CHAPTER 1

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1.1 HIV pandemic

By the end of 2008, an estimated 33.4 million people were living with HIV/AIDS worldwide, with 2.7 million people newly infected that year. Almost 30 years into the HIV epidemic, most infections still occur in Sub Sahara Africa, the region that is hardest hit by HIV/AIDS with 1.9 million adults and children newly infected with HIV in 2008 and 1.4 million AIDS deaths in the same year.

Although on another scale, HIV infections also remain of major public health importance in high income countries, with evidence of increasing transmission in several European countries. According to UNAIDS, an estimated 2.3 million people were living with HIV/AIDS in Western & Central Europe and North America by the end of 2008. National epidemics remain concentrated among high-risk populations, with men who have sex with men (MSM) accounting for the majority of HIV infections in most Western European countries. In Eastern Europe, injecting drug use is the predominant mode of HIV transmission.

In the Netherlands, there were an estimated 18,500 people living with HIV/AIDS (PLWHA) in 2005, 15-49 years old, representing 0.2% of the adult population in the Netherlands. The HIV epidemic in the Netherlands remains concentrated in particular among MSM, but also among heterosexuals originating from HIV endemic countries.
1.2 STIs worldwide

More than 340 million cases of sexually transmitted bacterial and protozoal infections occur throughout the world every year, with the largest proportion in the region of south and south-east Asia, followed by sub-Saharan Africa, Latin America and the Caribbean. Millions of viral STIs also occur annually, attributable mainly to HIV, human herpesviruses, human papillomaviruses and hepatitis B virus. Worldwide, up to 4000 newborn babies become blind every year because of eye infections due to untreated maternal gonococcal and chlamydial infections. Globally, all these infections constitute a huge health and economic burden, especially for low-income countries where they account for 17% of economic losses caused by ill-health.

In Europe, chlamydia remains the most frequently reported STI mainly affecting young persons between 15 and 24 years of age. Women are more often diagnosed with chlamydia than men, whereas gonorrhoea is more commonly reported in men. The proportion of gonorrhoea cases among MSM in Europe has increased over the last few years. Over the past ten years a number of European countries have experienced a rise in the rate of syphilis cases. Initially occurring predominantly among MSM, outbreaks have since been reported among various other populations including commercial sex workers, migrant communities and among heterosexual adults. In the Netherlands, in addition to HIV also other STIs are concentrated in high-risk groups such as ethnic minority populations, young adults, and MSM.

1.3 Prevention, testing and treatment

Primary prevention methods are used to promote safer sex, preventing new STI, including HIV infections. Secondary prevention is aimed at early detection of HIV and STI infections followed by treatment. Tertiary prevention is closely related to treatment and care; it is meant to prevent avoidable suffering from HIV/AIDS for people who are HIV infected and to treat people diagnosed with STI. After the introduction of highly active antiretroviral therapy (HAART) in 1996, the focus has shifted from primary HIV prevention to improved access to HIV/STI testing and counselling.

The Netherlands officially shifted from a restrictive HIV testing policy to an active testing policy rather late in 2001. In 2004 the opting-out strategy for HIV testing was put into practice among pregnant women nationwide. Recently two STI clinics reported on successful implementation of an opting-out policy for HIV-testing and this policy will be rolled out in all STI clinics nationwide in 2010.

Although this active testing policy is successful, the percentage of people knowing their positive HIV status is still relatively low (60%) [see Chapter 2] and a considerable proportion of infected people are diagnosed late. At an individual level, the consequence of late diagnosis could result in treatment being less effective with a worse outcome. Moreover, at a population level, late diagnosis indicates a longer period of contagiousness. The majority of new HIV infections are thought to arise from this population undiagnosed. Some studies show that many people reduce their sexual risk behaviour after diagnosis of HIV infection. At the same time, other studies show increases in risk behaviour, especially among MSM, due to “treatment optimism”, which refers to a reduced fear of HIV and AIDS since the introduction of HAART.
In addition to HIV treatment, also rapid and appropriate treatment of other STI is of great importance for public health, because it shortens the infectious period and limits the transmission of the disease. STI testing and treatment is provided by first line care in the Netherlands; general practitioners and STI clinics. In total, 29 STI centres provide STI testing and care, free of charge, targeted at high-risk populations. In addition, an internet-based screening program for youth from 16 to 29 years was introduced in the Netherlands in 2008. This screening aims at early detection and treatment of asymptomatic chlamydia infections and is currently being evaluated.

1.4 High-risk populations

Ethnic minority populations

Ethnic minority populations from HIV endemic countries, also referred to as migrants in this thesis, form a risk group for acquiring HIV. In the Netherlands these ethnic minority populations mainly originate from Caribbean (Surinam, Netherlands Antilles) and African (Ghana, Cape Verde) countries. They account for approximately 30% of non-Western immigrants and 4% of the total population.

In 1997, the HIV prevalence was 0.8% among migrants from the Netherlands Antilles, 0.3% among Afro-Surinamese and 1.8% among Ghanaian migrants living in Amsterdam. In 2005, an overall prevalence of 0.2% for the general population was estimated. In addition, national HIV and STI surveillance data showed that these ethnic groups account for a disproportionate burden of STI and HIV found in STI clinic attendees. An STI was diagnosed in 21% of Surinamese and Antillean clinic attendees in 2006 compared to 12% of Dutch attendees. Of heterosexually acquired HIV infections diagnosed in the Netherlands, 40% occurred in sub-Saharan African clinic attendees. It is of public health concern that HIV infections among ethnic minority populations are often diagnosed late.

The importance of migration in the spread of HIV and STI has been discussed widely and it is considered as one of many social factors that have contributed to the AIDS epidemic. People who have recently changed residence are likely to be at higher risk for HIV, in particular migrant men.

Studies in various countries have reported ethnic variations in sexual behaviour that may contribute to the observed differences in HIV and STI prevalence. Concurrent partnerships, sexual partnerships that overlap in time, may differ between ethnicities. Such concurrent partnerships increase the opportunity for infections to spread rapidly in a network of sexual partners and based on mathematical modelling this phenomenon has been recognized as an important determinant of the spread of HIV and other STIs. We studied therefore, the occurrence of concurrent partnerships and its association with sexual risk behaviour among ethnic minority populations in the Netherlands [Chapter 3].

In addition, migrant populations may practice unsafe sex in their country of residence, but also in their country of origin, while visiting their family and friends. In Chapter 3 the sexual behaviour of migrants while travelling to their home country is explored. To gain insight into the potential for HIV/STI transmission within and among different migrant populations, we studied sexual mixing behaviour, condom use and other risk-related characteristics of Surinamese, Antillean and sub-Saharan African migrants living in the Netherlands.
In addition, we have used mathematical modelling to understand the contribution of migrants originating from HIV endemic countries to the spread of HIV in a lower endemic country, such as the Netherlands [Chapter 3].

**Commercial sex workers**

Commercial sex workers (CSW) are worldwide considered as an important risk group for heterosexual spread of HIV. Talbott (2007) argued that the number of HIV infected sex workers in a country is highly significant for explaining the HIV prevalence across countries.\(^3\)\(^5\) The HIV prevalence among female sex workers in sub-Saharan Africa varies between 21% and 75%\(^6\) and sex work is assumed to have had a significant impact on the spread of HIV in this area.\(^3\)\(^5\) In Western Europe, the prevalence of HIV in female sex workers is generally below 2%, except for those who are injecting drugs.\(^7\)\(^8\) Higher rates were found in transgender CSW, ranging from 14 to 74%.\(^9\)\(^10\)

An estimated 24,000-31,000 CSW are working in the Netherlands.\(^11\) The proportion of migrants among CSW was estimated in 1999 to be at least 68%.\(^12\) Unsafe sexual behaviour among CSW may lead to further spread of HIV to the general population, since CSW and their clients may act as a bridging population.\(^12\)\(^13\) We assessed the prevalence and determinants of HIV and sexual risk behaviour among various groups of CSW in large cities in the Netherlands [Chapter 4].

**STI clinic attendees**

STI clinics in the Netherlands provide STI testing and treatment targeted at several high-risk populations, such as young people, MSM, CSW and ethnic minority populations. About 30% of all STI related episodes in the Netherlands are seen in these STI clinics.\(^14\)

In 2008, 88,435 consultations were registered in the national registry of STI clinics, of which 40% were in young people, 16% in MSM, 9% in CSW, and 19% in ethnic minority populations. Chlamydia is the most commonly diagnosed STI with 9,403 diagnoses in 2008.\(^15\) Since STI transmission is uniquely linked to human behaviour, its control depends on the identification of important risk groups and their risk behaviours associated with STI transmission. Anyone diagnosed with an STI has been at increased risk for any other STI as well, and simultaneous infection with more than one STI is common.\(^15\)\(^16\)\(^17\)

We hypothesized that populations coinfected with STI may have a high transmission potential and therefore we studied populations coinfected with bacterial STI [Chapter 5].

Monitoring the resistance of certain bacterial STI to antibiotic treatment, such as gonorrhoea, is significant to limit the burden of gonorrhoea and to anticipate on novel future treatment options that may be needed to treat it effectively.\(^18\) The “Gonococcal Resistance to Antimicrobials Surveillance project” (GRAS) is implemented within the present national registry of STI clinics.\(^19\) In Chapter 5 we discuss the susceptibility of gonococci to ciprofloxacin, prior first line therapy for gonorrhoea, and 3\(^\text{rd}\) generation cephalosporins, the current first-choice of therapy.
1.5 Study populations used for this thesis

This thesis used several settings to study the epidemiology of HIV and STI among high-risk populations: community-based anonymous unlinked HIV surveys among ethnic minority populations and among commercial sex workers, the national registry of consultations of all STI clinic attendees and the GRAS project. Furthermore, data of various national and regional studies and settings were used for mathematical modelling and the HIV estimation tools.

From 2002 through 2005, cross-sectional community-based anonymous unlinked HIV surveys were carried out among migrants from HIV endemic countries living in the three largest cities in the Netherlands, namely Rotterdam (2002-2003), Amsterdam (2003-2004) and The Hague (2005). These surveys were conducted in collaboration with the municipal health services (GGD’en). Participants were included if they or one of their parents were born in Surinam, the Netherlands Antilles, Aruba, Ghana or Cape Verde; if they were aged between 18 and 55 years; and if they currently lived in the Netherlands. Participants were interviewed using a structured questionnaire covering demographics, sexual behaviour, travelling behaviour, drug use, testing and treatment history for STI and HIV. A saliva sample was collected for HIV antibody testing.

Among commercial sex workers, anonymous unlinked HIV surveys were conducted between 2003-2005 in Rotterdam, Amsterdam and The Hague. Venue based sampling was used to approach commercial sex workers in different settings. In line with the HIV survey among ethnic minority populations, also CSW were administered a questionnaire and a saliva sample was collected for HIV antibody testing.

The national registry of STI clinics covers all STI consultations carried out in the Netherlands. All new STI consultations and corresponding diagnoses are rendered anonymous and reported to the Centre for Infectious Disease Control (Cib-RIVM) for surveillance purposes. The reporting of STI consultations is facilitated by a web based application (SOAP) that is nationwide since 2004. At each consultation, information on demographics, sexual and drug related behaviour, diagnostics and clinical outcome is recorded by the clinician or nurse in the online RIVM registration database. All clinic attendees are offered testing for chlamydia, gonorrhoea, syphilis, and HIV. Testing for other STIs, such as HBV, trichomonas, HSV, and genital warts is performed on clinical indication.

The GRAS project is implemented within the present national registry of STI clinics in 2006, covering systematically collected data on gonorrhoea and antimicrobial susceptibility patterns linked with epidemiological data from STI clinic attendees.

1.6 Outline of this thesis

This thesis describes the epidemiology of STI, including HIV, among ethnic minority populations, among commercial sex workers and among STI clinic attendees. Additionally, mathematical modelling is used to assess the HIV prevalence in the Netherlands and to study the transmission dynamics of HIV among migrant populations.
Gonococcal resistance to antibiotics among STI clinic attendees is explored. The research presented in this thesis has been coordinated at the National Institute for Public Health and the Environment (RIVM), Centre for Infectious Disease Control, Department Surveillance and Epidemiology, in Bilthoven, the Netherlands.

In **Chapter 2** different methods are described to estimate the total number of people living with HIV/AIDS (PLWHA) in the Netherlands. Estimates of the number of PLWHA are used for national planning of HIV prevention and treatment services. Three different estimation tools were used to assess the merits of different methods.

**Chapter 3** covers four studies on HIV and sexual behaviour among ethnic minority populations. The first study explores condom use and other risk-related characteristics of ethnic minority populations from HIV endemic countries living in the Netherlands, and whether it is associated with sexual mixing patterns with other ethnic groups including the indigenous Dutch population. The second study describes concurrent partnerships and its association with sexual risk behaviour among ethnic minority populations living in three large cities in the Netherlands, using data of community based HIV surveys. The third study focuses on migrants travelling to their country of origin and assesses whether this population might be a bridge for HIV transmission. In the last study of this chapter mathematical modelling is used to understand the contribution of migrants originating from HIV endemic countries to the spread of HIV in the Netherlands. Data of the community based HIV surveys were used among data of other (behavioural) studies to develop a mathematical transmission model.

**Chapter 4** includes a cross sectional anonymous unlinked HIV survey among commercial sex workers in the Netherlands to assess the prevalence and determinants of HIV and sexual risk behaviour among various groups of CSW.

**Chapter 5** includes two studies among STI clinic attendees. The first study seeks to identify specific subpopulations at risk for STI coinfections using data of the national registry of STI clinics. In the second study the epidemiology of gonococcal resistance to antibiotics among STI clinic attendees is described.

In the general discussion, **Chapter 6**, main findings are discussed, and related to recent literature. Furthermore, implications for prevention and policy are discussed and recommendations for further research are presented.
References


