		
HEP B	Total Hepatitis B	*	(*)	*		b	
	Age/Sex	*	(*)	*			
	Sexual preference		(*)				
	Inject drug use		(*)				
	Ab neg carrier				*	b	

1 = Surveillance system not appropriate for very low incidence STDs, unless sentinel clinicians diagnose/treat majority of cases.
* = collection of data item appropriate to surveillance system.
(*) = collection of data item appropriate if suitable sentinel clinicians can be identified.
+ = collection of data item appropriate if relevant diagnostic facilities available.

a = ante-natal testing
b = blood donor screening
c = military/prisoners
d = prostitutes
e = family planning clinics
e = family planning/contraceptive clinics
f = pharmacy surveys
g = prevalence surveys
h = aetiological/antimicrobial studies

Table 4. *Proposed surveillance systems for STDs.*

al disease. Data derived from the clinician based notification systems appropriate to this purpose do not readily lend themselves to the calculation of STD incidence, and the proportion of cases notified is frequently less than 50%. Furthermore the diseases usually selected for surveillance; syphilis, gonorrhoea, chancroid and lymphgranuloma venereum, have become less common, while others such as genital warts and herpes have increased in importance.

Other influences which may affecting STD occurrence, but are unrelated to sexual behaviour, should be born in mind when considering trends in STD surveillance data. These include improved treatment and contact tracing programmes, the widespread use of antibiotics, changes in the biological properties of the STD pathogens and demographic changes. The availability of data for long enough periods to allow the analysis of trends also needs to be considered. Perhaps greatest shortcoming of existing data is the lack of information generally available on the sociodemographic and sexual behavioural characteristics of cases, and the proportion of cases that are reinfections.

In order that STD surveillance systems should provide information which will be of use in monitoring AIDS prevention in the future, these systems must themselves be improved, in parallel to an expansion of research effort directed towards achieving a greater understanding of sexual behaviour, and the relationship between such behaviour and STD transmission.

Our ability to infer trends in sexual behaviour from trends in STD incidence would be enhanced if we were better able to define those parameters of sexual behaviour which are important in determining STD risk, and to quantify their effect. This would be best achieved through appropriately designed longitudinal studies. In addition the distribution of these parameters among the general population and groups of particular epidemiological relevance should be determined through surveys of sexual behaviour. Such a programme of research might be developed in parallel and perhaps in conjunction with programmes directed to the elucidation of the epidemiology of HIV infection.

Efforts to improve coverage, accuracy, validity and timeliness of data produced by existing surveillance systems are being supplemented in many countries with new schemes, using a variety of approaches, and targeted at various populations. Among the most promising of these approaches is the development of networks of sentinel STD clinics which allow surveillance of a wide range of STDs, and the collection of detailed information regarding sexual lifestyle and previous history of sexually transmitted disease. The linkage of such data with HIV serostatus of ascertained cases may prove particularly valuable. The main drawback of these networks lies in the uncertainty as to their representativeness of the population at large, and the lack of denominator information. Interpretation of data may be further limited by our ignorance of the distribution of the epidemiological parameters measured, within the wider population. There is therefore a requirement whenever sentinel approaches to surveillance are used to carry out special studies, both of the distribution of these parameters in the population at large, and of the patterns of attendance of people with STDs at the various health care facilities. In addition any changes to surveillance systems should ensure that new data can be analysed together with that which has been collected in the past.

It must be acknowledged that the problems of using STD occurrence as an indirect indicator of the success or otherwise of HIV/AIDS prevention programmes are not purely technical or scientific. In particular any changes in statutory notification systems require change in the law. In addition, there may be marked differences in perception of the public health importance of STDs between governments, the public and those scientists and doctors working in the field. Attention must therefore be given to channels of communication between epidemiologists, public health physicians and Health Ministries. In addition persuasive arguments to support our perception of the importance of the STDs could be developed by using Health Economic and Health Services Research analyses of the burden which these diseases place on scarce health service resources. Ethical problems arising from the disclosure by physicians of information on their patients, and consent of patients to testing when screening or special surveys are being carried out require special attention.

Despite all the problems, the frequency of occurrence of STDs may prove to be the most objective, reliable and timely indicator of sexual behaviour, and thus of the effectiveness of our HIV prevention programmes, which is available to us in the developed world. In order for the full potential of the approach to be realized there is a need for individual countries to develop appropriate structures within which to develop STD surveillance systems and epidemiological research programs. In addition, the experience of individuals responsible for such systems and programmes should continue to be shared at a supra national level.

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Zusammenfassung

Die Verwendung von Daten über das Auftreten sexuell übertragbarer Krankheiten zur Kontrolle der AIDSprävention

Die Überwachung der Auswirkungen von AIDSpräventionsprogrammen ist von zunehmender Wichtigkeit aber aus methodologischen Gründen schwierig durchzuführen. Die Verwendung von Messmethoden, die aus Überwachungssystem zur Epidemiologie von sexuell übertragenen Krankheiten stammen, als Indikatoren für risikovolles Sexualverhalten oder für HIV-Inzidenz, gilt weltweit als ein möglicher Ansatz. Dieser Beitrag diskutiert zuerst kritisch die theoretische und empirische Basis für diese Strategie, und zeigt anhand einiger Beispiele die Fallstricke auf, die sich bei der Interpretation von Trends von sexuell übertragbarer Krankheiten ergeben können. Probleme, die bei der Interpretation von Typen von Daten zur Überwachung der sexuell übertragbaren Krankheiten, die in den europäischen Staaten zur Verfügung stehen, auftreten können, werden diskutiert. Vorschläge, in welche Richtung Überwachungsdaten über sexuell übertragbare Krankheiten weiterentwickelt werden müssen, damit ihr Wert für die AIDSüberwachung steigt, werden unterbreitet. Schliesslich werden Bereiche in der klinischen und epidemiologischen Forschung identifiziert, die dazu beitragen können, unsere Fähigkeiten solch angereichertes Datenmaterial über sexuell übertragbare Krankheiten zu interpretieren, zu verbessern.

Résumé

L'usage de l'occurrence des maladies sexuellement transmises (MST) pour le suivi de la prévention du SIDA

Le monitoring des effets des programmes de prévention du SIDA prend une importance croissante mais pose des problèmes méthodologiques. L'usage de mesures issues des systèmes de surveillance épidémiologique des MST, comme indicateurs de comportements sexuels à haut risque ou d'incidence du VIH a été largement reconnu comme une approche possible à ces problèmes. Cet article examine d'abord les bases théoriques et empiriques de cette stratégie et souligne, en se servant d'exemples, quelques uns des pièges dans l'interprétation des séries temporelles de l'occurrence de MST. Les problèmes d'interprétation des différents types de données sur les MST actuellement disponibles dans les pays d'Europe de l'Ouest sont discutés. Des pistes en direction desquelles les systèmes de surveillance pourraient être développés de façon à accroître leur valeur dans le monitoring de la prévention du SIDA sont proposées. Enfin sont identifiés des domaines de la recherche clinique et épidémiologique qui pourraient augmenter notre capacité à interpréter de telles données améliorées de surveillance des MST.

References

1 *Coyle SL, Boruch RF, Turner CF.* Evaluation AIDS prevention programmes, National Academy Press Washington DC 1989; 43–47.

2 *Hicks C, Spurgeon P, Stubbington J.* The importance of psycho-social variables in changing attitudes and behaviour. Health Education Journal 1988; *47*:15–17.

3 *Gill ON, Adler MW, Day NE.* Monitoring the prevalence of HIV: Foundations for a programme on unlinked anonymous testing in England and Wales. BMJ 1989; *299*:1295–1298.

4 *Kreiss J, Carael M, Meheus A.* Role of sexually transmitted diseases in transmitting human immunodeficiency virus. Genitourinary Medicine 1988; *64*:1–52.

5 *Weber JN, Wadsworth J, Rodgers LA, Moshtael O, Scott K, McManus T, Berrie E, Jeffries D, Harris JRW, Pinching AJ.* Three year prospective study of HTLV–III infection in homosexual men. The Lancet 1986; *1*:1179–1182.

6 *Andersen RM.* Directly transmitted viral and bacterial infections in man. In: Anderson RM (eds). Population Dynamics of Infectious Diseases; Theory and applications. London 1982; 1–37.

7 *Rein MF.* Epidemiology of gonococcal infection. In: Roberts RB (eds). The Gonococcus. New York John Wiley & Sons 1977; 1–31.

8 *Hethcote HW, Yorke JA.* Lecture Notes in Biomathematics 1984; *56*:1–105.

9 *Tomlinson DR, French PD, Harris JRW, Mercey DE.* Does rectal gonorrhoea reflect unsafe sex? The Lancet 1991; 337–501.

10 *Hessol NA, O'Malley P, Lifson A, Cannon L, Kohn R, Barnhart L, Harrison J, Bolan G, Doll L, Rutherford G.* Incidence and prevalence of HIV infection among homosexual and bisexual men [Abstract], 1978–1988. V International Conference on AIDS, Montreal, 1989 (June).

11 *Renton AM, Whitaker L.* Preventing the spread of HIV infection. BMJ 1991; *302*:1207–1208.

12 New cases seen at genitourinary medicine clinics in England 1976–1986. Bulletin 2/7/88. Department of Health and Social Security 1988.

13 New cases seen at genitourinary medicine clinics in England 1987: summary information from SBH 60. Department of Health and Social Security 1989.

14 New cases seen at genitourinary medicine clinics in England 1988: annual and december quarter figures. Summary information from form KC 60. Department of Health and Social Security 1990.

15 Surveillance and monitoring of sexually transmitte diseases. Report on a meeting Rome, 1989. WHO Region Office for Europe EUR 7 ICP/VDT 011. Copenhagen Denmark 1989.

16 *Renton AM, Whitaker L.* Assessing the impact of prevention through monitoring STDs. International Conference on Monitoring AIDS Prevention. Montreux, Switzerland 1990.

17 European Community Concerted Action on Monitoring HIV Seroprevalence in a Sentinel Population of STD Patients. Results of the Pilot Study. Institute of Hygiene and Epidemiology. Brussels, Belgium 1990 (June).

18 *Banatvala JE, Chrystie IL, Palmer SJ, Summer D, Kennedy J, Kenny A.* HIV screening in pregnancy. The Lancet 1991; *337*:1218.

19 *Piot D, Meheus A.* Epidemiologische gegevens over seksueel overdraagbare aandoeningen in Belgie. In Eylenbosch WJ, Vuylsteek K, Depoorter A, Meheus A (eds). Topics uit de Sociale Geneeskunde. Leuven 1984; 181–186.

20 Annual reports to the Board of Health and the epidemiological department of the National Bacteriooogical Laboroty, Sweden. Verbal communication: Prof Margarita Bottiger, Dept of Epidemiology, National Bacteriological Laboratory, Sweden 1991.

21 *Gellan MCA, Ison CA.* Declining incidence of gonorrhoea in London. The Lancet. 1986; *11*:920.

22 Annual returns to DHSS from Praed St Clinic, St Mary's Hospital, Paddington. New cases seen 1976–1986. DHSS Form SBH 60.

23 Verbal Communication. Anneke van den Hoek.

24 Verbal Communication. Margareta Bottiger.

25 Verbal Communication. Wolfgang Heckman, AIDS-Zentrum im Bundesgesundheitsamt, Berlin FRG.

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