





# Accessible health care is critical to the effective control of sexually transmitted infections

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## ABSTRACT

Bacterial sexually transmitted infections (STIs) are rising relentlessly in virtually every country and among most risk groups. These infections have substantial individual and community consequences and costs. This review summarises the evidence for the effectiveness of different strategies to control STIs and assumes countries have sufficient financial resources to provide accessible health care. Reducing the probability of transmission essentially involves increasing condom use, which is problematic given that condom use is currently falling in most risk groups. Interventions to increase condom use are expensive and hard to sustain. Only a limited number of studies have shown it is possible to reduce the rate of partner change and sustained changes are difficult. In contrast, the provision of accessible health care has a powerful effect on the incidence rate of STIs, with dramatic falls in STIs in virtually all countries following the discovery of antibiotics. More recent studies support the powerful role of accessible health care as a strategy for putting substantial downward pressure on STI rates. Accessible health care has a powerful effect on the incidence of STIs. The professionals who are responsible for funding these services need to appreciate that they are ultimately responsible for the rates of STIs in their communities. In contrast, personal behaviour plays a less powerful role in determining the incidence of STIs and is hard to change and sustain at a population level. The public needs to appreciate that it is the governments they elect and not individuals who are responsible for the rates of STIs in their communities.

**Keywords:** condom use, control, health care, HIV, partner number, sexually transmitted infections.

## Introduction

The unrelenting rise in the incidence of bacterial sexually transmitted infections (STIs) over the past 20 years should encourage governments to optimise effective control strategies.<sup>1</sup> The consequences of not doing so mean substantially more resources will be needed in the future because, like other infectious diseases, the earlier an infection is controlled, the easier and cheaper it is to control.<sup>2,3</sup>

Most STIs have substantial consequences for individuals and costs to the community. Gonorrhoea is of particular concern because rising rates increase the probability of developing antimicrobial drug resistance.<sup>4</sup> In response to this specific risk, the World Health Organization (WHO) and the United States Centres for Disease Control and Prevention (CDC) have recommended reducing the prevalence of gonorrhoea as a key strategy to mitigate against antimicrobial resistance.<sup>4,5</sup> To do this, it is necessary to have a thorough understanding of the factors that determine the incidence of an STI in a population and also identify which factors are most amenable to successful interventions. This paper describes the contribution that accessible health care makes to STI control and discusses its contribution relative to other strategies that improve STI control. Accessible health services here refers to any health service that provides testing and treatment for symptomatic or asymptomatic STIs, whether they be general, specialist, clinical or virtual. This paper assumes that the country has sufficient financial resources to provide accessible health care.

## Principles of STI control—theoretical considerations

The incidence of an STI in a specific population is determined by its reproductive number ( $R_0$ ), which is a product of three factors: (1) the probability of transmission per partnership; (2) the rate of partner change in a population; and (3) the duration for which an infection is transmissible. Therefore, the incidence of an STI in a population can be reduced by targeting one or more of these factors.

### Reduce the probability of transmission

Condoms prevent the transmission of an STI by providing a barrier to transmission during oral, vaginal or anal sex. At the start of the HIV epidemic, when HIV was untreatable and almost universally fatal, condom use for vaginal and anal sex increased dramatically.<sup>1</sup> This change in condom use was associated with a precipitous decline in syphilis and other STIs among men who have sex with men (Fig. 1). However, as the fear of HIV reduced with effective treatment, condom use for anal sex began to fall (Fig. 2). These reductions in condom use accelerated substantially with the introduction of highly effective biomedical prevention strategies such as pre-exposure prophylaxis (PrEP), which provides almost 100% protection against HIV acquisition.<sup>1</sup> Over this time, there have been substantial rises in STIs to levels now approaching those seen before the appearance of HIV (Fig. 1). Increasing condom use substantially for anal sex in the current environment will be challenging. Another important consideration is that condoms have never been commonly used for oral sex, and so if an STI is transmitted

substantially by oral sex, condoms are not a realistic option for prevention.<sup>1</sup>

The other issue with condoms for STI prevention is that to work effectively, the penis needs to be the key site of transmission or acquisition of the STI. Recent work suggests that this may not be true for the transmission of gonorrhoea and that, at least in men who have sex with men, only the minority of transmission involves the penis.<sup>6,7</sup> A considerable amount of transmission is thought to occur through kissing, saliva during sex and oral–anal contact (rimming) rather than penetrative sex.<sup>8</sup>

### Reduce the rate of partner change

Reducing the rate of partner change is challenging because, like condoms, reducing partner numbers involves reducing pleasure.<sup>9</sup> Several systematic reviews have addressed whether it is possible to reduce an individual's number of sexual partners.<sup>10</sup> One systematic review and meta-analysis of seven studies, published in 2008, assessed the effectiveness of HIV voluntary counselling and testing, and found that when compared to no counselling, there was no significant effect on the numbers of sexual partners.<sup>10</sup> A Cochrane review published in 2011 that included 23 randomised trials of interventions to reduce STI risk in women found similar results with no statistically significant effects on abstaining from or reducing sexual activity.<sup>11</sup> However, another systematic review in 2015 of nine experimental or observational studies assessed interventions using counselling, home-based HIV testing and programs to reduce stigma.<sup>12</sup> The study found that these interventions resulted in a reduction in stigma and a reduction in self-reported new casual sex partners in the

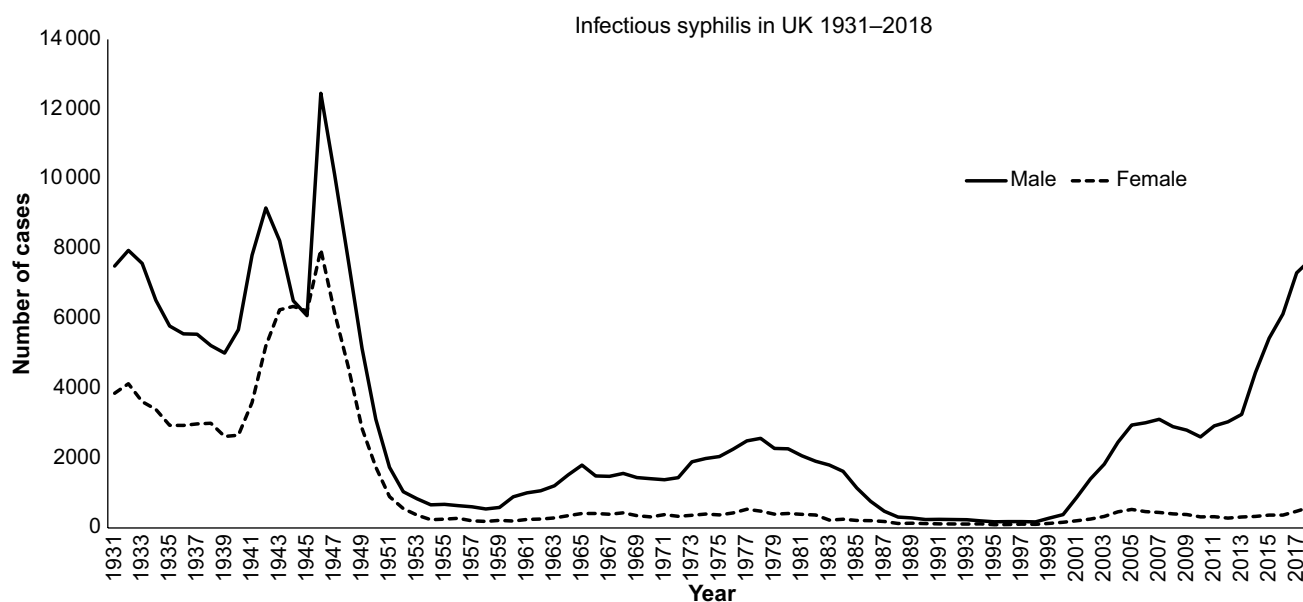
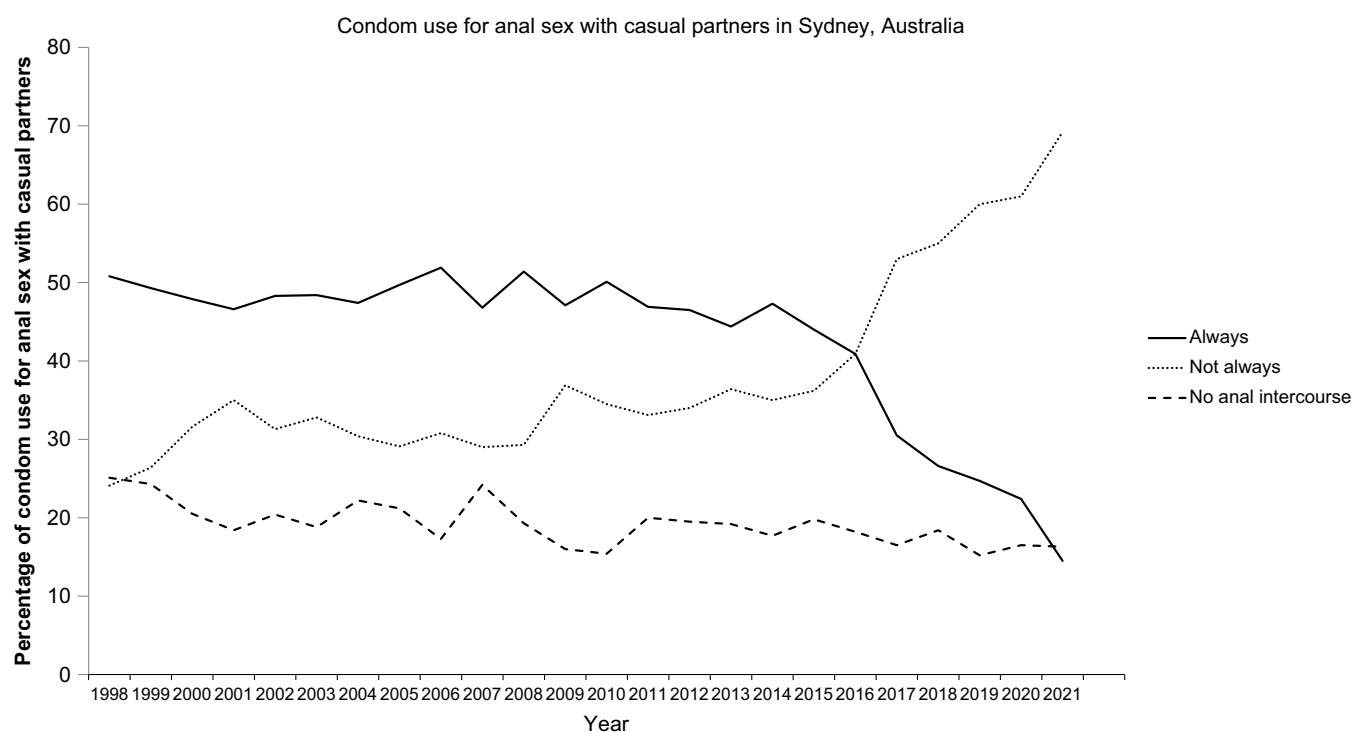


Fig. 1. Number of cases of infectious syphilis notified in the United Kingdom 1931–2018. Source: UK Health Security Agency.



**Fig. 2.** Condom use for anal sex with casual partners, as found in the Gay Community Periodic Survey in Sydney, New South Wales, Australia. <https://www.arts.unsw.edu.au/centre-social-research-health/our-projects/gay-community-periodic-surveys>.

past 3 months.<sup>12</sup> Taken together, these and other studies suggest reducing the number of sexual partners is challenging and even if it occurs, is hard to sustain.

### Reduce the duration of infectiousness

Antibiotics make bacterial STIs non-infectious within days;<sup>13,14</sup> therefore, the sooner an STI is treated after it becomes infectious, the less likely it will be that it is transmitted. Specifically, if syphilis presents in the primary stage and is treated, it will be infectious for only about 1 week. In contrast, if the symptoms of primary syphilis are not recognised, or individuals with these symptoms cannot access treatment, then the individuals will remain infectious until the symptoms of secondary syphilis prompt treatment.<sup>15</sup> If the symptoms of secondary syphilis are not recognised, then the individual may be infectious for up to 1 year.<sup>15</sup>

In this context, it is no surprise that the discovery of antibiotics in the 1940s dramatically affected the reproductive number of STIs. Fig. 1 shows the number of cases of syphilis in the United Kingdom following the discovery of penicillin. For women, who can represent heterosexual transmission, the number of cases of infectious syphilis peaked at 7980 in 1946 and has been in the low hundreds virtually every year since penicillin treatment began 75 years ago.

### The importance of symptoms

The effect of health care on the control of an individual STI depends on the characteristics of the symptoms from that STI and, in particular, whether symptoms occur and prompt early presentation to health care for treatment.<sup>16</sup> If symptoms are prominent, occur early after infection and occur in almost all cases of the infection, then almost all infected individuals are likely to seek health care shortly after infection. STIs with these characteristics will be more sensitive to accessible health care than STIs that are largely asymptomatic. Even in the recent coronavirus disease 2019 (COVID-19) epidemic, people that have conditions with more severe symptoms continued to attend health care, whereas attendances of those with milder symptoms fell.<sup>17</sup> If STIs are largely asymptomatic, new cases cannot prompt individuals to attend health care at the time the infection occurs, and therefore accessible health care will be a less effective control strategy. Chlamydia is an example of a largely asymptomatic infection with only a small minority of men and women (10–20%) reporting symptoms.<sup>18</sup>

An important contributor to the effect of health care is the health literacy of the population and their ability to recognise symptoms, know that these symptoms are likely to be an STI and know how to seek health care for treatment.<sup>19</sup> A recent publication described the duration of symptoms before attendees sought health care and confirmed individuals with more severe symptoms tended to occur earlier (unpubl.

observations, C. K. Fairley, pers. comm.). For example, gonococcal urethritis presented much earlier than the milder non-gonococcal urethritis (median 3 days vs 7 days). But certain risk groups also present earlier than others when they have the same condition. For example, men who have sex with men (MSM) present earlier with symptoms of non-gonococcal urethritis (median 5 days vs 7 days), genital warts (median 30 days vs 60 days) or molluscum contagiosum (14 days vs 30 days) than heterosexual men, suggesting that improving health literacy may improve healthcare-seeking behaviour.

Access to health care and STI testing can also reduce the incidence of asymptomatic infections by reducing the duration of infection, although the effect size of the reduction is substantially smaller than the effect size seen with highly symptomatic STIs.<sup>20</sup> A reduction in the duration of infection occurs when individuals with asymptomatic infections are identified and treated through screening programs, contacted by a sexual partner, or if infections are unknowingly treated by antibiotics given for other conditions.<sup>21–23</sup> The effect size of treatment is less for asymptomatic infections because treatment occurs too infrequently to substantially reduce the duration of untreated infection. For example, yearly screening programs of an asymptomatic STI that lasts about a year can shorten the duration by a factor of about two (i.e. shorten duration from 12 to 6 months). Consistent with this was the finding from the largest and most recent evaluation of a chlamydia screening program that found no benefit of screening.<sup>22</sup>

## Evidence for the importance of health care internationally

In addition to the biological plausibility of access to health care reducing the reproductive rate for symptomatic STIs, considerable epidemiological data support the proposition that access to health care provides a powerful effect on STI control. This includes ecological studies and epidemiological data.

### Ecological studies

Ecological studies can provide evidence of the population effect of antibiotic treatment by comparing STI rates before and after introducing antibiotics into a population. To do this, countries need to have systematically collected STI notifications over many years. The UK has collected notifications of infectious syphilis since 1931, and these data demonstrate a >90% decline in notifications over 10 years following the introduction of antibiotics in the 1940s (Fig. 1).<sup>24</sup> The decline in congenital syphilis over this same time has been even more pronounced, with a fall in incidence from about two per 1000 births in Scotland to <0.1 in <10 years. The United States (US) has collected the number of cases of

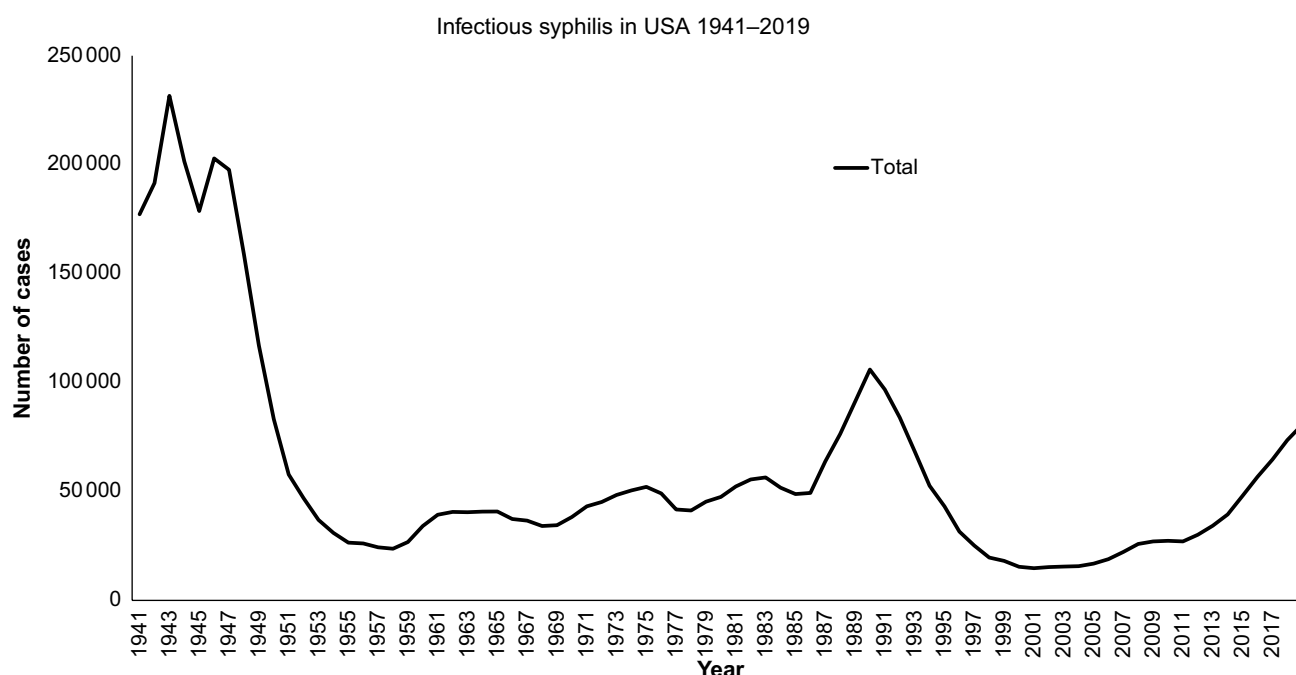
syphilis and cases of infectious syphilis since 1941 and like the UK, showed a >90% fall in cases over about 10 years (Fig. 3).<sup>25</sup> Similar data are available from a single sexual health service in Australia over 100 years and showed that rates fell by >90%.<sup>26</sup> The similar size of the fall over a relatively short period of time in all three countries and the lack of an alternative explanation indicates how powerful the effect of introducing penicillin can be on the incidence of syphilis. In these data from the UK, USA and Australia, it is also possible to observe the effect of changes in notifications on other factors, including the rises associated with the sexual revolution of the 1960–70s, substantial falls with the appearance of HIV, and rises again with the successful treatment of HIV. The magnitude of these changes is less pronounced than the introduction of antibiotics (Figs 1 and 3).

The data from the UK, Australia and USA are supported by similar falls in infectious syphilis between 1950 and 1960 that was seen in seven European countries, Canada and Costa Rica.<sup>27</sup> Unfortunately, data before 1950 is not presented, but the gradient of the graphs between 1950 to 1955 indicate that rates were very likely to be falling rapidly before 1950 (Fig. 4).<sup>27,28</sup> The data from these 12 countries from three continents are remarkably consistent and strengthen the plausibility that antibiotic treatment dramatically reduces the incidence of syphilis.

## Epidemiological studies

### Sexually transmitted infections

One of the first epidemiological studies to highlight the dramatic effect that access to health care could have on the rates of bacterial STIs within specific populations was set in remote parts of Australia.<sup>29</sup> In 1995, researchers compared the prevalence of treatable bacterial STIs to untreatable human papillomavirus (HPV) infection in two populations; Indigenous Australians living in remote communities with very limited access to health care, and non-Indigenous Australians living in the nearest capital city, Darwin, who had easily accessible health care.<sup>29</sup> They used the prevalence of the untreatable STI (i.e. HPV) as a marker of sexual risk, and so were able to use this prevalence to compare the sexual risk of the two populations. They found that the prevalence of any genital HPV type was significantly lower in Indigenous Australians living in remote communities (42%) than in individuals from Darwin (55%);<sup>29</sup> however, the Indigenous Australians living in remote communities had a significantly higher prevalence of trichomonas (27% vs 1%), gonorrhoea (22% vs 6%) and chlamydia (8% vs 4%) than those living in Darwin. Because the HPV prevalence was lower in the Indigenous Australians, they concluded that the STI risk among this population was lower and therefore, the higher prevalence of bacterial STIs in the Indigenous Australians was due to reduced access to health care as a result of living in remote communities.<sup>29</sup> This study prompted the



**Fig. 3.** The number of cases of infectious syphilis in the USA 1941–2019.

Australian Health Minister to substantially increase STI health care in remote indigenous communities.<sup>30</sup>

Another study from the Southern states of the US between 2013 and 2015 examined the effect neighbourhood-level access to health care in the area of an individual's residence had on their chance of acquiring an STI.<sup>30</sup> The study found a four-unit increase in the percentage of residents who had a primary care provider, and this was associated with a 39% lower risk of having an STI after adjustment for individuals' demographic and extensive behavioural (including sexual risk) data and area-level characteristics, including healthcare access. These findings are consistent with previous US studies showing that individuals with access to primary care providers receive more STI testing and treatment as part of their regular care.<sup>31–35</sup>

## Discussion

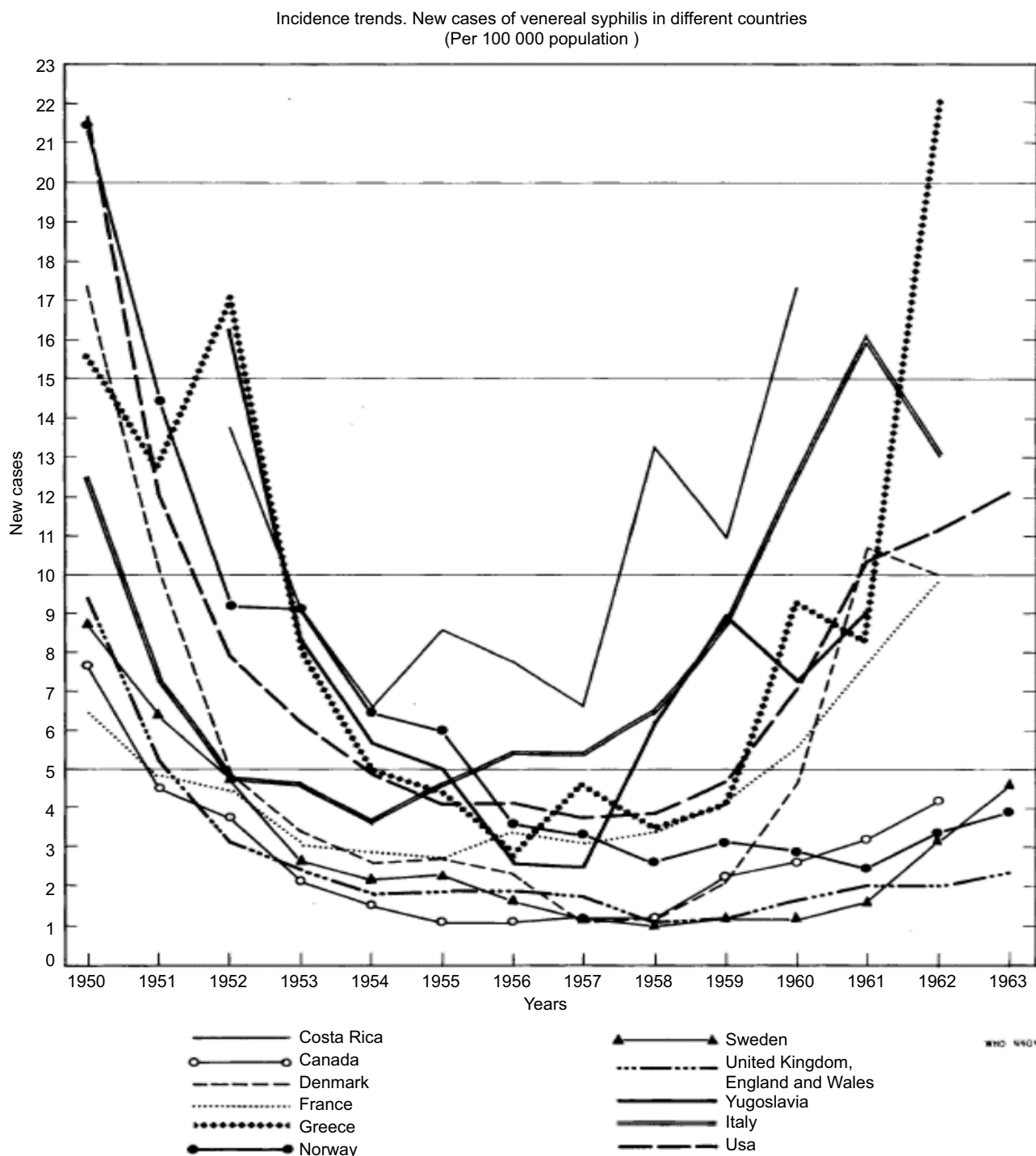
In this paper, we compiled data showing the dramatic effect that health care can have on the incidence of some STIs. Syphilis rates fell precipitously in many countries when penicillin was introduced. Substantial reductions also occurred in gonorrhoea (Fig. 5). Data from these ecological studies were consistent with data from cross-sectional studies from different continents that used individual-level data to demonstrate the effect accessible health care has on STI control. The effect size and sustainability of providing accessible health care are both more effective and sustainable than other interventions such as increasing condom use or

attempts to reduce the number of partners.<sup>36</sup> In the context of the rising rates of STIs around the world and the threat they pose, it would seem foolish for countries not to provide their populations with access to the most powerful STI control intervention: health care for the testing and treatment of STIs.

The magnitude of effect that accessible health care and antibiotics have on the incidence of STIs depends on the specific features of the STI.<sup>16</sup> Chancroid and donovanosis reduced very dramatically with the introduction of antibiotics and in most developed countries, and have essentially disappeared apart from imported cases.<sup>37</sup> Both infections have severe symptoms that would almost certainly rapidly prompt individuals to attend health care.<sup>37</sup> In the US, chancroid cases peaked in 1947 with nearly 10 000 cases and, like syphilis, fell precipitously during the 1950s.<sup>38</sup> In the US, there were only nine cases in 2019. No cases of donovanosis have been reported in Australia since 2016.<sup>39</sup> In contrast, health care has a limited impact on chlamydia infections, with endemic infection in every country. Chlamydia infection, although easily treated with antibiotics, is asymptomatic or only mildly symptomatic in most men and women, so symptoms cannot prompt presentation to health care for treatment.<sup>18</sup> Screening programs have attempted to reduce the prevalence of infection, but the largest study of the effectiveness of chlamydia screening reported no significant improvement in chlamydia control from screening.<sup>22</sup>

Frequent screening may shorten the duration of infection in specific populations.<sup>20</sup> Increasing the frequency of syphilis screening in MSM appears to have detected syphilis earlier

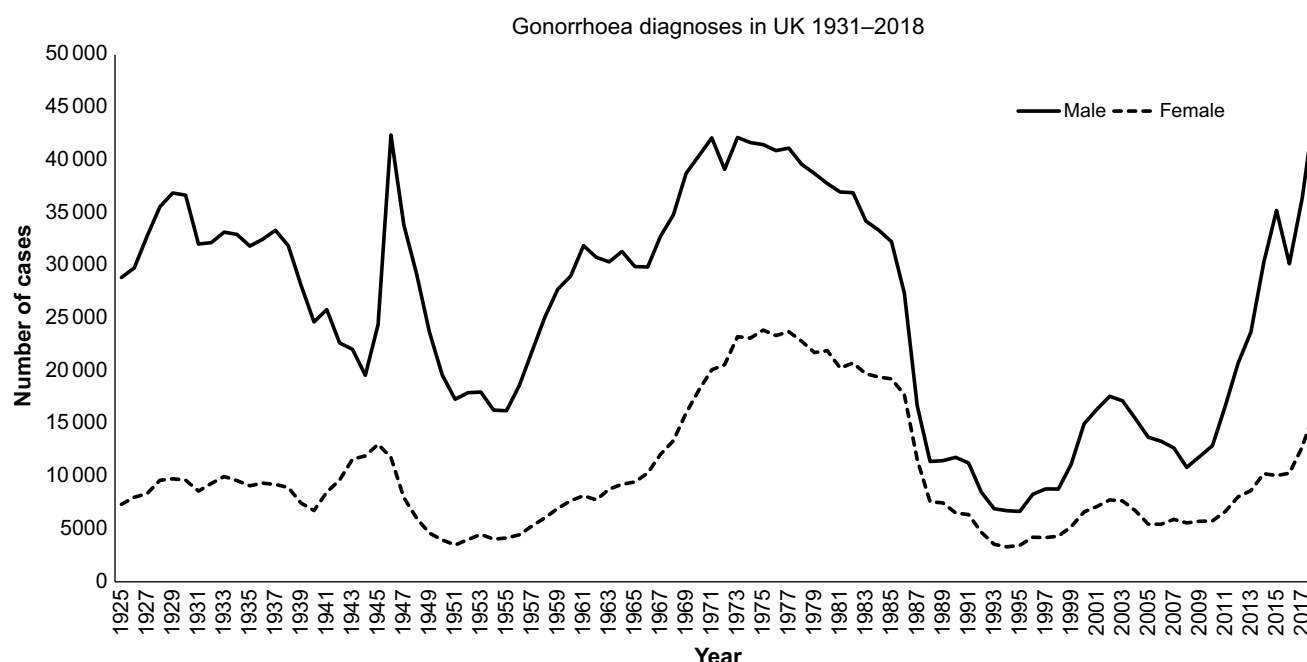




**Fig. 4.** Reproduction of Fig. 4 in: Review of the Organization's Program in Endemic Treponematoses and Venereal Infections. Report by the Director-General, Executive Board, 34th Session, Provisional Agenda Item 3.5 (EB34/11). 1 May 1964. Organisation Mondiale De La Sante. World Health Organization.

and therefore reduced the duration of infectiousness. The study that documented this used data among individuals attending 46 publicly funded sexual health clinics between 2007 and 2014.<sup>20</sup> Among 359 313 clinic visits by MSM, syphilis testing at least once a year about doubled to 91%

in individuals without HIV and 77% for persons living with HIV.<sup>20</sup> Correspondingly, there were substantial increases in the proportion of syphilis cases diagnosed in the early latent stage (from 27 to 44% for men without HIV, and 23 to 45% for men with HIV) and substantial falls in cases



**Fig. 5.** Number of cases of gonorrhoea notified in the United Kingdom 1931–2018. Source: UK Health Security Agency.

diagnosed as secondary syphilis (24–19% and 45–26%, respectively).<sup>20</sup> These data imply that screening of this frequency is likely to reduce the reproductive rate for infection in the MSM population.

Condoms are an effective primary intervention for preventing STIs and pregnancy, but the capacity to materially increase their use in the 2020s is limited, particularly compared to the ability of governments to provide accessible health care.<sup>36,40</sup> Indeed, condom use in some groups is falling precipitously (Fig. 2) and in others, somewhat modestly. Among MSM in Australia, consistent condom use with casual partners for anal sex in Sydney has fallen from 44% in 2015 to 18.5% in 2021 as pre-exposure prophylaxis for HIV has become widely available.<sup>41</sup> Similar but less marked trends in condom use occurred in secondary school students (condoms always fell from 43 to 38%).<sup>42,43</sup> But even if it were possible to increase condom use in the current environment, sustaining higher levels of condom use beyond 12 months is also difficult.<sup>36,40</sup> One of the larger randomised studies of condom use was undertaken between 1993 and 1996 and involved 5758 heterosexuals randomised to four arms. One arm was provided with two brief didactic face-to-face preventative sessions, whereas another arm received two longer 20-min counselling sessions modelled after the US CDC's recommendations. Individuals were followed up for 12 months. The incidence of STIs was 30% lower after 6 months and 20% lower after 12 months in those with the 20-min counselling sessions than those who took part in didactic sessions.<sup>36</sup> No unprotected vaginal sex at 3 months was 44% in the 20-min counselling sessions and 38% in the didactic sessions, but this difference

fell away rapidly, so there was no statistical difference between the groups by 9 months.<sup>36</sup> When investigators extended the counselling intervention to test whether 10 sessions were better than the two in project RESPECT, they found a 20% increase in condom use occurred, but this did not translate into significant reductions in HIV incidence.<sup>40</sup> Nonetheless, relatively simple measures should be optimised, including ensuring there is widespread access to them in a community, and health promotion ensures when they are used, they are used effectively.

For health services to have their optimal effect, governments need to ensure that the health services they provide for individuals with STIs are 'accessed' by individuals soon after they develop symptoms. This includes ensuring that this high-risk population can recognise what symptoms are from an STI and then have the ability to navigate the health system and identify a health service to attend. The characteristics of an optimal health service are described in a separate series of articles in this special issue, as are the groups at highest risk of an STI and the health literacy skills required in seeking out such services. As part of this strategy, some websites have specifically focused on advising individuals how urgently to visit health services depending on their symptoms<sup>44</sup> or have used artificial intelligence to estimate the probability of different clinical diagnoses.<sup>45</sup>

We have not specifically discussed other factors that influence STI rates, such as inequality and other social determinants of health within populations, the levels of stigma against individuals at risk or with STIs, or other factors related to health care such as partner notification

infrastructure and support. We feel these are outside of the scope of this paper, but these factors are associated with limited access to health care and higher STI risks, and thereby can influence the rates of STIs in populations.<sup>46</sup>

We have also not discussed specific services directed towards specific public health issues such as congenital syphilis, which is rising in most developed countries. We kept the remit of this paper narrowly around the role of health services for the control of STIs, but clearly for some conditions such as congenital syphilis, specific programs are required to prevent adverse outcomes from syphilis. Such services are beyond the scope of this paper, but include more frequent antenatal screening and prevention of re-infection.

Our paper assumes that the country or health area has sufficient financial resources to provide accessible health care. If it does not, then clearly this review is of limited relevance because it is not a potential control strategy. However, consistent with our argument about the importance of accessible health care is the observation that STI rates are generally high in countries with limited financial resources.

Access to health care for other conditions such as respiratory tract infections can inadvertently reduce STI rates by asymptomatic STIs being unknowingly treated by antibiotics used for other conditions.<sup>21,23</sup> For example, the treatment of community-acquired pneumonia with doxycycline for 7 days will effectively treat chlamydia, most cases of gonorrhoea, and substantially reduce the duration of infection for syphilis. A study from nearly 20 years ago found that countries with higher levels of antibiotic use tended to have lower levels of chlamydia.<sup>21</sup> However, high levels of antibiotic use can result in higher risks of antibiotic resistance and make those STIs that acquire resistance easily more difficult to treat.<sup>47</sup> It is possible that when *Treponema pallidum* acquired macrolide resistance from the widespread use of azithromycin, this resistance may have fuelled recent rises seen in some populations that were previously inadvertently treated for syphilis.<sup>47</sup>

A detailed description of what constitutes accessible health and how to achieve it are beyond the scope of this review;

however, once one accepts the argument that 'accessible health care' is the key driver of the incidence rate for STIs, achieving this will require detailed recommendations for change that will be different depending on the current situation. Examples include a high level of self efficacy among the population, appropriately designed healthcare services that are financially, geographically and temporarily accessible, and these healthcare services need to include all the key features of a high-quality STI service (e.g. available treatment, contact tracing and others).

Our aim in this paper is to provide the evidence to support the concept that effective access to health care is both the most powerful and easiest intervention for controlling STIs. We acknowledge the very substantial political and pragmatic

challenges in obtaining sufficient government funds to achieve this, when politicians and the public feel disinclined to provide funds for conditions that appear on the surface, at least, to be an individual's own fault.<sup>27,48</sup> However, the reality is that the largest driver of STI incidence in a community is poor access to health care, which is not an individual's 'choice' but a government decision to neglect to fund these services.<sup>49</sup> As professionals in the area, it is part of our role to help politicians, through whoever advises them, to understand that a high incidence of STIs is not an individual's choice but a government's choice.

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**Data availability.** All data in this paper are publicly available.

**Conflicts of interest.** CKF is the Editor-in-Chief of *Sexual Health*, and EPFC, IS and JSH are Joint Editors of *Sexual Health*, and JJO is the Special issues Editor for *Sexual Health*. All were blinded from the peer review process for this paper.

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