Improving the prevention of Sexually Transmitted Infections (STIs)

A study using Chlamydia trachomatis as a model infection

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ABSTRACT

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Despite the current preventive strategies sexually transmitted infections (STIs) are rising. This thesis presents a model with the aim of improving the prevention of STIs. Chlamydia being the most common STI in Sweden serves as a model infection.

The presented model is based on five performed studies. First we evaluated the feasibility of taking a urine sample at home and sending it with mail for Chlamydia analysis. Postal screening was thereafter analyzed for cost effectiveness estimating the cost per prevented sequel and the prevalence threshold. A population based study of all the 22-year old men in Umeå tested the feasibility of the Internet as a tool in facilitating Chlamydia testing and also attempted to engage men who often have low participation in Chlamydia screening programs. A questionnaire to all 18-year old youths in four northern Swedish cities was analyzed concerning condom use. Finally, ordering home a Chlamydia test from the Internet was tested as method for self-selective screening.

The studies showed that it was both feasible and acceptable by the population to send in urine samples with mail for Chlamydia analysis. Large-scale postal screening would be cost-effective in a female population if the C. trachomatis prevalence exceeds 5% and cost effective in a male population if the C. trachomatis prevalence exceeds 12.3%. Using the Internet as a tool in Chlamydia testing proved feasible and almost 38% of all the 22-year old men in Umeå participated. Condom usage being the most important STI preventive measure during a sexual intercourse proved to be dependent on more male factors than female factors, where the use of oral contraceptives was the strongest factor associated with non-condom use. Ordering a test on the Internet proved to be a feasible self-selective screening method.

Condom use should continuously be promoted to sexually active people especially if oral contraception is used. Success and cost effectiveness in controlling STI transmission is likely to depend on achieving consistent and regular coverage of testing and partner notification among both women and men. The suggested model uses the Internet as a tool in communicating preventive STI information and allowing a self-selective screening, which may be used as an adjunct to regular recruitment in striving for improving the STI prevention.

Key words: STI, prevention, Chlamydia, postal screening, cost effective, condom, Internet, self-selective screening.
The thesis is based on the following papers:


V. Novak DP, Karlsson R. Simplifying Chlamydia testing- an innovative Chlamydia trachomatis testing approach using the Internet and a home sampling strategy: a population based study. (Accepted for publication in *Sexually Transmitted Infections*, 2006).
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<table>
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<th>Abbreviation</th>
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<tbody>
<tr>
<td>AIDS</td>
<td>Acquired Immunodeficiency Syndrome</td>
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<tr>
<td>CI</td>
<td>Confidence interval. A range of values for a variable of interest constructed so that this range has a specific probability of including the true value of the variable.</td>
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<tr>
<td>Epidemiology</td>
<td>The study of the distribution and determinants of health related states or events in specific populations.</td>
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<td>GUM</td>
<td>Genitourinary Medicine Clinics</td>
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<td>HIV</td>
<td>Human Immunodeficiency Virus</td>
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<tr>
<td>Logistic regression</td>
<td>A statistical analysis predicting the likelihood (OR) of an outcome based on certain variables when the dependent variable is dichotomous.</td>
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<td>MSM</td>
<td>Men who have sex with men</td>
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<tr>
<td>NAAT</td>
<td>Nucleic Acid Amplification Test- laboratory based test for the diagnosis of genital <em>Chlamydia trachomatis</em>.</td>
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<tr>
<td>OR</td>
<td>Odds ratio. It is defined as the ratio of the odds of an event occurring in one group to the odds of it occurring in another group</td>
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<tr>
<td>PCR</td>
<td>Polymerase Chain Reaction, a specific kind of NAAT.</td>
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<td>PID</td>
<td>Pelvic Inflammatory Disease, often caused by an STI.</td>
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<tr>
<td>Prevalence</td>
<td>The number of instances of a given disease or other conditions in a given population at a designated time.</td>
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<tr>
<td>Prevention</td>
<td>Measures to prevent occurrence of disease or to arrest its progress and reduce its consequences once it is established.</td>
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<tr>
<td>Risk factor</td>
<td>An aspect of personal behaviour or lifestyle, an environmental exposure, or an inborn or inherited characteristic.</td>
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<tr>
<td>STD</td>
<td>Sexually Transmitted Disease. Refers only to infection causing symptoms or problems.</td>
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<tr>
<td>STI</td>
<td>Sexually Transmitted Infection. Refers to infection with any germs that causes an STD, even if the infected person has no symptoms.</td>
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<td>YHC</td>
<td>Youth Health Centre</td>
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*Most of the definitions derive from:*
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PROLOGUE

The thoughts to this thesis started during my medical school years while I was involved in “Kärlekatsakuten”. A volunteer organisation where medical students go to schools and talk to teenagers about sex and feelings. It was during these visits I became aware of the huge need among teenagers to get answers to their questions. Questions that could be very simple but yet dire since they had no one to ask or entrust. Many of them never dared to test themselves for various reasons and there was a visible need for better communication between them and the health care. I saw that the prevention of sexually transmitted infections (STI) could be improved.

Communication plays a central role in our society today and also in the transmission of STIs. Sexually transmitted infections are also named communicable diseases. ‘Communicable’ referring to something capable of being communicated or transmitted. Preventing transmission with increased communication therefore became the mantra of my thesis.

This thesis I present does not only suggest improvements in STI prevention by facilitating communication, it also intends to serve an educational purpose.

Umeå, Sweden January 6th 2006
**Introduction**

Scandinavia is known for its liberal attitude towards sexuality (1). Sex education has been mandatory in schools since the mid-1950s. During the recent decades Youth Health Centres in Sweden have been established, with the aim of giving young people a balanced and positive view of sexuality, including respect, responsibility, and gender equality. Public health strategies to increase the youth's sexual health include information, free testing, treatment, and partner tracing. In 1988 Chlamydia, Gonorrhoea, Syphilis, and HIV infections were included in the Swedish Law for Communicable Disease Control whereby the reported prevalence of STIs decreased during a few years. Despite preventive measures the decrease slowly vanished during the early nineties and during the last seven years the number of STIs have increased steadily. Even though the domestic spread of HIV is currently, in an international perspective, low and stable there are certain factors indicating increased risk behaviour and that the risk of spreading HIV (and other STIs) in the society is large.

- A large and steady increase in number of STIs among all age groups. The largest increase is seen among the youth, the young adults, and among men who have sex with men (MSM).
- The increased spread of Chlamydia in Europe during the last years (2) and the quick spread of HIV infections especially in the Baltic states and Russia.
- A large increase in HIV infections- primarily heterosexually transmitted- that is caused by the immigration of infected persons from areas where HIV is more prevalent in the population.
- An increasing group whom due to successful treatment and care, live with HIV infection.

Preventive efforts can be focused on different groups of individuals such as young sexually active people, immigrants from STI endemic areas, MSM, pregnant women, intravenous drug users, and travellers to STI endemic countries. Chlamydia trachomatis being the most common infection in Sweden it is well suitable for a model infection for preventive measures. This thesis, with including articles, focuses on C. trachomatis and young sexually active people and aims at presenting a preventive STI model.

**Youth and young adults**

Many people who work preventively divide the youth group into three parts; 10-13 year old, 14-19 year old, and 20-29 year old, the latter often named young adults. Young adults in Sweden have recently been in focus due to health changes. In the Public Health Report from 2005 a decrease in mental health, increase in alcohol consumption and an increase in obesity was observed among youths and young adults spurring preventive health measures (3).

The youths’ and young adults’ sexual health is of concern for a healthier future with high fertility. According to the Swedish Government Report (4) many young adults wait to have steady relationships and many wait to become parents. A Swedish woman gives birth to an average of 1.65 children during her life period a number which has been relatively constant during the last 10 years and puts Sweden in the lower half of Europe’s statistics in childbirth (5). More and more persons live alone or in temporary non-married constellations. Many travel long distances for long periods of time and many study abroad. This extended pe-
period of youth and independency enables more young adults to have a higher number of sexual partners than teenagers and older adults. With the epidemiological increase in STIs during the last years among youths and young adults this makes them a group exposed to risks.

Youth Health Centres (admitting persons up to age 23) and standard school education (up to age 18) provide a firm base for youth prevention. For the young adults who finished the standard school education and are too old for Youth Health Centres there is no natural arena for STI prevention.

The preventive corner stones

Prevention is theoretically and practically divided into three categories depending on when and by whom the prevention is applied.

The most important measure to prevent the spread of a STI in the society is primary prevention. These are measures that prevent persons who are exposed to an infectious agent from becoming infected alternatively attempts to eliminate or reduce the exposure of the infectious agent. Primary preventive measures can be both medically and behaviourally focused. They can be generally aimed at the whole population or specifically aimed at risk persons. Concerning STIs the medical primary preventive measures are very limited. Vaccination is only available to prevent Hepatitis B and in combination with screening donated blood for infectious agents no other medical primary prevention is available. The only effective primary prevention currently available are measures effecting personal behaviour. These can be general such as sexual education in schools or focused such as handing out condoms during music festivals or informing tourist going abroad about the importance of protecting themselves against STIs.

Secondary prevention are measures aimed at preventing an already infected but asymptomatic person not to spread the infection further and to minimise medical complications. Primary- and secondary prevention can often go hand in hand, for example a Chlamydia infected person is treated and at the same time informed about safe sex to prevent future re-infections. Partner tracing is also an important part of secondary prevention enabling early detection of STIs among exposed persons. Large-scale secondary preventive measures have been screening programs.

Tertiary prevention measures are aimed at reducing medical complications by medical treatment.

For me the cornerstones of successful STI prevention are: knowledge, norms/values, empowerment, gender equality and supporting environments.

Knowledge

Knowledge, while not sufficient, is indispensable. It provides protection against individual vulnerability and gives the tools for understanding and avoiding risks. Where epidemics have been slowed education has been the foundation (6). Worldwide, many young girls do not know that an HIV-infected person may look healthy e.g. 15% of the Turkish girls to over 40% of the girls in Niger (6). The United Nations General Assembly Special Interest (UNGASS) decided that by the year 2005 at least 90% of the population aged 15 to 24 should have access to information, education, including peer education and youth specific services necessary to develop the life skills to reduce their vulnerability to STIs (7).

Herlitz et al has assessed the changes in knowledge, attitudes, beliefs, and practices associated with STI in Sweden from 1987 to 2003 (8-10). During the 1980s, a number of nationwide information campaigns were un-
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der tained to prevent the spread of HIV in the general population of Sweden but since 1987 no national campaign has been implemented targeting the general population. Since then prevention campaigns have been modified focusing directly on adolescents, immigrants, refugees from endemic countries, MSM, and HIV infected persons and their relatives. The number of newsflashes from the Swedish equivalent of the Associated Press peaked after the national campaign in 1987, with 944 articles concerning HIV. After this time the number of articles concerning HIV/AIDS continually decreased with fewer than 200 newsflashes per year in 1997. Herlitz et al concluded that since 1987 the general public engagement in HIV issues has decreased, more permissive attitudes concerning sexuality have emerged, and the fear of becoming infected with HIV has decreased. Herlitz et al also concluded that odds ration for engaging in casual sex without the use of a condom increased with age but was relatively small in the youngest age group. A suggested reason to this is that the sex education among young people tends to give short-term rather than long-term effects. Sexual health information should therefore be available and easy accessible for all age categories at all times to increase the preventive effect.

Norm and values

It is always difficult describing and interpreting the present society. Trends and changes are always seen more clearly in hindsight. Forsberg has done an attempt at explaining the adolescent sexuality in Sweden based on a research review (11). The author states that some people believe that not much has changed while many other claims that Sweden is in the middle of a social transformation that is at least as revolutionary as that from agrarianism to industrialism. Such social transformations took place around 1920 and 1960 and were associated with economical expansion, which is evident not only in research, but also in the STI statistics, where we could see distinct increases in the incidence of gonorrhea and other STIs. The current social transformation is also followed by an increased number of STIs (12). Forsberg writes, “This epoch is often described as a transition period from the industrial society to the informative society”. This information society has enabled adolescents with a sexual curiosity to quickly access a vast amount of information. Sexual material and pornography is accessible to essentially anyone who wants it. The author further states that along with the rapid advance in technology the Swedish demography is changing. With more people than ever in Sweden with roots from abroad, the Swedish view of sexuality is currently subject to influences from many directions (11). There are signs indicating a more open attitude towards sexuality reflecting in the more permissive attitude towards sex outside established relationships, with lower coitarche and more number of sexual partners, more often oral- and anal sex than older generations (13) and greater acceptance of homosexuality (14). There are also other signs indicating a more conservative view of sexuality with respect to sex roles due to multicultural influences. A study of a multicultural school showed that all girls, independent of country origin have a later coitarche than boys (15). This is in contrast to the general trend in Sweden where teenage girls are considered to be the more sexually experienced gender with earlier coitarche and more sexual partners (13, 16). Norm and values among young people are therefore dynamic and possible to influence, which should be considered in preventive measures.
When wanting to improve the prevention of STIs one has to take into account the gender-based dynamics within the sexual relationship of men and women.

Sex is governed by gender where men and women act on different premises. The current social norm, where girls have a narrower field of sexual action than boys (17, 18), promotes that girls should have few sexual partners. For boys, on the other hand, where there is a higher tolerance concerning their sexual behaviour (19) the social norm indicates that boys should have more partners. There is also a growing global understanding that the HIV epidemic is not only about epidemiology but it is also fuelled by social factors such as gender inequality which rests on power relationships (20).

It is well known that STIs are transmitted easier from a man to a woman than vice versa and that the only reliable protection available today against an STI is the condom, which is worn by the man. Sexual relationships with an imbalance in gender power decreases the woman’s ability to suggest condom use (20, 21). A further problem is the lower STI testing rate among men than women. In C. trachomatis population screening men participate consistently lower than women (22-24). This gender difference in sexual health responsibility is also seen at Swedish Youth Health Centres where 90% of all appointments are by women (25). Further, women contributed during 2003 with 73% of the total number of C. trachomatis tests in Sweden (26). Why there is this gender difference needs to be questioned. Is it because women have a more natural connection with health facilities by regular oral contraception prescriptions visits enabling them to easier take a STI test than males? Or could it be that women in a sexual relationship take more responsibility for their own and their partner’s sexual health?

The British Chief Medical Officer’s Expert Advisory Group (27) and other researchers (28) suggest short term benefits if women are screened while other researcher state that restricting male participation to that of traceable contacts makes successful eradication of STIs unlikely (29). Since sexually transmitted infections affect both sexes, men are at least as important as women in the dynamics of transmission and it is therefore important to engage both males and females equally in population screening of STIs. Screening focused only on women would liberate men from the responsibility for their own and their partner’s sexual health. Including men in screening would make more men aware of the risks with STIs and the value of taking responsibility for their sexual health. Finally, from a gender health equality perspective men should have the same opportunities for screening as women.

In improving the STI prevention it is therefore important to strive for gender balance within sexual relationships and STI testing.

Empowerment

An important part of gender equality is empowerment. The term empowerment has recently become a popular term often used as an attention grabber in daily press but not always clearly understood. Empowerment is a term shared by many disciplines and arenas but the meaning of the term varies among disciplines and a clear universal definition is hard to find. A general definition is however attempted by Page et al who suggest, “Empowerment is a multi-dimensional social process that helps people gain control over their own lives. It is a process that fosters power (that is, the capacity to implement) in people, for use in their own lives, their communities, and in their society, by acting on issues that they define as important” (30).

In an STI prevention perspective this means
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supplying an arena where individuals can make active sexual health decisions avoiding potential risks. It means helping people gain control by giving them the necessary knowledge and the possibility to act after own risk assessment, such as making a decision to use condom and be selective in their choice of sexual partners.

As earlier mentioned information and education is important but it is not sufficient since it does not address the power imbalance between men and women. During the last decades there has been an enormous increase in media and the same time period has also seen the emergence of new social and cultural groups, and increased flexibility of norms, lifestyles and attitudes (4). The increased amount of media causes individuals to quicker be informed about risks in the society. More information, on the other hand, doesn’t necessary mean increased knowledge. It may instead lead to increased worry and confusion and may also lead to unnecessary stigma and intolerance.

In the ancient rhetoric model (Rhetoric) from Aristotle (384 BC–322 BC) he mentions the importance of credibility and attitude of the speaker to enable the message to be accepted. This ancient rule is just as important today. Studies have shown that the higher confidence a person has in an institution and/or person the higher the possibility he/she will accept the preventive information (31). To increase the empowerment of individuals it is therefore important that they receive accurate preventive information from reliable sources in a tolerant arena allowing individuals to make their own decisions increasing their sexual health.

Supporting environments

There are three factors that affect the rate in which an STI is spread in the society. These factors are included in a basic but accepted epidemiology formula (32):

\[ R_0 = \beta \times k \times D \]

- \( R_0 \) is the rate in which an STI spreads in the society
- \( \beta \) is the risk of STI transmission from an infected person to a susceptible person
- \( k \) is the number of sexual contacts an individual has
- \( D \) is the duration an infected person is infectious

If \( R_0 < 1 \) the disease will eventually disappear, if \( R_0 = 1 \) the disease will become endemic (disease found regularly in the population) and if \( R_0 > 1 \) there will be an epidemic (disease very common in the population). Even though there are some objections to the generality of this formula one can mathematically prove that these three factors equally influence the rate in which an STI spreads in the society equally (32, 33). A 20% decrease in one of these three factors will have the same effect as a 20% decrease in any of the other factors. The first factor (\( \beta \)) can be changed by using a condom. The second factor (\( k \)) may be changed with information campaigns and increased empowerment. The third factor (\( D \)) can be affected by informing individuals to test themselves after they have had unprotected sex. It is also this factor that the health care system can directly affect by quickly finding and treating infected individuals. It is therefore of great importance that a supportive environment is available which enables young people to get quick access to information and health care.

Supportive environments have emerged over time. In response to the epidemics of Syphilis and Gonorrhea in the early part of the 20th century United Kingdom established a national network of genitourinary medicine clinics (GUM). Since then there has been a year after year increase in the number of patients attending GUM clinics and with the recent rise in the rates of STI there is an increasing pressure upon the GUM clinics (34). This has lead to
that many GUM clinics cannot live up to the government's recommendation of access without delay for persons presenting a clinical problem suggestive of an STI (34). Foley et al assessed the access to GUM clinics in the United Kingdom and found that an average of 16% of patients was offered consultations as late as one week after telephone contact. In this study, only persons with acute symptoms such as penis discharge, pain when urinating, and difficulties walking or sitting were included. One might speculate that the time to health care access would be longer among persons presenting milder or no symptom such as the case with most people infected with Chlamydia.

During the recent decades Youth Health Centres (YHC) have been established in Sweden, with the aim of supporting young people and giving them a balanced and positive view of sexuality, including respect, responsibility, and gender equality. YHC are present in most Swedish cities. The age limit varies but one is eligible for treatment and counselling at most YHC if you are below the age of 23 years. Are you older, treatment and counselling can be found at STI clinics, which are present only in larger cities in Sweden. Apart for YHC and STI clinics a worried-well citizen can always be tested for an STI at the local health centre free of charge.

The Swedish Institute for Infectious Disease Control conducted a study to test the waiting period at various YHC and STI clinics (33). The study concluded that the waiting period for a clinical visit was on average 2-4 days for someone who had mild symptoms and suspected to have an STI. There was however a large variation in waiting times between the clinics with three clinics having waiting periods between three to five weeks which epidemically is not acceptable. The study didn't take into account the amount of waiting time in telephone queues to make a clinical appointment and also the effect of summer holidays where all clinical services in Sweden are minimised.

In a preventive aspect the supporting environments can therefore be further improved by increasing the health service accessibility. Allowing persons to take tests at all hours of the day and in any season of the year will minimise the possibility of spreading any STI further.

Sexual networks

In the late 1960s, a psychologist Stanley Milgram from Harvard wanted conduct an experiment to see how small the world really is. He named this well-known experiment the small-world problem (35). The importance of this experiment is further discussed in Malcolm Gladwell’s the Tipping Point (36). Milgram wanted to test how well humans are interconnected by a chain of letters. He got the names of 160 randomly selected people in Omaha, Nebraska, and mailed each of them a packet. In the package was the name and address of a stockbroker who worked in Boston, Massachusetts. Each person was instructed to write his or her name on the package and send it to a friend or acquaintance that he or she thought would get the package closer to the stockbroker. The friend or acquaintance would then send the package on to someone who he/she thought was closer to the stockbroker and so on. When the packages finally arrived at the stockbroker’s house Milgram could look at the list of names and see how many hands they went through to reach the final destination. The purpose of this was to see and establish how closely connected someone chosen at random from one part of the country was to another person in another part of the country. Milgram found that most of the letters reached the stockbroker in only 5.9 steps. This is where we get the concept of six degrees of separation.

After Milgram's findings a great deal of sys-
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tems proved to be small worlds such as Hollywood actors linked to each other by movies they acted in together, businessmen linked by common company boards, and even letters in the English alphabet interconnected by common words (37). A new research field emerged among sociologists and mathematicians studying various networks. Sociologists would describe the network of social contacts in a group of people by so called sociograms and mathematicians would describe the interconnection of computers and serves as graphs.

Since the end of the 1990s epidemiologists found the importance of using this network theory in understanding the human sexual contacts. The same sociogram as above can be used as an example of a sexual network where an STI travels between the persons. Common among sexual networks is the clustering tendency where nodes or people tend to form into natural groups that are interconnected by one or a few persons (C and D in figure 1). Few networks are however static, and sexual networks are certainly not with the constant emergence and dissolution of sexual partnerships. Soon the network theory became so complicated that the sexual networks were named complex networks with a scale free property (38-40). The study of scale free networks is still in its infancy but might hold a promise for the future in preventive thinking. Being a scale free network implies that the distribution of connectivity is extremely uneven, where many have few sexual partners and few have many sexual partners. The sexual networks expand continuously by the addition of new people and the new people preferentially make contact to persons who are already well connected (37). Evidently, in sexual networks, as in other scale-free networks, “the rich get richer”. The plausible explanation for this is an increased skill in acquiring new partners as the number of previous partners grows, varying degrees of attractiveness, and possibly the motivation to have many new partners to sustain self image (39). Preventive measures based on sexual network theories are aimed at the well-connected individuals, the persons with many sexual partners.

Figure 1. A sociogram, showing the social contacts between twelve people.
If we remember the epidemiological formula previously mentioned:

$$R_0 = \beta \times k \times D$$

$k$ is the number of sexual contacts an individual has which also mean how well he/she is connected within the sexual network. If one can decrease the connectivity (number of sexual partners) of this person, $R_0$ may go below one preventing an epidemic. Another possibility to decrease $R_0$ is to decrease $\beta$, which is the risk of STI transmission from an infected person to a susceptible person, by making the well-connected individual use a condom. Finally one can quickly find and treat a well-connected individual who is infected with an STI and thereby preventing a quick spread of the disease. Scale-free networks have proven to be robust against random elimination of a node but highly susceptible to break down if the best connected nodes are eliminated (39, 41). For example if person A in figure 1 was infected with an STI and taken away from the network no large changes would be noticed. He/she had only one contact and the network keeps being well connected enabling a further slow spread of the infection. If one, on the other hand, quickly finds and treats an infected person who has many sexual contacts, e.g. person D in figure 1, the networks falls apart. The STI can no longer spread quickly through the network, jumping over to other cluster and an effective preventive measure is achieved.

From an STI perspective, it is therefore vital that preventive measures focus on persons with many sexual contacts. The epidemiological implication of such efforts is to identify and test young people who change partners frequently.

**Epidemiology of STI - an overview**

Today there are a total of nine well-known STIs: Syphilis, Gonorrhoea, Chlamydia, Herpes genitalis, Ulcus Molle, HIV/AIDS, Genitoanal papillomavirus, Cytomegalovirus and Hepatitis B. The following epidemiology will only consider Syphilis, Gonorrhoea, and HIV, and Chlamydia.

**Syphilis**

In the early part of the 20th century syphilis was endemic throughout Europe, North America, Africa, and Asia. The problem was exacerbated by social breakdown and huge population movements during the First World War (42). Following the First World War, the availability of clinical service and social stabilisation led to a reduction in incidence of syphilis. However, this was short lived and syphilis incidence increased rapidly during the Second World War (42). After the Second World War, syphilis again declined rapidly as a consequence of improved clinical service and especially after the introduction of penicillin (42). In the 1960s and 1970s there was an increase in syphilis in many parts of the developed world particularly among MSM (43).

The 1980s saw the widespread promotion of safer sex messages as a consequence of the HIV epidemic and this led to a reduction of Syphilis in many parts of the world (42). Unfortunately, Eastern Europe and some inner-city areas in North America and Great Britain have recently seen an alarming rise (44-46). In several of the newly independent states of the former Soviet Union, syphilis has increased 15-30 times (46). A considerable part of this increase has probably occurred as a result of social breakdown in the former USSR, resulting in poverty, unemployment, and large-scale migration. In addition the availability of quality health care has declined and the process of partner notification has all but evaporated. In the United States, a
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programme for the elimination of syphilis was proposed in the late 1990s, but the number of reported cases has increased in the past 5 years (45).

In Sweden, during the year 2004, a total of 194 cases of Syphilis were registered which is an increase by 8% from the previous year and the highest number since the year 1983.

**Gonorrhoea**

The trends in Gonorrhoea infection have in many industrialised countries partially mirrored those for Syphilis, with peaks following both world wars. A decline in Gonorrhoea cases was noted in most western European countries starting in the 1970s and reached an all time low by 1995 in many EU states (47). However, since 1997 there has been a steady increase in Gonorrhoea cases in most EU countries. In England, Wales, and Northern Ireland the diagnosis has doubled from the year 1996 to 2001 (47). Ireland noticed a three fold increase during the same time period (47). Lately a widespread resistance for the standard antibiotic treatment (quinolones) has been noted in Asia and the Pacific (48).

During the year 2004, 569 cases of Gonorrhoea (481 males and 80 females) were registered in Sweden, where Stockholm has 52% of the yearly Gonorrhoea cases.

**HIV**

During the summer of 1981 the first case of AIDS was reported in USA. It was primarily noticed among young homosexual men but soon similar cases were present among intravenous drug users, haemophiliacs (who often need blood transfusion), and heterosexual men.
and women. Today it has become a world wide epidemic with large increases in Africa, Caribbean, and Asia.

The current pandemic resulted from at least two different epidemics superimposed (49). Two different agents, related to one another, triggered them. One epidemic was centred in one place, West Africa, whereas the worldwide spread of HIV began in three places, one in central Africa and the other two on the coasts of North America. HIV antibodies have been found in serum collected from people in Kinshasa, Zaire as long back as the year 1959 and the earliest discovery in USA was from material saved from a patient who died in the year 1967 (50). African primates have been identified to carry multiple viruses similar to the human HIV, which may have been transferred to humans. African primates have long been hunted, handled, and eaten. Anicet Kashamura, in his work on sexual customs of the tribes inhabiting the Great African Lakes region, wrote, “To stimulate a man or a woman, and arouse intense sexual activity in them, one injects their thighs, pubic region, and back with male monkey blood (for a man), and she-monkey blood (for a female)” (49). Due to political, demographic, and economic changes which occurred in central Africa during the 1960-70 epidemiological fundamentals were laid for a spread of the infection (50).

Early in the HIV epidemic, recipients of blood or blood products were a significant source of HIV infections in developed countries. Most of these infections occurred before 1985, when HIV antibody screening of all blood products became available. Initially the spread of HIV to Europe came from USA but recently it has come from immigrants from HIV endemic areas. The overall rise of HIV

**Figure 2.** Trend in number of diagnosed Gonorrhoea cases in Sweden. Data from the Swedish Institute for Infectious Disease Control.
among heterosexual individuals in the United Kingdom is among people who originated from and were infected abroad, mainly Africa (51). However the number of people becoming infected with HIV through heterosexual intercourse in the United Kingdom is rising steadily. As the number of heterosexuals living with HIV in the United Kingdom grows, the likelihood of heterosexual transmission within the country will increase.

During the last seven years, most countries in the former Soviet Union have been severely affected by HIV epidemics that continue to spread as a result of injected drug use (52). Data also indicate that an HIV epidemic is fuelled by heterosexual transmission dependent on so-called bridge populations that link high-risk groups with the general population (52).

The development of the Swedish HIV-epidemic during the 1990s has been influenced by the global HIV situation. Persons infected abroad, usually in high endemic areas, compromise 2/3 of the reported cases in Sweden. The largest group of persons infected abroad are immigrants who became infected (mostly heterosexually) before arrival to Sweden. The incidence of HIV cases transmitted heterosexually therefore fluctuates yearly, as can be seen in figure 3, depending on the number of immigrants and their country of departure. During the year 2004, a total of 427 cases of HIV were registered in Sweden, which is an increase with 11% from the previous year. There has been a steady increase in number of cases infected by heterosexual contact since the year 2000 while homosexual and intravenous transmission has levelled out.

Figure 3. Number of newly diagnosed HIV infections in Sweden by transmission group and year. Data from the Swedish Institute for Infectious Disease Control.
**Chlamydia**

The bacteria was first associated with the eye disease Trachoma, thereby the name *Chlamydia trachomatis*. During the early 20th century it was found that *C. trachomatis* could also give genital infections and in the western world it has become better known as a sexually transmitted infection than an ocular infection (50). Trachoma is still the leading infectious cause of blindness world wide, affecting an estimated 300-500 million people of whom 5.9 million are blind. Once endemic in most countries, this ocular disease has largely disappeared from Europe and the Americas due to the introduction of antibiotics and clean water. Trachoma continues to be hyper endemic in many of the poorest and most remote areas of Africa, Asia, Australia, and the Middle East (53).

Trachoma has afflicted mankind since ancient times. There is evidence of its existence in China as early as the 27th century BC and in Egypt the features of Trachoma were described on the papyrus. Ancient Greek physician, including Hippocrates, wrote descriptions of treating Trachoma and the chronic sequelae of infection. In fact, trachoma is the derivation of the Greek word for “rough”, or “swelling” which happens to the conjunctiva after multiple infections (53, 54).

*C. trachomatis* is currently the most common bacterial STI in virtually every population examined (48). Recent trends have show that Chlamydia has steadily been increasing across the western hemisphere during the last seven years (2, 55, 56). Chlamydia infection increased with 5.1% in USA from the year 2002 to the year 2003 and during the same time period Chlamydia infection increased with 7.9% in Great Britain and over 10% in Switzerland (55, 56). The Nordic countries have a similar

![Figure 4. Rate of Chlamydia infection per year in the Nordic countries. Data from EpiNorth and WHO.](image-url)
Background

The trend in Chlamydia infections is increasing since 1997 (figure 4).

During the year 2004, a total of 32,075 (18,211 females, 13,833 males, 31 unknown sex) C. trachomatis cases were registered in Sweden, which was an increase with 20% from the previous year. The number of C. trachomatis tests per year have increased yearly since 1997 and was 2004 close to 400,000. This means that approximately every twentieth Swede get tested yearly. The increase in number of tests is correlated with the introduction of non-invasive test methods, urine PCR, during 1997. Among the tests, 27% of the female and 44% of the male tests, were due to partner tracing. One third of the infected males and females sought for symptoms.

Among all the tests taken in Sweden year 2003, twelve percent of the male tests were positive and five percent of the female test were positive (Figure 5). This higher prevalence among the males is probably due to that the majority of males that take Chlamydia tests in Sweden are part of a partner tracing chain where the female took the initiative to the first test. Conclusively the slowly increasing Chlamydia trend among both males and females is caused by an increased number of tests taken and also by a higher proportion of positive tests (12).

The average age of an infected female in Sweden is 22 years and the average age of an infected Swedish male is 25 years. The average age for infections has been decreasing steadily during the last few years. Females contributed during 2003 with 73% of the total number of C. trachomatis tests and males contribute with 27% of the tests (12).

The number of C. trachomatis cases reported varies with season with the most cases in the fall (Figure 6).

The “Fall diagnosis” is increasing with each year and it is dominated by the younger age group, 14 to 20 years of age who test themselves after the summer vacation.
Microbiology and clinical manifestations of *C. trachomatis*

**Microbiology**

*C. trachomatis* is an obligate intracellular bacterium which needs living cells to multiply such as urethral or columnar endocervical cells in the genital region. Within these cells *Chlamydia* increases with binary fission until the host cell dies and the infectious particles leave the dead cell to find a new host cell. In the laboratory cell culture this life cycle takes 48-72 hours. There are 18 distinct serotypes of *C. trachomatis* currently identified (57) where serotypes D to K cause sexually transmitted genital infections and neonatal infections. *C. trachomatis* facilitates an HIV infection because infected and sore mucous membranes are rich in blood-vessels and lymphocytes, a predisposition to be infected with HIV. Therefore, a step in decreasing the spread of HIV is to decrease the spread *C. trachomatis* (58).

**Clinical Manifestations**

As many as 85 to 90 percent of *C. trachomatis* infections in men and women are asymptomatic (59, 60). Untreated *C. trachomatis* infections can cause urethritis, cervicitis, endometritis, epididymitis, perihepatitis, conjunctivitis and arthritis (61-64).

**Male complications**

**URETHRITIS**

The incubation time varies but is usually 10-14 days. Symptoms, if present, would present as pain when urinating and/or urethral discharge.

**PROSTATITIS**

Urethritis can be followed by a prostatitis. In Sweden untreated urethritis caused by *C. trachomatis* are in 25% of the cases complicated with prostatitis (65).
EPIDIDYMITIS
Scrotal pain, swelling, and fever. The majority (over 70%) of epididymitis cases among men younger than 35 years are caused by *C. trachomatis* (66).

PROCTITIS
Chlamydia infection rarely gives symptoms but symptoms may be anal discharge, irritation, pain when defecating, and occasionally bleeding.

DECREASED FERTILITY
The role of *C. trachomatis* in male infertility is still a matter of debate but it is generally accepted that it causes a decrease in male fertility. In the pre-antibiotic era, chlamydial bilateral epididymitis caused infertility in a considerable proportion of cases (57). The sequel of ascending infections might be occlusion in the canalicular system of the genital tract, damage of the cells involved in sperm production, or immunoreaction with the production of antisperm antibodies (57). Studies among infertile couples showed a lower pregnancy rate among couples where the man was positive for *C. trachomatis* IgG, as marker of previous chlamydia infection (67, 68). It still remains unknown if *C. trachomatis* exerts a direct effect on the sperm quality and/or if the male glands are merely reservoirs for *C. trachomatis* that are repeatedly transmitted to the female partner, thereby causing for example tubal damage and diminished pregnancy chances (68).

Female complications

CERVICITIS/URETHRITIS
Clinical examination may find a yellow cervix discharge and sometimes hemorrhagic cervix erosion. The clinical signs are too inconsistent as a base for diagnosis. Urethritis symptoms, if present, would be pain when urinating and/or urethral discharge.

EDOMETRITIS
Chlamydia can be isolated from the endometrium from females infected with *C. trachomatis*. Metrorrhagia, bleeding not related to the menstrual cycle, is the cardinal symptom if endometritis.

PELVIC INFLAMMATORY DISEASE (PID)
PID is caused by ascending Chlamydia infection from the lower genital tract. Thus cervicitis is followed by endometritis, salpingitis and then PID. *C. trachomatis* is the major cause of PID not associated with pregnancy or invasive surgical procedures (57). Untreated *C. trachomatis* heals with scarring which increases the risk for complications. PID is correlated with the presence of chlamydial antibodies (69-72). Tubar pregnancy is often an aftermath of upper genital tract infection with *C. trachomatis* (70, 73, 74) as is female infertility (71).

The sharp worldwide increase in the incidence of PID during the past two decades has led to a secondary epidemic of infertility and ectopic pregnancy (57). Chlamydia PID is the most important cause of infertility and adverse pregnancy outcome in developed countries (57).

INFERTILITY
After a single episode of PID the relative risk for tubal factor infertility is approximately 10%. Each repeat episode of PID doubles the risk so that it is approximately 20% after two episodes and almost 40% after three or more episodes (57, 75, 76). Martin et al.(77) showed that the mean duration of gestation was shorter among females infected with *C. trachomatis* than non-infected females, and that stillbirth and neonatal death was also significantly more common among infected females giving birth.
ECTOPIC PREGNANCY
Scarred fallopian tubes may allow the passage of sperm to fertilize the egg but the fertilized egg may be too large to pass through the scarred tubes into the uterus for implantation. Instead the fertilized egg travels backward and gets implanted into the fallopian tube or in the abdomen. This is associated with mortality of the foetus and mother. Ectopic pregnancy is the main cause of maternal mortality in the first trimester of pregnancy in developing countries (57). In the United States, deaths resulting from ectopic pregnancies account for 9% of all pregnancy-related mortalities (57). Women with a history of PID have a 7- to 10-fold increase in tubal pregnancy compared with women with no history of PID (57, 75, 76). The incidence of ectopic pregnancies has increased, just like PID, during the last two decades.

ADVERSE PREGNANCY OUTCOME
There is some evidence that C. trachomatis may also contribute to pregnancy complications other than ectopic pregnancy (77, 78) including premature rupture of membranes, preterm birth, low birth weight (<2500 grams) and stillbirth. Early pregnancy loss or recurrent pregnancy loss may be induced by asymptomatic C. trachomatis infection through the operation of immune mechanisms (79, 80).

PERIAPPENDICITIS
The appendix can be infected with C. trachomatis since it may spread from the Fallopian tube to the appendix often leading to no or low fever.

PERIHEPATIT
C. trachomatis may spread from the cervix via the uterus to the Fallopian tubes and further up along the colon to the right part of the diaphragm and infect the liver capsule. The liver parenchyma is not affected. The liver values are normal. The symptom is pain in the upper right quadrant of the abdomen.

UTERINE CERVIX CARCINOMA
A prospective sero-epidemiologic study provides evidence that infection with C. trachomatis increases the risk for subsequent development of invasive squamos-cell carcinoma of the uterine cervix (81). The risk is still raised when adjusting for smoking and HPV infections (81).

Female and male complications

ARHTRITIS
Reiter’s syndrome (conjunctivitis, arthritis, and urethritis) is associated with Chlamydia infections. C. trachomatis has been isolated in from urethra among 40% with Reiter’s syndrome and serum antibodies have been identified among two thirds of patient with Reiter’s syndrome (82, 83).

TRACHOMA
More than 300 million persons worldwide have been are affected by Trachoma and it is the most common reason for infectious cause of blindness worldwide (53). This ocular disease is caused by the C. trachomatis serotypes A-C which are different from serotypes D-K which cause the genital infection. Blindness is caused by repeated episodes of infection with C. trachomatis. Multiple infections cause a scarring of the conjunctiva which decreases the lubrication of the eye. Extensive scarring causes the eye lashes to turn inward, trichiasis, further destroying the eye’s surface. Scarring and little protective lubrication invites secondary infections which inevitably destroys the cornea giving it irreversible opacities (53).

Trachoma afflicts the most impoverished communities on earth (53). The spread of the infection is facilitated by poor hygienic conditions with often little water allowing nose- and eye secretion to be exchanged between individuals. The crowded living conditions
make women most susceptible to Trachoma. The *Musca sorbens*, an eye-seeking fly, breeds preferentially in human faeces on the ground and spread the infection further where no latrines are present (53).

Due to its absence in developed countries, Trachoma has largely been forgotten as a public health issue. This has however changed since the World Health Organisation endorsed an alliance for the Global Elimination of Blinding Trachoma by the year 2020 (84).

**CONJUNCTIVITIS**

Conjunctivitis is most likely caused by direct contact of genital secretions from partner or autoinfection. Most common age of being infected is 15-30 years of age with a top at age 20 (85). The incubation time varies from one week to a few weeks. Often only one eye is infected.

**Neonatal complications**

Children who are born through a birth canal infected with *C. trachomatis* may acquire the infection. The risk for transmission has been estimated to be 30% (86).

**NEONATAL CONJUNCTIVITIS**

*C. trachomatis* is the most common cause of neonatal conjunctivitis and is isolated from the eye among 15-25% of the neonates with conjunctivitis. The conjunctivitis usually starts during the first to third life week of the child. It starts in one eye but both eyes soon become infected if no treatment is given.

**NEONATAL PNEUMONIA**

The child usually becomes sick at 3-12 weeks of age with nose congestion, coughing, and increased breathing rate. Short periods of apnoea may occur and the child seldom has fever. Follow-up studies at age 7-8 years show that children who have been infected with Chlamydia pneumonia as infants are more likely to have airways complications such as asthma (87). Chlamydia infections during infancy should therefore be considered a potentially serious complication (65).

**Diagnosis**

Isolation of *C. trachomatis* from the cervix was first achieved by Jones et al. (88) and isolation from male urethra associated with neonatal conjunctivitis was performed by Gordon et al. (89). The first cultures of *C. trachomatis* from the fallopian tubes of patients with PID were made by Eilard et al. (90, 91).

As *C. trachomatis* is an obligate intracellular organism, diagnostic tests have generally depended on the collection of cellular material using invasive intimate procedures. Prior testing methods, such as cell culturing and immunosorbent assay, depended upon viable testing material. Viable testing material almost always meant making invasive tests at a medical clinic.

Since 1996 there has been commercially available nucleic acid amplification tests (NAAT) for the diagnosis of *C. trachomatis*. NAAT proved to be more sensitive and specific than previous diagnostic tests (culture and enzyme-linked immunosorbent assay on cervical swabs) (92-95). Further advantages with NAAT compared to previous diagnostics tests was a faster analysis and more tolerant to transports. A major breakthrough was the observation that NAATs could be used with non-invasive specimen such as first-void urine specimen with reported sensitivities ranging from 84% to 98% (92, 95-97). The sensitivity among females was similar to that obtained from cervical swabs (97, 98). The use of non-invasive diagnosis of Chlamydia infections in both men and women enables population-based prevalence surveys and broad-based screening approaches to control Chlamydia infections.
**Treatment**

Chlamydia infection can effectively be treated with antibiotics. *C. trachomatis* is sensitive to tetracycline (99). Tetracycline should not be given to pregnant females and children under the age of 8 years, where erythromycin is preferred. Resistance to these antibiotics has not yet been seen (86). In patients believed to have a low compliance an alternative of one dose of 1g of azitromycin can be given (100).

A follow up control of the treatment with a new test is often recommended to guarantee eradication of the infection. Partner tracing a minimum of six months back in time is also recommended.
AIMS

The aim of this thesis is to find a way to prevent the increasing trend of STI and to present a STI prevention model. The specific questions that need to be answered are:

• Is there a feasible screening method with a high male and female participation?
• Is the screening for C. trachomatis cost-effective?
• What factors are related to risky sexual behaviour, such as non-condom use?
• Is it possible to design a method where there is a continuous self-control of C. trachomatis in the society by the help of the Internet?
METHOD AND MATERIAL

Despite the society's preventive measures the number of Chlamydia infection has been rising steadily since 1997. New thoughts and new approaches are needed. With the development of new molecular techniques, urinary testing for C. trachomatis has proven to be feasible with both high sensitivities and specificities (92, 96, 97). This development has opened the possibility for simplifying the testing procedure by taking a urine sample at home and sending it in for analysis. This means that no physician visit would be necessary to take the test and this is a tempting new thought stimulating people to get tested more often.

Macleod et al was one of the first to do a larger clinical study with this home sampling method (24, 101). They performed a study where 100 men and 100 women, aged 18-45 years received a test package and instruction take a urine sample and send it in for analysis of C. trachomatis. With the help of reminding letters, telephone calls, and personal visits an astonishing 83% participated (101).

With this encouraging result we attempted to perform a pilot study in Sweden, to assess the feasibility of this new method. We used the similar methods as Macleod, to enable a comparison, but we also chose to only focus on men and women aged 20-24 since they were a group in which Chlamydia was increasing extensively. During the winter of year 2000 a random sample of 100 men and 100 women aged 20-24 from the population register with permanent addresses in Umeå, Sweden were selected. Subjects were sent a biological substance transport envelope containing a covering letter with a brief description of the study and facts about C. trachomatis including the possibility to be asymptotically infected. A urine specimen container to be returned in the prepaid envelope was also enclosed. Instructions for collecting first void urine specimen, and storing before mailing, were provided.
After three weeks, subjects who had not responded or from whom we had not received a returned unopened letter were sent an envelope identical to the first but with a modified covering letter. This covering letter gave the subjects an opportunity to explain their non-participation. Subjects were classified as no longer living at their registered address on the basis of the return of an unopened letter. A letter was later sent to all participating in the study telling them the results of their own \textit{C. trachomatis} tests. Infected participants received treatment and underwent partner tracing.

**Paper II**

The objective was to find a screening method with a high male participation rate. In our pilot study a significant more amount of women participated than men. Women participating more than men in Chlamydia screening elsewhere had been seen (24, 101). Another purpose of the study was to try to estimate the prevalence of \textit{C. trachomatis} in a population. Twenty two year old men were chosen as subjects since the highest increase in Chlamydia cases had been seen in this age group from the previous year (12).

All 22-year old males living in Umeå received a biological substance transport envelope, during the year 2002, containing a cover letter with a brief description of the study and facts about \textit{C. trachomatis}, including the possibility of being asymptomatically infected. A coded urine specimen was to be returned in the prepaid envelope. Instructions were provided for collecting first void urine specimen, and storing the specimen before mailing. Two weeks after sending the urine sample the participants could retrieve their test results by entering their code on an Internet site. Participants who received a positive test answer were requested to contact us for treatment. The Internet site also provided information about \textit{C. trachomatis} and gave relevant links to other STI Internet sites.

**Paper III**

Untreated Chlamydia infections have been shown to be costly to the society. It was estimated that in the USA Chlamydia infections cost over $2 billion in the year 1995 (102, 103). With the increasing trend in Chlamydia infections this cost has most likely increased (55). A number of studies have assessed the cost-effectiveness of screening for asymptomatic \textit{C. trachomatis} with the means of NAAT (104-108) suggesting that screening may be cost-effective. All of these studies were focused on the cost-effectiveness of screening women only. Screening women for \textit{C. trachomatis} immediately became interesting after Scholes et al published a randomised study with strong evidence that screening is effective in preventing PID (109). Cost-effective screening studies among women were further motivated by the fact the cost of medical complications following untreated Chlamydia infections is larger among women than among men. A cost-effective analysis is depended on the medical costs of each treatment, which varies between countries. Only one prior cost-effectiveness analysis of screening and treatment for \textit{C. trachomatis} by NAAT had been done in Sweden (108). A new testing method using home obtained urine samples and NAAT was now available but had not yet been analysed cost-effectively. Our pilot study showed that this new method was feasible and acceptable by the population but was it cost-effective? Was the method cost-effective for both men and women? Could the cost-effectiveness motivate a screening of the population? Paper III sought the answers to these questions.

The outcome measure in the analysis was the number of prevented medical sequels. Both
men and women were included in the analysis. The cost of screening was compared to the cost of medical sequels if no screening was done. The probabilities to acquire medical complications if untreated were derived from the literature and the costs of the medical complications were taken from the Umeå University Hospital's price list. To address concerns regarding variations in the parameter estimates used in the model, we performed sensitivity analyses, which varied the probability and cost estimates of events over plausible ranges and explored their effects. In other words, when we performed the economic calculation we tested to see how it changed depending on screening participation rate and the various probabilities to acquire medical complications if untreated.

Paper IV

Paper IV is based on data retrieved from a Youth Health Centre (YHC) questionnaire. A questionnaire, with a return envelope, was sent to all 18-year old males and females with permanent addresses in Gällivare, Umeå, Härnösand, and Östersund during the year 2001. A total of 2333 youths, registered in the Swedish Population Register as living in these cities, received a questionnaire. The non-responders received a reminding questionnaire after three weeks. The questionnaire was answered by 59% (1370/2333) of the study population. The responders consisted of 60% (817/1370) girls, 38% (523/1370) boys. Forty eight percent of the participating boys and 36% of the participating girls were virgins at the time of the study. The response rate according to city was: Gällivare 52% (102/198), Umeå 61% (711/1173), Härnösand 54% (170/317), Östersund 60% (385/645). Upon receiving the questionnaire answers were inserted into a database anonymously. All participating cities housed YHC. The questionnaire consisted of 47 questions regarding their social lifestyle, physical-, psychological-, and sexual health. The questionnaire has been designed by the YHC employees in the respective cities and was based on previous validated questionnaires (13, 110). The questionnaire was pre-tested on 10 subjects from each city. The characteristics of the study population are shown in table 1. Compared with boys psychosocial status was lower among girls. A higher proportion of girls has been forced onto sex or had experienced unwanted violence during sexual intercourse.

Primary prevention of STI is an important health priority. Unfortunately there are no STI vaccines, except for hepatitis B vaccine, and topical micro biocides to prevent STI are not available. Beyond mutual lifelong monogamous relationship among uninfected couples, condom-use is the only effective method for reducing the risk of HIV and STI infection available to sexually active individuals. A US National Institute of Health report has highlighted the shortage of long term studies quantifying the protection effect against STIs (111). The reason for this is that randomized studies are ethically problematic and therefore high-level evidence is unlikely to emerge. Nevertheless, when a population widely adopts condoms, an associated major decline in the incidence of most STIs is typically seen (48, 112, 113).

Condom sales in Sweden have, according to the major sales organisation declined from 25 million condoms per year in the late 1980 to approximately 18 million condoms a year in 2003 (114) and today the rate of condom use in Sweden is similar to the rate in the year 1989(9). The decision to use a condom is based on the will and initiative of both partners. With the current decrease in condom use and increasing STI epidemiology it is of interest to analyse which factor are associated with the young men's non-condom use. The aim of paper IV was to explore which male factors
### Factors

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<th>Factors</th>
<th>Boys (%)</th>
<th>Girls (%)</th>
<th>P value</th>
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<td>n.s.</td>
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<td>65</td>
<td>n.s.</td>
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<td>n.s.</td>
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<td>5.3</td>
<td>n.s.</td>
</tr>
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<td>Youth Health Centre, visit with partner</td>
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<td>0</td>
<td>&lt;0.001</td>
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<td>Love problems</td>
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<td>28</td>
<td>n.s.</td>
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<td>13</td>
<td>n.s.</td>
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<td>Consume alcohol</td>
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<td>90</td>
<td>n.s.</td>
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<td>n.s.</td>
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<td>&lt;0.001</td>
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<td>Using drugs regularly</td>
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<td>2.0 (1.0-4.0)</td>
<td>n.s.</td>
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<tr>
<td>Used condom during last intercourse to prevent STI</td>
<td>33</td>
<td>1.3</td>
<td>&lt;0.001</td>
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</table>
are associated with non-condom use and also which female factors are associated with non-condom use among their sexual partners.

Since using or not using a condom is based on a decision involving two sexual partners we decided to do the analysis separate for boys and girls to find which boy and girl variables factors affect the condom use. The associations between the independent variables and the dependent variable (non-condom use) were investigated by multivariate logistic regression analysis. The independent variables were tested for multicollinearity by looking at correlation and tolerance. The independent variables were also checked for possible two-way interaction.

Paper IV’s aim was to find factors associated with non-condom use among young men and women to improve future preventive measures.

**Table 1.** Characteristics of the study population by gender.

<table>
<thead>
<tr>
<th></th>
<th>Boys</th>
<th>Girls</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partner used condom during last intercourse to prevent STI</td>
<td>0.5</td>
<td>21</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Used alcohol or drug during last intercourse</td>
<td>19</td>
<td>18</td>
<td>n.s.</td>
</tr>
<tr>
<td>Sex with partner of same sex</td>
<td>2.3</td>
<td>3.6</td>
<td>n.s.</td>
</tr>
<tr>
<td>High sex lust</td>
<td>56</td>
<td>49</td>
<td>0.06</td>
</tr>
<tr>
<td>Feelings of guilt and shame after an intercourse</td>
<td>18</td>
<td>26</td>
<td>0.012</td>
</tr>
<tr>
<td>Forced to have sex</td>
<td>8.0</td>
<td>21</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Unwanted violence in a sexual scenario</td>
<td>0.5</td>
<td>4.3</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

NLSP = number of lifetime sexual partners, STI = sexually transmitted infection, P25 = 25th percentile, P75 = 75th percentile.

Paper V

New contact opportunities with changed sexual networks have emerged with the Internet, which has also enabled new ways to reach target populations with preventive information. To engage youths in their sexual health it is important to supply youth friendly services and easy accessible health care. With this study we wanted to investigate the feasibility of a simpler and more effective Chlamydia testing method using home sampling and the Internet.

The study was conducted from September 2004 to April 2005. All males and females with permanent addresses in the county of Västerbotten were eligible to participate. An informative Chlamydia web site offered the opportunity to order home a Chlamydia test package for free (see the project flowchart in figure 8). To receive a test package, participants needed to type in their civic registration number, postal address, and an optional email address. Orders were stored in a database and test packages were sent to the participants. The test package contained a cover letter, a personally coded urine specimen container, a laboratory requisition slip, and a personally coded questionnaire regarding social status and sexual experiences. The cover letter briefly described the study and gave instruction on how to obtain a first void urine specimen and how to store the specimen before mailing. They were informed that only four central research persons were aware of their identity. The participants could then send
in their coded urine specimen, the laboratory slip, and the coded questionnaire in a prepaid preaddressed biological substance envelope to the local laboratory.

The laboratory test results were fed into the database as a simple text file. The participants could access their results by typing in their personal code. If the urine sample was negative for *C. trachomatis* a message appeared on the screen telling them that they were not infected with Chlamydia but if they still had symptoms or worried about other STI they should contact their physician. If the urine specimen was positive for *C. trachomatis* a message appeared on the screen instructing them to print out a physician referral sheet for treatment. The treating physician confirmed that the infected person had sought treatment by sending the central research figure a letter. Infected participants that do not take the required steps in order to get the test result or get treated are contacted by us, according to the Swedish law.

**Figure 8.** Project flowchart showing the independent active steps of the participants in dotted lines where the health system works as a service supplier and organiser.
RESULTS AND COMMENTS

**Paper I**

Being the first study in Sweden, testing the feasibility of this new home sampling method for Chlamydia testing, the results were encouraging. After one reminding letter 59% participated and none of the 98 urine specimens that arrived to the laboratory had leaked, or were in some other way damaged during the transport. One percent of the study participants were infected with *C. trachomatis*.

The study further showed that the women in the study sent in significantly more urine samples for testing than the men (59 women and 39 men). This trend could also be been seen in previous studies (24, 101). Further research was therefore needed to find method to increase the male testing rate (see paper II).

The home sampling method proved to be feasible and also acceptable by the study group which raised the question if this method could be used as a Chlamydia screening tool for the whole population (29). The answer to this question could only be found if further research was done to assess the cost-effectiveness of screening a population by using this home sampling strategy (see paper III).

**Paper II**

The Internet proved to be an accessible tool in screening. The results were easily inserted into the database by the investigators and conveniently retrieved by the participants. Only three of the men in the study did not have Internet access and had to obtain their results by telephone. All of the other men were able to obtain their results from the Internet at any time of the day, and infected men contacted us independently for treatment. Only one man had to be contacted, because language difficulties prevented him from understanding the instructions.

The participation rate was 38.5% after two postal contacts which is high considering that 14% of the non-participants were virgins (see table 2). Fifteen percent had recently been tested for Chlamydia (see table 2). This may indicate that the method was selective in the sense that people that had not tested themselves recently took the chance and participated in the study.

In Sweden almost 400 000 Chlamydia tests are taken yearly in a population of 9 million which would mean that if every test is from a different individual 4% of the population get tested each year. Non participants may however believe that a test taken a few years ago qualifies as recently and therefore do not perceive themselves as being at risk of being infected with Chlamydia and thereby did not participate. Worth noting is that men relied in a higher extent on their partners having tested themselves than having performed an own test.

The 38.5% participation rate was the highest published male participation rate in *C. trachomatis* screening. Two previous published population based screening studies of 21 to 23 year old, using postal urine specimens as the test material, had a 26.8% and a 0.4% answer rate (22, 23). Even the most recent systematic postal screening for genital *C. trachomatis* from the year 2004 had a lower male participation rate. That study was conducted in the United Kingdom and performed among 5 454 men aged 16-24 years using postal invitations, phone calls, and home visits and achieved a 26.6% participation rate (115).

Among the participants we detected four *C. trachomatis* positive men. The *C. trachomatis* prevalence among the 22 year old men in our study group was thus 1.1%. This was a similar
prevalence rate as in the pilot study conducted in the same region during the year 2000 among men and women aged 20-24 years. This prevalence is however lower than the percentage positive male tests found during customary care, involving visits to healthcare centres, STI clinics, and YHC which is usually above 10% (12). Most men tested during customary care are partners of an infected person and thus obliged to be tested according to the Swedish law and are considered a risk group. The participation rate doesn’t allow us to predict anything about the general prevalence of C. trachomatis in the society but one can say that the method reached outside the high-risk group.

In summary, the Internet proved to be an accessible tool in C. trachomatis screening, achieving a high male participation rate. The method also reached young men outside the high risk groups.

**Paper III**

Female screening provided higher cost savings than no screening as the C. trachomatis prevalence exceeded 5.1 percent (see figure 9)

The figure shows how the cost-effectiveness varies depending on participation rate and the risk estimate for the occurrence of sequel disease. With a high participation and using the highest risk estimate found in the literature the method becomes cost effective at lower prevalence. For instance using the highest published estimate of the occurrence of PID in untreated C. trachomatis cases (30%) would make the method cost-effective already at a 3.6% prevalence rate of C. trachomatis in the society. If on the other hand we only used the lowest published risk estimate of PID (8%) the screening strategy would provide cost savings at C. trachomatis prevalence exceeding 8.4%.

The female threshold prevalence of C. trachomatis in our study was 5.1%, over which the method was cost-effective. This is comparable to previous studies with female thresholds ranging from 3.9% to 6.0% (104-106, 108).

Finding and treating asymptomatic infected male carriers is more costly than females and a C. trachomatis prevalence over 12.3% is needed to be cost-effective (see figure 10). We believe that male screening can still be beneficial to the society, at lower C. trachomatis prevalence, as

<table>
<thead>
<tr>
<th>Reasons for not participating</th>
<th>Number of 22-year old male</th>
<th>n=110 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forgot</td>
<td>14 (12.7)</td>
<td></td>
</tr>
<tr>
<td>Thought it unnecessary, since they believed they were not infected with C. trachomatis</td>
<td>55 (50.0)</td>
<td></td>
</tr>
<tr>
<td>Had recently been tested for C. trachomatis</td>
<td>17 (15.5)</td>
<td></td>
</tr>
<tr>
<td>Partner had recently been tested for C. trachomatis</td>
<td>23 (20.9)</td>
<td></td>
</tr>
<tr>
<td>Didn’t care</td>
<td>28 (25.5)</td>
<td></td>
</tr>
<tr>
<td>Had never had sexual intercourse</td>
<td>16 (14.5)</td>
<td></td>
</tr>
<tr>
<td>Inconvenient</td>
<td>18 (16.4)</td>
<td></td>
</tr>
<tr>
<td>Unnecessary, as they were in a steady relationship with partner</td>
<td>60 (54.5)</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Result of the follow up questionnaire to all non-responders, 640 males.
the infection is sexually transmitted and causes expensive female medical sequels.

In Chlamydia screening studies most of the cost saving achieved come from predicted costs of treatments and predicted complications avoided. Economic models are highly sensitive to assumptions about the incidence of complications (116) as shown above in the case of PID. These predictions are notoriously difficult to measure since piecing together the natural history of Chlamydia disease is troubled with the ethical problem of studying the prognosis of untreated infection (116).

A limitation of the study was that it only carried out a partial analysis, which only considered the medical sequel costs of untreated *C. trachomatis* infections. “Prevented cases” is not an ideal effect measure because comparisons with other studies are excluded. The sequel disease will inflict pain, suffering and lost quality of life on the affected. To get a more comprehensive view, Quality Adjusted Life Years (QALY) and lost reproductive opportunities should also be included but unfortunately we lack the information necessary for calculations of QALY’s. The analysis also did not take the time perspective into account because we do not know how long after an infection a sequel occurs.

The cost saving could however have been underestimated since we didn’t include the indirect costs believing that most participants were students and students do not economically contribute to the nation’s production (117). A further underestimation of the cost saving could have been caused by the fact that in the total screening costs two physician appointments were included. One appointment to treat the infected person and one appointment to treat his/her partner. In a population with a *C. trachomatis* prevalence of 1.02%, like in our pilot study, 8% of the total cost of screening 1,000 individuals ($2,662/$32,000) would be treatment costs. Calculating with only one physician appointment would almost halve the treatment costs making the method more cost-effective. At higher Chlamydia prevalence this cost saving would be even more visible.

Figure 9. The effect of prevalence, participation rate, and risk estimate on the incremental cost-effective ratio of females when switching from no screening to screening.
Results och comments

The cost-effectiveness can be further improved by either decreasing the postal fee or laboratory fee, which should be possible in large-scale attempts. The study showed that a 10% decrease in laboratory costs corresponds to a 50% decrease in the postal costs in increasing the cost effectiveness.

In summary, the study shows that it is cost-effective to screen a female population if the C. trachomatis prevalence exceeds 5%. This is based on an analysis with possible underestimation of medical complications costs and over estimation of screening costs. It is cost-effective to screen a male population if the C. trachomatis prevalence exceeds 12.3% but cost savings can be found at lower prevalence since the infection is sexually transmitted and causes expensive female medical sequels.

**Figure 10.** The effect of prevalence, participation rate, and risk estimate on the incremental cost-effective ratio of males when switching from no screening to screening.

The cost-effectiveness can be further improved by either decreasing the postal fee or laboratory fee, which should be possible in large-scale attempts. The study showed that a 10% decrease in laboratory costs corresponds to a 50% decrease in the postal costs in increasing the cost effectiveness.

In summary, the study shows that it is cost-effective to screen a female population if the C. trachomatis prevalence exceeds 5%. This is based on an analysis with possible underestimation of medical complications costs and over estimation of screening costs. It is cost-effective to screen a male population if the C. trachomatis prevalence exceeds 12.3% but cost savings can be found at lower prevalence since the infection is sexually transmitted and causes expensive female medical sequels.

**Paper IV**

The most common reason for not using a condom was that they believed they did not have any STI (61/109), and the second most common reason was that they didn’t know why they didn’t use the condom (18/109). The final multivariate model including all the significant variable from the univariate analyses are shown in table 3.

The low percentage of those reporting the use of a condom in our study is itself a risk factor for STIs. Only 30% of the boys and 21% of the girls, in our study, reported the use of a condom to protect against STIs during their previous intercourse which is in comparison to recent population surveys in Great Britain and United States (118-121). The low condom usage indicates the importance to evaluate the factors associated with condom use to improve preventive measures.
Results och comments

In our study of 18-year-old youths in northern Sweden, the multivariate logistic analysis showed four male variables and two female variables significantly associated with non-condom use. Oral contraception was the strongest variable associated with non-condom use among boys OR of 11.7 (95% CI 5.09-26.8) and girls OR of 10.7 (95%CI 5.50-20.8). This indicates that the concern of becoming pregnant outweighs the concern of becoming infected with a STI.

The study also showed the gendered difference in the importance of mental status in condom usage, where boy’s mental status plays a larger role in the condom decision process than the girl’s mental status. With every step increase in the depression index the OR for not using a condom among boys increases by 1.55 (95%CI 1.05-2.29). The composite index of feeling depressed is the sum score of five items: 1) Do you feel low 2) Do you have a low self confidence

<table>
<thead>
<tr>
<th>Boys p value</th>
<th>OR (95% CI)</th>
<th>Girls p value</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weekend housing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>with parents</td>
<td>.181</td>
<td>.267</td>
<td></td>
</tr>
<tr>
<td>with partner</td>
<td>.039</td>
<td>5.45 (1.09-27.4)</td>
<td>.133</td>
</tr>
<tr>
<td>alone</td>
<td>.181</td>
<td>2.16 (0.45-10.3)</td>
<td>.298</td>
</tr>
<tr>
<td>other</td>
<td>.723</td>
<td>1.42 (0.21-9.79)</td>
<td>.271</td>
</tr>
<tr>
<td>Born abroad</td>
<td></td>
<td>.785</td>
<td>0.83 (0.23-3.09)</td>
</tr>
<tr>
<td>Free time with friend</td>
<td></td>
<td>.167</td>
<td>0.65 (0.36-1.20)</td>
</tr>
<tr>
<td>TV and movies</td>
<td></td>
<td>.030</td>
<td>0.04 (0.002-0.74)</td>
</tr>
<tr>
<td>Free time with partner</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feeling depressed</td>
<td></td>
<td>.029</td>
<td>1.55 (1.05-2.29)</td>
</tr>
<tr>
<td>Smoking habits</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>non-smoker</td>
<td></td>
<td>.106</td>
<td></td>
</tr>
<tr>
<td>party smoker</td>
<td></td>
<td>.044</td>
<td>2.80 (1.03-7.63)</td>
</tr>
<tr>
<td>smoker</td>
<td></td>
<td>.306</td>
<td>1.94 (0.55-6.90)</td>
</tr>
<tr>
<td>Drink alcohol</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>.071</td>
<td>2.21 (0.93-5.21)</td>
</tr>
<tr>
<td>Partner takes OC</td>
<td></td>
<td>.000</td>
<td>11.7 (5.09-26.8)</td>
</tr>
<tr>
<td>Uses OC</td>
<td></td>
<td>.000</td>
<td>10.7 (5.50-20.8)</td>
</tr>
<tr>
<td>High sex lust</td>
<td></td>
<td>.258</td>
<td>1.58 (0.72-3.48)</td>
</tr>
<tr>
<td>Forced into sex</td>
<td></td>
<td>.021</td>
<td>2.65 (1.16-6.04)</td>
</tr>
<tr>
<td>Visit YHC alone</td>
<td></td>
<td>.052</td>
<td>1.99 (0.99-3.99)</td>
</tr>
</tbody>
</table>

OC = oral contraceptive, YHC = youth health centre.

Table 3. Final model. Multivariate logistic regression, OR (odds ratio) with 95% CI (confidence interval), controlling for sociodemographic status + psychosocial status + substance consumption + sexual behaviour and experiences.
3) Do you not feel satisfied with yourself 4) Do you think life is not worth living 5) Do you feel that your psychological well-being is bad or really bad. So, boys who in a higher extent answered “yes” to these five assumptions were more likely to not use a condom than boys who answered “no” to these assumptions. This mental aspect was not present in the condom decision aspect among girls.

Preferring to watch TV and movies on their free time might be a protective factor for adolescent girls’ sexual health. Among girls age 18 in northern Sweden who watches TV and movies on their spare time have fewer total number of sexual partners and use condoms in a higher rate than girls who have other spare time activities. Watching TV and movies one might speculate is often done in company of friends and/or family and studies show that good contact with family or good peer influence is consistent with condom usage (122).

The study showed that there are more male variables than female variables affecting the condom use. This reflects the fact that there is a gender power imbalance between the man and a women in sexual relationships (21) and that the condom is a contraception and STI protection used by the male. The female might purchase the condom, suggest the usage, and even put it on the male but if the male’s personality or mental status isn’t supportive- no condom will be used. It has also been shown that men with lower confidence in sexual situations will most likely not use a condom (123). An African study showed that a gender power imbalance in a sexual relationship between a man and women significantly affected the women’s ability to suggest condom use and that the gender power imbalance also influenced men’s inclination towards refusing to use the suggested condom (20).

Preventive measures should therefore focus on young sexually active people, encouraging them to use condom even if they already use oral contraceptives. Condoms should be easily accessible. We should also focus on men’s condom decision making and increasing women’s empowerment.

Validity and reliability of paper IV

Being a population-based questionnaire studies and with a 41% non-participation rate, one must consider the validity of the studies. We have a reason to believe that the sample validity is fairly high since there was no difference in answer rate between the cities. A comparison of some of the variables in our study (snuffing, smoking and Youth Health Centre visits) with other studies, in the same region, show a similar pattern (25, 110).

The external validity, the extent to which the results are applicable to other populations, should be carefully questioned. The results may not be applicable to Sweden as a whole since the participants were living in small cities (<100,000) and it is for example well known that number of lifetime sexual partners is higher in larger cities (118). Further we have no information about the participants’ social class status making generalisation difficult. Concerning the reliability of the study questionnaire answers, we found that questions like alcohol- and condom use during the last intercourse were answered similarly by the respondent and his/her counter part.

Paper V

During the study period between September 2004 and April 2005 we had a total of 19,158 visits, 1,450 orders were made, and 906 tests were analysed. A flowchart of the participants and the study population is shown in figure 11.

The participation rate related to percent positive tests can further be illustrated by figure 12.
Results och comments

These figures show that the highest participation rate was among 20-24 year old where over three percent of the total population participated. This is a sexually active population difficult to reach preventively. Youth Health Centres (often up to age 23) and standard school education (up to age 18) provide a firm base for youth prevention but for the young adults who finished the standard school education and are too old for Youth Health Centres there is no natural arena for STI prevention. The high participation rate among 20-24 year old proves that Internet may be an accessible arena for this group with preventive information and easy testing.

The overall Chlamydia prevalence among the male participants was 6.0% and among the female participants it was 4.6%. This prevalence is higher than the previous studies (Paper I and II), which was approximately 1%, and similar to current regular female testing rates. In current testing, which includes testing at YHC, Health Clinics and STI clinics, the female prevalence is 5% and the male prevalence is as high as 13% (124). Almost half (44%) of the men in Sweden are tested due to partner tracing giving them a higher Chlamydia prevalence than the women (124) but in our study where men tested themselves after making their own risk assessment gave a more equal gender prevalence.

The proportion of male tests returned (men 40%, women 60%) is higher than in opportunistic screening programs (125) (which reflect the health service use), but is comparable to previous population based screening efforts (23, 115, 126).

The web site received an average of 85 visits per day with more visits and orders after the

Figure 11. Flowchart of the participants and the study population.
weekend. An average of 14 orders was made per day. Most visits and orders were done during the afternoon. The method is very sensitive to marketing, which can be seen in figure 13 portraying the order frequency during the study period related to the marketing campaign. Initially the study was supported by a press conference and one poster being sent to every secondary school and YHC in the county. After the initiation of the project the ordering frequency relied solely on the word of mouth. This was done deliberately to see if the method had any value within the population. To test the sensitivity to advertisement we bought commercial space on a popular chatting site and also did local advertisement in a popular gym, which increased the ordering frequency drastically.

A limitation was that participation was low in the age group below 20 years which is an important age group as it recently has shown the largest increase in number of Chlamydia infections in Sweden (124). A further limitation was that more than a third of the ordered testing packages in the study were never returned with urine samples. This was more common among the younger age groups. The fact that it takes an average of three weeks from ordering to submitting indicates that persons may keep their tests for future use but there is also the possibility that, especially among the young, some participants sent joke testing packages to each other which were never used. This non testing problem has been identified elsewhere where 67% of the downloaded syphilis tests were never performed during an online syphilis testing study (127). Whatever the reason for not using the test packages, the non used packages are still fewer in comparison to systemic postal screening (115).

The association between Chlamydia infection (dependent variable) and test reasons (independent variables) was investigated by multivariate logistic regression analysis. The analysis showed that believing to be infected with Chlamydia and having symptoms were the
strongest factors correlated to being infected, especially among the men. The odds ratio for having a Chlamydia infection if one had symptoms was 2.9 among women and 6.9 among men. The odds ratio for having a Chlamydia infection if one believed to be infected was 9.1 among the men and non significant among the women.

The Web site allowed participants to receive easily accessible STI preventive information and relevant links to other STI sites. The Web Site also allowed interested and worried people to mail a question to us. All though this option was discretely offered on the site as a possibility to ask questions about the Web site, it was used extensively. Approximately one hour per day was spent by a physician answering medical question to young people. The questions ranged from STI and symptoms to concerns about current relationships. A physician answered questions as soon as possible and they were appreciated by many young people sending thank you notes back. This need for information and medical answers was a surprise for us. During the planning of the study the purpose of the question function were purely technical, allowing persons to tell us if the ordering didn’t work or if the Web page didn’t function. Very few questions turned out to be technical; the vast majority of the questions were about medical concerns. The discrete option remained through out the study period and one physician answered medical questions. The popularity and appreciation of asking a physician on the Internet shows that there is a large need for better communication between the young people and the health care.

In summary, self-risk assessment improves the chance of finding positive Chlamydia test results, especially among men, if an accessible
testing method is offered. Success in controlling Chlamydia transmission is likely to depend on achieving consistent and regular coverage of testing and partner notification among both women and men. This new method may be used as an adjunct to regular recruitment in striving for this goal.
DISCUSSION

One important way of reducing the incidence of HIV/AIDS infections is to treat sexually transmitted infections promptly (128). It is also important to work preventively decreasing the risk of spreading STIs in the society. This is what the thesis has focused on—improving the current STI preventive efforts.

Health services for STIs

STIs, excluding HIV, are generally not considered dangerous and just as easily treated as other infections. Yet we tolerate a much higher rate of STI circulating among our young people than we would ever tolerate for other infections considered serious. Why? The absence of symptoms is a major factor but also the long time span until sequelae become a concern, play a large role. This along with the stigmatisation of infected persons makes us tolerate the high STI rates.

STIs are everybody’s business. If they do not directly affect us they indirectly affect us. Even if we chose to ignore them, we would still have to pay for their consequences. Untreated infections are costly for the health care and the personal suffering from infections cannot be measured in monetary values. Globally, the bulk of people with STIs are managed in the generalist primary-health services, in the non-medical sector or by self-treatment (48, 129, 130). Specialist STI or sexual-health services are in many places few and have a fragile resource base even in the face of rising disease rates (48). A further obstacle to proper testing and treatment is that STI diagnoses are stigmatising, increasing the psychosocial morbidity including victim blaming, which discourages people from seeking care (130-132).

Postal screening for STI

Being infected with either Chlamydia or Gonorrhoea doesn’t give any symptoms in the majority of the cases among men and women (133-135). Thus most infected people have no incentive to seek medical care, allowing infections to persist and spread in subsequent sexual encounters. It is also no longer a hypothesis that infections with Chlamydia and Gonorrhoea enhances HIV transmission, it is a fact (136). Detection and treatment of classic STIs must therefore be undertaken in HIV positive individuals to reduce their viral infectiousness.
and among their possible partner to reduce susceptibility to infection (136).

The development of molecular amplification techniques has enabled testing for Chlamydia and Gonorrhoea with non-invasive procedures (92-94). By avoiding the hassle and perceived stigma of clinic attendance and decreasing the involvement of health care staff, home-based screening may encourage testing, diagnosis, and treatment among those less likely to seek medical care under other circumstances. This concept has been used successfully in both Chlamydia screening (23, 24, 101, 115) and Gonorrhoea screening (137).

Our pilot study showed that it was feasible and acceptable by the population to take a urine sample at home and send it in for analysis. The participants understood the instructions and infected individuals sought treatment. The cost-effective analysis of the method showed that it was cost-effective to use this method on the whole population if the female *C. trachomatis* prevalence was over 5%. Among men it was cost-effective at *C. trachomatis* prevalence over 12% but could be cost saving at lower prevalence preventing the spread of Chlamydia and thus preventing costly female medical complications.

**Should we screen for Chlamydia?**

Genital Chlamydia poses a major global health problem because it is a transmissible cause of reproductive morbidity. The technological advances in Chlamydia diagnosis are driving the current health policy debate about the introduction of national Chlamydia screening programmes (116). As a matter of fact a national screening program exists in England since 2002 (125, 138) and the Centres for Disease Control and Prevention in USA recommends screening all sexually active women aged 25 years and under (139).

Screening, of any sort, has always been a source of many debates. The appropriateness of screening for a disease is usually assessed by the 10 principles set out by Wilson and Jungner in 1968 for the WHO (140). Genital Chlamydia has been judged to fulfil these criteria either as a whole (141, 142) or in part (143). Does Chlamydia screening satisfy the following Wilson and Jungner criteria with respect to the thesis' findings?

1. **The condition screened is an important health problem**- *C. trachomatis* infections are the most prevalent sexually transmitted bacterial infection recognized throughout the world (57). The considerable morbidity and costs associated with untreated infection is discussed in detail in paper III.

2. **There should be an accepted treatment recognised for the disease**- The treatment for *C. trachomatis* is cheap, effective and safe. A standard 7-day, twice daily, doxycycline regimen is prescribed. In cases where the compliance is suspected to be low a single dose Azitromax 1g can be given. However research of the acceptability and cost-effectiveness of the different regimes is required (27, 107). For instance it is not clear if a single dose treatment would improve the cost-effectiveness of treatment due to increased compliance.

3. **The condition is recognizable at an early stage**- Being infected with Chlamydia doesn’t give any symptoms in the majority of the cases among men and women (133-135). After a one week incubation period it is however possible to test and find asymptomatic infected individuals with a suitable and acceptable test (see below).

4. **There should be a suitable and acceptable screening test**- Since 1996 there has been commercially available nucleic acid amplification tests (NAAT) for the diagnosis of *C. trachomatis*. NAAT proved to be more sensitive and specific than previous diagnostic tests (culture and enzyme-linked immunosorbent assay on cervical swabs) (92-95). NAATs could also be used with non-invasive specimen such as first-void urine specimen with reported sensitivities ranging from 84% to 98%
Our studies further show that home sampling is both feasible and acceptable by the population.

5. *The natural history of the condition is known.* Very considerable advances have been made in defining the natural history of untreated Chlamydia (57). Although the exact number of complications received from untreated Chlamydia infections cannot be estimated, we now understand the medical consequences of untreated Chlamydia infections. The fact that women can become infertile has been known for a long time but the role of C. trachomatis with regard to inducing male factor infertility is still a matter of debate (57).

6. *There is an agreed policy on whom to screen.* Today there is no agreed policy on whom to screen. Subjects to screen are those who are affected most by the disease and have the largest contribution to the spread of the disease- young sexually active individuals who have not yet given birth. The Centre for Disease Control and Prevention in USA recommends screening all sexually active women aged 25 years and under (139) and a national opportunistic screening program existing in England since 2002 targets all people under 25 years of age (125, 138).

I believe that a successful screening can only be achieved if both sexes are included in the screening process equally. Our study results show that new innovative screening methods can achieve a more gender equal participation rate.

7. *Treatment started at an early stage should be of more benefit than treatment started later.* Symptomatic infection is not a prerequisite for eventual development of tubal damage and it is suggested that silent infections are in fact the most common cause of tubal infertility (57). Generally an early treatment of an infection with potential sequel is preferred but with Chlamydia we do not know when the medical sequels arise since we have no ethical opportunities to examine this.

8. *Facilities for diagnosis and treatment should be available.* Currently there are possibilities to diagnose an infection at Health Clinics, YHC, and STI clinics where available. Our studies showed that it was possible to further increase the facilities for diagnosis and thereby increasing the accessibility. With an Internet access and a postal address the diagnosis can be done anywhere at any time.

9. *The screening should be acceptable to the population.* Our screening studies showed that collecting urine at home and sending it in by mail to be tested for C. trachomatis, proved to be both feasible and acceptable to the population. Using the Internet to order test packages and check test results also proved to be feasible and acceptable.

10. *The cost effectiveness of the screening should be balanced in relation to expenditure on medical care as a whole.* The cost-effectiveness of mass screening a population for Chlamydia by means of home sampling is discussed in detail in paper III. Calculating with Swedish medical costs postal screening became cost-effective for women at a population prevalence of over 5% and a male prevalence of over 12%. In postal screening however most test packages sent out were not used (over 60% of the packages were not used in study II). When offering people to order personal testing packages from the Internet most of the packages sent out were used (35% of the packages were not used in study V). A cost-effectiveness analysis is still needed to be performed on the Internet method but it is believed to be more cost-efficient than regular postal screening.

With the addition of our research results Chlamydia screening almost fulfills the criteria set out by Wilson and Jungner. The cost-effectiveness of the acceptable treatment needs further research, as does the Chlamydia impact upon the male factor fertility. Screening is not cost-effective at the Chlamydia prevalence as low as 1% found in studies I and II. Screening would almost be cost-effective for women at a female prevalence of 4.6% found in study V that is however a selective approach and not a population based screening effort. Finally there is no agreed policy on whom to screen.

With an undecided target population a mass population screening for Chlamydia is there-
fore not supported at low prevalence. There are however three different STI screening approaches that could be applicable.

Population screening is a large scale screening attempt, screening a whole population. The effectiveness of home sampling as a population-based universal screening strategy has been assessed. Randomized trials in Denmark invited school students (144) and the general population (23) to submit self-taken urine or vaginal specimen for Chlamydia testing. Among women, in the prevention group receiving a testing package at home, the incidence of PID was reduced by 50% compared to the control group (144). The effect of population-based screening is clear in preventing medical complications of asymptomatic infections but the cost-effectiveness has to be questioned. With population based screening the screening costs can be very large and the economic outcome very dependent upon participation rate and Chlamydia prevalence rate. Our screening study shows that the cost-effectiveness is very dependent upon the participation rate especially at lower Chlamydia prevalence rates.

Opportunistic screening, is taking the opportunity to offer a test to all persons that walk through a medical facility door. The National Chlamydia Screening Program in the United Kingdom has since 2002 performed an opportunistic screening for Chlamydia aimed at women and men under the age of 25 years attending clinical settings (125). The long term effect, such as PID and infertility, of this screening programme in is still too early to evaluate. In its first year a total of 16 413 persons were tested, with a 10.1% prevalence among women and 13.3% prevalence among the men, but only 7.1% of the tests were taken by men (125). The cost-effectiveness of this study however still needs to be evaluated. The problem however with opportunistic programmes is that they only reach health service users, and among young sexually active people, these are mostly women.

Selective population screening is selecting a certain group of people perceived as being at risk of having or getting an infection. The strongest evidence to date that screening is effective in preventing PID was achieved by a selective population screening approach (109). Scholes et al determined if women were at high risk for Chlamydia infection by a questionnaire and then selected high risk women to be included in the study. The findings that the incidence of PID was 56% lower (95% CI: 10-80) in the intervention than the control group sparked the value of further Chlamydia screening research. With selective screening the potential for introduction of bias in the study design is large making results vary and difficult to interpret (116). A study of the value of screening criteria concluded that the usefulness of selective screening models are often too optimistic and that they have very low external validity (145). Due to more complicated and costly female sequels of untreated Chlamydia infections men are seldom selected in selective screening. For success and replicable results, solid and method proof selection criteria needs to be found which can be applicable at all places and at all times. So far no uniform selection criteria has been found or accepted.

One testing method used in most countries, where health facilities are present, is where the members of the population perform an own risk assessment and go to a health facility to take a test. Despite this self selective approach STI infections have been rising steadily since 1997 (12, 55, 56). Self-selective testing is affected by the same problem as opportunistic screening being that they only reach health service users who among young sexually active people are mostly women.

The Internet based testing method is none of the above screening methods. It opens a new
field in epidemiology where there is lacking appropriate nomenclature. I suggest using the term self-selective screening. Participants do their own risk assessment based on their own experiences and the preventive information given on the Internet site but the testing procedure is simplified. Believing to be infected with Chlamydia, which in a sense is a self-selective process better than any questionnaire, proved to be associated with Chlamydia infection. Male participants who believed they were infected with Chlamydia had a 9.10 OR (95% CI 2.80-29.5) of being infected. The Internet based testing service can be offered to the general population or to a selected population.

**Internet based self-selective screening**

Screening has expanded from traditional clinical sites to non-clinical venues such as schools, streets, and nightclubs to reach at–risk individuals not likely to be tested elsewhere (24, 146). The next theoretical step is changing the responsibility and venue of specimen collection to the individual at home, using the mail to transport the samples.

In today’s information society young people live in an information world where practically everything is available at their fingertips. They read and learn from the Internet, they make new contacts on the Internet and they make purchases on the Internet. In this world nothing has previously been so central and connecting to so many young people as the Internet. This is a generation used to accessibility where pizzas can be ordered with the Internet and delivered at their doorstep in a matter of minutes. For this generation to sit in telephone queue to make a clinical appointment for a STI test is unthinkable. To then have to wait a week for the clinical appointment is surely associated with many thoughts of dejection. There are, of course, many clinics with drop in times for people to get tested but in the comfort of ones own home excuses are easily found not to go to the clinic. In an ever-changing society with every changing demand, the current health care system is not adapting.

Young people are bombarded with information from the media but there are risks with increasing media such as the quality and effect of the information. Ambivalent research results are simplified and individuals can often read different messages when experts cannot agree on conclusions. Young people have questions and concerns now more than ever. They have an instant access to all information and many services and also demand an instant access to their health care system. This is shown in the surprise use of a discreet question button on the Chlamydia Internet site. Daily medical questions were received which needed to be answered by a physician. There was an obvious need to ventilate concerns with a reliable source. The Internet site wasn’t only used for questions but it proved to be a used testing service among young adults in Sweden with a consistent flow of orders. With little or no advertisement of the Internet site as much as 3% of all 20-24 years old in a Swedish county tested themselves for Chlamydia with this method. The method increases the empowerment by giving young sexually active individuals accessible and reliable preventive information along with easier and more accessible testing. This should, however, not replace clinic- or institution based testing: it should be seen as a supplement to more traditional testing methods.

The long-term effects of this method have to be analysed. If this simplified testing method increases risk behaviour by less condom use the method has to be re-evaluated. During a two-week period we posted a question on the Internet site for every visitor to answer, “Do you think you would use condom to a lesser
extent if it was easier to get tested for Chlamydia?” Over 90% of the 980 answers were “No” without any statistical difference between the sexes. Even though these answers are not representative of the whole population 10% said they would use condoms less if an easy testing method were available. Continuous evaluation of condom use therefore has to be performed by consistently sending questionnaires with the ordered test packages. The questionnaire contains questions regarding condom use and only after a longer period of time can one see a trend in the answers indicating more or less condom use. A limitation is that we do not know if the method causes a health selection. Further research is therefore needed to evaluate the Internet based testing method upon sexual health inequalities.

The acceptability of the method might have been due to the fact that the testing was accessible and free. According to the Swedish law, testing for certain STIs in which Chlamydia is included is free of charge. Charging a nominal fee for the testing packages would most likely decrease the number of tests performed. It has been shown that going from free and accessible condoms to condoms with a small cost drastically decreased the condom usage among American youths (147). In paper IV we evaluated factors associated with the non-use of condoms among young people. We found that using oral contraception was associated with odds ratios of over 10 in not using a condom. Becoming pregnant was of a higher concern than becoming infected with an STI. It has been advocated that the optimal approach to preventing unintended pregnancies and STI infections in those who are sexually active is “The belt and suspenders” approach, using condom together with hormonal contraception (122). The study also showed that boys feeling depressed with lower self-confidence used condoms in a lesser extent. Using a condom means that it has to have been purchased somewhere at a local store or pharmacy which can be an obstacle for many young people. With condom vending machines stirring controversies (148) and the ever decreasing number of machines in Europe purchasing a condom is most often associated with a personal contact. The cost of one condom often exceeds $1 (149), which in combination with the cost of oral contraception may seem excessive. The Internet method can be further developed to include the possibility to get condoms sent home with the test package for free. Easily accessible condoms could also be a mean of increasing the empowerment in a sexual relation. Persons ordering a test package are obviously someone who has had sex without a condom. By self-risk evaluation or by persuasion of a friend or partner they have ordered a test. These might be persons who didn’t dare to buy a condom and even less dared to get tested in a clinic. Having a condom present also minimizes the risk of spreading the possible infection further during their wait for the testing result. Sending condoms to this person is an excellent opportunity for primary prevention with minimal costs reaching risk individuals.

The Internet based testing method can also be used as a population screening. A selected population could receive a mailed card inviting them to get tested for Chlamydia by ordering a testing package from the Internet site. This is a screening method previously used and evaluated. All women aged 21-23 years in Danish county were included in a randomized screening study where the effectiveness of two home screening methods were compared (23). One group was mailed test packages directly and the other group received an invitation card with the possibility to return it for ordering a test package. The results showed that the testing rate was similar between the groups, where 38% of the women receiving the test package directly and 27% of the men receiving the test package
Discussion
directly got tested. In the group receiving an invitation card 33% of the women and 16% of the men got tested. In study II we analyzed the cost-effectiveness of screening a population by sending everyone a test package directly. The study found that the cost-effectiveness was very dependent on the participation rate since a high non-participation meant that many sent test package were not used increasing the effective screening cost. On the other hand performing a population screening by offering everyone an invitation card with the offer to order a test package from the Internet would be more cost effective than sending test packages to everyone.

The Internet self-selective model has proven to reach a population with higher Chlamydia prevalence than our previous population based screening attempt. From an epidemiological aspect this is very important. Effective and successful prevention is focused on risk individuals where the biggest effect of the preventive measure can be seen. In the future the Internet preventive model can include a risk evaluation questionnaire on the Web site. The questionnaire could contain questions about previously known risk factors that are associated with STIs to further improve the self-selective process. The purpose of the questionnaire would not only be an own self-risk evaluation but also to increase their own consciousness and awareness. Reaching a certain score or answering “yes” to a certain number of questions would render a recommendation to order home test package.

Psychosocial aspects
In the case of a positive test result the infected individual has to contact a physician for antibiotic treatment and partner tracing. Qualitative studies concerning psychosocial aspects of having a STI have highlighted the risk of anxiety and a feeling of isolation and stigmatization when a positive result is obtained (150, 151). A potential drawback of home-sampling strategies is that at the time of obtaining the test result there is no healthcare workers present for examination or to give face-to-face advice. This concern was investigated when three Danish Chlamydia screening studies based on home obtained urine samples were performed. The purpose of the study was to evaluate the use of dedicated hotlines to provide advice to young individuals (152). The study noticed that 0.1% (8/8,909), 0.7% (66/9,000), and 2.7% (124/4,622) of the subjects used the service. Although less than 20% of the calls were emotional concerns relating to a test result the authors concluded that there is a need for advice and counseling in connection with strategies involving home-obtained samples for C. trachomatis testing (152). However the accessibility and emergency of the phone service could be questioned when the dedicated phone line was only offered during one hour each afternoon on working days and the test results might have been obtained at other times during the day. A majority of callers also mentioned that they would have contacted another healthcare provider if the hotline had not been accessible. It is clear however that some sort of support related to home sampling is needed. Suggestions are using a dedicated telephone hotline in association with the Internet based testing and/or increasing the present “asking a doctor” function. It could be questioned as Andersen et al poses (152), if this support should be part of the screening effort or implemented within the existing healthcare facilities.

Ethics
The practise of medicine has gone through many changes since the time of Hippocrates (460 B.C.). During the time the Hippocratic
Oath was written by the Pythagoreans the medical knowledge was a gift to a selected few. Medical professionals had all the knowledge and accordingly thought that they also knew what was in the patients’ best interest- and the knowledge was thus used in a paternalistic manner to treat and care for the patients. Although the paternalistic practise of medical professionals still remains today medical professionals no longer have an exclusive right to the knowledge (153). With the help of libraries and the Internet the modern patient may have read more about the illness than the treating physician. This information-shift confronts paternalism with autonomy.

Paternalism has a valid place in medicine (153) but with increased information accessible to patients an increased respect for patient autonomy is demanded. This thesis suggests a continuous self-selective control of STI by means of the Internet, which opens a whole new field of medical practise and ethics. It is now possible for the patient to take much more responsibility than before. The field of eHealth has briefly been discussed in recent literature raising the question “How much information and responsibility can be transferred to the patient when the technology allows it?” (154). I believe, that if technology allows it, as much information and responsibility as the person desires should be supplied as long as valid autonomous choices can be made.

The suggested method in this thesis respects autonomy in the sense that it allows people to make an autonomous choice. Information is given so a competent choice can be made based on knowing the consequences of sending in a urine sample for analysis and the consequences of possibly being infected. The users are informed that they are not obliged to tests themselves by making an order since they can make yet another volunteer decision at home if they want to send in their urine for analysis. It is therefore important that an informed consent is made confirming that they have understood the information before ordering home a test.

Autonomy, in this case, is on the other hand not supreme since once the choice is made to send in the urine sample for analysis more actors are involved. If the test turns out to be positive then the infected person has to be treated according to the law. The infected person can even be treated against his/her will, which shows that the societal interest can override the personal autonomy referred to as social paternalism.

Using the Internet based method gives the user all the relevant information he/she needs but the responsibility for a satisfactory medical outcome is shared between the user and the caregiver.

The Internet and cellular mobile telephone use

The number of Internet users is increasing from year to year, as is the Internet penetration in the population. In Sweden, with the worlds highest Internet penetration over 80% of the population aged 16-74 years have Internet access at home (155). In the European Union the most well connected countries are Denmark with a 69% penetration and the Netherlands with a 66% penetration and the least connected country is Lithuania where 20% of the population have internet access at home (156). Overall 47% of the population in the European Union have Internet access at home but the number of Internet users has grown by more than 131% in the European Union from the year 2000 to the year 2005. The trend in North America is similar, 67% of the population have Internet access in their homes and the number of Internet users has doubled since the year 2000 (156). In Asia, Japan, Hong Kong, and Singapore are places where over 60% of the
population has Internet access and the number of user in Asian has increased with over 160% in five years (156).

In many countries the cellular mobile phone is more common than using the Internet. With the advance in technology most communication in the future will be done with cellular mobile telephones. Worldwide the cellular mobile phones have increased more rapidly than the Internet. In Russia where the Internet penetration is 15% there is over 35 cellular mobile subscribers per 100 inhabitants (157). In India the youths are driving the mobile revolution where mobile phone subscribers are poised to outnumber those with a fixed line (158). Monthly India adds 1.5 million mobile subscribers and the mobile usage is spreading from white collar workers to blue collar workers (158). The explosion of communication will undoubtedly increase contacts between individuals and lead to more complex sexual networks making it more difficult to stop the spread of STI. Special preventive attention should be given to countries where communication pattern changes drastically and quickly. Future STI preventive models will not solely rely on the Internet but may also use the telecommunication for its message and service.

Travellers

With the increasing STI epidemiology in the world and with an increasing travelling and sexual risk taking trend among young people more preventive measures should be aimed at persons travelling abroad. Statistics show that the number of trips from Europe to Asia has doubled since 1990 (4). During the same time period HIV has increased noticeably in Asia. The risk behaviours of travellers abroad has consistently been reported (159) and as many as 76% of the men and 59% of the women were drunk during their previous sexual intercourse abroad (160). Effective preventive measures are difficult to find since travellers are a heterogeneous group but study results show that 30% of the Swedish persons who became infected with HIV heterosexually abroad took an own initiative to make the test upon return (4). The rest were discovered by opportunistic and preventive measures. Increasing the accessibility of STI testing, for concerned travellers returning from sexual experiences abroad, is a good secondary preventive effort.

Partner tracing

Partner tracing is central in the prevention of spreading STI. Prompt testing of exposed partners provides an excellent opportunity to decrease the duration of the infectiousness and interrupt disease transmission. Even though the public-health efficacy of contact tracing or partner notification is still argued (161), a Swedish retrospective study showed that over 66% of the known tests from partners traced were infected (162). In Sweden it is mandatory by law that partner tracing is performed and it is often done by a specially trained social worker. In other countries partner tracing is merely recommended as preventive effort in stopping the spread of the STI. It is known, however, that success of partner tracing varies between clinics and partner tracers (162). Far from optimal partner tracing results have been published with rates below 1.0 partners per infected patient (163, 164). There is room for improvement.

Except for being a tool in finding new infected individuals partner tracing is also an excellent opportunity for a preventive discussion with an individual being at risk of being infected. With the ever-increasing mobile society and sexual networks spanning over large distances more is demanded from a partner tracer. For many persons it may feel uncomfortable and
upsetting to be contacted, as a part of a partner tracing chain, and become informed that you might be infected with a sexually transmitted infection. To then also be requested to come to a clinician for a test may be an embarrassment and an obstacle for making the test.

The Internet based testing method may be a way to simplify the partner tracing procedure for both the partner tracer and the individual at risk. The partner tracer can order a test on the Internet and have it sent home to the exposed partner. The preventive discussion can be performed by telephone when calling the partner to inform him/her that a test package is on its way. A Danish study compared two partner testing methods and concluded that more partners were tested and more infections were detected when partners are given the opportunity of home sampling compared with office sampling (165). Using the Internet as a partner-tracing tool eliminates the need to book clinical appointments, the test can be taken faster, and the infectious time limited.

A STI preventive model
The results from the performed studies have given the foundation for formulating a STI preventive model. For successful STI prevention both primary- and secondary prevention has to be included. The model should be cost-effective to be readily implemented in the health care. The model should be acceptable and accessible to the population with an aim of increasing the communication between the population and the health care.

My suggested STI preventive model uses the current testing and communicational techniques available. The Internet, with its ability for two-way communication, reaches a large proportion of the population allowing for primary prevention. Concerning secondary prevention it can be fulfilled in various ways. The Internet can be used as a platform for population based screening where a certain population would receive a postcard inviting them to order a test from the web site. This Internet based population screening would be more cost-effective than a general postal screening relying on sending packages to a whole population (see paper III) since the number of non-used packages would be less. The Internet can also be used as a continuous self-selective screening method where people believed to be infected can order home a test package. Condoms can be supplied with the orders whereby improving the empowerment within the sexual relationships.

The presented and suggested preventive model for STI has been proven to work for C. trachomatis but can also be applicable to other STIs. The NAAT method used to test for C. trachomatis can be used to analyse for Neisseria gonorrhoea and Mycoplasma genitalium in the same urine sample with even higher sensitivity and specificity for N. gonorrhoea than for C. trachomatis (94).

Success and cost effectiveness in controlling STI transmission is likely to depend on achieving knowledge, consistent and regular coverage of testing, and partner notification among both women and men. The suggested model should work as an adjunct to regular health care measures in improving the STI prevention.
Figure 14. The suggested STI preventive model based on the study findings of the thesis.
SUMMARY AND CONCLUSIONS

- It is feasible and acceptable to screen for C. trachomatis by using home obtained urines samples mailed in for analysis.

- It is cost-effective to perform a postal screening of a hole population if the female Chlamydia prevalence exceeds 5.1% and the male Chlamydia prevalence exceeds 12.3%. Male screening can however be cost-saving at lower prevalence preventing future expensive medical costs associated with female complication of untreated Chlamydia infection.

- The male screening participation is high if the result from home obtained urine samples sent in for analysis can be retrieved by a personal code on the Internet.

- There are several factors differed by gender associated with non-condom use which can be used in preventive efforts.

- Using the Internet to order home a Chlamydia test package, send in a urine sample for analysis, and then retrieve the test result from the Internet with a personal code was feasible and acceptable by both men and women.

- A STI preventive model is presented and suggested which simplifies the testing method and increasing the health care accessibility by means of the Internet. The model can be used as a continuous self-selective control of STI or used as a screening tool for a population.
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