

# Changing Epidemiology of Sexually Transmitted Infections: Call for New Strategies Against the Increase in Chlamydia Infection in Sweden

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**Abstract:** This descriptive analysis of sexually transmitted infections (STIs) is based on data regulated by the Swedish Communicable Disease Act and consists of free testing and treatment, partner tracing and notification. Today, chlamydia is the only STI that affects the general population in Sweden. In the past gonorrhoea and syphilis had an appreciable effect on the general population. However, in the 1990s both of these diseases became rare. HIV has almost exclusively been restricted to three subpopulations (men who have sex with men, injecting drug users and people from HIV endemic countries). The Swedish strategy employed to reduce gonorrhoea and syphilis has been highly successful as demonstrated by a substantial decrease in the incidence of gonorrhoea and syphilis in the mid-1990s. A recent slight increase in syphilis and HIV might be due to the introduction of highly active antiviral therapy (HAART) that may have promoted promiscuous behaviour. The present chlamydia strategy, which focuses on opportunistic screening, partner tracing and condom use, has failed despite being one of the world's most all comprehensive plans. The number of chlamydia cases more than doubled after 1998, and in 2007, the number was the highest ever recorded in Sweden. This noticeable increase in chlamydia cases has important implications and suggests that greater attention should be given to transmission dynamics, including the effects of screening programmes and acquired immunity. Complication and clearance rates after asymptomatic chlamydia infection need to be established, but the most important goal is to encourage behavioural changes in terms of fewer episodes of unprotected sexual intercourse and fewer sexual partners.

**Keywords:** *Chlamydia trachomatis*, Gonorrhoea, Syphilis, HIV.

## INTRODUCTION

The Swedish strategy against sexually transmitted infections (STIs) is regulated by the Swedish infectious disease law and consists of free testing and treatment, partner tracing and notification. All physicians are required by law to report individuals with a suspected STI to health authorities, who have a long and successful tradition in dealing with symptomatic infections such as gonorrhoea and syphilis.

For more than 50 years, the Swedish government has implemented mandatory sexual education in secondary schools. Sexual education consists of information concerning contraception, STIs and the use of condoms or other contraceptive methods. Sexual education also provides information about the municipality-based youth health centres that focus on youth issues related to sexuality and health.

In the past gonorrhoea and syphilis posed a serious public health threat in Sweden. Today, however, neither gonorrhoea nor syphilis poses a threat to the reproductive health of the general population. Genital infections that are caused by *Chlamydia trachomatis* (*C. trachomatis*) are the most common bacterial STI in the Western countries [1, 2] and the only STI that affects the young adult population in Sweden [3].

At the end of the 1970s, a gradual increase in the number of syphilis cases was recorded, which mainly concerned men who have sex with men (MSM) in large cities [4], whereas there was a steep decline in the number of cases of gonorrhoea for both genders. With the appearance of HIV in the beginning of the 1980s, we experienced a marked decline in the number of syphilis cases, mainly because reduced sexual risk taking among MSM. The same trends were found in other Western countries [5].

HIV infection was first introduced in Sweden in 1979-1980 in a sexually active population of MSM in Stockholm [6]. The spread of HIV among injecting drug users (IDUs) was observed in Stockholm between 1983 and 1984, at which time about half of the opiate users became infected. The spread of the disease, however, was quickly under control in the following years [7]. HIV was never introduced into the general Swedish population, which was confirmed by a vigorous testing of different categories of people in Sweden [8]. All pregnant women have been offered free testing for HIV, a programme that currently covers 98% of all pregnancies. In the beginning of the 1990s when the fear of HIV was at its peak in Sweden, about 350 000 HIV tests (excluding blood donors and pregnant women) were performed yearly. HIV has largely been restricted to the following subpopulations: MSM, IDUs and people from countries with high HIV prevalence. To prevent contracting HIV national campaigns have been pursued since 1988 for safer sex (mainly through the promotion of condom use). The decrease in chlamydia cases between 1988 and 1995 was largely due to a change in sexual behaviour to fewer

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sexual partners most likely because of the awareness of the dangers of HIV [8]. However, a reverse trend was observed once the fear of HIV infection subsided, i.e. as soon as it became evident that HIV never reached the general population [9, 10]. During the same period, a comparable attitude toward safer sexual practise was confirmed in other Scandinavian countries. This trend, however, as in Sweden, was reversed after 1995 [11].

In addition to opportunistic screening and contact tracing, the Swedish strategy has principally focused on condom use [12]. Despite the longstanding chlamydia control activities, diagnosed chlamydia cases more than doubled after 1998. The highest ever recorded incidence rates of chlamydia per 100 000 population (513/100 000) were noted in 2007 [3]. However, 2008 and 2009 experienced a slight reduction of cases, a trend that continued even during 2010.

The Swedish strategy is based on the assumption that there will be a high risk of complications after an asymptomatic chlamydia infection. Yet, new data indicate that there has been an overestimation of the risk for pelvic complications [13, 14] and that the natural course of asymptomatic chlamydia infections is a high degree of clearance [15]. Overestimation and uncertainty of the complication rate produce misleading results about the cost-effectiveness of screening programmes [16].

It has been suggested that treatment shortens the duration of infection and thus impairs development of protective immunity, which ultimately increases the risk of re-infection [17].

This epidemiologic study is a descriptive analysis of the changing epidemiology of STIs in Sweden. Research questions elucidated are what mechanisms underlie the rising case rate of chlamydia in an area of intensified control efforts and how screening programmes influence immunological responses.

## METHODS

This epidemiological report describes data based on mandatory notifiable cases of STIs in Sweden as reported to the local County Medical Officer and the Swedish Institute for Infectious Disease Control. Gonorrhoea, syphilis *C. trachomatis* and HIV are regulated under the Communicable Disease Act under which physicians are required by law to report all STI cases to public health authorities. The report contains a coded case number based on the unique personal identity number assigned to every Swedish resident and gives information on the persons gender and year of birth. Other information includes country of birth, risk category, mode of transmission and risk category of sexual partners. Notification involves compulsory testing of partners. Testing and treatment are free of charge. The notification of STI cases is high in Sweden where physicians report more than 90% of suspected STI cases.

Opportunistic screening for chlamydia is offered in a variety of health care settings, including youth and antenatal clinics. However, despite being very extensive, it does not fulfil the suggested definition of a national screening programme [18]. Since 1997, all laboratories in Sweden have used nucleic acid amplification tests (NAATs) to diagnose chlamydia infections. Before that period, tissue cell culture,

enzyme immunoassay (EIA) or direct fluorescence assay were used.

In 2006, a new genetic variant of *C. trachomatis* (nvCT) was discovered in Sweden [19] that could not be detected by some of the commonly used diagnostic tests and diagnostic approaches (Abbott Laboratories and Roche Diagnostics). This new variant led to underreporting in 13 of 21 counties in Sweden that used these common tests [20]. Since 2007, only NAATs that could identify the nvCT have been used.

The Swedish population reached 9 340 682 inhabitants in 2009, with 18.6 % of foreign origin [21].

## RESULT

### Chlamydia

In Sweden, the rate of reported chlamydia cases decreased from 29 300 cases in 1988 to 14 000 in 1994. This trend, however, saw a reversal in 1995. After 1995, the rate of reported chlamydia cases has shown a constant annual increase of approximately 15%, reaching in 2005 the same level as in 1988 [9, 10]. The trends remain even with the correction because of the use of EIA or tissue culture before 1997. The increase was temporarily suppressed in 2006 because the nvCT could not be discovered by two of then existing diagnostic tests (Abbot/Roche). The inability of the tests to detect the nvCT led to false negative results and underreporting [19]. The nvCT was widely spread throughout Sweden, with its proportion of cases varying from 10 to 65% in the 13 counties that had used these tests [20]. However, because chlamydia cases increased in parts of Sweden using tests that could detect the nvCT, this suggested a general increase of chlamydia infections even in 2006. After a change to diagnostic kits that could detect the nvCT, a sharp increase of 39% was found compared with the number of cases reported in 2007, and is the highest ever recorded figure in Sweden (Table 1). In 2008 and 2009, however, the increase seems to have been reversed as indicated by a decrease of 28% in 2008 and an additional 10% reduction in 2009 (Table 1). The decrease continued by a further 8% during the first 6 months in 2010 when compared with the same period in 2009.

The increase observed in 2007 can be explained not only by the diagnostic kits used to diagnose the nvCT but also by an increase of 16% in the number of persons tested (Table 1). The number positive tests in relation to the number of persons tested, however, had continuously increased from 5.2% in 1998 to 10.0% in 2007.

Of persons tested, approximately 10% are tested because of symptoms associated with Chlamydia infection, 40% because of contact tracing and 50% because of different screening programmes.

In Sweden, between 70 and 80% of chlamydia specimens are obtained from women though male testing has gradually increased. In 2007, 8.9% of women tested were positive to chlamydia infection and 14.2% of males. In 2009, these figures were 5.6% among women and 11.1% among men. In 2007, the highest per cent positive tests in relation to number tested was found among women in the youngest age group (15-19 years), whereas the highest incidence rate (reported cases per 100 000 women) was found in the age group 20-24 years.

**Table 1. Chlamydia Cases in Sweden 1998 – 2009**

Year	Population in Sweden	Persons Tested n	Positive Tests n	Incidence Per 100 000 Population	% Positive Among Persons Tested
1998	8 854 322	317 911	16 549	171.7	5.2
1999	8 861 426	328 365	17 880	201.8	5.4
2000	8 882 792	346 269	21 065	237.1	6.1
2001	8 909 128	364 879	23 306	261.2	6.4
2002	8 940 788	374 126	25 227	282.2	6.7
2003	8 975 670	386 377	28 338	315.7	7.3
2004	9 011 392	431 067	34 173	379.2	7.9
2005	9 047 752	460 067	34 955	386.3	7.7
2006	9 113 257	450 054	33 682	369.6	7.5
2007	9 182 927	536 484	54 852	597.3	10.2
2008	9 256 347	491 433	39 559	456.5	8.0
2009	9 340 682	506 620	36 328	406.2	7.2

In 2008, the largest incidence decrease (reported cases per 100 000) was noted in the youngest age group (15-19 years, 15% for women and 13% for men) and in 2009 the decrease continued in this age group (11.6% for women and 10.3% for men). Chlamydia infection is mainly reported as heterosexually transmitted (>90%) and 85% of these infections are transmitted in Sweden.

### Gonorrhoea

The incidence of gonorrhoea in the beginning of the 1970s was 500 per 100 000 persons in Sweden. Ten years later the incidence had decreased to 100 per 100 000 and in 1996, the incidence was only 2.4 per 100 000. After 1998, an

increase was observed and in 2008, the incidence rate was 7.9 per 100 000 persons (Table 2). After a slight decrease in 2009, an increase of 28% (9.0 per 100 000 or 842 cases) was reported in 2010 (data not shown).

The number of persons infected in Sweden increased from 43% (1.7 per 100 000) in 1998 to 61% (4.2 per 100 000) in 2009. Approximately 80% of the gonorrhoea cases are men and about one third of the cases involve persons of foreign origin.

Since 1998, between 25 and 59% of the male gonorrhoea cases have been men of homosexual orientation. The percentage of heterosexual women infected in Sweden is

**Table 2. Gonorrhoea Cases in Sweden 1998 – 2009**

	Total n (inc*)	Infected in Sweden n (inc*)	Heterosexual		Homosexual n (%**)	Unknown n ***
			Men n (%**)	Women n (%**)		
1998	343 (3.9)	148 (1.7)	211 (nk)	60 (nk)	72 (76)	-
1999	426 (4.8)	206 (2.3)	227 (36)	63 (67)	122 (67)	14
2000	590 (6.6)	345 (3.9)	258 (38)	80 (66)	244 (78)	8
2001	529 (5.9)	282 (3.2)	261 (34)	86 (70)	170 (76)	12
2002	505 (5.6)	286 (3.2)	225 (31)	92 (71)	185 (85)	3
2003	596 (6.6)	377 (4.2)	252 (40)	116 (77)	220 (80)	8
2004	571 (6.3)	340 (3.8)	229 (45)	81 (70)	252 (72)	9
2005	691 (7.6)	441 (4.9)	237 (48)	110 (60)	327 (78)	17
2006	675 (7.4)	366 (4.0)	273 (48)	134 (64)	205 (81)	63
2007	642 (7.0)	395 (4.3)	275 (51)	126 (82)	195 (79)	46
2008	721 (7.9)	481 (5.2)	308 (51)	137 (73)	249 (88)	0
2009	611 (6.5)	377 (4.2)	275 (51)	142 (77)	172 (74)	1

\*Incidence per 100 000 population.

\*\*(% ) Infected in Sweden. nk= not known.

\*\*\*Gender or way of transmission unknown.

higher than for men. Women infected in Sweden are often infected after contact with persons of foreign origin, whereas heterosexual men mostly have been infected abroad, the most frequent place being Thailand followed by the Philippines. MSM are mostly infected in Sweden (Table 2).

### Syphilis

In Stockholm, the incidence of syphilis rose from 9.2 per 100 000 in 1972 to 20.3 per 100 000 in 1982 (4). After 1982, there was a sharp reduction of reported syphilis cases and in 1986 syphilis like gonorrhoea was rare in Sweden.

With the increasing number of immigrants to Sweden the number of syphilis cases increased from 42 cases (1.6 per 100 000) in 1998 to 231 cases (2.5 per 100 000) in 2007 (Table 3). In the beginning of 2000, an outbreak of syphilis among MSM occurred in Stockholm city in which approximately 70% of the male syphilis cases were MSM; an increase among MSM was also observed in 2007 when 113 cases were reported, which can be compared with 62 cases the year before. Heterosexual transmission mainly affects individuals of foreign parentage. These individuals are infected before arrival in Sweden and diagnosed in connection with seeking asylum. The proportion of women has varied from 36% in 1998 and 12% in 2004 which reflects variations in the migration pattern from Eastern Europe, Asia and Africa. Between 6 and 39% of heterosexual males and 15 and 38% of women were infected in Sweden mainly in contact with persons from the same ethnic group. The criterion for notification of syphilis is primary, secondary or early latent syphilis. Persons with late latent syphilis do not fulfil the criterion for notification. Unknown cases (Table 3) refer to the way of transmission (mother-child or blood contamination) or that the criteria for notification are uncertain.

### HIV

HIV has mainly been restricted to three subpopulations in Sweden: MSM, IDUs and immigrants from endemic areas.

HIV never spread to mainstream heterosexual society in Sweden. As of 2009, 8935 HIV-infected persons have been reported in Sweden and approximately 5000 are still alive today. Of all HIV cases reported in Sweden, more than 80% are heterosexually infected and originating from endemic areas. The variability in reported HIV cases reflects the number of immigrants with origins from countries with high HIV prevalence during different periods. Since 2002, a mean of 247 persons being heterosexually infected has been reported each year (Table 4). The heterosexual transmission had mainly occurred before arrival in Sweden. In 2009, only 28 of 221 heterosexually HIV-infected persons resided in Sweden and 21 of the 28 cases were born abroad (Table 4) (infected in Sweden indicates the percent of those in each group that has received the infection in Sweden). Heterosexual transmission of HIV in Sweden mainly involves persons of foreign extraction in contact with a person from the same ethnic group. Swedish women infected in Sweden have often been in contact with a person belonging to a known risk category (e.g. a person coming from a HIV endemic area of the world or a person injecting drugs), whereas Swedish men heterosexually infected acquired the infection while working or travelling abroad, for the most part in Asia or Africa.

After the first rapid increase of HIV among MSM and IDUs in 1980-1985, a marked reduction occurred in new cases. The HIV infection rate among MSM has been relatively constant with approximately 50% of the infections originating in Sweden (Table 4). Since 2005, a slight increase of HIV among MSM was observed suggesting an increase in unsafe sex practices in this group. The infection was mainly restricted to the age group 34-39 years. HIV transmission in the drug user population has been relatively modest with most cases (average 70%) having their origin in Sweden. Since 2002, between 25 and 35 cases, mainly in the age group 25-29, have been reported annually. One exception occurred in 2007 when 61 cases were reported (3). In some of these cases a recombinant HIV strain (CRF01-

**Table 3. Syphilis Cases in Sweden 1998 – 2009**

	Total n (inc*)	Infected in Sweden n (inc*)	Heterosexual		Homosexual n (%**)	Unknown *** Mode of Transmission
			Men n (%**)	Women n (%**)		
1998	42 (0.5)	15 (0.1)	21 (nk)	15 (nk)	5 (nk)	-
1999	38 (0.4)	16 (0.1)	17 (6)	13 (33)	8 (50)	-
2000	99 (1.1)	49 (0.6)	31 (18)	16 (20)	42 (67)	10
2001	78 (0.9)	35 (0.4)	15 (26)	10 (20)	46 (60)	7
2002	128 (1.4)	65 (0.7)	22 (23)	20 (25)	73 (75)	13
2003	177 (2.0)	107 (1.2)	33 (36)	23 (21)	97 (75)	24
2004	190 (2.1)	98 (0.9)	42 (21)	22 (26)	103 (65)	23
2005	107 (1.2)	57 (0.6)	16 (7)	17 (18)	61 (61)	13
2006	142 (1.6)	43 (0.5)	27 (30)	26 (15)	62 (56)	27
2007	231 (2.6)	123 (1.6)	44 (39)	41 (34)	113 (79)	33
2008	172 (1.9)	71 (0.8)	25 (36)	43 (28)	76 (64.5)	28
2009	181 (1.9)	72 (0.8)	33 (18)	42 (38)	74 (68)	32

\*Incidence per 100 000 population.

\*\* (%) Infected in Sweden. nk= not known.

\*\*\*Unknown mode of transmission or uncertainty regarding the criteria for notification.

**Table 4. HIV Cases in Sweden 2002 – 2009. Mode of Transmission**

	All Cases n (%*)	Heterosexual n (%*)	IDU n (%*)	Homosexual n (%*)	Unknown n
2002	278 (28)	152 (12)	31 (68)	68 (56)	27
2003	363 (24)	207 (12)	32 (69)	78 (53)	46
2004	430 (21)	263 (15)	31 (52)	83 (51)	53
2005	388 (22)	197 (12)	25 (72)	100 (56)	66
2006	377 (26)	198 (30)	35 (86)	94 (50)	50
2007	541 (32)	288 (14)	61 (85)	130 (62)	122
2008	448 (26)	202 (13)	23 (70)	115 (55)	108
2009	486 (24)	221 (13)	27 (63)	134 (44)	95

\*% infected in Sweden.

AE) previously only found among IDUs in Finland was discovered. Whether these HIV cases represented new or old infections discovered because of an intensified screening activity among the drug user population in 2007 is uncertain. However, the increase seems to have been temporary and a decrease to the same level as before 2007 was observed in both 2008 and 2009 (Table 4).

The 10% of HIV cases that have an uncertain way of transmission could be either mother-child or blood transfusion that occurred before arrival in Sweden (Table 4).

## DISCUSSION

*C. trachomatis* infection has increased in Sweden despite extensive screening of women, contact tracing and partner intervention, which includes counselling and free testing and treatment [12]. The decrease of chlamydia observed since 1988 coincided with large national campaigns for safer sex in an effort to prevent HIV [9, 10]. The change in sexual behaviour to fewer sexual encounters and a lower likelihood of engaging in unprotected sex and in high-risk sex was primarily due to an awareness of HIV. This trend for safer sexual practice was observed in several countries in Western Europe during the same period and as in Sweden, a trend that was reversed in the mid-1990s [1].

The spread of HIV has mainly been restricted to three subpopulations in Sweden: MSM (30%), IDUs (10%) and heterosexuals coming from HIV endemic areas (50%). HIV has never been introduced into the general population in Sweden.

In the beginning of the 1970s, the incidence of gonorrhoea was at the same level as chlamydia is today. Gonorrhoea has since declined to very low levels and like syphilis, very rarely occurs in Sweden. The high morbidity of syphilis throughout the 1970s and in the beginning of 1980s was largely restricted to MSM and persons of foreign origin. The increase in syphilis incidence at the end of the 1970s is largely a consequence of the homosexual liberation movement [4, 5]. In the beginning of the 1980s, this increase in syphilis showed a marked decline, mainly because of a general awareness of HIV. The incidence of syphilis remained at its lowest level until 2000 when outbreaks among MSM were observed in Stockholm and in several large cities in Western Europe [1]. This recent increase in syphilis and HIV, found mainly among MSM, might be

because highly active antiretroviral therapy (HAART) promoted behavioural changes to more risky sexual activity, i.e. individuals perceived that HIV was no longer a serious threat [22]. After an initial rapid spread of HIV among MSM and IDUs, there was a marked decline. MSM and IDUs seemed to have reached a relatively stable rate after 2001 though a slight increase in MSM has been observed since 2007. In the past 10 years approximately 25 IDUs have been infected yearly in Sweden, with the exception of 2007 when 61 cases were identified because of enhanced screening activity among the IDU population. However, in 2008-2009 the number HIV cases returned to previous figures (Table 4).

More than 90% of heterosexually transmitted HIV cases involve people of foreign origin that were infected before arrival in Sweden. The variability in the number of reported HIV cases reflects the number of immigrants coming from high HIV prevalence countries at different time points. Today, chlamydia is the only sexually transmitted infection that affects the general population in Sweden. Evidence for the long-term effectiveness of chlamydia screening programmes is lacking [23, 24]. Large-scale screening of asymptomatic women has not reduced the prevalence of chlamydia in Sweden [25] or in other Scandinavian countries [26, 27]. Most screening programmes for asymptomatic chlamydia infections are based on the assumption of the risk of complication after an asymptomatic chlamydia infection, a conception that has lately been questioned [13-15]. In 2006, an unexpected decrease in chlamydia infections occurred in Sweden, which was largely due to the inability of earlier diagnostic kits to detect the new variant (nvCT) cases [19, 20]. Consequently, there must have been several persons with undiagnosed chlamydia infection and an increase in pelvic complications among young women would have been expected. However, there has been no indication of an increase in chlamydia-related complications, which supports the argument that the risk is overestimated.

The role of chlamydia in male infertility is also under discussion. In this regard, there are no conclusive studies showing that chlamydia-infected men are less fertile than uninfected men [28-30]. Complications seem to be related to whether the infection was symptomatic or asymptomatic and overestimation is greatest in low prevalence areas.

One important task recently discussed, but which has not received adequate attention is how screening influences

immunological responses [31]. Questions have been raised concerning screening and its effect on protective immunity and the time course of immunity after untreated infection [32]. Data supporting the contention that treatment debilitates development of protective immunity and increases the risk for re-infection have been reported [17]. No investigation has yet shown that screening programmes lead to a decrease in chlamydia-related complications. Long-term data on the effect of treatment of asymptomatic infections are scarce, especially in low prevalence settings.

However, it might be that during an era of control [32], sequelae are declining despite rising case rates of chlamydia infection. This paradoxical observation has been observed in other population datasets and may suggest that control is achieving its stated goal of reducing sequelae by arresting immunopathology triggered by chronic infection.

Data have also been presented on the high degree of clearance after asymptomatic chlamydia infection [15, 33, 34]. An investigation in Stockholm showed that 75% of the partners had a negative chlamydia test 6 months after exposure to the infection [35] and another Swedish study confirmed this finding by showing that 70% of chlamydia partners had cleared up after 7-12 months [36].

Although most screening programmes have been directed toward women, asymptomatic infections among men will probably contribute significantly in maintaining the dissemination of the infection. Several European studies have shown that the prevalence of chlamydia is higher in men than in women [16, 23, 24]. In Sweden, more men than women had positive tests in relation to the number of persons tested in 2007. However, many women are tested in screening programmes and thus probably have a lower risk than men, who are primarily tested in connection with contact tracing or with symptoms. On the other hand, the transmission rate from men to women is higher because of the exposure of the epithelium in women. This observation suggests that men ought to be included in chlamydia screening programmes. Mailing the specimens was shown to be the most effective strategy to reach young male adults [37, 38]. To increase the cost effectiveness of screening programmes selective screening has been suggested [39, 40]. Although the importance in targeting high-risk persons has been discussed, the difficulty still lies in defining these groups. Patients attending STI clinics or youth health centres could be such groups [41]. An investigation in Stockholm confirmed that the incidence of chlamydia increased with the number of sexual partners [42] and that only 10% of infected individuals had had more than three partners in the past year [43]. Individuals with more than three sexual partners might represent the high-risk group that fuels the spread of the infection [44].

Several factors are known to influence the incidence rate. Contact tracing implies that persons with a higher risk are being tested and consequently contribute to the high incidence rate of chlamydia in men. Another factor that would influence the rate of chlamydia in addition to the proportion of risk-related individuals being tested is compliance of reporting. However, no change has been reported in the proportion of risk-related persons being tested that explains the increase. An increase in coverage is another important factor because coverage and incidence rates tend

to rise in parallel. The increase of positive tests in relation to the number of persons tested, however, indicates a real increase that culminated in 2007 (Table 1).

In Sweden, sexual education has chiefly focused on condom promotion whereas the need for change in sexual behaviour has not been properly addressed for fear of moralising or offending people. Condom use is protective against STIs but many men dislike using them. Further, condoms alone have limited impact in generalised epidemics [45]. Behaviour changes in "partner limitation" have been able to reduce the prevalence of HIV in several African countries [46] and there are indications that the arrest of chlamydia infections in the youngest age group (15-19 years) observed in 2008 and 2009 implies a change in sexual behaviour to fewer partners and delayed sexual activity.

In conclusion, the Swedish strategy to reduce HIV, gonorrhoea and syphilis has been successful. HIV has remained confined to distinct vulnerable groups. However, the present chlamydia strategy in Sweden has not succeeded despite being one of the most comprehensive plans of action in the world. Accordingly, new strategies need to be established and questions concerning immunity and screening activities must be carefully weighed. To increase cost-effectiveness selective screening and identifying high-risk individuals are necessary. Complication and clearance rates after asymptomatic chlamydia infection need to be established and a change in sexual behaviour has to be promoted.

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#### CONFLICT OF INTEREST

None declared.

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