
**An epidemiological approach to Sexually
Transmitted Diseases - with special reference to
contact tracing and screening.**

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We travel not for trafficking alone:
By hotter winds our fiery hearts are fanned:
For lust of knowing what should not be known
We make the Golden Journey to Samarkand

*From James Elroy Flecker:
The Golden Journey to Samarkand*

In memory of my parents, Sonja and Knut

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ABSTRACT

Sexually Transmitted Diseases (STD) are a major health problem all over the world. The diseases are often spread by unsuspecting asymptomatic individuals. One important means of controlling STD is thus the identification of asymptomatic persons.

The purposes of this thesis were a) to describe methods of identifying infected individuals through contact tracing and screening, b) to evaluate contact tracing routines, c) to compare epidemiological characteristics of two different groups of chlamydia-infected women and their partners and d) to see if data from contact tracing could be used in a model describing partner choice and STD spread.

A microepidemic of penicillinase-producing gonococci was effectively controlled through contact tracing by cooperating counsellors. Serotyping of gonococci and graphic description proved of great help in mapping the contact chain. Contact tracing integrated in the psychosocial long-term care of HIV-infected patients resulted in identification of a great number of previously unidentified individuals. Screening for *Chlamydia trachomatis* (Ct) among asymptomatic patients of family planning clinics revealed a 7.3 % Ct prevalence. Four factors were significantly correlated to the risk of being infected: age 18-23, duration of present relationship < 1 year, failure to use condoms and no previous history of genital infection. Abstention from testing was especially high in areas with low socio-economic status. In these areas, increased resources for health care are needed.

Five different levels of management of Ct infections were compared. Increased measures to verify that reported partners were examined decreased reinfections and after Ct was included in the STD Act more reported partners than before came for examination.

Index patients found by chlamydia screening and their partners have a lower average number of recent partners than index patients visiting an STD clinic and their partners. Partners of female patients in the STD clinic group were also more often Ct-positive. The differences between the groups are small and do not justify different ambitions in partner management.

Choice of steady partner was rather restricted and choice of casual partner followed a more random pattern. Our data thus do not support a pure random mixing model for STD spread.

Key words: *Chlamydia trachomatis*; choice behavior; contact tracing; HIV; *Neisseria gonorrhoeae*; partner notification; risk factors; screening; sexual partner; sexually transmitted disease; legislation.

This thesis is based on the following papers, which will be referred to by Roman numerals:

- I Ramstedt K, Hallhagen G, Bygdeman S, Lincoln K, Kallings I, Gillenius C, Sandström E. Serologic classification and contact tracing in the control of microepidemics of β -lactamase-producing *Neisseria gonorrhoeae*. Sex Transm Dis 1985; 12: 209-214.
- II Ramstedt K, Hallhagen G, Lundin B-I, Håkansson C, Johannisson G, Löwhagen G-B, Norkrans G, Giesecke J. Contact tracing for human immunodeficiency virus (HIV) infection. Sex Transm Dis 1989; 17: 37-41.
- III Ramstedt K, Forssman L, Johannisson G. Contact tracing in the control of genital *Chlamydia trachomatis* infection. Int J STD AIDS 1991; 2: 116-118.
- IV Ramstedt K, Forssman L, Giesecke J, Granath F. Risk factors for *Chlamydia trachomatis* infection in 6,810 young women attending family planning clinics. Submitted for publication.
- V Ramstedt K, Forssman L, Giesecke J, Johannisson G. Epidemiological characteristics of two different populations of women with *Chlamydia trachomatis* infection and their male partners. Accepted for publication in Sex Transm Dis 1991.
- VI Ramstedt K, Giesecke J, Forssman L, Granath F. Contact matrices for choice of sexual partner according to rate of partner change and social class of the partners. Submitted for publication.

CONTENTS

ABBREVIATIONS	8
INTRODUCTION	9
Contact tracing	9
Screening	11
Health care system and legislation in Sweden	12
AIMS OF THE STUDY	13
PATIENTS AND METHODS	14
Geographical setting	14
Definition of social class	14
Studies on risk factors for chlamydial infection	15
Contact tracing	15
Introduction	15
- <i>Chlamydia trachomatis</i> infections	16
- β -lactamase-producing gonococci infections	17
- Human immunodeficiency virus infections	17
- Chlamydial reinfections	19
Studies on contact pattern	19
Microbiology	20
Statistical methods	21
RESULTS	22
Studies on risk factors for chlamydial infection	22
Contact tracing	24
- <i>Chlamydia trachomatis</i> infections	24
- β -lactamase-producing <i>Neisseria</i> <i>gonorrhoeae</i> infections	25
- Human immunodeficiency virus infections	25
- Chlamydial reinfections	26
Studies on contact pattern	27

DISCUSSION	29
Case-finding strategies	29
- Screening	29
- Risk factors for contracting chlamydial infection	30
- Contact tracing	31
 Influence of different strategies on number of partners examined and reinfection rate	 34
Contact tracing in two different populations of chlamydia- infected women and their partners.....	35
Influence of socioeconomic background and rate of partner change on partner choice	37
 SUMMARY AND CONCLUSIONS	38
ACKNOWLEDGEMENTS	39
REFERENCES	40

ABBREVIATIONS

STD	Sexually transmitted disease
HIV	Human immunodeficiency virus
PPNG	Penicillinase- (β -lactamase-) producing <i>Neisseria gonorrhoeae</i>
Ct	<i>Chlamydia trachomatis</i>
AIDS	Acquired immunodeficiency syndrome
WHO	World Health Organization
SBL	National Bacteriological Laboratory
ELISA	Enzyme-linked immunosorbent assay
OR	Odds ratio

INTRODUCTION

"Few fields of medicine are more dynamic than sexually transmitted diseases. For instance, in the United States during the past decade, this discipline has evolved from one emphasising the traditional venereal diseases of gonorrhea and syphilis to one concerned with the bacterial and viral syndromes associated with *Chlamydia trachomatis*, herpes simplex virus, and human papillomavirus to one preoccupied with the fatal systemic infections caused by human immunodeficiency virus. Awareness of health and economic importance of STD complications and late sequelae has also increased considerably during the last decade"(1). In Sweden gonorrhea has changed from being hyperendemic during the 1970's (last peak 1976: 321 cases per 100,000 inhabitants) to a rare disease (1990: 10 cases per 100,000 inhabitants). Diagnoses of genital *Chlamydia trachomatis* (Ct) infections have been reported from all active laboratories in Sweden since 1982. The numbers reported represent samples taken rather than true prevalence. The incidence in 1990 was 319 cases per 100,000. Human immunodeficiency (HIV) infection has been reported since 1985 and the accumulated number of reported cases in Sweden by the end 1990 was 2,655 (2,193 males, 462 females). The accumulated number of reported AIDS cases at the same date was 509 (467 males and 42 females).

Sexual behaviour is the common denominator in sexually transmitted diseases (STD) and that is why instruments for STD control must consider social and behavioural items more thoroughly than for other communicable diseases. Doctors treating these patients should have an epidemiological approach to the disease as well. It is important that the patients also understand this approach and why it is influential.

People with symptomatic infection seek medical care. Asymptomatic carriers of STDs tend to be more sexually active and transmission is probably more often caused by them (2). To reduce the prevalence and incidence of treatable STD, we have to find and treat asymptomatic individuals. A recent study from Colorado reported most chlamydia cases detected as a consequence of screening or contact tracing (3). Patients with untreatable STD like HIV infection must be found and counselled in a professional way so that they change their behaviour in order to prevent further sexual, parenteral and perinatal transmission. Asymptomatic patients may ask to be tested after or as part of general preventive activities, e.g. information campaigns (which will not be discussed in this thesis), or be found either by contact tracing or screening.

Contact tracing

Contact tracing or partner notification is a general term used to describe the process of identifying and informing sexual partners of their potential exposure to an STD in order to

bringing them to rapid treatment. The aim is to stop the spread and to prevent complications. This basic strategy has been discussed both in the United States and in the United Kingdom (4-8), especially the contact-tracing process (9-13). Contact tracing with Public Health Department involvement in the United States was first implemented in 1936 by Surgeon General Thomas Parran as part of a national syphilis prevention and control programme (14). The clinical care for STD in the United States is divided between local health department clinics and private physicians, whereas in Europe a centralised system has developed around the speciality of venereology and genito-urinary medicine (14). In January 1948, The Ministry of Health in the United Kingdom sent a letter to the local authorities, medical officers of health, and physicians-in-charge of special treatment centres entitled "Expiry of defence regulation 33 B. Suggested method of continuing to trace sources of venereal infection". The experience in the United Kingdom was that the use of so-called contact slips, what we now call "patient referral", was only useful with steady relationships and these new recommendations gave a model for reporting all other contacts to the County Medical Officer of Health (4).

In Sweden, a Royal letter was sent to the provincial governors in 1812 about tracing venereal diseases through visitation. Ten years later, in 1822, a letter from the Royal Medical Board was sent to the County Medical Officers directing them to ascertain the spread of primary venereal diseases and also to find out from whom and to whom infection could have been transmitted and to report suspected infected persons to the sheriff or the clergy (personal communication Prof Nils Thyresson). The latest rules (before the STD Act of 1918) about examination of prostitutes in Sweden came in Stockholm in 1875. Social workers for contact tracing at the clinics for venereal diseases were first employed in four cities in Sweden in 1944. In the 1960's all cities had social workers for this purpose.

Contact tracing has been used for STD control activities in Sweden (15-18) and in other countries in Europe (5,19) as well as in a developing country (20). The method has also been effective in the control of outbreaks of infection due to antibiotic-resistant gonococcal strains and for the identification of "core-groups" (21-24). In Sweden an increasing number of gonococcal infections are acquired abroad and the domestic spread is often stopped by contact tracing (18). Hammar et al showed already in 1972 that re-interviewing patient with gonorrhea increased the number of partners reported (15).

Contact tracing for HIV infection has been controversial, especially in the USA (25,26). Two editorials in major medical journals have, however, stressed the need for research on the method's applicability to HIV infection (27,28). A concise account of the arguments has been published by Potterat et al (29). Several studies have shown that HIV patients are able to identify their partners and some authors have also stressed the

educational value to the HIV negative partners (30-34) especially in heterosexual populations (35).

In January 1989 the WHO held a consultation session on partner notification for patients with HIV infection, which stated that: " Partner notification programmes, a form of contact tracing, should be considered, but within the context of comprehensive AIDS prevention and control programmes"(36).

Some American authors have described the spread of gonorrhea by "core-groups", which represent a small portion of those at risk, as being directly or indirectly responsible for most cases (22-24). A seldom discussed aspect of contact tracing is that it provides epidemiological information from the most basic level. By structured analysis of collected contact-tracing data, much could be learnt about STD epidemiology. Even the "core-group" concept could be studied. Several authors have, for example, pointed out that models of the spread of STD must take sexual partner mixing patterns into account, as different results are obtained assuming a random or a restricted pattern for choice of sexual partner (37,38). Random mixing is often assumed in published models (39,40). The validity of this assumption could to some extent be tested by an analysis of contact-tracing data.

Screening

While contact tracing is most effective in the control of STDs with low prevalence, screening combined with contact tracing is most effective for treatable STDs with high prevalence. Screening for syphilis has been carried out for a long time in Swedish medical practice but during later years screening has been more selective and been restricted to STD and antenatal clinics.

Culture for gonorrhea has been performed on very liberal indications for decades, not only at STD clinics but also at family planning clinics and antenatal clinics.

Since the middle of the 1980's, selective screening for HIV infection has been common at STD clinics, antenatal clinics and sometimes also in general medical practice in Sweden.

With the introduction of cell culture methods for *Chlamydia trachomatis* in 1965, it became possible to test large numbers of patients. However, these methods were not used in practice until the 1970's. Some screening studies for chlamydial infections from gynecological departments and family planning clinics were reported in the 1970's (41). Screening studies in the last 10 years have shown a prevalence of Ct infection among women in different outpatient settings of between 4 and 25 per cent (42-51). In two small studies, the prevalence of Ct infection in young asymptomatic men was 10 and 19 per cent respectively (52,53).

The health care system and legislation in Sweden

Health care in Sweden is almost exclusively funded through a national insurance scheme, where the counties are responsible for the operation of hospitals as well as outpatient clinics. Visits to a doctor generally entail a small charge, but examination and treatment for an STD covered by the act is free of charge, as are visits to family planning clinics for contraceptive advice.

All persons in Sweden have a unique 10-digit national identity number, where the first six digits are year, month and day of birth. It is given to every Swede shortly after birth, and to immigrants when they are granted a residence permit. All medical records are marked with and filed according to the this personal identity number, the only exception being records of patients seeking anonymously for HIV testing.

The present legislation for the control of STDs in Sweden dates from 1918, with changes in 1968 and 1988. Its most important features are:

- examination and treatment for STDs listed in the act are free of charge for the patient
- whilst still infected, the patient has to follow the restrictions given by his or her doctor to prevent further spread of the disease
- the doctor is obliged to inquire from whom the patient could have contracted the disease and to whom he or she might have passed it on
- the possibly infected partners named in this interview are obliged to be examined
- cases of STD are reported anonymously to the county Medical Officer of Health.

The responsibility for ascertaining that partners have been contacted and examined thus lies solely with the patient's physician, and not with the health care authorities. At STD clinics in Sweden, this work is referred to social workers (counsellors). If a named partner refuses to be examined, however, the Medical Officer of Health is informed, and may choose to take action and even in extraordinary circumstances ask for help by the police to bring the person to a doctor for examination.

Four diseases are now (1991) listed in the Swedish STD legislation. Syphilis and gonorrhea have been included since 1918. HIV infection and AIDS were included on 1st November 1985, which means that the rules concerning restrictions and contact tracing apply to this disease also. Infection with *Chlamydia trachomatis* was included in the act on 1st April 1988.

AIMS OF THE STUDY

- # to describe methods of identifying infected individuals in order to limit the spread of STD (I,II,IV,V)
- # to determine whether different ambitions in partner management influenced the rate of chlamydial reinfection and number of partners examined (III)
- # to evaluate the outcome of contact tracing in two different patient groups with chlamydial infection (V)
- # to evaluate whether accumulated results of contact tracing could be used for description of sexual contact patterns (VI)

PATIENTS AND METHODS

Most of the data collected for this thesis emanated from regular day-to-day work with STD patients in Gothenburg, and from the tracing of their contacts prescribed by Swedish law. Laboratory reports on positive Ct cultures from the microbiological laboratory constituted an additional data source. For the studies on *Chlamydia trachomatis* epidemiology, an extended screening programme was set up at the family planning clinics for a 15-month period. This programme also made use of a special questionnaire, which was distributed to all patients and partners.

Geographical setting

Gothenburg is the second largest city in Sweden, and is an important industrial and shipping centre. In 1988 the city had 430,000 inhabitants. Approximately half of these were women, some 33,400 of whom were 15-25 years of age. Gothenburg has two major hospitals, Sahlgrenska Hospital and Östra Hospital. Gothenburg also has two specialised STD clinics, one at Sahlgrenska Hospital and an outpatient clinic at Sociala Huset. The STD clinic at Sociala Huset has some 4,500 consultations per year. Across the city, there are distributed 14 family planning clinics attached to antenatal clinics. The patients at these family planning clinics are, as a rule, seen by a specially trained midwife who works under the supervision of a gynecologist. Patients with problems or questions related to the reproductive sphere may of course also choose to visit other outpatient clinics, or private practitioners.

Definition of social class (IV, V, VI)

In the studies where the patients were assigned an index for income and social welfare expense, it was based on their mail district number. Social welfare expense was estimated from the number of persons registered by the social welfare authorities for financial problems, alcohol abuse, social problems, etc. From official statistics, figures of the city of Gothenburg for mean income and mean social welfare expense for each mail district were obtained. Each patient and partner in the studies (IV,V,VI) was assigned the average income and the average welfare expense index corresponding to his or her mail district. These two figures were thus not collected for each patient or partner individually, but rather assigned according to his or her area of domicile. The indices for income as well as social welfare expense were approximately normally distributed in the entire study population and since there were no official classifications into different classes we chose to divide the patients into three classes for each variable: "low", "medium" and "high", so that each group would contain approximately the same number of individuals.

Studies on risk factors for chlamydial infection (IV)

The prevalence of chlamydial infection and risk factors for being infected were studied in a screening programme running from 15th October 1987 to 31st December 1988. All women aged 25 years or younger (N= 6,810) visiting any of the 14 family planning clinics for contraceptive counselling filled in a questionnaire covering: age, mail district code, previous pregnancies, previous genital infections, contraception, age at first intercourse and duration of present relationship. After being informed about chlamydial infection, they were asked if they wanted to participate in a screening programme for Ct infection. If they accepted, samples for culture of *Chlamydia trachomatis* from the cervix only were taken. They were also asked how they wanted to be informed about the result and were informed that they would be referred to the STD clinic if found Ct-positive. The counsellor at the STD clinic was informed of all positive cultures by the staff of the family planning clinic and she then contacted the patient by letter or telephone and informed her about the disease and its treatment. Partners were asked either by the patient herself or by the counsellor to come to the STD clinic for information and examination. The partners were asked questions about mail district code, previous genital infections, condom use and number of partners during the last 6 months.

Contact tracing (I, II, III,V,VI)

Introduction

Contact tracing is the most important method described throughout this thesis, and forms the basis of papers I, II, III, V and VI. Contact tracing implies ascertaining the names of sexual partners from a patient with an STD, and trying to reach them for counselling and testing. Partners may be contacted by the patient or by the health care worker.

Definitions:

Index patient: The patient first diagnosed and from whom the contact tracing is performed. A reported partner who is found positive becomes a new index patient.

Patient referral: Partners are informed by the index patient of their probable exposure to the STD and of the obligation to seek medical care. If the partner chooses to make an appointment at a clinic different from the index patient's, the consultation has to be confirmed to the original clinic.

Provider referral: The index patient reports the name and address of the partner to the health care worker, who then writes a letter to the partner asking him to call for an appointment at the same clinic as the index patient. If the partner wishes to go to another clinic he can bring this letter and ask the doctor to confirm that he

has been examined by sending the letter back to the clinic from which it came. Names of those index patients who choose provider referral are never revealed to their partners.

Regular or steady partner is in all papers (except for paper VI) the partner with whom the patient has an on-going sexual relationship at the time of diagnosis. All other partners are *casual or non-regular*.

In paper VI the patient described each partner as a steady or a casual partner regardless of when during the last six months they had a relationship.

The index patient can of course choose to use patient referral for one partner and provider referral for another partner. Sometimes the index patient starts by trying to persuade the partner himself, but later on a provider referral may become necessary.

Operational management of the patient with an STD might be organised on five different levels, where each higher level implies a higher ambition in finding and treating partners:

- I. The patient is treated but not informed about routes of transmission. Nor is the need for partner treatment stressed.
- II. The patient is treated and any regular partner is also treated, (without any examination) by giving the patient a prescription for the partner.
- III. The patient is treated, informed about routes of transmission and asked to tell all partners to have an examination, including treatment if necessary.
- IV. Equal to level III but including provider referral with non-mandatory verification that all partners have been examined, and that regular partners have been treated, regardless of the culture result.
- V. Equal to level IV but including mandatory control by the index patient's physician, according to the STD legislation, that all partners have been examined/treated.

All five levels were employed in the care of patients with chlamydial infection in different periods and at different departments in Gothenburg.

Chlamydia trachomatis infection (III, V)

In the screening programme described above, 5,785 women of 25 years of age or younger who visited a family planning clinic were examined for chlamydial infection. All Ct-positive women were referred to the STD clinic at Sociala Huset, where contact tracing was performed. In the middle of this study period, Ct infection was included in the Swedish STD legislation, which made it possible for us to study the impact of this legislation on contact tracing by comparing data before (level IV) and after (level V) the introduction of the law. Except for this change in legislation, the design of the study remained the same throughout the study period.

Study V was designed to evaluate the possibility that different levels of ambition in contact tracing could be applied in the two groups of Ct-positive women. The index patients consisted of two groups of women: *Group A*: All Ct-positive women (N=425) from the screening programme (IV). *Group B*: One hundred consecutive Ct-infected women attending the STD clinic, 25 years of age or younger. Of these, 35 attended for genital symptoms, 45 for a check-up, and 20 were reported partners of Ct-infected males. *Partners*: In contact tracing for Ct infection, patients were asked to identify all sexual contacts in the preceding 6-month period.

β-lactamase-producing *Neisseria gonorrhoeae* infections (I)

All patients (N=42) with a penicillinase-producing *Neisseria gonorrhoeae* (PPNG) infection diagnosed between January and August 1983 in Gothenburg (in the whole of Sweden 172 PPNG infections were diagnosed in 1983) were included in a study on how to control a microepidemic of this infection. The majority of these patients attended one of the two STD clinics, but some patients attended gynecological or other outpatient clinics or private practitioners. All PPNG isolates were auxotyped and serologically classified.

In the case of PPNG infections of unknown origin, where rapid intervention is required, the STD-counsellors engaged in the contact tracing conferred about the identity of the reported sources of infection and a thorough description of the patients and their contacts was obtained. At clinics where no counsellor was employed, the physician conducted these interviews.

Human immunodeficiency virus infections (II)

Ninety-one patients (83 men and 8 women) with HIV infection diagnosed between 1985 and 1988 at three clinics in Gothenburg (the two STD clinics and the Department of Infectious Diseases at Östra Hospital) were interviewed about their sexual contacts.

Contact tracing for HIV infection in Sweden is always carried out by someone directly engaged in the long-term time care of the patient. This may be the physician, a specially trained counsellor working with the physician, or both. Patient referral is encouraged when regular partners are concerned, but provider referral is always available for all partners.

Contacts were traced back up to three to four years from diagnosis of the index patient, or even further. Accounts of probable acute primary HIV infections, or frozen sera, sometimes aided in deciding this time limit. The method is illustrated by the graph in Figure 1.

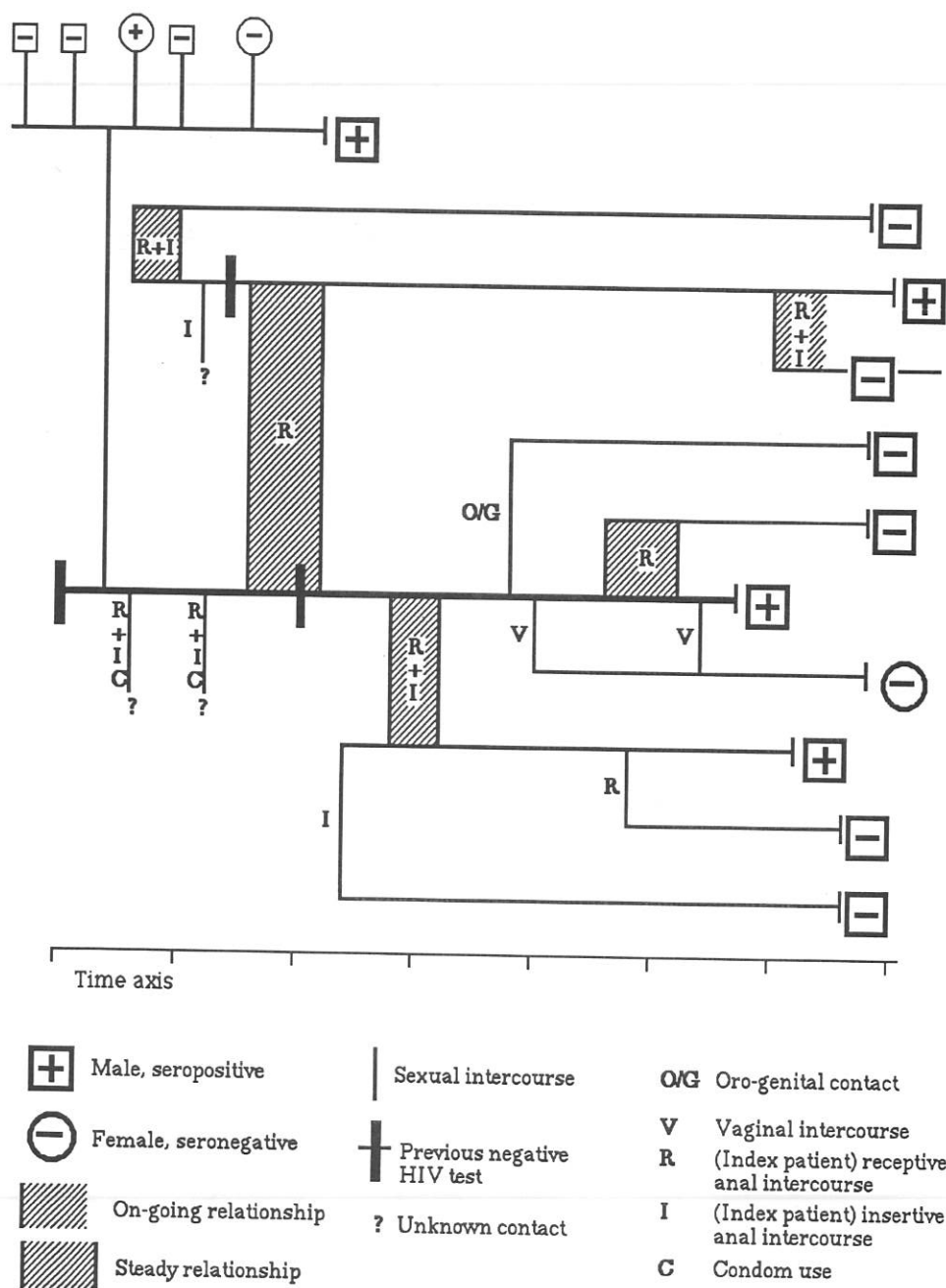


Figure 1. Description of a contact chain where the index patient is shown as the heavy, horizontal line in the middle.

Chlamydial reinfections (III)

In a retrospective study, data on Ct-positive women registered at the Microbiological Laboratory, Sahlgrenska Hospital, were collected during two 15-month periods (N=2,181). The first period ran from January 1979 to March 1980 and the second from January 1983 to March 1984. For all women who had two positive cultures for Ct in either of these time intervals (N=156), medical records were scrutinised for sexual partner data such as probable source of infection. Reinfection was defined as having a Ct infection during the first 12 months of each study period, and then a new Ct infection within the same period plus 3 months. The level of management was determined by the routines of the clinic treating the first infection. During this study four levels of management were used at different clinics in Gothenburg. Tests of cure were not routinely performed but all women received tetracycline treatment for 9-10 days. Treatment failures could be neglected as very few cases are positive after treatment (41).

Studies on contact pattern (VI)

The patients in this study were the 525 Ct-positive women of study V, plus their male partners. They were all asked about the number of partners in the previous six months, and this figure was called "rate of partner change". The women were also asked to indicate for each male partner if they considered this a steady or a casual partner, and the males were asked the same question about the index women. We constructed contact matrices for pairs, based on reported type of relationship, with number of partners in the previous six months (N=530 relationships) and social class according to the social welfare expense index described above (N=300 relationships) as independent variables. The lower number of relationships used in the study of social class is due to the fact that persons living outside the city of Gothenburg could not be assigned a social welfare expense index.

The study in paper VI describes how information on mixing patterns could be gathered from contact tracing data. If women and men are grouped into those with high and low rate of partner change, how often do people from these groups form couples? In discussions on models for sexual mixing patterns, two extreme types of mixing patterns could be envisaged and depicted by two theoretical graphs (Figures 2 and 3):

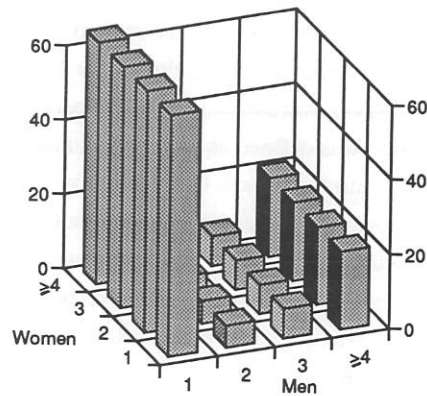


Figure 2. Purely random mixing

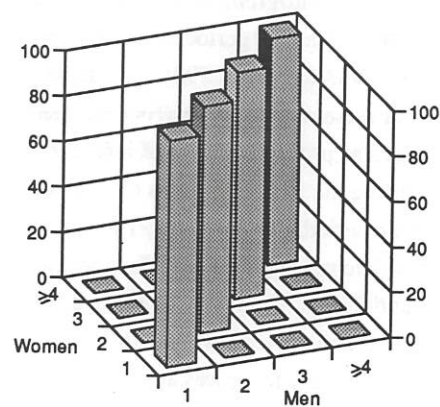


Figure 3. Completely restricted mixing

On the left axis of these two graphs is the woman's rate of partner change, and on the right the man's. For women from one group, the height of each bar shows the percentage of their male partners belonging to different groups.

Figure 2 shows a random choice of partner. For each group of women the distribution of male partners by rate of partner change is similar, and equal to the average distribution among all men in the population under study. For example: since males with just one partner per time period are most frequent, any woman who chooses a partner would have the greatest probability of randomly meeting one of them.

Figure 3 shows a completely restricted mixing pattern, where women chose only males from their own group.

Microbiology

All samples for diagnosis of Ct infection in Gothenburg were sent to the Department of Virology, Institute of Medical Microbiology, where McCoy cell cultures for *Chlamydia trachomatis* were performed (54).

Gonococci culture was performed as described in paper I.

Serogrouping and auxotyping of the gonococci were performed as previously described (55-58).

HIV antibody tests were performed with the conventional ELISA-test (Abbot diagnostica and Behring). Positive reactions have been confirmed by Western Blotting.

Statistical methods (III-VI)

A difference was considered statistically significant when $p < 0.05$ (two-tailed).

The chi-square test was used for comparison of proportions, for the univariate analyses of Ct prevalence and for the test of homogeneity.

The t-test was used in the analysis of difference between means.

Logistic regression (59) using the CATMOD procedure of the SAS system (60) was used in the multivariate analyses of factors influencing abstention from testing and Ct prevalence .

Two-way ANOVA was used in the analyses of variation of number of partners with respect to group and duration of relationship.

RESULTS

Studies on risk factors for chlamydial infection (IV)

Of the 6,810 consecutive women who were included in the screening study, 5,785 consented to have a chlamydia sample taken. This entire group corresponded to 20 % of the female population of Gothenburg in that age group. Ct culture was positive for 425 of these women (7.3%). The age distribution of the entire group is shown in Figure 4, together with the abstention rate and percentage of positive cultures for each age-group.

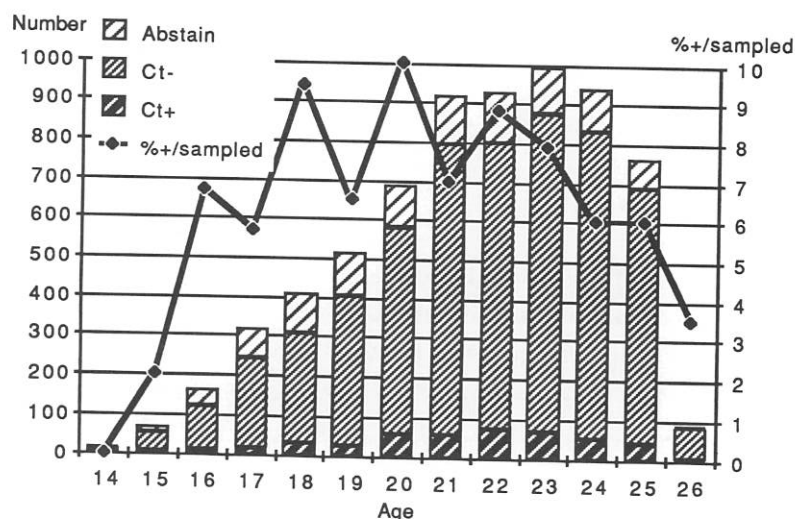


Figure 4

Age distribution: number abstaining from Ct testing, Ct-positive and Ct-negative among 6,810 women answering the questionnaire. Percentage Ct-positive among 5,785 women sampled.

Analysis of abstainers

Responses to the questionnaires for those women who agreed to culture and those who abstained were compared in a multivariate logistic-regression analysis. The variables found to be significantly associated with abstention were age, welfare expense index and previous pregnancies. Women ≤ 17 years of age were more likely to abstain than those older. Those with a high welfare expense index were more likely to abstain than those with a low index. The abstention rate for women who had given birth was higher than for those who had never been pregnant. Since each of the 14 family planning clinics participating in the study serves women in its surrounding area, and there is a skewed

distribution of socioeconomic problems across the city, the rate of abstention is also significantly correlated to clinic.

Risk analysis

The data were first subjected to a univariate analysis, in which the principal findings were as follows:

For both welfare expense index and income, the most privileged women showed the lowest rate of infection but differences between the groups were small. Women who had had one or more legal abortions had a slightly lower risk of being infected than those who have never been pregnant ($p < 0.001$).

Furthermore, women who reported at least one previous genital infection were found to have a lower risk of being Ct-infected at the time of the study ($p < 0.05$). As the multivariate analysis below shows, this finding is somewhat misleading, since the influence of this risk factor is age-dependent. The difference in prevalence between women who reported one or more previous Ct infections and those who reported no previous genital infection was not significant.

The analysis of the influence of contraceptive use on Ct prevalence is not straightforward, since several different combinations are possible. For example, when grouping the women who reported condom use into the two groups "condom only" and "condom in combination with oral contraceptives", we found that the women who reported use of both condoms and oral contraceptives had twice as high a Ct prevalence as the group who reported condom use only.

The data were then subjected to a multivariate analysis, which gave a model with four independent risk factors. These were age, previous genital infection, duration of present relationship and type of contraceptive used. The only significant interaction between these factors was that between age and history of previous genital infection. Age at first intercourse could not be shown to have any influence on present infection rate.

To summarise, the main findings were that, within the limited age bracket of the study, the women aged 18-23 ran the highest risk of being infected, that those who had a present relationship of <1 month's duration had the highest risk, and that use of condoms leads to a lower risk. For the variable "previous genital infection", the influence is age-dependent so that for women aged ≤ 17 , history of previous genital infection was a risk factor for being infected, while for women aged 18 or older the opposite applies: those who reported no previous genital infection had a slightly higher risk.

Contact tracing (I, II, III, V)

Chlamydia trachomatis infections (III, V)

When chlamydial infection was included in the Swedish legislation on STDs in April 1988, doctors became obliged to manage Ct-positive patients on level V. The influence of this change in legal status on the results of contact tracing is shown in Table I comprising data from women screened at family planning clinics.

Table I *

Result of contact tracing before and after inclusion of Ct infections in the STD legislation (level IV vs level V). Sixty partners who were not examined because they were anonymous or living abroad are excluded from the figures for refusals

	Ct-positive women	Partners reported N per index patient	Partners examined N per index patient	Partners refusing N %
Level IV	191	252 1.32	212 1.11	40 16
Level V	234	285 1.22	284 1.21	1 0.3

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We also wanted to evaluate the results of contact tracing in two different populations with Ct infections and their partners. The most important differences between the two groups studied were that Ct-infected women primarily visiting an STD clinic (group B) reported a higher average number of partners (1.8) and a lower percentage of steady partners at the time of diagnosis (46 %) than Ct-positive women visiting family planning clinics (group A) (1.3 and 71 % respectively).

These 525 women (both groups combined) reported a total of 722 male partners, 530 of whom could be notified, interviewed and examined at an STD clinic. The partners of the women in group A had a lower prevalence of Ct infection (25%), and also less genital symptoms, than the group B men, where the Ct prevalence was 45%. Group B men also more often reported previous Ct infections and a higher average number of partners in the preceding six months. They also demonstrated signs of lower socio-economic status than the group A men.

One-third of the male partners of the women in group A and over half of the male partners in group B reported at least one more female contact beside the index patient during the last six months, leading to the identification of an additional 21 and 26 Ct-positive women respectively. If we add these Ct-positive women to the Ct-positive men identified by the female index patient, we found in group A 1 infected person per 3.5 infected index women and in group B 1 infected person per 1.2 infected index women.

The median time between examination of the index patient and partner was 21 days for steady and 22 days for casual relationships (V). There were no significant differences in median time with respect to type of relationship or between patient groups. However, 75 % of the contacts were examined within 35 days in group A and within 48 days in group B.

The median time between examination of the index patient and the start of contact tracing was 12 days.

β-lactamase-producing *Neisseria gonorrhoeae* infections (I)

During January-August 1983, 43 PPNG strains were isolated from 42 patients in Gothenburg. Five patients were diagnosed during the first eight days and it was suspected that a local PPNG outbreak was developing. Intensive contact tracing started. After serological classification, 27 patients (13 women and 14 men) were confirmed to have the "epidemic strain". The study included six female prostitutes. One prostitute visited a gynecological outpatient clinic for vaginal discharge; all the other five were identified by their male partners and referred to one of the clinics staffed with specially trained counsellors. One of the prostitutes was the direct or indirect source of infection for at least five individuals before she was identified. The objective was to trace so far back that each patient could identify at least one culture-negative contact. Fourteen individuals known to have had intercourse with some of the patients involved either before or after the supposed date of their PPNG infection were culture negative for *N. gonorrhoeae*. Contact tracing was difficult because the patients had attended six different clinics in Gothenburg but after six months of intensive contact tracing no *N. gonorrhoeae* of the "epidemic strain" were isolated at the laboratory.

Human immunodeficiency virus infections (II)

The results of contact tracing from HIV patients diagnosed between 1985 and 1988 were evaluated. Out of 136 patients diagnosed in Gothenburg during that time, 91 reported one or more sexual partners, altogether 188 identified partners. These were all examined and tested for HIV infection at least six months after the last possible transmission episode.

The results of the testing are shown in Table II, where the number of positive partners out of the total number tested for each type of partnership is given. Altogether 38 partners were found to be seropositive for HIV out of the 188 tested. Twenty-one of these partners were unaware of their infection before they were notified.

Table II.*

Number of positive partners out of the total number tested by gender of index patient and partner and by type of relationship. An HIV-positive partner is considered a new index patient if he has any further partners. Five male patients are registered both as a partner and as an index patient.

Index patients:	Male partners		Female partners	
	Regular	Non-regular	Regular	Non-regular
Male (n= 83)	14/38	16/92	0/18	2/13
Female(n= 8)	3/7	3/20	0/0	0/0

Total: 38 positive contacts out of 188 tested.

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Chlamydial reinfections (III)

Over one third (57/156) of the reinfections during the two 15-month periods (1979/80 and 1983/84) occurred within the first 12 weeks after the initial infection. There was no difference in number of reinfections between the two study periods. Despite the fact that in 1983 no case was managed on level I, compared to 372 cases in 1979, the total percentage of patients reinfected by their steady partner was similar in the two periods. The probable source of infection for all women in the two study periods in relation to the level of management is given in Table III. At one clinic, working on level IV, only 2 out of 25 reinfected women were reinfected by their steady partner. At another clinic, working on level III, 25 out of 31 reinfected women had this source of reinfection. Levels of contact tracing and reinfection are presented in Table IV.

Table III*

Reinfections in 2181 Ct-positive patients studied in 1979/80 and 1983/84 in relation to level of case management

Level	Index patients N	Reinfections			Total reinfected N (%)	
		By regular partner N (%)	By new partner N (%)	Unknown source N (%)		
I	372	23 (6.2)	6 (1.6)	9 (2.4)	38	(10.2)
II	167	- -	- -	3 (1.8)	3	(1.8)
III	997	60 (6.0)	20 (2.0)	4 (0.4)	84	(8.4)
IV	645	6 (0.9)	22 (3.4)	3 (0.5)	31	(4.8)
All levels	2181	89 (4.1)	48 (2.2)	19 (0.9)	156	(7.2)

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Table IV*

Number - and percentages - of index patients managed on each level of contact tracing and reinfections during the two periods 1979/80 and 1983/84.

Period	Patients	Level I	Level II	Level III	Level IV	Reinfections
1979/80	658	372 (57%)	75 (11%)	-	211 (32%)	44 (6.7%)
1983/84	1523	-	92 (6%)	997 (66%)	434 (28%)	112(7.4%)
Total	2181					

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Studies on contact pattern (VI)

In the study in paper VI, the following mixing pattern for women's choice of steady male partners was found (Figure 5):

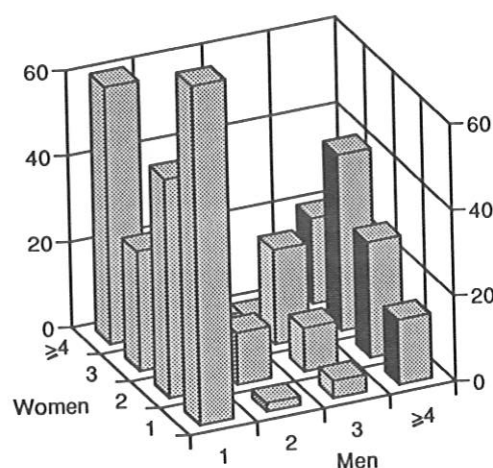


Figure 5. Women's rate of partner change vs. that of their chosen partner, steady partners (data from paper VI).

A ridge going roughly from the front left to the back right corner can be seen. (The high bar in the back left corner only corresponds to 3 men). This means that our data reject ($p < 0.001$) a pure random mixing model (the null-hypothesis), in that to some extent women tend to choose partners having a similar rate of partner change as themselves. Women with a low rate seem to choose men who also have a low rate, whereas women with a higher rate of partner change to a larger extent seem to prefer high-rate partners.

The graph in Figure 5 only shows women's choice of partner for steady relationships. Casual relationships were analysed in the same way, but for such pair formations no significant deviation from a random mixing model could be found.

A similar analysis was also made for the variable "social expense index", where for each couple the index of the woman is plotted against that of her chosen partner. Here, the same statistical findings were made as above: in steady relationships, women chose a partner from their own social class (i.e. they showed a restricted type of mixing pattern) more often than would be predicted by a random model, whereas for casual partners the hypothesis of random choice could not be rejected.

DISCUSSION

CASE-FINDING STRATEGIES

Early disease detection is crucial to STD intervention strategies.

Screening

To reduce the prevalence of chlamydial infections, it is important to identify asymptomatic individuals, who are significant sources for the spread of the infection (2).

A high prevalence of chlamydial infections is found both in symptomatic and in asymptomatic women in family planning and teen-age clinics (42-51). A strong correlation with age has been demonstrated, with the highest risk under the age of 25 (42-44,46,51). Our study was therefore limited to sexually active women under this age. The screening study included 20 % of the female population between 15 and 25 years of age in Gothenburg. Between a quarter and a third of all chlamydial infections diagnosed in the city during the study period were diagnosed within the study. The overall prevalence figure (7.3%) of our study is in agreement with other screening studies (42,43,46,49,50). Continuous screening can be expected to reduce Ct prevalence (2,46). We observed a gradual reduction in prevalence during the study period. This may, however, reflect a process in society and not the effect of the programme *per se* (61).

To ensure efficacy of screening, high participation is important. In screening for gynecological cancer social factors relating to the risk of developing cancer have also been shown to relate to the tendency not to participate in sampling (62). In some areas characterised by a high rate of socioeconomic problems, the rate of abstention from testing was high. The time required to motivate these patients for Ct testing may not be available to the midwives, who, in these areas have a very heavy work-load. We found Ct infection to be spread in all social classes, just as Handsfield et al did (42). A calculation of the theoretical Ct prevalence among abstainers predicts the same prevalence as among the women examined. Thus, about 70 Ct-infected women and their partners were probably missed. By increased information and better health care resources in problem areas, the dilemma of non-participation might be reduced.

Sampling techniques (63) and testing methods (54) are important for the yield of the screening procedure and the figures found in our study represent minimum values.

Application of our figures to data from cost-benefit and cost-effectiveness analyses of Ct screening programmes described earlier (64-68) indicates a net saving for society by the programme.

If a screening programme for STD is initiated, it is important that resources are allocated for information and contact tracing.

The income and social welfare expense indices in this and other studies in this thesis are indices assigned to each patient according to her area of domicile. They are thus not based on each individual's situation. We suspected that detailed questions concerning socioeconomic factors might reduce the response rate to the questionnaire. Our technique has an inherent risk of so called ecological fallacy (69). This means that within an area with certain characteristics, there may exist a small cluster of individuals not representative of the entire area. The possible existence of such ecological fallacy must be kept in mind in evaluation of our results.

Risk factors for contracting chlamydial infection

One way to increase the cost-effectiveness of a screening programme would be strict definition of the high-risk group. Such selective screening, i.e. sampling only a subgroup of the population exhibiting certain risk factors, has been suggested (42-45, 48-51). In a family planning clinic population in Seattle, five risk factors for Ct infection were identified: age 24 years or less, intercourse with a new partner within the preceding two months, use of no contraception or a nonbarrier method and certain clinical examination results. The Seattle group concluded that 90 % of all infections would be detected if screening included women with two or more of these risk factors (65 % of the total) and that it would encompass all who had a 4.7% or greater predicted risk of being Ct-positive (42).

A study of risk factors in an unselected population from London showed good agreement with those found in Seattle: women ≤ 25 years of age, unmarried, nulliparous, requesting termination of pregnancy, using oral contraception as opposed to barrier methods and who had cervical ectopy or cervicitis were at increased risk (44).

In a family planning clinic study in Manchester (50), no significant difference occurred between patients attending because of genital symptoms and those without symptoms. Ct prevalence was correlated to five risk factors: age less than 25, no stable partnership, hormonal contraception, nulliparity and West Indian ethnic origin.

In our study we chose to exclude criteria which could only be determined by vaginal examination. Our risk factors show good agreement with the three studies above and could be determined by asking the patient a few simple questions. Short duration of the present relationship was the single factor most strongly associated with increased risk of being infected. The others were age 18-23, no history of genital infection and failure to use condoms. However, a single risk factor should not be used as a criterion for screening of the sexually active except, perhaps, the risk factor young age. The difference in Ct prevalence between the group with the highest and lowest combined risk scores

according to our analysis is high. However, the difference between the group with the highest combined risk score and the entire population is only two-fold.

The association between STD and hormonal contraception has been described by other investigators (70). Several reasons for this exist, one important factor being failure to use a condom in a casual relationship. Our observation that women who used condoms in combination with oral contraception had a higher risk than those using either method separately probably indicates that these women consider themselves at high risk but do not use condoms consistently enough for STD protection.

The Seattle study found no covariation between Ct prevalence and previous STD (42). In our study, reported previous genital infection was a major risk factor for women under the age of 18. In the age-group 18 or older, the highest Ct prevalence (15.6%) was found in the group who had not had a genital infection, whose present relationship had lasted less than 1 month and who did not use condoms. In contrast, in women who had had at least one genital infection, whose present relationship had lasted more than 12 months and who used condoms, only 0.7% were infected. Limiting screening to a selected group of sexually active women under the age of 25 in the present high-prevalence situation, however, would seem to imply too many missed cases to warrant the economic saving, so that routine screening rather than selective screening among young individuals seems wise (46). With a future reduction of the Ct prevalence to a level of around 2 % or below, selective screening might prove more appropriate (2,64).

Short summary:

Chlamydia screening in family planning clinics included a considerable proportion of the female population in the age-group. A substantial number of asymptomatic cases were found. The prevalence of Ct infection was found to be in the lower range of that reported by others in similar settings and to be falling. Abstention from testing leading to missed cases was a problem and was found to be related to certain problem districts. Risk factors identified were in agreement with those reported by other authors. In the future knowledge of risk factors may be used to define the risk population to increase the cost-effectiveness of screening.

Contact tracing

A major tool in case finding is contact tracing. This strategy implies asking perfect strangers about their best-guarded secrets: with whom they have sex, when, and in what ways. Remarkably, they frequently answer. Sexual history is especially relevant for men who have had sex with other men (71). On both sides of the Atlantic there is a clear consensus that a basic strategy in the management of sex partners includes identifying them and bringing them to medical examination. The applicability of this approach may be limited

by lack of resources (14) and different follow-up activities should be incorporated (8,20,72,73).

In our study on the PPNG epidemic (I), it became very clear that even prostitutes could be identified by their male partners. This often took time, since they usually did not know the woman's name, but they could recognise her if they returned to the street or the club where they had met. As one man said: "Of course I know whom I have sex with, even if I pay her". The epidemiological usefulness of serotyping in the contact tracing process has been pointed out (21-23) and made it possible to establish a probable source of this microepidemic. The value of close cooperation between all personnel involved in contact tracing became obvious. The graphical presentation made the chain of transmission more comprehensible and also illustrated the epidemiological importance of the time from infection to treatment and time from infection to partner change. It is important that contacted partners receive an early appointment. In study V, the median time between examination of the chlamydia-infected index patient and her steady partner was 21 days, but this also included 12 days which was the median time from examination to diagnosis and the start of contact tracing. It has been recommended that the partner should be examined within 48 hours (74). In Satin's and Mills' study on contact tracing for gonorrhea and syphilis, a high proportion were interviewed and treated at their first attendance at the clinic, which reflects the difference in diagnostic methods between gonorrhea and Ct infection (8). In our setting, allocation of more resources to epidemiological work would mean shorter handling times, leading to reduced risks of propagation of the infection and reinfection by the steady partner. Schachter recently stressed the importance of a programme for chlamydia control based on, among other things, contact tracing (75).

The influence of the mode of referral on the outcome of contact tracing has been discussed by Katz et al (65). In the Swedish model of referral for STD patients, patient and provider referral are mixed according to the wishes and needs of the patient. Provider referral should take the form of a letter, where the partner is asked to call or write to make an appointment, but when dealing with an HIV infection the reason for this request is often not stated. HIV infection was included in the Swedish STD legislation in 1985, which meant that contact tracing became compulsory. While there has been unanimous agreement concerning contact tracing for treatable STDs such as syphilis (76,77) and gonorrhea, this practice has been questioned for HIV infection. In the United States, the Center for Disease Control (32,78) and the Surgeon General are strongly in favour of contact tracing, but others have argued that the disease may be driven underground (25). However, in low-prevalence situations, it has been considered less controversial (28-31). The need for further research into the usefulness and cost-effectiveness of contact tracing in HIV infections has recently been stressed (27,28). In Sweden, almost all clinics have

counsellors for the psychosocial care of HIV-positive patients and when they are also made responsible for the contact tracing, the programme does not become so expensive. If one counsellor with a normal Swedish salary finds one HIV-infected patient by contact tracing in one year, this is cost effective in comparison with the cost of finding one case through general screening (personal communication Johan Giesecke SBL). Paper II reports our experiences with contact tracing in HIV/AIDS patients. The usefulness of the graphic presentation of the contact chain is illustrated once more. The numerical description of the outcome of the contact tracing procedure shows the potential for case finding as well as for individual sex counselling.

Contact tracing for HIV infection has been criticised as conflicting with issues of social concern such as confidentiality for the index patient and the partner's right not to know (79). The cornerstone of our work is confidentiality. If confidentiality is broken, the partner will not continue to have risky sex with the known HIV-positive index patient, but on the other hand he might assume that all other partners are uninfected and thus have risky sex with them and also be less likely to practise safe behaviour with future partners (78). In one study of 25 HIV-positive women, 68 % said that they would give the names of their partners if their own identity were not revealed. If their names were given to the partners, only 20 % said they would cooperate with the partner notification process (78).

Early during the supportive talks with the counsellor, one should always let the patient talk freely about his partners if he wishes, but mention that the question of contacts will be brought up later in a more structured way. The best way is sometimes to draw a graph illustrated in Figure 1 (without test results) together with the patient. If the index patient has a regular partner, then this person will almost always accompany the patient on one of the first visits after diagnosis. This is the ideal opportunity to suggest that the partner should also be tested. With this structured interview and guaranteed confidentiality, 91 partners of 188 index patients were identified and counselled. Twenty-one of the 38 found HIV positive were unaware of their infection before they were notified. The patient must also feel that he is participating in a campaign to stop the spread of the virus - this is the viewpoint of general prevention. Another important point is to make the patient realise that it is essential for his partners to know if they are infected, thus giving them the opportunity to come under medical care, making it possible for them to avoid becoming infected with other diseases, and giving them a chance to change their lifestyle. Making the patient cooperate is time consuming. Most of the time is spent building up a trustful relationship between counsellor and patient. If time is scarce, this model will not work, and it is better to use the self-referral model described by Parra et al: "Total patient responsibility; no identification of sex partners requested; appointment cards are issued to patients for distribution to sex partners" (74).

Short summary:

Contact tracing or partner notification is an important method of identifying individuals at high risk for STD who may not be aware of their exposure. A graphic description of the transmission data is a useful tool in this work. In our study on PPNG, we had good help of the serogrouping of the gonococci. Close cooperation between counsellors involved in the work with PPNG cases was also important. The time-consuming interview with an HIV-positive patient has to be carried out by someone engaged in the medical and psychosocial care of the patient. Talking to uninfected contacts gives a golden opportunity to inform them about risk behaviour on a very personal level. The notion of a "near miss" makes these talks very real. Confidentiality of the index patient during the contact-tracing process is essential and of great importance for the number of partners reported. In a low-prevalence situation, contact tracing is probably more cost-effective than a large screening programme for HIV.

Influence of different strategies on number of partners examined and reinfection rate.

Satin and Mills in 1978 reported the results of contact tracing for gonorrhea and syphilis from 5 clinics in the United Kingdom; 23-71 % of the reported contacts were not known to have been examined (8). They concluded that contact tracing has to include all infected patients, otherwise the effect of contact tracing on the control of STD is of limited value and also difficult to assess (7). In their study, one of the reasons offered in explanation for failure to interview all patients was: "A doctor chooses not to refer a patient, having decided that the patient has had no sexual partners other than the one who transmitted the infection and should be protected from understanding the implications of the sexual transmission of his/her infection"(7). In our study (III), all patients were interviewed and the average number of reported partners per woman who came for information and examination increased substantially when the STD Act was expanded to include Ct infections. Montesinos et al reported that the most effective approach to the problem was to let the counsellor ask the index patient to accept a follow-up telephone contact if their sexual partners failed to attend or call within a week. Ninety per cent of the partners came for examination with this approach. This approach was also the least expensive compared to two other managements without control (80). Re-interviewing patients with gonorrhea has been found to increase the number of reported partners (12,13,15). The only changes in patient management in our study were that a sentence was added in the written information saying: "Ct infection is now included in the STD legislation and we have to check that every reported partner has really been examined for Ct infection" and that we offered free treatment. Most of the partners not examined before the law, were not informed directly by us but only through one or two letters. If the system does not include verification that the partners have really been examined, one

misses the opportunity to motivate those who think they are uninfected. It is very difficult to motivate asymptomatic men to seek medical attention (10).

In the study of reinfections (III), it was also evident that if control of partner attendance was increased, the number of reinfections decreased. Patients with gonorrhea who continue to have sexual relations with untreated partners run the highest risk of reinfection (81). Although the operational approach to the management of chlamydial infections improved from 1979/80 to 1983/84, the proportion of patients reinfected by a steady partner remained stable. The standard of information to Ct-positive patients improved during these years so that no patients were treated without being given information about the transmission of the infection in 1983/84. The reasons for the unchanged percentage of overall reinfections might be that the majority of patients during both periods were managed on a level, where there is no systematic verification that the reported partners have actually been examined, and the failure to consistently treat steady partners may also have contributed (14). It is also most likely that more samples were taken in 1983/84 as the indications for Ct sampling were widened during these years. In the small group of patients managed on level II (just treating the steady partner by giving the Ct-positive woman two prescriptions), reinfections were rare compared to the other groups. Assuming that the 425 Ct-positive women from the screening study (IV) had been managed on level II, we would have missed 40 non-steady Ct-positive male partners and 21 Ct-positive women reported by these partners and, most important, we would have missed the individual information to all the reported partners. It is obviously better to treat a partner than leave him untreated but optimal prevention of the spread of infection is not achieved as all the previous contacts are not sought.

Our analysis of reinfections represents minimum figures for at least four reasons: A second Ct culture was only taken from the women who sought testing, the study only covered a 15-month period, and a few women may have been treated without a positive Ct-culture.

S h o r t s u m m a r y:

In optimal contact tracing, verification should be obtained that all reported partners have been informed and examined.

Contact tracing in two different populations of chlamydia-infected women and their partners.

Differences in characteristics between Ct-positive women diagnosed in screening programmes and women attending STD clinics and their respective partners have to my

knowledge not been reported earlier and very few studies report on partners of Ct-positive patients (3,16,17,82).

The theory that "core-groups" are responsible for the spread of STD (14, 22-24) could perhaps be applicable to chlamydia spread in our setting. We expected the women visiting STD clinics (group B) to be our "core-group" especially in comparison with the women found in the screening programme (group A). But we have no reason to believe this to be true, since we found very small differences between the groups. Women in group A more often lived in relationships of more than one year's duration, and the proportion of women with more than 3 partners in the last 6 months was also lower in this group.

Others have described a discrepancy between knowledge and actual behaviour (83-88) and this is in agreement with our result on condom use. Group B more often reported use of condoms. Obviously, condoms were not used consistently enough to prevent Ct infection. This is also in agreement with observations reported in paper IV. As the proportion of women without contraception was also high in group B, this group appears to exhibit a double risk behaviour. The fact that the women at the STD clinic often did not use contraceptives should encourage STD clinics to offer contraceptive counselling as part of their service or to establish close cooperation with family planning clinics. "The marriage of the disciplines of family planning and STD is destined to be a fruitful one. Strange bedfellows no longer, these related fields are growing increasingly intertwined in research and in clinical practice" (89).

The difference between group A and group B women with respect to number of partners and previous STDs was also seen in their male partners, i.e. higher risk behaviour in group B. There was no difference in income index between the women but the male partners of group B came from areas with lower income. Others have found that men are more risk prone than women (90). In both groups, more men than women reported ≥ 3 partners during the last 6 months. The risk of women transmitting chlamydial infections to their male partners has been investigated by others and the prevalence among partners of Ct-positive women was found to be between 24 and 53% (16,17,82). In study V the male partners of the women in group A were more often asymptomatic and Ct negative (25% Ct positive) than the male partners of the women visiting the STD clinic (46% Ct positive). The reason for this may be that they have no infection or are in a latent-persistent stage of infection in which it can be difficult to obtain a Ct positive culture (2). From both groups, steady and casual partners were traced, informed, examined and interviewed about further female contacts, which led to the identification of additional Ct-infected women. Casual and previous partners of the women in group A had a higher Ct prevalence (33%) than their present steady partners (24%), however not significant. This underlines the need for tracing both steady and casual partners.

There was an inverse relationship between the duration of present relationship and the number of partners reported in both groups. Group B men reported 1.8 partners during the last six months, compared to 1.3 for group A men, but contact tracing in both groups revealed many complicated chains of transmission even in group A. All partners in both groups who visited the STD clinic were offered HIV testing. Nearly all accepted. None was found to be HIV-positive. The psychology of contact tracing among women found in the screening programme and their partners is more complex, as we have reason to believe that risk awareness is lower among these women.

As the men of group A women were often asymptomatic and Ct-negative, it is very important that these patients are counselled by skilled and trained counsellors with epidemiological and biological knowledge so that apprehension and feelings of guilt can be avoided. All cases of STD should be handled the same way, even if the index patient is found in a screening programme.

Short summary:

We found small differences between the women found in the screening programme and those attending the STD clinic. All cases of STD should be handled by skilled and trained counsellors.

Influence of socioeconomic background and rate of partner change on partner choice

A Swedish report from 1985 showed that women choose their partner for marriage from their own social class. This pattern is not so clear in men; they probably have other criteria than social class when they choose their wife (91).

This is in complete agreement with our results. When women choose steady partners they tend to do so from the same sexual activity and social class as themselves. For casual partners, the pattern seems more random. The classification of a relationship as "steady" or "casual" is the individual's own. This structure did not change when we excluded all women who reported partners who could not be identified. A few women seemed to live in serial monogamy (they reported 4 steady partners in a 6-month period), which is not unusual among young people in Sweden (92). Aral et al ask for more research to provide a more accurate estimate of the population at risk for STD (93). We believe our results to show that the assumption of random mixing in models for the spread of STD is not justified. The rate of spread and possible final magnitude of an epidemic of STD will be overestimated if models with that assumption are used.

Short summary:

Birds of a feather flock together if they are going to flock for a long time.

SUMMARY and CONCLUSIONS

- # Screening for *Chlamydia trachomatis* in family planning clinics is one important method of finding patients with asymptomatic infections. The prevalence of chlamydia-infected women visiting family planning clinics was low in our study (7.3%).
- # By screening all women below 26 years of age visiting these clinics, we found 30% of the female chlamydial infections in this age-group in the city. The infection was widely spread among young sexually active individuals.
- # Four factors were found to be significantly correlated to the risk of being infected: age 18-23, duration of present relationship < 1 year, failure to use condoms and no history of genital infection.
- # The rate of abstention was especially high in areas with low socio-economic status.
- # Contact tracing is another way to find asymptomatic STD-infected patients. In our study on the PPNG microepidemic, we found that close cooperation between the counsellors involved was very important and serogrouping of gonococci was also useful.
- # The time-consuming interview with an HIV- positive patient has to be carried out with confidentiality by someone involved in the psychological and medical care of the patient. In this way, several new cases are identified. Talking to an uninfected contact gives an opportunity to inform him or her about risk behaviour on a very personal level.
- # In all complicated contact tracing, graphic description of the contact chain has been shown to be of great help.
- # To achieve optimal results of contact tracing, all reported partners should be informed and examined.
- # Women with Ct infection diagnosed at the STD clinic had a higher average number of partners than women with Ct infection diagnosed at family planning clinics. There was no support for the idea of a "core-group". Contact tracing should be carried out equally meticulously among patients from screening programmes and traditional STD clinic patients.
- # When women choose their male steady partner, they choose from their own social class and sexual activity group. However, they choose their casual partners from all classes and activity groups. If our results show the real mixing, the assumption of random mixing in models for the spread of STD is not justified.

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