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Sexually Transmitted Diseases Among Adolescents in Developed Countries

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Context: Sexually transmitted diseases (STDs) are responsible for a variety of health problems, and can have especially serious consequences for adolescents and young adults. An international comparison of levels and trends in STDs would be useful to identify countries that are relatively successful in controlling the incidence of STDs, as a first step toward improving policies and programs in countries with high or growing STD incidence.

Methods: Incidence data for the past decade on three common bacterial STDs—syphilis, gonorrhea and chlamydia—were obtained for as many as 16 developed countries from official statistics, published national sources or scientific articles, and unpublished government data. Rates of incidence per 100,000 were calculated for adolescents, for young adults and for the total population. (These estimates should be considered conservative, because STDs commonly are underreported.)

Results: The incidence of these three STDs has generally decreased over the last decade, both in the general population and among adolescents. However, the Russian Federation is an important exception: Syphilis has risen dramatically in the 1990s. Except in the Russian Federation and Romania, the syphilis rate in the mid-1990s was quite low, with rates of less than seven reported cases per 100,000 teenagers in most developed countries. Gonorrhea incidence is many times higher than that of syphilis in several countries, and this disease disproportionately affects adolescents and young adults. Gonorrhea rates among adolescents can be as high as 600 per 100,000 (in the Russian Federation and the United States), although in many countries the reported rate among teenagers is below 10 per 100,000. In all countries with good reporting, chlamydia incidence is extremely high among adolescents (between 563 and 1,081 cases per 100,000). The reported incidence of all three STDs is generally higher among female teenagers than among males of the same age; this is especially true for chlamydia.

Conclusion: Prevention programs, active screening strategies and better access to STD diagnosis and treatment services, especially for adolescents and young adults, are necessary to reduce the incidence and the burden of STDs among young people.

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Sexually transmitted diseases (STDs) are recognized as a major public health problem in most of the industrialized world. The World Health Organization (WHO) estimates that in the mid-1990s, 30 million curable sexually transmitted infections (syphilis, gonorrhea, chlamydia and trichomoniasis) occurred every year in North America and

western Europe, with an additional 18 million cases in eastern Europe and Central Asia.[1] These counts do not include incurable STDs such as genital herpes and human papillomavirus infection, for which no up-to-date estimates have been made by the WHO. Approximately 74,000 new HIV infections are estimated to have occurred in 1997 in North America and western Europe.[2]

Information is scarce on trends in Europe and North America for chlamydia (defined here as including only genital chlamydial infection), genital herpes and human papillomavirus infection, and when information is available it covers only the 1990s.[3] Although some increases in incidence are documented, it is unclear how much of this upward trend is due to improvements in case ascertainment and surveillance or to actual increases in STD incidence. Most developed countries have seen dramatic declines in the incidence of syphilis and gonorrhea since World War II. Some eastern European countries nevertheless have recently experienced increases in these two STDs.

STDs deserve attention not only because of their high prevalence but also because they frequently go undetected and untreated, and can result in serious reproductive morbidity and mortality.[4] Compared with the extensive efforts devoted to research and intervention on HIV and AIDS, very little attention has been paid to other STDs. We attempt in this article to increase awareness of at least one central aspect of the most common curable STDs—their incidence. Recent findings showing that some STDs act as a cofactor or facilitator for HIV transmission argue that research on STDs other than HIV and AIDS can also contribute to better insights into HIV infection.[5]

A central goal of this cross-national comparison is to assess the incidence of syphilis, gonorrhea and chlamydia among young people in developed countries.* Two valuable European cross-national studies on STDs have already been carried out, but these do not provide national population incidence. One presented STD prevalence data based on self-reports from national surveys in eight countries,[6] while the other provided prevalence among individuals attending STD clinics in 17 European countries.[7] To our knowledge, however, a comparative study of current STD incidence and recent trends across developed countries has not as yet been attempted, in part because of the problems and limitations of existing data.

Systems for collecting STD information vary widely across developed countries; the resulting variation in data quality affects interpretation and limits the conclusions that can be drawn. In addition, official statistics are circumscribed by the extent to which STDs are "silent," and therefore are never identified or counted. STD policies and health care systems can also contribute to explaining variation in incidence. Nevertheless, there are real advantages to carrying out a comparative analysis of STD incidence, providing that data quality is taken into account when interpreting the results. Such an analysis can identify countries that have been relatively successful in controlling the incidence of STDs, and can represent a first step toward finding directions for improving policy and programs. Countries with high or growing incidence may look to other countries with lower or declining STD levels to learn from their successes.

This article addresses the current incidence and recent trends of STDs among adolescents aged 15-19 and young adults aged 20-24 in the developed world.

Compared to males and older women, female adolescents are at higher physiological risk of contracting an STD.[8] Moreover, teenagers and young adults are likely to be at greater risk for STDs than are older adults because they are less likely to be married and more likely to have multiple partners, to have unprotected sex and to have high-risk partners. They may have poorer access to information and greater difficulty in accessing services than adults have. We also present infection rates for the total population of a country, to provide a broader perspective and a point of comparison against which the situation for young people can be assessed. This article also contrasts rates for young men and young women, because of important differences between the sexes in the risk of transmission, the likelihood of diagnosis and the potential severity of consequences.[9]

DATA AND METHODS

Countries and STDs Covered

Although we initially intended to cover all developed countries in this article, the lack of STD incidence data in some countries and the poor quality of existing data in others narrowed the scope of the study to 14 countries in Europe, the United States and Canada. Complete statistical data by sex and age are not available for all years, for all three selected STDs or for all 16 selected study countries (Table 1).

Table 1. Types of data collection systems for monitoring sexually transmitted diseases (STDs), by type of provider, and proportion of diagnosed STD cases that are estimated to be reported by official statistics, all according to country, 1998

Country	National coverage			National sentinel network			Estimated reporting rate	
	Physician	Laboratory	STD clinic	Physician	Laboratory	STD clinic	Syphilis and gonorrhea	Chlamydia
Belgium	S, G*	No	No	No	G, C†	No	Low*	Low
Canada	S, G, C†	No	No	No	No	No	High	High
Denmark	S, G, C	S, G, C†	u	No	No	No	High	High
England & Wales	No	No	All†	No	All	No	High	Medium
Federal Republic of Germany	S, G†	No	No	S, G	No	No	Low	u
Finland	S, G, C†	No	No	u	S, G, C	u	High	High
France‡	S, G*	No	No	C	G, C	No	Low*	Low
German Democratic Republic§	S, G†	u	u	S, G	u	u	Probably high	u
Netherlands	S, G†	No	No	No	No	No	Low	u
Norway	S, G, C†	S, G, C	u	u	u	u	High	High
Romania§	S, G†	No	No	u	u	No	Probably high	u
Russian Federation§	All†	No	All	u	u	No	Probably high	Probably high
Slovak Republic§	S, G†	No	No	u	No	u	Probably high	u
Sweden	S, G, C†	No	No	u	S, G, C	No	High	High
Switzerland	S, G*	S, G, C†	No	All	No	All	Medium*	Low
United	S, G, C†	No	No	No	No	No	S: High; G:	Medium

States							medium	

*Formal declaration by physicians exists, but is not used as a source of statistics because underreporting is too high to produce reliable data. Other sources (national sentinel network of laboratories for France and Belgium, national laboratory reporting for Switzerland) are used instead in these countries. †Official statistics from this type of data collection system are the basis of estimates presented here for all STDs listed. ‡None of the available sources of data for France have been used directly, as they represent a very low proportion of diagnosed cases. Instead, national estimates are presented for gonorrhea (1990 and 1996) and chlamydia (1996). Completeness of these estimates is considered to be high for gonorrhea and medium for chlamydia (because male cases are probably highly underrepresented). §Political, social and administrative changes in the early 1990s may have negatively affected the completeness of reporting. *Notes:* For estimated reporting rates, completeness is classified as low when fewer than 50% of diagnosed cases are estimated to be reported, medium when 50-70% are estimated to be reported and high when more than 70% are estimated to be reported. S=syphilis. G=gonorrhea. C=chlamydia. All=all common STDs. u=data unavailable or could not be obtained.

Government statistics on reported STD incidence were obtained directly from three types of sources: published official documents, unpublished government data and scientific journal articles.[†] Literature and reports in French, Italian, German and Dutch were included. For northern European countries, eastern European countries and the Russian Federation, we mainly used published literature and government reports that were in English, although some statistical reports in the original language were also used. A frequently used source was personal communication with officials and experts to obtain unpublished statistics or to obtain more complete data by sex or age and for years other than those in published data. This was the sole or main source in Canada, Denmark, England and Wales, the Federal Republic of Germany (West Germany), Finland, the German Democratic Republic (East Germany), the Netherlands, Norway, Sweden and Switzerland. Published official data were the main source in Belgium, France, Romania and the United States. Journal articles or published international statistics were the main source for the Russian Federation and the Slovak Republic.[‡]

The earliest data collection systems typically included syphilis, gonorrhea, lymphogranuloma venereum and chancroid. (There are some minor variations in the categories of syphilis cases that are counted, but these do not have any significant effect on comparability across countries.[§]) Lymphogranuloma venereum and chancroid have almost disappeared in the developed world; as a result, they are not covered in this article. Reporting on chlamydia, an STD that is now one of the most prevalent, was added to surveillance systems in the late 1980s or early 1990s in Canada, Denmark, England and Wales, Finland, Norway, the Russian Federation, Sweden, Switzerland and the United States.

Data Collection Systems

STD incidence statistics are typically obtained from reporting by physicians, laboratories and specialized STD clinics. Coverage by any of these can be national or based on a sentinel network of selected facilities. Combining the three sources and the two types of coverage means that, theoretically, there are six modes for collecting STD data (Table 1). The most common system used to collect incidence data is national compulsory physician reporting, in which all practitioners and medical facilities nationwide are required to complete a standardized form for each STD patient, providing the diagnosis and some demographic data (generally, but not always, sex and age).

There are a few exceptions to this pattern. Switzerland is the only selected country to rely on national laboratory reporting alone for its STD statistics. Denmark primarily

relies on this same source, but cross-checks it with physician reporting. In England and Wales, STD statistics are based exclusively on declaration from public specialized STD clinics (genitourinary medicine clinics). Finally, Belgium and France use sentinel systems, based on networks of laboratories or physicians, as the only or the principal source for STD data.**

There are advantages and limitations to each type of system. Although national compulsory physician reporting has the advantage of national coverage, private doctors do not always provide complete reporting. Moreover, they often do not confirm diagnoses with laboratory tests, thereby yielding potentially inaccurate numbers. This difficulty also affects national compulsory laboratory reporting, as laboratories only see and report cases that physicians send to them for confirmation.

The accuracy of compulsory national STD clinic reporting depends on the proportions of and the representativeness of the population using such services. This source is accurate only when a high proportion of all who seek STD care use such clinics. Sentinel systems do not provide national coverage, and clients of participating providers may not be representative of all those infected with an STD. Additionally, all network participants may not report every year, so trend data may not be comparable across time periods.

In addition to variations in the completeness of reporting of *diagnosed* STD cases, the proportion of *infected* people who are actually identified as having an STD also varies. These variations can stem from a number of problems: differences in ease of access to STD services; how extensive and active partner notification policies and programs are (also called "case-finding"); whether the sexually active population is universally screened (as opposed to selective screening of high-risk groups only); and whether an STD has clearly recognizable symptoms, which determines whether care is sought and the STD reported.

Other factors that may also affect an individual's decision to seek STD services, and in turn influence reported incidence, include the cost of services, whether they are covered by insurance, the extent to which confidentiality and anonymity are assured, and perceptions of risk and patterns of health-seeking behavior (which depend at least in part on the prevalence of a particular STD in a group or area).

The states of the former Soviet Union, other eastern European countries and the four Nordic countries have relatively more active and extensive screening and case-finding policies. In Canada and England and Wales, partner notification takes place, but with no systematic and compulsory policy. However, the practice of STD screening is expanding and covers a large proportion of people seen for general health care.

In the United States, partner notification and counseling are recommended for all STDs (especially for high-risk groups), and such activities are supported with federal funds. However, the application of these policies and the allocation of funds to these activities are highly variable by state, since states determine their own priorities based on the relative burden of STDs and other communicable diseases. In addition, screening is recommended (and is increasingly being used) for chlamydia. In Belgium, France, West Germany, the Netherlands and Switzerland, STD case-finding and screening policies are not active because STD care is less centralized, taking place

mainly at private facilities that are less likely to comply with case-finding policies. Clearly, all other things being equal, the more active case-finding policies are and the more widespread STD screening is, the larger the fraction of STD cases that will be identified and reported.

Completeness and Quality of STD Data

The proportion of diagnosed STD cases that are recorded and reported in official statistics varies greatly across countries and by disease. An estimate of the proportion of diagnosed cases that are actually reported—referred to here as the reporting rate—is available for some countries from specific studies or from official government reports. For those countries that lack an official or published estimate of the reporting rate, national experts were asked for their estimates.

We considered reporting to be high if 70% or more of diagnosed STD cases are reported. High reporting for syphilis and gonorrhea was found in the four Nordic countries,[10] Canada, and England and Wales,[11] while high reporting for syphilis (but not for gonorrhea) was found in the United States (Table 1).[12] The four selected eastern European countries (East Germany, Romania, the Slovak Republic and the Russian Federation) were also estimated to have this high reporting level for both syphilis and gonorrhea, at least until the political, social, economic and administrative changes of the early 1990s; reporting is thought to have deteriorated since then, but no up-to-date information is available for these countries.[13]

We considered the level of reporting as medium if 50-70% of diagnosed cases are reflected in official statistics; this was considered true of the United States for gonorrhea and of Switzerland for both syphilis and gonorrhea. Reporting was classified as low if fewer than 50% of diagnosed cases are reflected in official statistics; this was judged true for both syphilis and gonorrhea in Belgium, France, the Netherlands[14] and West Germany.[15] ††

Reporting rates for chlamydia were classified as high in the four Nordic countries, in Canada and in the Russian Federation (the only eastern European country for which data on chlamydia could be obtained), medium in England and Wales and the United States, and low in Belgium, France and Switzerland (Table 1). Because of these limitations, the rates that we present are considered minimum estimates of diagnosed STD cases, even for countries with an efficient, comprehensive national reporting system. Additionally, these data are minimum estimates of total cases, since some STD infections are never diagnosed.

Continuity in a country's data collection system is a key determinant of whether comparable trend data are available. Countries that have more consistent and complete trend data are the Nordic countries, the former Soviet states, England and Wales and, to some extent, Canada and the United States. Changes in the definition of STD cases, in testing procedures, in policies for identifying cases, and in a system's geographic coverage within a country can all affect the data. Several countries had discontinuities in their reporting systems prior to the early 1980s, and for this reason we present trend data only for the period 1985-1996.

Data Obtained

We present information over time on syphilis for the total population for all but three countries: Data are available for the Slovak Republic only since independence in 1990, and no data on syphilis are available for Belgium and France. For gonorrhea, trend information is available for the total population for all 16 selected countries, although for France and the Slovak Republic, data are available only for the 1990s.

Age-specific data from the mid-1980s to the mid-1990s (necessary to document the situation of adolescents) are available on both syphilis and gonorrhea for seven of the 16 selected countries. For the other nine countries, only partial data are available for adolescents—for only one disease, only for the later period (1990-1996) or (in the case of three countries) only for a recent year.

The collection of statistical data on chlamydia began in the late 1980s, and information is available for 11 countries starting in different years. Trend data on adolescents are available only for seven of these 11 countries, and only for the period 1991-1996.

In France, sentinel data are the main source of statistics on STDs (chlamydia and gonorrhea). However, national estimates of the incidence of gonorrhea and chlamydia, by sex, were calculated by national experts.[16] To create national estimates by sex and age for France, we applied the age distributions for males and females from sentinel data to national sex-specific STD estimates. Although far from perfect, these estimates give a rough picture of the level of incidence by age and sex in France.

To compare countries, we calculated annual STD rates. These are expressed as the number of reported cases per 100,000 total population per year, including both the sexually active and those not sexually active. Countries provided numbers of reported cases or incidence rates, or both. When countries provided both rates and numbers, these were cross-checked for internal consistency.

RESULTS

Incidence of Syphilis

•*Recent level.* In the mid-1990s, the reported incidence of syphilis among adolescents was low in most developed countries (Table 2). Seven countries with high-quality reporting had an annual syphilis rate of less than three cases per 100,000 (Canada, Denmark, England and Wales, Finland, East Germany, Norway and Sweden). West Germany, the Netherlands and Switzerland, where reporting quality is medium or low, also had low rates, but their actual rates would be somewhat higher after allowing for underreporting.

Table 2. Annual reported rates for sexually transmitted infections among adolescents, by gender, and in the total population; ratios of infection rates among adolescents to rates among selected groups; and percentage of all infections that occur among adolescents and young adults; all by type of infection and by country

Infection and country	Rate (per 100,000)				Ratio of rates			Of all reported infections, % that occur in age-group		
	Among 15-19-year-olds			In total population	Females 15-19 to males 15-19	All 15-19-year-olds to total population	All 15-19-year-olds to all 20-	15-19	20-24	15-24
	Total	Female	Male							

							24-year-olds			
Syphilis										
Canada (1996)	0.6	0.9	0.3	0.3	3.00	2.00	0.75	15	20	35
Denmark (1995)*	0.6	1.3	0.0	0.4	†	1.55	0.47	11	26	37
England & Wales (1996)	0.2	0.2	0.2	0.2	1.00	1.00	0.59	5	11	16
Federal Republic of Germany (1995)‡	1.2	1.1	1.2	1.2	0.96	0.99	0.30	5	20	25
Finland	1.8	2.5	1.2	4.2	2.08	0.43	0.44	3	6	9
German Democratic Republic (1995)	2.2	2.6	1.8	2.3	1.43	0.98	0.22	6	25	31
Netherlands (1995)‡	1.0	1.1	0.9	1.3	1.31	0.75	0.34	4	16	20
Norway (1995)	0.0	0.0	0.0	0.1	†	0.00	0.00	0	33	33
Romania (1994)§,**	57.5	u	u	25.9	u	2.22	0.64	17	48	65
Russian Federation (1994)**	211.4	313.4	112.3	85.7	2.79	2.47	0.64	18	51	69
Slovak Republic (1996)	u	u	u	2.8	u	u	u	u	u	30
Sweden (1995)	0.6	1.2	0.0	0.8	†	0.76	0.49	4	10	14
Switzerland (1996)‡	0.5	0.5	0.5	2.5	1.04	0.20	0.27	1	5	6
United States (1996)	6.4	8.6	4.3	4.3	2.00	1.49	0.59	10	17	27
Gonorrhea										
Belgium (1996)‡	0.6	1.0	0.3	1.0	3.09	0.64	0.23	4	18	22
Canada (1996)	59.4	86.4	33.3	16.8	2.59	3.54	0.85	24	27	50
Denmark (1996)	5.0	5.0	5.0	3.4	1.00	1.48	0.31	9	23	32
England & Wales (1996)	76.9	95.7	59.1	22.4	1.62	3.43	0.83	20	30	51
Federal Republic of Germany (1995)‡	8.6	9.3	7.9	5.0	1.18	1.72	0.44	9	24	33
Finland (1996)	3.7	3.8	3.6	4.3	1.04	0.85	0.30	5	17	23
France (1996)††	7.7	8.4	7.0	8.4	1.20	0.92	0.44	10	24	34
German Democratic Republic	15.0	16.1	14.1	8.0	1.14	1.88	0.43	u	u	u

(1995)‡‡										
Netherlands (1995)‡	7.7	7.5	7.8	9.2	0.96	0.84	0.30	5	20	25
Norway (1995)	6.7	9.1	4.4	4.0	2.07	1.68	0.51	10	24	34
Romania (1994)§,**	65.8	u	u	23.1	u	2.85	0.77	22	52	74
Russian Federation (1994)*	596.5	589.1	603.7	204.6	0.98	2.92	0.72	21	54	75
Slovak Republic (1996)	u	u	u	4.2	u	u	u	u	u	67
Sweden (1995)	1.8	2.0	1.5	2.8	1.31	0.63	0.23	4	18	22
Switzerland (1996)‡	1.8	2.1	1.5	3.7	1.40	0.48	0.36	3	8	11
United States (1996)‡	571.8	758.2	394.8	125.1	1.92	4.57	1.09	31	29	60
Chlamydia										
Belgium (1996)‡	12.2	23.7	1.3	7.8	18.8	1.6	0.5	10	21	30
Canada (1996)	563.3	998.6	148.5	114.8	6.7	4.9	0.9	33	37	69
Denmark (1996)	1,081.1	1,875.0	287.0	255.0	6.5	4.2	0.7	25	43	68
England & Wales (1996)‡	232.8	389.0	85.1	75.9	4.6	3.1	0.8	23	34	57
Finland (1996)	650.8	1,122.1	198.7	184.2	5.6	3.5	0.6	22	38	61
France (1996)‡,††	55.1	110.9	1.6	60.2	69.7	0.9	0.4	10	28	38
Norway (1995)	u	u	u	215.4	u	u	u	u	u	u
Russian Federation (1996)	u	u	u	106.1	u	u	u	u	u	u
Sweden (1995)	569.6	921.0	235.2	156.0	3.9	3.7	0.5	21	45	66
Switzerland (1996)‡	37.7	72.2	3.9	39.1	18.6	1.0	0.4	5	17	22
United States (1996)‡	1,131.6	2,067.0	245.8	192.6	8.4	5.9	1.3	31	24	55

*Adolescent rates are calculated using the number of infection cases at ages 19 or younger per 100,000 population aged 15-19. †This ratio could not be calculated because the male rate for this year was zero. ‡Country has medium or low reporting rates (i.e., fewer than 70% of diagnosed cases are estimated to be reported). §Adolescent rates are calculated using the number of infection cases at ages 10-19 per 100,000 population aged 15-19. **Data shown as for ages 20-24 are actually for ages 20-29; data shown as for ages 15-24 are actually for ages 15-29. ††General population rates are calculated using the number of infection cases per 100,000 population at ages 15-59. ‡‡Adolescent rates are calculated using the number of infection cases per 100,000 15-17-year-olds; young adult rates are calculated using the number of cases per 100,000 18-24-year-olds. *Note:* u=data unavailable.

The United States, which has high-quality reporting, had a syphilis rate among adolescent females of about nine per 100,000, substantially higher than in most other developed countries. The Russian Federation, which has experienced an epidemic of

STD infections since the early 1990s, had an extremely high syphilis rate among female adolescents (313 per 100,000). Although sex-specific data are not available for Romania, its overall adolescent rate (58 per 100,000) is substantially higher than that of all other countries examined here except the Russian Federation.

The reported incidence of syphilis is 2-3 times as high among female adolescents as among male adolescents in Canada, Finland, the Russian Federation and the United States. When we compare incidence among adolescents to rates in the general population, five countries have adolescent rates higher than rates in the general population (Canada, Denmark, Romania, the Russian Federation and the United States). Adolescents tend to have a lower syphilis rate than young adults (those aged 20-24). The ratio of these rates shows that in many countries, the adolescent rate is less than half that of young adults (Table 2).

In eight countries , fewer than 10% of all reported syphilis cases are to adolescents (Table 2). In five countries, this proportion ranges between 10% (in the United States) and 18% (in the Russian Federation). The proportion of total cases to young adults is much higher: In five countries, this proportion is 25% or more, and in six it ranges between 10% and 24%.

•*Trend in syphilis, 1985-1996.* Between the mid-1980s and the mid-1990s, syphilis rates generally decreased, both for the total population and for adolescents (Table 3). This was not the case in the Russian Federation, however, where an epidemic started shortly after 1990. For the period 1985-1990, the incidence of syphilis in the total population increased only in East Germany, Romania and the United States. During the period 1990-1996, just Finland, the Russian Federation and the Slovak Republic experienced relatively large increases. (Rates in Finland and the Slovak Republic are low compared with rates in the Russian Federation, however.)

Table 3. Average annual rate of change in STD incidence in the total population and among female and male adolescents aged 15-19, by country and STD, according to time period

Infection and country	1985-1990			1990-1996		
	Overall population	Females 15-19	Males 15-19	Overall population	Females 15-19	Males 15-19
Syphilis						
Canada	-13.7	-6.7	-16.5	-12.1	-20.4	-8.3
Denmark*	-15.7	u	u	-11.1	3.2	-33.3
England & Wales†	-14.7	u	u	-10.9	-8.5	-4.9
Federal Republic of Germany‡	-15.8	-14.4	-15.6	-0.5	9.4	11.1
Finland	-12.7	u	u	137.7	71.2	23.4
German Democratic Republic	37.5	22.6	-25.0	-5.7	-12.5	-3.6
Netherlands‡	-2.5	u	u	-10.5	u	u
Norway	-12.2	u	u	-14.4	u	u
Romania	46.3	u	u	2.9	u	u
Russian Federation	-8.8	-0.1	-1.4	374.5	502.6	523.4
Slovak Republic	u	u	u	61.1	u	u
Sweden	-1.4	-17.1	14.3	-10.8	-16.7	-12.9
Switzerland‡	-5.1	-32.4	-50.0	-9.5	-16.0	-10.0

United States	15.0	24.3	5.8	-13.1	-13.0	-13.3
Gonorrhea						
Belgium‡	-17.3	u	u	-12.5	-14.4	-17.7
Canada	-13.7	-11.7	-11.4	-11.0	-10.4	-11.8
Denmark	-16.0	-16.5	-17.0	-15.2	-16.1	-15.5
England & Wales†	-14.3	u	u	-2.4	-3.0	-3.3
Federal Republic of Germany‡	-16.6	-16.7	-14.9	-9.8	-7.6	-11.2
Finland	-13.5	-12.4	-15.9	-15.1	-16.2	-15.3
France§	u	u	u	-13.5	-10.9	-15.0
German Democratic Republic**	-13.6	-12.9	-12.7	-13.6	-14.0	-13.4
Netherlands‡	-14.3	u	u	-11.4	u	u
Norway	-17.0	u	u	-12.9	u	u
Romania	-9.5	u	u	-7.8	u	u
Russian Federation	-2.6	9.8	17.7	15.0	5.4	19.0
Slovak Republic††	u	u	u	-14.8	-15.5	-14.5
Sweden	-17.0	-18.4	-18.4	-12.6	-14.4	-14.3
Switzerland‡	-1.4	-11.3	-4.7	-6.7	-10.3	-7.9
United States‡	-6.4	-3.9	0.5	-8.7	-5.9	-9.8
Chlamydia						
Belgium‡	u	u	u	-8.9	-8.8	-15.4
Canada	u	u	u	-6.6	-7.1	-7.4
Denmark	u	u	u	-2.2	4.0	6.5
England & Wales†	u	u	u	0.6	5.6	0.4
Finland	u	u	u	-3.6	0.6	-0.6
Norway	u	u	u	-1.6	u	u
Russian Federation	u	u	u	62.0	u	u
Sweden	u	u	u	-7.0	-5.3	-3.1
Switzerland‡	u	u	u	-4.8	2.6	-10.5
United States‡	u	u	u	3.6	u	u

*Adolescent rates are calculated using the number of infection cases at ages 19 or younger per 100,000 population 15-19. †Adolescent rates are for 16-19-year-olds. ‡Country has medium or low reporting rates (i.e., fewer than 70% of diagnosed cases are estimated to be reported). §For 1990, adolescent rates are calculated using the number of gonorrhea cases aged 16-20 per 100,000 population aged 15-19; for 1996, adolescent rates are calculated using the number of gonorrhea cases aged 20 or younger per 100,000 population aged 15-19. For both years, general population rates are calculated using the number of gonorrhea cases per 100,000 population aged 15-59. **Adolescent rates are calculated using the number of gonorrhea cases per 100,000 population aged 15-17. ††Adolescent rates are calculated using the number of gonorrhea cases per 100,000 population aged 15-24. *Notes:* u=data unavailable.The time periods for all countries are the same as shown except in the following instances: For syphilis in 1985-1990, exceptions are Finland and the German Democratic Republic (each 1985-1989) and Switzerland (1988-1990). For syphilis in 1990-1996, exceptions are Denmark (1992-1995), Finland (1992-1996), the German Democratic Republic (1989-1996), Romania (1990-1994), the Russian Federation (1990-1994) and Switzerland (1991-1996). For gonorrhea in 1985-1990, exceptions are Belgium (1986-1990), East Germany (1985-1989) and Switzerland (1988-1990). For gonorrhea in1990-1996, exceptions are Belgium (1991-1996), the German Democratic Repulic (1989-1996) and Romania and the Russian Federation (each 1990-1994). For chlamydia in 1991-1996, exceptions are Denmark (1994-1996) and the Russian Federation (1993-1996).

In the period 1985-1990, syphilis rates among adolescents declined everywhere but in the United States (among both males and females), Sweden (among males only) and East Germany (among females only). During 1990-1996, the syphilis rate rose dramatically in the Russian Federation among both female and male adolescents.

While increases also occurred in Denmark (among females only) and in Finland and West Germany (among both males and females), the rates in these countries were much lower than in the Russian Federation, and the absolute size of the increases was small. A comparison of rates of change among adolescents and in the total population during the period 1990-1996 showed noticeable differences in three countries: In the Russian Federation, syphilis rates rose more rapidly among adolescents (among both males and females) than in the total population; in West Germany, rates increased among adolescents but changed little in the total population; and in Finland, adolescents' rates rose less steeply than those of the total population.

Incidence of Gonorrhea

•*Recent level.* In the majority of countries, the reported incidence of gonorrhea among adolescents is relatively low—less than 10 per 100,000 in nine countries and 10-20 per 100,000 in one (Table 2). (Completeness of reporting is low in some of these countries, so the true incidence of gonorrhea is somewhat higher than reported rates.) In Canada, England and Wales, Romania, the Russian Federation and the United States, however, the reported incidence of gonorrhea is distinctly higher, with the Russian Federation and the United States approaching 600 per 100,000.

In all but two of the lower incidence countries (Norway and Belgium), female adolescent gonorrhea rates are equal to or slightly higher than those of adolescent males (the ratio of the two rates varies between 1.0 and 1.4). By comparison, rates among female adolescents are much higher than those among male adolescents in the higher incidence countries (except in the Russian Federation). A second important difference between the two groups is that in the lower incidence countries, rates for adolescents are much lower than those for young adults (23-51% of young adult rates), while in the higher incidence countries, rates are more similar.

In the lower incidence countries, gonorrhea rates among adolescents tend to be lower than those in the total population; this infection is more concentrated among adolescents in the second group of countries (Canada, England and Wales, Romania, the Russian Federation and the United States). The situations in the Russian Federation and the United States are by far the most extreme. In the Russian Federation, male and female adolescents have a rate three times as great as the general incidence; in the United States, annual gonorrhea rates among female and male adolescents are 3-6 times as great as in the total population (125 per 100,000). However, since reporting on gonorrhea is estimated to be only about 50% complete in the United States, actual rates of diagnosed cases would be about twice as high. By comparison, even the countries with the next most serious problem—Canada, England and Wales, and Romania—have much lower incidence rates among adolescents and in the total population.

The proportion of all reported gonorrhea cases occurring to adolescents is 20% or more in Canada, England and Wales, Romania, the Russian Federation and the United States. In all other countries examined here, no more than 10% of cases occur among adolescents. Typically, fewer than one-third of all reported cases occur among young adults aged 15-24, but this proportion is 50% or more in six countries—the five countries listed above, as well as the Slovak Republic.

•*Trend in gonorrhea, 1985-1996.* The trend in the incidence of gonorrhea from 1985-1996 is similar to that of syphilis, with a steady decrease in almost all countries examined here (Table 3). Incidence declined in the total population in all countries during the period 1985-1990, and in all but the Russian Federation from 1990-1996. The declines were of similar magnitude among male and female adolescents, in most countries and for both periods. The Russian Federation is the important exception, with an average annual increase of 15% in the incidence among the total population in the 1990s. Gonorrhea increased sharply among adolescents (more so for males than for females) in the Russian Federation throughout the period 1985-1996.

Declines in the total gonorrhea rate were large in most countries. Annual rates of decline of 13% or more were found during the period 1985-1990, and slightly lower rates of decline (typically about 10% or more) in 1990-1996. The Russian Federation, Switzerland and the United States had lower rates of decline during 1985-1990; from 1990-1996, England and Wales had a much smaller decrease than other countries.

Incidence of Chlamydia

•*Recent level.* In the six countries with high reporting rates,[#] chlamydia incidence among adolescents ranges from 563 cases per 100,000 in Canada to 1,132 per 100,000 in the United States (Table 2). The countries with low or medium reporting rates show much lower incidence (rates between 12 and 233 per 100,000), but their true levels are probably higher.

In countries with age-specific and sex-specific information and high-quality reporting, the incidence of chlamydia is 4-6 times higher among female adolescents than among male adolescents. In the five countries with low or medium reporting, females have an even higher apparent incidence than males, although these differences may largely be the result of sex-specific differences in the likelihood of being screened, tested and reported.

Reported chlamydia incidence is 1.6-6.0 times higher among adolescents than in the total population, except in two countries with low reporting rates (France and Switzerland). Adolescents have lower reported chlamydia rates than do young adults in all countries except the United States, where they have a somewhat higher rate. In Canada and Denmark (countries with high reporting rates), rates for adolescents are closer to those of young adults.

In countries with high reporting rates, the proportion of total cases of chlamydia occurring to adolescents varies between 21% (Sweden) and 33% (Canada). For young adults, this proportion ranges from 37% (Canada) to 45% (Sweden). When adolescents and young adults are taken together, the percentage exceeds 60%.

•*Trend in chlamydia, 1991-1996.* In seven of the 10 countries with trend information, the reported chlamydia rate in the total population declined, from an annual rate of decline of less than 2% in Norway to 9% in Belgium. The U.S. rate increased by nearly 4% per year, which may reflect increasingly active screening programs. The Russian Federation experienced an annual increase of 62%, which may be partly due to better reporting but more likely reflects its current STD epidemic. Among the countries with high-quality reporting, the largest decreases are found in Canada and Sweden.

Considering the five countries with data and with medium- or high-quality information, the trend is somewhat different among female adolescents. Declines are found in Canada and Sweden, while increases were recorded in Denmark, England and Wales, and Finland. Male adolescents were more likely than females to have experienced a decline, with only Denmark showing a substantial increase. No clear conclusions can be drawn, however, given the small number of countries with incidence data on chlamydia. It remains possible that changes in screening policies and inadequacies of reported statistics may have influenced the trends observed in some of these countries.

Reported chlamydia incidence increased more steeply—or declined more slowly—among adolescents than in the general population, except in Canada. In Denmark, chlamydia decreased in the total population but increased among adolescents. In Sweden, the rate of decline was faster in the general population than among adolescents. In England and Wales, the increase among female adolescents was larger than that among male adolescents or in the general population.

•*Prevalence of chlamydia.* Prevalence (the percentage of a population that has a particular infection at the time they are surveyed, as ascertained by testing) is an important complement to incidence, especially for countries with low-quality incidence data for chlamydia. However, prevalence studies are difficult to compare, either across countries or over time, because study designs and population samples vary greatly.

Studies of the prevalence of chlamydia were identified in 11 of the 16 selected countries: Recent prevalence studies based on cross-sectional samples of women show high levels in a range of countries:The proportion testing positive for chlamydia varied between 1% in France,[17] 3% in Switzerland,[18] 3-4% in Germany[19] and 5% in the Netherlands.[20] The median prevalence seen in general practice in England and Wales was said to be nearly 5% among women,[21] while studies in the United States indicate a prevalence of 5% or more among sexually active women.[22] Data from national laboratory reports show rates for the total population of about 5% in Denmark (1996) and Sweden (1997).[23] The few studies focused on men alone also showed a similar prevalence among cross-sectional populations (4% in Germany,[24] 5% in the United States[25] and 6% in the United Kingdom.[26])

Some countries have experienced declines in prevalence among the general population during the 1990s, with laboratory data showing decreases from 6% to 5% in Denmark between 1992 and 1996 and from 8% to 5% in Sweden between 1988 and 1996.[27]

Prevalence rates among adolescents tend to be higher than those among adults. Prevalence was much lower in cross-sectional samples of female adolescents in Belgium (2% in 1996-1997),[28] among women younger than 21 in France (5% in 1993) [29] and among those attending a Swedish youth clinic (5% in 1993)[30] than in the United States (10% of sexually active adolescent women[31]).

DISCUSSION

Overall, syphilis, gonorrhea and chlamydia disproportionately affect adolescents and young adults. The situation varies depending on the STD and the country, but in all but a few countries, these age-groups account for more than one-fifth (and often more than

one-third) of reported cases for all three diseases. In Romania and the Russian Federation, more than half of all reported annual cases of syphilis are to young people; in the case of gonorrhea, one-half or more of all cases occur among youth in all three eastern European countries for which we have data (Romania, the Russian Federation and the Slovak Republic), as well as in Canada, England and Wales and the United States.[§§] In six of the nine countries with data, more than half of annual reported chlamydia cases are to 15-24-year-olds.

The measures used in this article are rates calculated based on all people of a given age or sex, or the total population, and the proportion of STD cases that occur to those in a particular age-group. These commonly used measures facilitate comparison across groups and countries.

However, other characteristics of groups vary, and may contribute to explaining their differences in STD incidence. Age and sex differences in STD rates may reflect different risk behaviors, but they also reflect the proportions of the group who are engaged in behaviors that put them at risk of STDs. For example, sexual activity is the most basic STD risk factor, and the proportion sexually active is lower among adolescents than among young adults; additionally, the STD rate for the total population includes in its denominator people of all ages, including children; and finally, rates for each age category include in their denominators both those who are sexually active and those who are not sexually active. The proportion married may also affect STD risk: Where this proportion is higher, the likelihood of having multiple sexual partners is lower and STD risk is lower. Young adults are more likely than adolescents to be married, lessening their STD risk relative to that of adolescents.

Overall, trends in syphilis and gonorrhea incidence are similar, and declines have occurred in most developed countries—with the striking exception of the Russian Federation. However, the incidence of gonorrhea is many times higher than that of syphilis in almost all countries studied here. This difference was most pronounced during the 1980s, but remained substantial in the mid-1990s.

Even with declines, the incidence of gonorrhea continues to be especially high among adolescents in some countries. The United States and the Russian Federation have the highest adolescent rates, with a large proportion of all reported cases occurring among adolescents. Incidence rates often are even higher among young adults than among teenagers—probably reflecting the fact that young adults are more likely than adolescents to be sexually active.

The Russian Federation stands out as having exceptionally high incidence of both syphilis and gonorrhea among adolescents. There is no definitive understanding of the reasons behind the epidemic of syphilis in the 1990s and the slower but steady increase of gonorrhea among adolescents. However, several contributing factors have been put forward: economic and social disruptions, more liberal attitudes toward sexuality, and increased opportunities for travel and migration. Also, the replacement of the traditional state-funded health care system with a regional system funded largely by employment-based taxes (and to a lesser extent by local and federal funds), as well as the general economic crisis, have resulted in uneven delivery, accessibility and use of health services.[32] The resources available in Russia for STD control declined from 1990 to 1995, perhaps by as much as 50%.[33]

Although U.S. gonorrhea and syphilis rates have decreased overall since the 1970s, the incidence of these two STDs is still significantly higher in the United States than in western Europe. Among adolescents, gonorrhea levels are particularly high, and incidence among blacks and Hispanics is higher still. For example, in 1997, the reported gonorrhea rate among black adolescents (2,828 per 100,000) was 24 times the rate among non-Hispanic white teenagers (119 per 100,000), and 12 times the rate among Hispanic teenagers (231 per 100,000). Syphilis rates, although much lower overall, also differed greatly across racial groups: In 1997, the rate among black adolescents (23 per 100,000) was much greater than rates among non-Hispanic white teenagers (fewer than one per 100,000) or among Hispanic teenagers (two per 100,000).[34]

Underreporting of STDs is probably more common among whites in the United States because they are more likely to obtain care from a private doctor, and therefore their cases are less likely to be reported and counted in official statistics. Racial and ethnic differentials cannot be explained entirely by higher underreporting, however. In the United States, race and ethnicity correlate with other, more fundamental determinants of health status: High proportions of minority youth and of economically disadvantaged adolescents have difficulty accessing good quality medical care.[35] Gonorrhea incidence among white adolescents remains higher than rates seen in most European countries, and the incidence rate for syphilis is similar to those for most European countries. Less widespread and less intensive prevention policies probably contribute also to the higher overall incidence of STDs among U.S adolescents than among other European youth.

The incidence of chlamydia, the most prevalent of the STDs, is especially high among young women; this is at least partly due to the higher likelihood that young women will be screened and diagnosed. Several countries also have a high incidence of chlamydia in the total population, with annual rates of more than 100 per 100,000; in the few places where it is lower than this level, reporting is at a low or medium level of completeness.

Chlamydia appears to be increasing in some countries, but this may be tied mostly to more active screening programs. While their current adolescent chlamydia rates are still high, Canada and Sweden stand out as having experienced decreases in the early 1990s. One hypothesis that has been put forward to explain these declines[36] is that these countries started active screening programs earlier than others, and that such policies may have increased treatment of this STD. In other countries, a rising chlamydia rate may in part reflect an increase in screening and testing programs, but part of the increase may be real.

For the three STDs studied here, incidence among adolescents is generally higher for females than for males. This differential is somewhat unexpected, at least for gonorrhea, because males experience more evident symptoms and as a result are more likely to seek care, be diagnosed and be reported.[37] The gender difference can be explained largely by existing patterns of reproductive health service use: Males generally have less frequent contact with physicians for reproductive health care. Moreover, in the case of chlamydia, screening strategies are aimed primarily at women, so males have less of a chance to be screened or tested. Reported chlamydia

rates among females are likely to be a better indicator of the true population incidence.

Adolescent females may also be at somewhat higher risk of STDs than adolescent males because they are typically in relationships with partners two or more years older than themselves,[38] and older partners are more likely to be infected than partners who are their own age. In addition, the age and power differences may lessen young women's ability to initiate or insist on condom use. In fact, surveys show that female adolescents are less likely than males of the same age to report condom use.[39]

Differences in sexual behavior alone probably cannot explain the large observed cross-national variations in STD incidence. There is relatively little variation among developed countries in the proportion of adolescents and young adults who are sexually active or in age at first intercourse.[40] And while studies on adolescents' knowledge about STDs and contraception, their condom use and their number of partners show cross-country variations, these are difficult to interpret in relation to STD incidence without a careful contextual analysis of each study.[41]

In most of the countries examined in this article, levels of syphilis and gonorrhea have fallen to relatively low levels. Some fundamental changes have probably contributed to bringing syphilis and gonorrhea rates down in recent years and to keeping them at low levels: more widespread and better quality sexuality education, improved access to contraceptive and STD services, and a reduction in risk behavior because of HIV and AIDS, including increased condom use. Improved treatment of STDs has probably helped shorten the duration of infections, while better education and improved preventive behavior may have reduced the likelihood of transmission.

Nevertheless, even in countries with decreases, continued attention must be paid to groups that are at especially high risk of contracting and transmitting these diseases, even if these groups are relatively small in size: core groups that live in conditions of poverty and that have poor access to health care. Special attention should be given to drug users, who are at particularly high risk of contracting and transmitting STDs.

However, unlike gonorrhea and syph-ilis, chlamydia is rather widely distributed among the sexually active.[42] Given that this infection is often asymptomatic, screening is seen as the best way to reduce the incidence of this infection. Because transmission by asymptomatic people who are considered to be at low risk for STDs maintains the spread of chlamydia,[43] expansion of screening beyond high-risk groups may improve prevention of chlamydia and its serious consequences.*†[44] Large-scale screening and treatment programs for women have led to significant declines in chlamydia prevalence in Sweden and in the United States.[45] However, men also need to be screened, as they are an important source of transmission.[46]

In many countries, official statistics suffer from high levels of underreporting. Many have not adapted their reporting systems to collect data on the "new" STDs (chlamydia, genital herpes and human papillomavirus). Thus, paradoxically, information is particularly deficient on the STDs that are most common today.

As a result, the data presented in this article must be considered minimum estimates of the true incidence of these STDs, both because diagnosed cases are underreported and because not all cases are

diagnosed. Underreporting among teenagers may be even higher than in the general population: For a variety of reasons (such as inexperience, cost and lack of confidential services), adolescents have greater difficulty accessing STD services. The quality of epidemiologic data on STDs will not be improved without increased acknowledgment, at the national level, of the burden of STDs and of their public health cost.

Despite the many weaknesses of the official statistics presented here, they point to some broad priorities, such as increased efforts in the area of prevention, especially for young people and for the socially and economically disadvantaged. Well-designed education programs and behavioral interventions before initiation of sexual relationships can prevent risky behavior among adolescents and can reduce such behavior among youth who are already sexually active.[47]

Other policy approaches have also been shown to affect STD incidence. In addition to active screening strategies, partner notification or partner referral practices can be an effective tool.[48] Also beneficial is a more comprehensive approach to service provision, one that includes health education as well as direct STD services, and integration of such services into the provision of other types of health care (for example, family planning, maternal and child health care), especially for populations with reduced access to medical care.[49] STD facilities adapted to the specific needs of youth have also proven to be an important step in improving the sexual health of adolescents.[50] Steps toward raising awareness among the general population, policymakers and health care providers are also a priority.

To improve the design of programs and services, stronger efforts are needed to understand the factors that determine risky behaviors and their variation across populations. Declines in STDs in some countries, in particular the Nordic countries, offer hope that it is possible to reduce the burden of STDs through a combination of information and education programs, partner notification and active screening strategies, better access to STD health care, and programs promoting behavioral change.

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*Two viral and incurable STDs, genital herpes and human papillomavirus, are not covered here because the official statistical data are very limited: Most available information is based on surveys and small-scale studies. Hepatitis B was not included because most available data do not identify cases that are transmitted by sexual intercourse, as opposed to other modes of transmission.

†The data presented here are those that were accessible to the authors from these three types of sources. It is possible that additional data exist but were unavailable to the authors, or that data exist but were not compiled or organized, and therefore were not available for analysis. This situation may arise, for example, where data are collected in a decentralized system, or because of changes in data collection approaches or system administration.

‡Italy was considered for inclusion. However, data were available only from an experimental, nonrepresentative sentinel system of STD clinics, and were in aggregated form, were only for the period 1991-1996 and had no age detail.

§In most countries, statistics on syphilis include all categories of infectious syphilis—i.e. primary, secondary and early latent syphilis. In the United States, early latent cases are defined to be up to one year after infection, while in Europe the early latent category includes cases up to two years after infection. Two of the selected countries (Germany and the Netherlands) do not include early latent syphilis. Some countries include congenital syphilis, but as this condition is very rare in developed countries, it does not influence greatly the overall statistics. The Slovak Republic includes late latent as well as early latent cases; late latent cases represent 7% of all cases there.

**In Belgium, the sentinel network includes 40% of all laboratories in the country. (Source: Ducoffre G, *Surveillance des maladies infectieuses par un réseau de laboratoires de microbiologie: tendances épidémiologiques, 1983-1995,* Brussels: Scientific Institute of Public Health—Louis Pasteur, 1997). In France, nearly 5% of laboratories that test for gonorrhea and about 3% of those that test for chlamydia participate in the sentinel network. (Sources: Bouillant C et al., Les chlamydioses génitales en France en 1996, réseau RENACHLA, *Bulletin Epidémiologique Hebdomadaire,* numéro spécial, février 1998; and Goulet V et al., Les gonococcies en France, réseau RENAGO, *Bulletin Epidémiologique Hebdomadaire,* numéro spécial, février 1998.)

†† No official statistics on syphilis are available for Belgium and France. Theoretically, physicians and all medical facilities must report STD cases, but reporting is very low and data from these sources are not used for STD statistics. Sentinel systems have been set up for gonorrhea and chlamydia (but not for syphilis), and these are the source for official statistics in these two countries.

‡‡ Although data on chlamydia are available for 11 countries, they are considered less than 70% complete in five of these (Belgium, England and Wales, France, Switzerland and the United States). Special difficulties affecting chlamydia reporting arise from "silent" cases—i.e., when there are no detectable symptoms in a high proportion of cases, possibly up to 70% among women (see: Simms I et al., 1997, reference 26; Schachter J et al., Screening for chlamydial infection in women attending family planning clinics, *Western Journal of Medicine,* 1983, 138(3):375-379; and Stamm WE et al., *Chlamydia trachomatis* urethral infections in men: prevalence, risk factors, and clinical manifestations, *Annals of Internal Medicine,* 1984, 100(1):47-51). As a result, reported

statistics on chlamydia are very sensitive to how aggressive countries are in screening and testing. Denmark, Finland, Norway and Sweden instituted policies for active chlamydia screening starting in the early 1990s, and reporting is at a high level of completeness in each. Denmark, Finland and Sweden have more comprehensive reporting systems and have data for adolescents as well as for other age-groups, and probably give a good picture of the situation in Europe. However, even in these countries, reported prevalence levels must be considered as minimum estimates.

§§In the case of Romania and the Russian Federation, these proportions are for a broader age-group (ages 15-29), while in all other countries these proportions are for those aged 15-24.

* †Chlamydia can have in serious consequences; in Canada, up to 65% of all cases of pelvic inflammatory disease, 70% of all cases of tubal infertility and 30% of all ectopic pregnancies are attributed to prior chlamydia infection. (Source: Patrick DM, 1997, see reference 36.)