Prevention of Sexually Transmitted Infections Among Adolescents

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Introduction

Sexually transmitted infections (STIs), including human immunodeficiency virus (HIV) infection, can have profound impacts on adolescent sexual and reproductive health. While adolescents are a quarter of the sexually active population, they represent nearly half of all new STI cases globally (Da Ros and Da Silva Schmitt 2008). According to the World Health Organization (WHO) estimates, the highest prevalence of STIs is among young adults aged 20–24 years, and the second highest is among 15- to 19-year-olds (Dehne and Riedner 2005).

STIs have considerable impact on the morbidity and mortality for infected individual, but also their partners and children. For example, untreated chlamydial infections can lead to pelvic inflammatory disease (PID), chronic pain, and infertility among women; untreated syphilis during pregnancy can lead to fetal infection, stillbirth, and congenital anomalies (WHO 2008a). Approximately 70 % of all cervical cancer cases are caused by two strains of the human papilloma virus (HPV) (Munoz et al. 2003). HPV is also is the cause of the majority of anal cancers, 40 % of vulvar cancers, and variable proportions of penile, vaginal, ureteral, and neck cancers (Saslow et al. 2007). HIV/AIDS is the fifth leading cause of disease burden in the world and a leading cause of death in the Africa region (Mathers et al. 2008). Further, STI treatment and management consumes a substantial portion of national and global health resources. In the USA, for example, nearly 20 million new infections occur each year, about half are among 15- to 24-year-olds, and the annual cost to the US healthcare system is estimated at USD 16 billion in medical costs (CDC 2013). In South Africa, almost a third of all deaths and over 5 million disability-adjusted life years are attributed to STIs, primarily HIV infection (Johnson et al. 2007). Disability-adjusted life year is a health gap measure. It combines information on the impact of premature death and of disability and other non-fatal health outcomes.

A complex interplay of biological, cognitive, behavioral, sociocultural, and ecological factors put young people at risk of STIs. This chapter discusses the global spread of STIs, the pathogens, symptoms, and health consequences of select STIs, social and behavioral determinants of STIs; and it describes key public health

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A.L. Cherry et al. (eds.), *International Handbook on Adolescent Health and Development*,
DOI 10.1007/978-3-319-40743-2_10

approaches aimed at reducing the burden of STIs among adolescents.

Global Epidemiology of STIs in Adolescents

The incidence, prevalence, and population distribution of STIs are highly complex and dynamic. The population-level epidemic of each STI differs depending on a variety of demographic, sexual, behavioral, economic, and structural forces (Aral and Holmes 2008). Compiling globally comparable data on STI prevalence and incidence is hampered by the complexity and limitation of the current data collection systems: The WHO estimates that over a million people acquire a STI every day (WHO 2013). According to WHO estimates, there were close to 500 million new cases of one of four curable STIs—chlamydia, gonorrhea, syphilis, and trichomoniasis—among 15- to 49-year-olds in major geographic regions of the world in 2008, an 11 % increase from estimates for 2005 (WHO 2012). Dramatic increases in gonorrhea estimates in all regions of the world apart from Europe and increase in trichomoniasis among men and women in the Americas contributed in large part to the increased STI incidence rates between 2005 and 2008 (WHO 2012). Using available data, Fig. 10.1 presents WHO estimates of STI prevalence among 15- to 49-year-olds in major regions of the world, by sex and by type of STI (WHO 2012). Overall, these estimates find that women are more likely to be living with STIs; the male-to-female ratio for these four STIs was 1:14 (WHO 2012). For instance, prevalence of trichomoniasis is much higher among females than males in all regions of the world, and the highest prevalence is among women in Africa and the Americas. Rates of syphilis are similar among men and women in the Africa region and much higher than in other regions of the world.

Among young people specifically, studies show low awareness of STIs and a heavy disease burden. Some 58 % of adolescents in Sri Lanka, 29 % in India, and only 4 % in Timor-Leste were aware of STIs. In Bangladesh, for instance, more than half of the people who sought STI treatment at formal facilities were young people (WHO 2011). Another study in Mongolia among antenatal clinic attendees in 2002 found that a third of

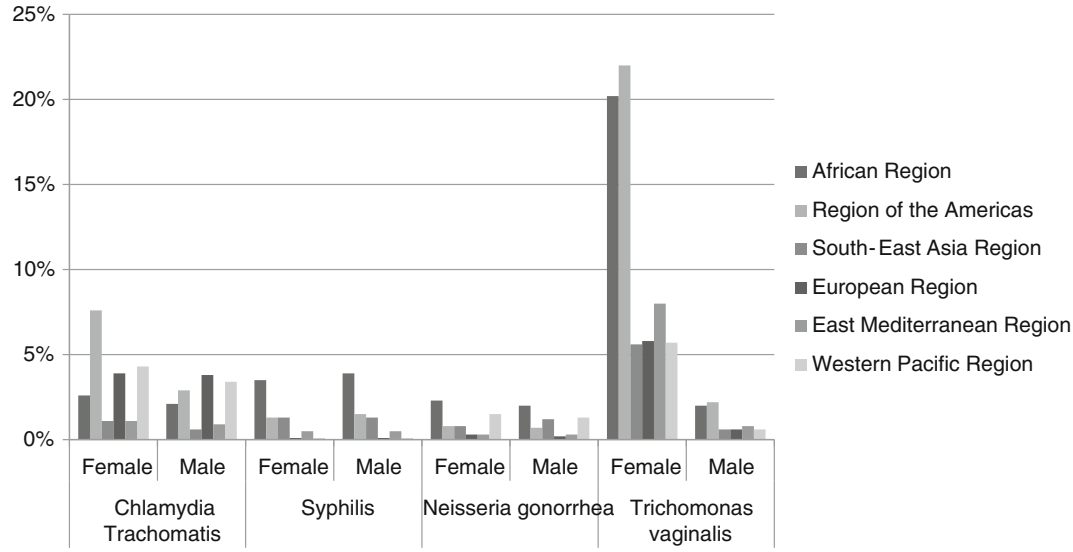

Fig. 10.1 STI prevalence among 15- to 49-year-olds, by sex and region. *Source* WHO (2012).

the women tested for STIs, with higher rates among young women compared to adult women (WHO 2008b).

The major challenge in assessing the global impact of STIs is the incomplete reporting of STI data. There are four interrelated challenges, some universal and some specific to adolescent statistics, in examining the prevalence and incidence of STIs among adolescents.

- First, STI data collection systems around the globe are highly varied and the data heterogeneous (Da Ros and Da Silva Schmitt 2008). STI data from each setting could be collected from a variety of sources including mandated reporting of specific STIs (particularly in developed nations), population-based surveys, sentinel clinics, mortality reporting systems, or small special studies. However, these data are not often well linked and may not use consistent case definitions (WHO 2014b). Except for recent efforts at collecting HIV biomarker data from population-based samples, the majority of the STI statistics are compiled using a collection of healthcare provider reporting systems, sentinel networks of selected facilities like antenatal care clinics, laboratories, or STI clinics (Da Ros and Da Silva Schmitt 2008; Panchaud et al. 2000). Data collection from beyond sentinel sites would require testing for each STI in large and representative population samples. Such efforts are costly, and thus, no global system of surveillance is yet in place.
- Second, underreporting and overrepresentation is a serious concern with current STI estimates. For a variety of reasons, women are more likely to be screened for STIs compared to men; this might explain much of sex differences in reported rates. Some data collection mechanisms, such as syphilis testing at antenatal care sites, produce serious underreporting overall or among specific groups, such as men, who do not visit antenatal care sites.
- Third, STIs are often asymptomatic, that is, individuals may be infected without exhibiting any symptoms. The asymptomatic nature of many STIs means that individuals may not report the illness or seek care, making it harder to document their prevalence. Further, since many STIs are particularly asymptomatic for women, data collection based on self-reports is often biased.
- Fourth, age-disaggregated STI data collection and synthesis are challenging. The variety of data collection systems and contexts also means that age-disaggregated data for 15- to 19-year-olds may not be collected and available. The USA and the Nordic countries have some of the most comprehensive age-specific data on STIs. The US Centers for Disease Control and Prevention, for instance, collects STI data in a variety of ways, including compiling data reported to state and local health departments and conducting population-based surveys to examine community prevalence of certain STIs such as herpes simplex virus (HSV), HIV. The most recent surveillance data from the USA (see Fig. 10.2) highlight higher rates of reported STI among adolescents (15- to 19-year-olds) and young adults (2- to 24-year-olds) compared to adults in the USA (CDC 2014a). While these data are useful and demonstrates age patterns of particular STIs, it is not without its limitations. For instance, the low rates of chlamydia among young men may be an artifact of chlamydia testing and screening that prioritizes women.

HIV/AIDS

HIV is a critically important STI; globally the predominant mode of HIV transmission is sexual (WHO 2007). Young people aged 10–24 years represent approximately 15 % of all people living with HIV, including an estimated 4.5 million youth (aged 15–24 years) and 2.1 million adolescents (aged 10–19 years) living with HIV by the end of 2012 (UNAIDS 2013a). The HIV pandemic has been particularly burdensome to young adults; currently, youth aged 15–24 account for 39 % of new HIV infections in people aged 15 and older. These estimates include both

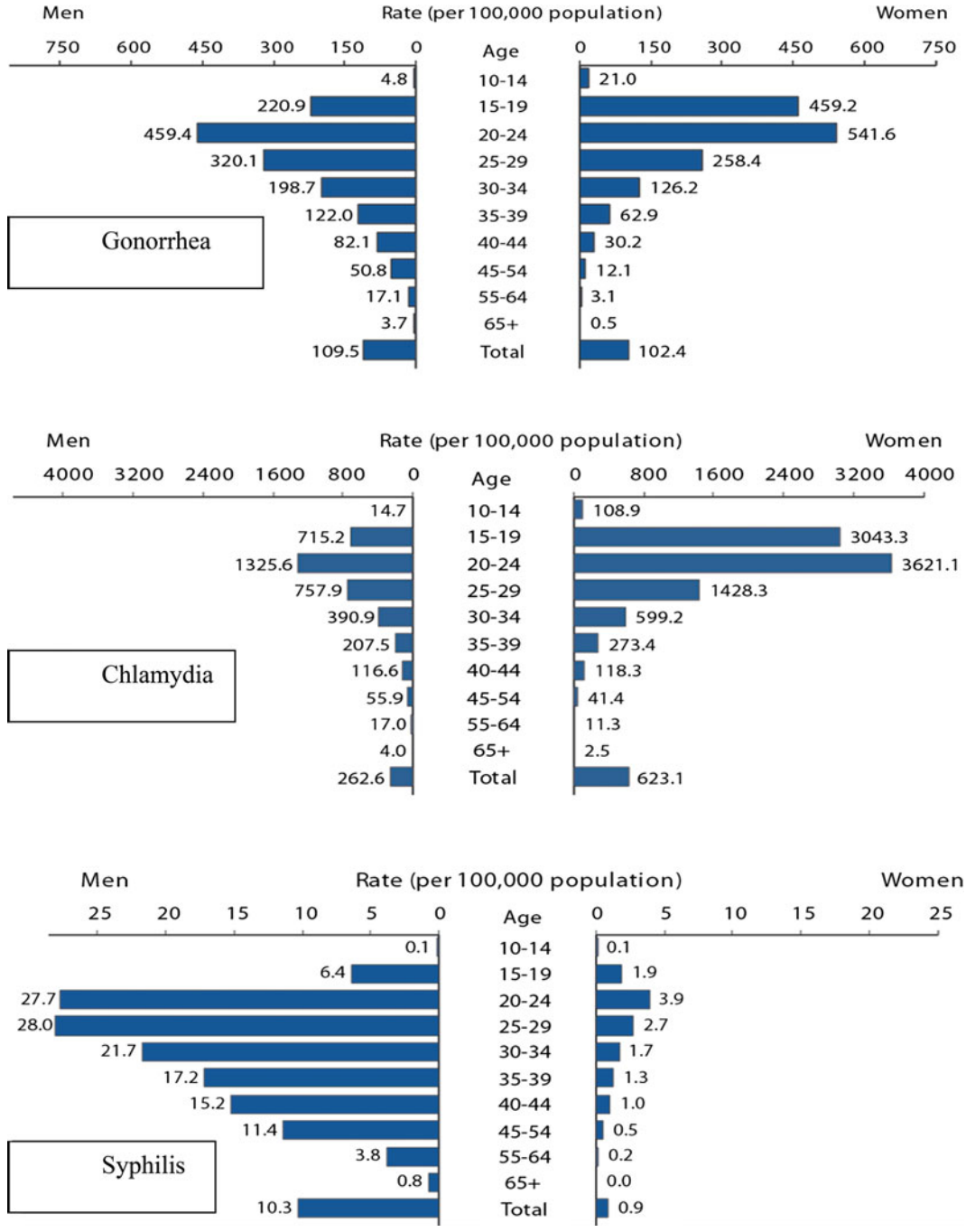

Fig. 10.2 Rates of reported STIs, by age and sex, USA, 2013. *Source* Centers for Disease Control and Prevention. Sexually Transmitted Disease Surveillance 2013. Atlanta: US Department of Health and Human Services; 2014

young people who acquired HIV thru mother-to-child transmission (e.g., perinatally) and young people who acquired HIV behaviorally (e.g., unprotected sexual intercourse). HIV continues to be one of the leading causes of death among young people globally. Between 2005 and 2012, HIV-related deaths among adolescents doubled, while the global number of HIV-related

deaths fell by a third (UNAIDS 2013a). In 2012, 61,000 10- to 14-year-olds, 46,000 15- to 19-year-olds, and 48,000 20- to 24-year-olds succumbed to AIDS-related deaths globally (UNAIDS 2013b).

Figure 10.3 highlights stark regional variations in HIV prevalence (UNAIDS 2013a). Young people in sub-Saharan Africa bear the highest burden of disease with a prevalence of 2.5 % among 15- to 24-year-old women and 1.2 % among 15- to 24-year-old men, compared to 0.5 and 0.3 %, respectively, among youth in the Caribbean. Eastern Europe and Central Asia along with Middle East and North Africa show growing epidemics among adolescents since the 2000s (Kasedde et al. 2013). Countries with the highest HIV prevalence have a sex disparity in HIV prevalence among young people (Idele et al. 2014). Approximately 60 % of all 10- to 19-year-olds living with HIV are girls, the vast majority of whom live in contexts with generalized epidemics fueled by unprotected heterosexual intercourse (Kasedde et al. 2013). High HIV prevalence among adolescent girls is a reflection of complex and often inadequate social, economic, educational, familial, and legal support for girls. Pervasive gender inequality, orphanhood, low socioeconomic status, early sexual debut, age disparate sexual relationships, and biological vulnerability are just some of the factors that perpetuate the epidemic among adolescent girls (Kasedde et al. 2013; Underwood et al. 2011). In concentrated epidemics on the other hand, young men who have sex with men and injecting drug users have the highest rates.

Finally, young people who were infected with HIV as children are a unique subpopulation. According to UNAIDS (2013a) estimates, in 2012, 260,000 children acquired HIV in low- and middle-income countries. In some countries with generalized HIV epidemics, like Chad, Ethiopia, or Nigeria, less than 50 % of pregnant women living with HIV have access to HIV medications during pregnancy for prevention of new HIV infections (UNAIDS 2013a).

Key "at-risk" Populations

Further embedded within these regional variations is significantly higher prevalence among key populations who have higher prevalence of HIV and STIs than the general population. In part, these "at-risk" populations usually live,

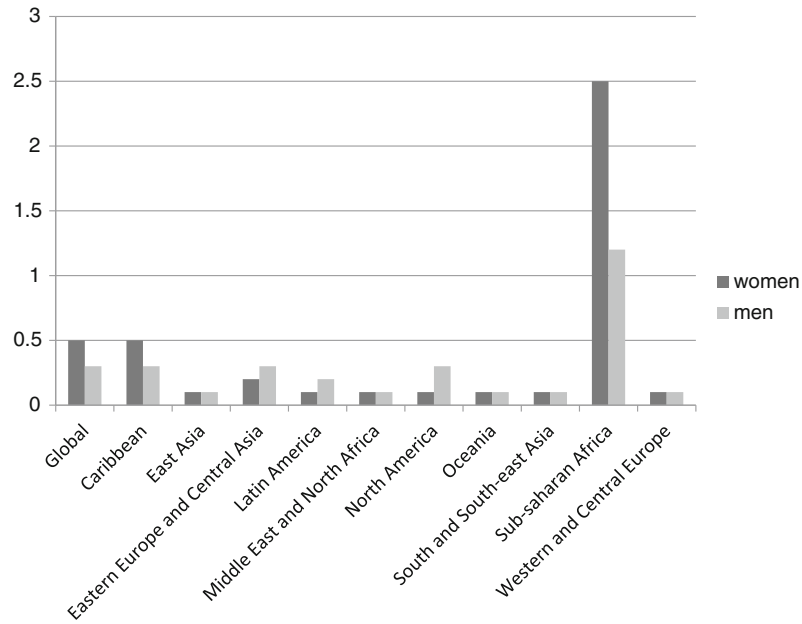

Fig. 10.3 HIV prevalence among 15- to 24-year-olds. *Source* UNAIDS (2013a)

work, and learn in conditions that contribute to or may predispose them to poor health. The higher rates of STIs among at-risk populations may also reflect their higher engagement in risky behaviors. Among adolescents and youth, this includes sex workers, men who have sex with men, and injecting drug users. Additionally, transgender adolescents, adolescents in detention and incarceration, and young people living in conflict or crisis situations are further at risk of HIV. Data limitations keep STI and HIV epidemics hidden among the most vulnerable youth populations to a large extent.

Sex Workers

HIV and STI epidemics have a profound effect on male, female, and transgender sex workers. While "sex work—defined here as the exchange of sex for money—and the structure of sex work vary substantially around the world—the heightened risk for HIV acquisition and transmission among sex workers operates through a similar variety of behavioral, biological, and structural risks" (Baral et al. 2012). Though age-disaggregated data on young people engaged in sex work remains scarce, a meta-analysis conducted by Baral et al. (2012) finds HIV prevalence of 11.8 % among sex workers in all regions of the world, with highest prevalence in sub-Saharan Africa, Eastern Europe, Latin America, the Caribbean, and Asia. Studies show that due to a variety of factors including biological vulnerability and heightened vulnerability to violence, adolescents engaged in sex work face heighted risk of HIV and STI infections (Silverman 2011; Zhang et al. 2012).

Men Who Have Sex with Men

Recent analysis of modes of HIV transmission has found that men who have sex with men (MSM) are at increased risk of HIV. Median HIV prevalence among MSM is greater than 1 % in all regions of the world (UNAIDS 2013a). MSM in low- and middle-income countries have a greater risk of being infected with HIV compared to the general population in the Americas, Asia, and Africa (Baral et al. 2007). While global age-disaggregated data on MSM are rare, country case studies highlight the increased risk of HIV and STIs among young MSM (Idele et al. 2014). For instance, a study examining HIV prevalence among MSM in Jamaica found that one-third of the men enrolled in the study were HIV positive and 60 % of them were young men under the age of 25 (Figueroa et al. 2013). Sexual practices, such as being the receptive partner during anal sex, coinfections with STIs, and being socially vulnerable (e.g., homeless or having experienced violence), increased the risk of HIV among MSM in Jamaica (Figueroa et al. 2013). Most young men in this study had not disclosed their HIV status to their partner and were not comfortable disclosing to anyone (Figueroa et al. 2013). In part, MSM hesitation to disclose HIV status or seek care emerges from social and criminal sanctions against same-sex relations. Some 76 nations have laws that criminalize same-sex relations; among these, some jurisdictions allow the death penalty (UNAIDS 2013a). Such punitive laws and other forms of discrimination regarding same-sex sexual relations create an environment that perpetuates homophobia and related stigma, act as a social deterrent to seeking HIV or STI services, and continue to engender high risk among MSM.

Injecting Drug Users (IUDs)

HIV and STI prevalence is also higher among adolescents who inject drugs. Certain STIs (HIV, hepatitis B, and syphilis) may also be spread by blood and blood exchange during the injection of drugs. Drug use might also enable engagement in risky sexual behaviors. In the Russian Federation, for example, while the national prevalence of HIV was approximately 1 % in 2012, the HIV prevalence among injecting drug users under age 25 was estimated at 25 % (Idele et al. 2014). Though adolescents are less likely to be injecting drug users, the risks are extremely high for those

who do inject. Similar to laws criminalizing same-sex relations, punitive drug policies—such as restrictions on drug substitution or needle exchange syringe programs—prevent or deter many people who inject drugs from the services they need (UNAIDS 2013a).

Pathogens, Symptoms, and Health Consequences of STIs

More than 35 different types of bacterial, viral, and parasitic pathogens can be transmitted sexually (Holmes et al. 2008). Common bacterial and protozoal STIs include gonorrhea, chlamydia, syphilis, and trichomoniasis. Common viral pathogens include hepatitis B virus, HIV, HPV, and HSV (Holmes et al. 2008; Mabey 2010). Table 10.1 includes summary information on the symptoms and health consequences of these STIs.

STI symptoms depend on specific pathogens but commonly include vaginal or urethral discharge (e.g., chlamydia, trichomoniasis, gonorrhea); sores on genitals, rectum or mouth (syphilis, HSV); and pain in the mouth, genitals, or abdomen. HIV attacks the human immune system and gives rise to a host of opportunistic infections and cancers. In the case of HIV, such opportunistic infections and cancers may not develop until about a decade after initial infection. Oftentimes, the initial symptoms are nonspecific and present as a flu-like illness. The most challenging element for STI treatment and control is the often asymptomatic nature of many STIs.

Left untreated STIs can cause serious complications and health consequences affecting the sexual and reproductive health of men and women over their lifetime. Chlamydia and gonorrhea in women can cause PID,[1] when the infection spreads from the cervix to the uterus and the fallopian tubes. PID is a major risk factor for ectopic pregnancy, infertility, and chronic pelvic pain. Syphilis during pregnancy can cause miscarriage, stillbirth, or premature delivery; and advanced stage syphilis (often called tertiary syphilis) can cause long-term complications such as negative effects to the brain, nerves, eyes, hear, liver, bones, joints, and blood vessels. Hepatitis B causes acute infection of the liver and may lead to chronic infection, progressive damage to the liver, and liver cancer. There are over 40 different types of HPV, and it is possible to get more than one type of HPV. The most common strains of HPV can cause genital warts and cervical, penile, anal, and oropharyngeal cancer. HIV causes AIDS, essentially damaging the immune system and resulting in myriad of problems.

STIs can be transmitted via contact with semen, vaginal secretions, and other body fluids and skin contact during vaginal, oral, or anal sex with a person who is infected. Hepatitis B, for instance, a virus that is 50–100 times more infectious than HIV, can be passed through several mechanisms including the exchange of semen, vaginal fluids, and blood during birth, sex with an infected partner, or sharing needles and other sharp objects, or through direct contact with blood or open sore of an infected person. HIV and syphilis can also be transmitted vertically, from mother to child (in utero, during delivery, or during the postpartum period). Casual interactions, like kissing or exchange of saliva with an infected person, can also spread HSV. HPV can also be spread by skin-to-skin contact, and symptoms do not have to be apparent for HPV to be passed along to a partner; so many infected individuals do not realize their infection status and may pass along this virus to their partner(s).

Factors Influencing STI Transmission Among Adolescents

Ranges of proximal and distal factors influence STI risk among young people. STI acquisition and its spread are influenced by pathogen-specific factors as detailed above, but also by

[1]Although gonorrhea and chlamydia are typically associated with PID, PID is a polymicrobial infection and can occur even then the STD screen is negative for gonorrhea and chlamydia, but patient meets other clinical criteria.

Table 10.1 Pathogens, symptoms, and health consequences of eight common STIs

STI	Pathogen	Symptoms	Health consequences
Bacterial infections			
Chlamydia	*Chlamydia trachomatis*	**Women**: 85 % asymptomatic. Cervicitis (infection of the cervix), endometritis (inflammation of uterine lining), salpingitis (fallopian tube inflammation) **Men**: 40 % asymptomatic. Urethral discharge, epididymitis (inflammation of the tube that connects the testicle with the vas deferens), orchitis (inflammation of the testicles) **Both sexes**: Proctitis (inflammation of the rectum), pharyngitis (inflammation of the throat), urethritis (urethral pain—the tube that carries urine from the bladder to outside the body), arthritis (joint pain)	**Women**: If untreated, for ~40 % of women, the infection can spread to uterus and fallopian tubes causing pelvic inflammatory disease (PID). PID complications include formation of scar tissue blocking fallopian tubes, ectopic pregnancy (pregnancy outside the womb), or tubo-ovarian abscess (abscess formation around the fallopian tube and ovaries; ruptures can lead to sepsis). Other consequences include infertility, perihepatitis (inflammation of the liver coating), and pre-term rupture of membranes during pregnancy **Men**: Infection sometimes spreads to the tube that carries sperm from the testicles, causing pain and fever and infertility **Infants**: Conjunctivitis, pneumonia
Gonorrhea	*Neisseria gonorrhoeae*	**Women** and **Men**: Symptoms similar to *Chlamydia*	**Women** and **Men**: See *Chlamydia* **Infants**: See *Chlamydia.* Also causes corneal scarring and blindness
Syphilis	*Treponema pallidum*	**Both sexes**: Open sore or ulcer on genitals, mouth, or rectum (primary ulcer/chancre is typically painless) with local lymph node swelling (adenopathy), skin rashes, genital warts (secondary syphilis), and other organ complications including the brain, nerves, eyes, hear, liver, bones, joints, and blood vessels (tertiary syphilis)	**Both sexes**: Increases risk of HIV transmission by three fold **Women**: Miscarriage, stillbirth, and premature delivery **Infants**: Congenital syphilis
Protozoal infection			
Trichomoniasis	*Trichomonas vaginalis*	**Women**: 80 % asymptomatic. vaginosis with profuse, frothy vaginal discharge **Men**: Often asymptomatic. Urethral discharge	**Women**: Pre-term birth **Infants**: Low-birth weight
Viral infections			
Human immunodeficiency virus (HIV)	Human immunodeficiency virus (HIV)	**Both sexes**: The virus attacks the immune system over time. Shortly after infection, some	**Both sexes**: HIV-related illnesses, opportunistic infections like tuberculosis,

(continued)

Table 10.1 (continued)

STI	Pathogen	Symptoms	Health consequences
		people have a brief illness like the flu. Extreme weight loss, fatigue, and fever	acquired immunodeficiency syndrome (AIDS), death **Infants**: HIV
Genital herpes	Herpes simplex virus (HSV)—type 2 and type 1 (less common)	**Both sexes**: Most carriers asymptomatic. Anogenital vesicular lesions and ulcerations (sores). Sores may appear as small, fluid-filled blisters on the genitals, buttocks, or other areas. The sores often are grouped in clusters. Stinging or burning while urinating. Swollen glands, fever, chills, muscle aches, fatigue, and nausea Recurrence after a primary outbreak is usually less severe than the first genital outbreak. Also recurrences are much less frequent for genital HSV-1 than HSV-2	**Both sexes**: Although rare, HSV can cause complications such as encephalitis (inflammation of the brain) and aseptic meningitis (inflammation of the lining of the brain) **Infants**: Neonatal herpes (often fatal)
Genital warts	Human papillomavirus (HPV)	**Women**: Vulval, anal, and cervical warts **Men**: Penile and anal warts	**Women**: Cervical carcinoma, vulval carcinoma, anal carcinoma **Men**: Carcinoma of the penis **Infants**: Laryngeal papilloma (tumors in the larynx)
Viral hepatitis	Hepatitis B virus	**Both sexes**: Most carriers asymptomatic	**Both sexes**: Acute hepatitis, liver cancer, and liver cirrhosis (scarring of liver and poor liver function associated with last stages of liver disease)

Sources WHO (2007,2012)

more proximal individual-level risk behaviors like initiation of sexual intercourse and number of sexual partners, and by more distal determinants like young people's ability to access STI testing and treatment services. STI transmission rates also depend on the probability of exposure to infectious persons, the efficiency of transmission per exposure, and the duration of infectivity (Aral and Holmes 2008).

Exposure to infected persons depends on a range of individual- and population-based factors. These include use of barrier methods, sexual practices, engaging in concurrent partnerships, sexual networks, prevalence of STIs within communities, access to treatment, and vaccination rates (for HPV and hepatitis B) (Mabey 2010). Certain sexual behaviors, such as anal sex, are higher risk than others in terms of increasing susceptibility to STIs. Additional individual-level behaviors like higher numbers of recent and lifetime sex partners, sexual concurrency—multiple and overlapping sexual partnerships, and higher rates of partner change, significantly contribute to STI risk. The sexual and behavioral characteristics of partners, such as partners' sexual concurrency, also influence STI risk. Young women are at higher risk of STIs and HIV and intimate partner violence (IPV). Recent studies show that experience of IPV among young women is associated with concurrent experiences of sexual risk and coercion, and limited condom use (Seth et al. 2013).

Efficiency of transmission includes individual susceptibility, the infectiousness of the pathogen, the concentration of the pathogen shed in sexual fluids, and the natural history of the infection (Aral and Holmes 2008). For instance, a cohort study in rural Uganda demonstrated that the average rate of HIV transmission varied by the duration after seroconversion. The transmission possibility was highest during early (within 2.5 months of seroconversion)- and late-stage infection (6–25 months before the death of the infected partner) compared to prevalent infections (Wawer et al. 2005). Thus, natural history of infections and particularly the timing of high and low levels of infectiousness are important dynamics for disease transmission (Aral and Holmes 2008).

Further, interactions among STI pathogens affect the spread and infectiousness of STIs. Diseases such as syphilis and HSV, which cause genital ulceration, can increase infectivity and susceptibility to HIV (Mabey 2010). STIs, like gonorrhea, which causes inflammation of the cervix or urethra, can increase shedding of HIV in seminal and vaginal secretions. Similarly, HIV increases susceptibility for the acquisition of other STIs (Mabey 2010).

Coupled with the asymptomatic or latent symptoms of many STIs, these factors combine to produce STI risk and fuel their ongoing spread. Table 10.2 summarizes some of the determinants that influence STI acquisition based on WHO's ecological model for adolescent health and development.

Public Health Approaches to Reducing the Burden of STIs Among Adolescents

Given the major burden of STIs on adolescent health and development, public health approaches to mitigating this burden are critical. A variety of individual- and population-based programs and policy approaches have been attempted to address the wide range of determinants that contribute to STI and HIV risk among young people. Classic epidemiological approaches to STI prevention emphasize reducing the

Table 10.2 Determinants of STIs transmission in adolescents

Levels	Determinants
Biology	Pathogen-specific transmission viability Interactions among STI pathogens
Individual	Number of sexual partners Sexual concurrency Type of sexual activity (anal, oral, vaginal) Partner choice Knowledge about STIs, STI screening, and treatments Condom use Ability to negotiation condom use or safer sexual behaviors
Interpersonal	Partner sexual concurrency and multiple partners Partner's STI or HIV status Partner's sexual activity
Community	Stigma around STIs Attitudes around adolescent sexual activity
Organizational	Availability of STI testing and treatments Availability of youth-friendly STI services
Environment	STI prevalence in the community HIV prevalence in the community HIV community-level viral load
Structural	Laws governing access to STI knowledge and care among adolescents Poverty
Macro	Stigma toward at-risk groups (e.g., homophobia)

risk of exposure to STI, reducing the efficiency of transmission, and shortening the duration of infection (Dallabetta et al. 2008). Below we highlight two areas of interventions targeted to prevent and mitigate the impact of STIs and HIV among young people: "primary prevention and STI management" (see Fig. 10.4). While many adult-focused interventions have been successful (e.g., condom use, uptake of HIV treatments, update of voluntary medical male circumcision), more evidence is needed on how to effectively engage youth in STI and HIV prevention efforts (Mavedzenge et al. 2014).

Primary Prevention: STI Avoidance

The major aim of primary prevention is to keep individuals and communities from acquiring STIs and HIV. Primary prevention is a cornerstone of STI and HIV control, particularly in resource poor settings with poor surveillance, diagnostic, and limited treatment options (Dallabetta et al. 2008). Behavior change, structural interventions, and prevention technologies are three major components employed in primary prevention programming.

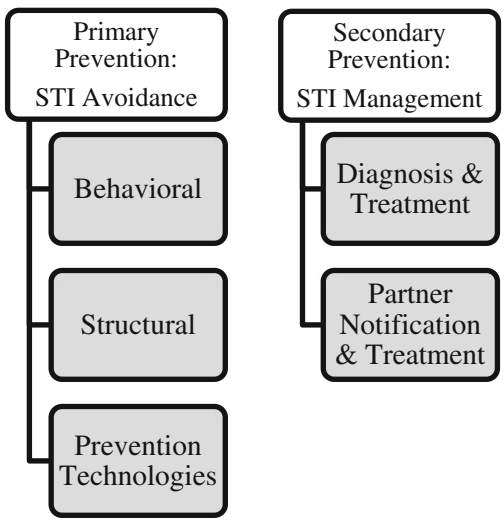

Fig. 10.4 Major public health approaches to STI prevention and management

Behavior Change for Risk Reduction

A major emphasis to date on youth STI prevention has been on individually focused behavior change interventions (McCoy et al. 2009). Often emerging from psychosocial models of behavior change, health information and education programs encourage sexual behavior change and risk avoidance. For example, many young people do not know how to recognize the signs and symptoms of STIs. In such cases, education about STIs is a critical public health approach for STIs. A recent review of evidence on adolescent-focused HIV prevention programs found strong evidence that "in-school interventions and interventions in specific geographically defined communities can positively impact important HIV-related outcomes, such as self-reported sexual risk behaviors" (Mavedzenge et al. 2014).

Promotion of Barrier Methods: Promotion of condom use is an integral component of social and behavioral risk reduction efforts for HIV and STI prevention. Clinical trials have proven the effectiveness of condom use for prevention of pregnancy, STIs, and HIV transmission (UNAIDS 2013a). The public health community continues to promote condom use as the best form of protection again STIs and as prevention from unintended pregnancies for those who are sexually active (Holmes et al. 2004; UNAIDS 2013b; Warner et al. 2006). A recent mathematical modeling study demonstrated that increases in condom use played a significant role in the declines in HIV incidence in South Africa between 2000 and 2008 (Johnson et al. 2012). Another study in Uganda found that consistent use of condoms significantly reduced incidence of HIV, syphilis, and gonorrhea/chlamydia after adjusting for individual-level socio-demographic and behavioral characteristics (Ahmed et al. 2001).

Despite successes, condom use among young people often remains low. A systematic review of literature on condom use errors found the most commonly reported errors to be not using condoms throughout sex, not leaving space at the tip, not squeezing air from the tip, putting the

condom on upside down, not using water-based lubricants, and incorrect withdrawal (Sanders et al. 2012). The same review also looked at condom problems with the most frequently reported as breakage, slippage, leakage, condom-associated erection problems, and difficulties with fit and feel. The three most consistent condom use dislikes, regardless of gender, age, education, and marital status, included: (1) condoms just do not feel right, (2) condoms decrease my sensation; and (3) condoms decrease my partner's sensation (Crosby et al. 2008; Oncale and King 2001). Discomfort associated with condom use has been shown to be associated with breakage, incomplete use, and decreased motivation to use condoms (Crosby et al. 2003). Furthermore, heterosexual young adults are more likely to use condoms for pregnancy prevention than disease prevention (Cooper et al. 1999). Little is known, however, about how adolescents use condoms for pregnancy prevention versus STI prevention. The intersection of disease and pregnancy prevention might more accurately reflect condom use intentions. Condoms remain the most effective tool for HIV and STI prevention during sexual intercourse. Yet, more work is needed to understand the motivations behind condom use, disuse, and consistent use; the predictors for each may be different.

While oral sex carries a lower risk of transmission of STIs, several STIs can still be transmitted through oral sex. One way to help protect from the spread of STI during oral sex is to use a dental dam (CDC 2014b). Dental dams are a square sheet of latex that is placed over the vulva and act as a barrier during oral–vaginal sex. Dental dams are also used as a method of protection during oral–anal sex. Dental dams can be purchased or made by cutting a condom. These types of barrier methods are relatively new and most research shows they remain underutilized the world over.

Partner Risk Reduction: Partner reduction through sexual abstinence, mutual monogamy with an uninfected partner, and reducing the number of sexual partners are often promoted as STI and HIV prevention strategies among young people. In the USA, in recent decades due to political and cultural forces, there has been an emphasis on "abstinence-only" sexual health education (*described in more detail in the chapter on "Adolescent Sexual Health and Sexuality Education"*).

Coates et al. (2008) argue that individually focused behavioral strategies are essential, but not sufficient to reduce HIV (and STI) incidence and need to be designed to approach multiple levels of influence. Largely missing is attention to relationship issues. "Relationship characteristics also play a pivotal role in influencing adolescents' risky behavior and their likelihood of acquiring an STI." (DiClemente et al. 2005). For instance, an examination of partner characteristics and HIV risk from Uganda demonstrated that young women's risk of acquiring HIV increased with partners who were truck drivers (engaged in a highly mobile activity), drank alcohol before sex, and used condoms inconsistently (Mathur et al. 2015). Programs using youth gender empowerment models based on Paolo Freire's theories have been shown to reduce sexual risk behaviors (e.g., Mpondombili Project, Stepping Stones, and IMAGE projects in South Africa) (Harrison et al. 2010). Stepping Stones, an intervention promoting sexual health of youth in South Africa with a focus on tackling distal determinants like the reduction in sexual coercion and IPV, has been shown to have a significant impact in biological outcomes including HIV, HSV-2, and pregnancy incidence (Harrison et al. 2010). Evaluation of Safe Homes and Respect for Everyone (SHARE) Project, an integrated IPV and HIV prevention intervention in Rakai, found lower self-reports of physical and sexual violence in the past year and reduced HIV incidence in the intervention groups. The SHARE project employed an ecological approach and had two aims: community-based mobilization to change attitudes and social norms that contribute to IPV and HIV risk, and a screening and brief intervention to reduce HIV-disclosure-related violence and sexual risk in women seeking HIV counseling and testing (Wagman et al. 2015).

Structural Interventions

The heavy emphasis on health education and risk reduction among youth is due, in part, to the assumption that behavioral determinants are more easily modified compared to structural or environmental determinants that influence HIV risk among young people. However, the daily lives and behaviors of young people are also influenced by structural and environmental determinants (like laws prohibiting adolescent access to reproductive health care) (Cohen et al. 2000). This category of interventions targets mediators of STI and HIV risk in specific contexts that have the potential to alter the prevention environment. For instance, this may include the development of policies to ensure condom use in venues associated with sexual encounters and high-risk behaviors. A review of interventions conducted with sex workers, found combining sexual risk reduction and condom promotion, improved access to STI treatments, coupled with the promotion and enforcement of a 100 % condom use policy at brothels, and empowerment of sex workers, and reduced the prevalence of STIs and HIV (Rojanapithayakorn and Hanenberg 1996; Shahmanesh et al. 2008; Swendeman et al. 2009). Similarly, needle and syringe exchange programs (often tied to drug policies) have demonstrated reduced risk of HIV infection among injecting drug users (Gupta et al. 2008). Other examples are a set of economic empowerment and conditional cash transfer programs aimed at addressing structural issues like access to schooling or poverty.

Cash transfers: Cash payments to improve health outcomes have a long history in development targeted toward alleviating household incomes to increase uptake of health services, but are relatively new in the HIV field (Pettifor et al. 2012). These payments can be unconditional (families or individuals are not required to do anything) or conditional (payments are tied to certain behaviors or activities). Thus, conditional cash transfer (CCT) programs attempt to impact structural antecedents to sexual health like education and poverty. While the program design varies, most programs link cash saving programs as a motivation for schooling attendance. Evidence evaluating CCT programs' effect on STI incidence is mixed and inconclusive. However, in settings where there are significant financial barriers to school attendance and attending school is a protective factor, research indicates that CCT programs have impact on outcomes like HIV incidence (Mavedzenge et al. 2014). In general, smaller payments made more frequently were more effective than the promise of larger payments in the future. In one large CCT program in Mexico, contraceptive use increased during enrollment in the CCT program, as did educational attainment levels (Darney et al. 2013). Another cluster-randomized trial in the Zomba District of Malawi assessed the efficacy of conditional (80 % school attendance) or unconditional cash payments on HIV and HSV-2 prevalence (Baird et al. 2012). The study found that individuals in the intervention group had lower HIV and HSV-2 prevalence. Additionally, girls in the intervention group were also less likely to have engaged in sexual activity, reported lower sexual frequency, and had fewer age-discrepant partnerships compared to girls in the control groups (Baird et al. 2012).

Prevention Technologies

Key biomedical interventions, like vaccines and voluntary medical male circumcision, have been highly effective in disrupting the spread of STIs and HIV.

Vaccines: To date, vaccines have been highly effective at combating infectious diseases. Vaccine initiatives for STIs/HIV can have a global impact on reducing morbidity, mortality, and curtailing disease transmission (Aral and Holmes 2008). Notable advances include highly efficacious vaccines against hepatitis B and HPV (see text box). The WHO estimates that more than 780,000 people die every year due to the consequences of hepatitis B (WHO 2014a). Hepatitis can be prevented, however, with a vaccine that provides greater than 90 % protection to infants, children, an adults immunized before they are exposed to the virus. The WHO passed a global

recommendation to vaccinate against hepatitis B in 1992. It recommends that all infants receive this vaccine, as soon as possible after birth, followed by three or four doses to complete the series during childhood. The complete hepatitis B vaccine series produces protective antibodies that last at least 20 years. In settings where children become chronically infected with hepatitis B, neonatal vaccination has reduced the rate of chronic infection from 8 to 15 % to less than 1 % (WHO 2014a). According to current WHO estimates, 183 nations include the hepatitis B as part of their vaccination schedules for infants. As a result, "79 % of children received the hepatitis B vaccine" (WHO 2014a).

Similarly, encouraging developments have taken place with the vaccine to prevent certain strains of HPV (see text box). And, recent developments are underway on a HIV vaccine as well. An AIDS vaccine trail in Thailand led to a 31 % reduction in HIV incidence among recipients (Rerks-Ngarm et al. 2009). While this AIDS vaccine trial demonstrated modest effects and did not affect viral load of patients with HIV, it outlined the biomedical possibilities of a "vaccine regimen that may reduce the risk of HIV infection in a community-based population with largely heterosexual risk" (Rerks-Ngarm et al. 2009).

Genital Human Papillomavirus (HPV) Vaccine

Several prophylactic HPV vaccines have been developed. Gardasil (Merck & Co., Inc.) protects against HPV types 6, 11, 16, and 18, which cause 90 % of genital warts. Cervarix (GlaxoSmithKline) protects against types 16 and 18 (Saslow et al. 2007), which cause 70 % of cervical cancers in the world (Agosti and Goldie 2007). Both vaccines are intended to be administered if possible before the onset of sexual activity (i.e., before first exposure to HPV infection) (WHO 2014c). Gardasil has also been shown to protect against cancers of the anus, vagina, and vulva. Only Cervarix is licensed in use for males, while both vaccines are licensed for use in females. Vaccine development continues and the US Food and Drug Administration has just approved a vaccine, which covers five additional types of HPV (31, 33, 45, 52 and 58), which cause an additional 20 % of cervical cancers. This vaccine is expected to be widely available in the USA by the end of 2015.

By August 2014, 58 countries had introduced HPV vaccine in their national immunization program for girls and in some countries also for boys (WHO 2014c). Most of the countries that have introduced HPV vaccine are from the WHO regions of the Americas, Europe, and the Western Pacific Region; only a few developing countries have adopted this vaccine (Hopkins and Wood 2013). Nevertheless, the WHO recommends that inclusion of HPV vaccines as a comprehensive strategy to prevent cervical cancers and HPV-related diseases. Although this vaccine has proven to be effective, the greatest barriers to introducing the HPV vaccine are the price of the vaccine itself and the costs of implementing a program to reach adolescents with this vaccine. In 2013, the GAVI Alliance, which provides technical and financial assistance for vaccines to countries that cannot afford such services, began providing support for the introduction of the HPV vaccine in developing countries around the world (Graham and Mishra 2011).

Voluntary Medical Male Circumcision (*VMMC*): VMMC is the partial or complete surgical removal of the foreskin of the penis. While male circumcision has been practiced for centuries due to religious or cultural beliefs, it has received greater attention in public health in the last decade as a method of preventing STI and HIV. Circumcised men appear to be at lower risk for syphilis, chancroid, and HSV-2. Recently, male circumcision has been shown to

reduce female-to-male transmission of HIV during heterosexual sex. Prior to 2005, an abundance of observational studies showed a protective effect of male circumcision with regard to HIV acquisition among heterosexual men (Siegfried et al. 2009). In the last decade, however, the publication of three randomized clinical trials in South Africa (Auvert et al. 2005), Uganda (Gray et al. 2007), and Kenya (Bailey et al. 2007) showed substantial reduction in HIV acquisition among men engaged in heterosexual sex. All three trials were prematurely terminated after they showed 38 and 66 % reduction in HIV acquisition over 24 months after circumcision. However, a trial of circumcision among HIV-infected men did not reduce HIV transmission to female partners and found that transmission might be accelerated if sexual activity was resumed prematurely after male circumcision before complete wound healing (Wawer et al. 2009). Additional studies in Uganda also demonstrate that over 98 % of circumcised men (aged 15–49 years) did not experience any negative effects on their sexual desire, function, or satisfaction following circumcision (Kigozi et al. 2008), and there is a high acceptability of male circumcision among adult men and female partners (Kigozi et al. 2008, 2009; Ssekubugu et al. 2013). The WHO currently recommends promoting VMMC in countries with generalized HIV epidemics. In the 14 VMMC scale-up priority countries in Africa (Botswana, Ethiopia, Kenya, Lesotho, Malawi, Mozambique, Namibia, Rwanda, South Africa, Swaziland, Uganda, the United Republic of Tanzania, Zambia, and Zimbabwe), outreach to adolescents aged 10–19 years of age ranged from 34 to 55 % (Njeuhmeli et al. 2014).

Despite these major successes, a few challenges remain in circumcision program implementation; these include religious or cultural beliefs that do not support male circumcision, lack of awareness among community members about the benefits of male circumcision, limited training of healthcare personnel, and limited availability of surgical materials (Siegfried et al. 2009). Among men from a non-circumcising community in Kenya, the major barriers to accepting male circumcision included cultural identification, fear of pain, excessive bleeding, and cost (Bailey et al. 2002).

In the rural southwestern district of Rakai, Uganda, for example, prior to the clinical trials, the prevalence of circumcision was 16.5 % and was practiced almost exclusively among Muslims (Gray et al. 2000; Ssekubugu et al. 2013). Since the rollout of HIV services in Rakai, the prevalence of circumcision among non-Muslim men has risen to 35 % (Gray 2012), yet the circumcision coverage among young men in this population remains lower than older men (23.2 % among 15- to 24-year-olds compared to 35.2 % in men 25–29 years). To address these challenges, the Rakai Health Sciences Program in Uganda uses a variety of outreach mechanisms —static clinics, surgical camps, and mobile clinics—to reach younger men. Further, they provide a package of interventions, including HIV counseling and testing to identify HIV-positive men and link them to care. The men also receive an HIV prevention package, which includes counseling regarding abstinence, partner reduction, and monogamy, condom provision and instruction, and STI treatment. Preliminary field-based data indicate that these outreach and engagement interventions are having a positive impact on circumcision coverage among young men. Evidence from other settings also confirms that young men are more receptive to VMMC campaigns, when communications emphasize social support and peer influence, when they reach young men through schools with support from teachers and parents, and when they are offered as a part of a package of HIV prevention interventions (Njeuhmeli et al. 2014).

Secondary Prevention: STI Case Management

The second major component in the public health approach to STIs is case management and includes the diagnosis and treatment of infected individuals and their partners to reduce disease morbidity and to prevent reinfection and transmission.

Diagnosis and Treatment

STI and HIV diagnosis programs are critical to the prevention-to-treatment continuum. Limited diagnoses of infections are increasingly recognized as a major problem leading to delayed initiation of treatment and retention into care, in turn leading to prolonged morbidity, premature mortality, and continued transmission (UNAIDS 2013b).

Syndromic management: Provision of effective services to symptomatic STI patients is a key goal of syndromic case management. This secondary prevention platform was endorsed by the WHO in the 1990s and remains the standard of care in resource poor settings due to a limited laboratory infrastructure for screening and testing (Gottlieb et al. 2014). Syndromic management uses genital symptom algorithms for urethral discharge, genital ulcer disease, vaginal discharge, scrotal swelling, and lower abdominal pain to guide treatment without the ready availability of diagnostic tests (Dallabetta et al. 2008). Syndromic management is not a perfect strategy; however, as many STIs are asymptomatic, symptom algorithms need to be adapted for local disease patterns, sexual behaviors, and other health-seeking behaviors. For instance, syndromic management has been effective for urethral discharge and genital ulcer disease syndromes, but poorly for herpes infection or vaginal discharge (Dallabetta et al. 2008). A study at a reproductive health clinic in Tanzania found high burden of STIs among youth, but limited success with syndromic management by gender (Chalamilla et al. 2006). For instance, all males with gonorrhea (more likely to be symptomatic after acquisition) received appropriate syndromic treatment, while only 28 % of women did so due to differences in disease pathogens and clinical manifestations.

Screening and Treatment: As most STIs are asymptomatic but can still lead to detrimental health consequences, standard syndromic management misses the greatest burden of STIs. Screening of high-risk populations and in high prevalence settings is an alternative option for finding asymptomatic infections. There is limited availability of data on STIs among youth in lower and middle-income countries. Syphilis is the only STI, where routine screening of women seeking antenatal care is being attempted globally. As adverse pregnancy outcomes occur in 80 % of women who suffer from active syphilis including stillbirth, perinatal deal, and serious neonatal infections, syphilis screening is seen as a cost-effective intervention even in low-resource settings (Dallabetta et al. 2008). It is estimated that "universal screening of pregnant women for syphilis, and treatment with single-dose benzathine penicillin, could prevent more than 500,000 perinatal deaths per year" (Mabey 2010).

In the USA, a growing focus of STI morbidity prevention in public health is on promoting testing, as exemplified by the CDC's "*Know Yourself. Know your Status*" project. Nonetheless, promotion of STI testing remains limited in success. Based on data from the USA, National Survey of Family Growth, STI screening services are among the least accessed by young women 15–24 years of age (Hall et al. 2011) and only a minority of patients are counseled about STIs and screenings (Tao et al. 2000). Other barriers to testing include never having been offered a test and low perceived risk of an STI, especially in the case of HIV testing (Peralta et al. 2007). Similarly, US college students have been found to avoid seeking screening unless symptomatic and delay seeking treatment when symptoms arise (Barth et al. 2002; Leenaars et al. 1993). Social stigma, in particular, has been linked to refusal or delay in STI screening among youth (Barth et al. 2002). Stigma has been associated with a decreased likelihood of being tested, which is independent of other factors like age and sex (Fortenberry et al. 2002). Likewise, research with young women shows that symptomatic women have been shown to delay care longer than men (Fortenberry 1997; Fortenberry et al. 2002; Lichtenstein 2003).

Access to STI services is a major barrier to youth around the world. As STI screening and treatment are generally provided within health facilities, these services are often inaccessible to youth due to numerous barriers such as high cost, lack of privacy and confidentiality, logistical or

administrative restrictions, or negative attitudes of health workers. This is particularly the case with disenfranchised youth (such as homeless, incarcerated, unemployed, gay and transgender youth, or out of school among others), who are also disproportionately affected by HIV and other STIs (Denno et al. 2012). Additional barriers to testing include inaccurate information about STIs, denial, moral connotations and stigma, fear and anxiety, and viewing the tests as physically uncomfortable (Bauer et al. 2004).

Given the barriers to STI testing among youth, community-based approaches to care might be the most effective way to deliver sexual and reproductive health services. New research and initiatives with youth are targeting increasing access to testing through nonclinical sites. These community-based approaches may include intervention delivery outside of traditional health facilities, for example, in pharmacies, jails, detention centers, on the street, in parks, or community centers (Denno et al. 2012). So far, however, STI screening conducted via community or street outreach appears to yield mixed results, likely dependent on the type of setting. For example, one study in the USA, conducted in the city of San Francisco, investigated the feasibility of street-based screening and treatment for chlamydia and gonorrhea for homeless youth 15–24 years old. The researchers reported particularly high screening and treatment rates (99.5 and 94.1 %, respectively) and moderate partner treatment rates (75 %) among the target population (Auerswald et al. 2006). However, an outreach STI prevention program in Rotterdam, the Netherlands, targeting men and women 15–29 years of age, of non-Dutch ethnicity (in group and street settings and in a vocational training school) found that testing rates for *chlamydia trachomatis* varied significantly by venue. The investigators reported that testing was highest in group settings (80 %), followed by the vocational school (73 %), and lowest in street settings (17 %) (Götz et al. 2006). More recent policies have also allowed a shift to self-testing programs, but empirical research is lacking on their use and impact on youth accessing care and treatment services (Mavedzenge et al. 2013).

Perinatally HIV-Infected Adolescents (PHIVA)

Young people who were infected with HIV as children need to be reached urgently with care and treatment services. While over 90 % of HIV + pregnant women are reached with preventative HIV treatments in high-income countries, only 62 % of HIV + women in low- and middle-income countries have access to prevention services (UNAIDS 2013a). In resource-limited settings, the absence of intensive follow-up after PMTCT means that many PHIVA are unaware of their HIV status and only learn during regular medical check-ups or when experiencing medical distress (Agwu and Fairlie 2013). Many prenatally infected youth only enter HIV care after they are severely immune-compromised. HIV-infected adolescents have to deal with issues of maintaining lifelong adherence to HIV treatments, metabolic complications due to the medications, and the impact of highly toxic medications on their physical and neurocognitive development (Sohn and Hazra 2013). Reaching PHIVA individuals with early diagnosis, care, and treatment is also critical for preventing continued transmission to sexual partners and children born to PHIVA (Kasedde et al. 2013).

Partner Notification and Treatment

Partner notification is another well-established component of STI case management. In this approach, the partners of the infected individual are reached for treatment. Partners of infected individuals (index cases) are generally reached through three mechanisms: (1) notification of partners by the index case, (2) notification of partners by healthcare providers based on information provided by index cases, and (3) a mixed approach whereby index cases refer partners to a clinic where a provider will notify them

(Alam et al. 2010; Dallabetta et al. 2008). Partner notification, like screening and testing, is not a stand-alone strategy, but works best when coupled with efficient treatment and care mechanisms. So far, no single strategy of partner notification has been shown to be more efficient than another; effectiveness varies by local social and structural issues.

In some places, expedited partner therapy is practiced whereby the index case receives either a prescription or the actual medication to give to the exposed partner. The aim of expedited partner therapy strategies is to enhance the patient referral process, speed up the time to treatment for the partner, and reduce the risk of reinfection in the index case (Ferreira et al. 2013). These strategies, however, are not applicable in all settings. In the UK, for example, expedited partner therapy cannot be provided unless the partner also received a clinical assessment before receiving treatment (Ferreira et al. 2013). Other disadvantages include adverse drug reaction, misdiagnosis, missed opportunity for diagnosis of latent infections, and missed opportunity for STI and HIV counseling.

Overall, however, provider-facilitated partner notification has been found to be effective in many developed country settings. A review of partner notification strategies found that index patient-oriented partner notification was preferred in settings where there was a shortage of healthcare workers and where there was good counseling for index patients (Alam et al. 2010). Previous research has shown that young people may be particularly reluctant to engage in partner notification due to shame and stigma related to an STI or HIV diagnosis, fear of notifying partners and related consequences, and mistrust of medical or public health services. In the USA, for example, a study among young African-American men in a low-income, urban community in San Francisco—with high STI burden—found that stigma and shame of a STI diagnosis was associated with lower likelihood of partner notification and providing a partner with STI medication (Morris et al. 2014).

HIV Treatments and the Risk of HIV Transmission

Antiretroviral therapies (*ARTs*) ARTs are available to treat HIV infection (NIH 2012). Even though these treatments do not cure HIV or AIDS, they are highly effective in suppressing the virus and they reduce the likelihood of horizontal (to partners) or vertical transmission (to infants). Treatment also improves the health and the quality of life of infected individuals. Interventions designed primarily for adults that had high-quality, consistent biological evidence of efficacy included provision of antiretrovirals for the prevention of mother-to-child transmission and HIV treatments (Mavedzenge et al. 2014). The HPTN 052 study, a randomized control trial examining the use of antiretroviral drugs to reduce transmission of HIV from an index patient with HIV to a sexual partner, was overwhelmingly successful resulting in a 96 % reduction in HIV transmission (Padian et al. 2011). Other subsequent trails have confirmed that ART reduces rates of sexual transmission of HIV and highly active HIV treatments have become defined as an essential part of HIV prevention (Cohen et al. 2011; Mavedzenge et al. 2014).

Since decreasing HIV community viral load via expanding the proportion of the population in ART treatment may decrease HIV transmission, a recent focus of biomedical interventions has been framed as "treatment as prevention." Pre-exposure prophylaxis (PrEP) is an option for people who do not have HIV but who are at high risk of getting it to *prevent* HIV infection by taking medication every day. These medications are similar to ARTs used by HIV-positive persons on treatment. PrEP is ongoing and has shown tentative success in South Africa with a 39 % reduction in overall infection rates of HIV in women

participants (Padian et al. 2011). Another study showed that PrEP reduced the risk of HIV infection by as much as 92 % (Grant et al. 2010). Post-exposure prophylaxis (PEP) is another option for individuals who may have been exposed to HIV. It involves taking ARTs within 3 days of potential exposure to reduce chances of becoming HIV positive. A recent study among gay men, other men, and transgender women (who have sex with men and were at high risk of HIV infection) was asked to take *two Truvada* pills (or a placebo) from one day to two hours before they anticipated having sex. If they actually did have sex, then they were to take another pill 24 h after having sex and a fourth pill 48 h after it. The period of taking PrEP would thus cover two to three days. If they continued having sex, they were told to continue taking PrEP until 48 h after their last experience. This study found an 86 % reduction in HIV transmission in the PrEP arm (Molina et al. 2015).

However, HIV treatment programs reaching youth are challenged by problems of adherence, issues related to cost and universal access, and in the case of PrEP and PEP difficulties in linking asymptomatic people to treatment and partner notification. Young people living with HIV—both perinatally and behaviorally infected—have significant healthcare needs. Poor outcomes across the HIV care continuum—from linkage to care and timely ART initiation to retention in care and viral suppression—have been reported among both perinatally and behaviorally infected young people. A large multi-country study on attrition into HIV care among youth found that 48 % in the pre-ART phase of care were lost to follow-up or had died one year after enrollment. This is a serious concern given that ARTs are not effective unless taken continuously (NIH 2013). Two recent oral PrEP trails were also discontinued due to lack of effect attributed to low adherence among women (Mavedzenge et al. 2013). Furthermore, while HIV treatments can provide significant protection from HIV, it is even more effective when combined with condom use and other prevention tools.

Conclusion

STIs and HIV present major public health issues among young people globally, as the youth bear the heaviest burden of STIs. More rigorous data collection and surveillance systems are needed to adequately understand and address STI and HIV epidemics among youth. There is an increasing recognition of the range of interrelated social, structural, behavioral, and biological factors that contribute to STI transmission among young people. Special attention needs to be given at various levels to enable adolescents to access services and enact behavior change to avoid STIs (Mavedzenge et al. 2014). Biomedical interventions play a pivotal role in addressing STIs among young people. Advances in vaccine research and HIV treatments are promising approaches to reduce the youth STI vulnerability and burden. Yet, biomedical approaches alone cannot improve the sexual and reproductive health of adolescents. In fact, the implementation of biomedical interventions often requires supportive interventions at the community and policy levels, particularly for reaching young people. Innovative efforts to create enabling social and legal environments for young people are needed to prevent harmful practices, like gender-based violence, and remove age restrictions and sex restrictions to accessing effective prevention, treatment, and care services. Meaningful participation and engagement of young people are also needed in designing, developing, and assessing effective program and policy

efforts to reach the most vulnerable youth. Finally, it is critically important to think about reaching youth with integrated programming efforts—to conceptualize STI and HIV prevention and care—as part of broader health and development services for youth.

Acknowledgments We would like to thank Drs. Gail Shust and Dina Romo for their collegial review of the chapter drafts and Ms. Kathryn P. Martin and Ms. Nityanjali Thumallachetty for their support in gathering data and literature for this chapter.

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