

Sexually Transmitted Infections in Adolescents

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Abstract: Adolescents are the age group at greatest risk for nearly all Sexually Transmitted Infections (STIs). Adolescents are often at a higher risk for acquiring STIs because they are unable to conceptualize actions and their consequences. STIs are more prevalent among adolescent women than men, thus two thirds of newly infected adolescents aged 15-19 years are female. For reasons of biology, gender and cultural norms, adolescent females are also more susceptible than males to STIs. Biologically, adolescent women face increased anatomical and physiological susceptibility to infection due to increased cervical ectopy. The clinical presentation of STIs in adolescents should be carefully examined because some conditions are asymptomatic while other unrelated disease symptoms can easily be mistaken for STIs. This review presents some emergent epidemiological data from developed and developing countries that demonstrate the heavy burden of STIs on adolescents. However, more adolescent-specific STI studies are needed worldwide.

Keywords: Sexually transmitted infections, adolescents.

INTRODUCTION

Adolescence is the age range when persons are 10-19 years old [1]. Adolescents make up approximately 20% of the world's population; about 85% live in developing countries [2]. The definition of adolescents overlaps with that of the youth (aged 15-24 years) and young people (aged 10-24 years) [3].

The World Health Organization (WHO) estimates that each year, there are over 340 million new cases of curable bacterial and protozoal Sexually Transmitted Infections (STIs), namely those caused by *Treponema pallidum*, *Neisseria gonorrhoeae*, *Chlamydia trachomatis* and *Trichomonas vaginalis*, as well as many millions of persistent viral STIs, including some 5 million new Human Immunodeficiency Virus (HIV) infections, Human Herpes Viruses (HHV), Human Papilloma Viruses (HPV), and Herpes Simplex Viruses (HSV) [4]. STIs are spread primarily through person-to-person sexual contact [4]. STIs are a major worldwide public health concern and enigma [5]. Nearly a million people acquire an STI, including HIV, every day [4]. The annual occurrence of STIs, including HIV, accounts for the loss of more than 51 million years of healthy life among men, women and children worldwide [6]. In developing countries, STIs account for 17% of economic losses caused by ill-health [7]. In the United States of America (USA), annual health costs for STIs has reached US\$17 billion [8].

Adolescents are the age group at greatest risk for nearly all STIs [5]. One in 20 young people contracts a curable STI each year [1]. One out of four sexually active adolescent women is diagnosed with an STI every year [5, 9]. The

reasons for this trend are many, including cognitive development, physiologic susceptibility, peer pressure, logistic issues, and specific sexual behaviours [5].

In the USA, for example, 15 million people become infected with an STI each year [10, 11]. Adolescents aged 15-19 years account for approximately 3 million cases, meaning one out of four sexually active teenager reports an STI every year [8, 11]. This high prevalence will not only affect teens during adolescence, but also have an impact on their adult years through long-term sequelae, ectopic pregnancy, chronic abdominal pain, or infertility which can result from pelvic inflammatory disease (PID) [5]. Most STIs are sub-clinical and asymptomatic, making them a hidden epidemic [12].

STIs found in adolescents include gonorrhoea, *Chlamydial* infection, syphilis, trichomoniasis, chancroid, genital herpes, genital warts, HIV infection and hepatitis B infection [4]. Several STIs, in particular HIV and syphilis, can also be transmitted from mother to child during pregnancy and childbirth, and through blood products or tissue transfer [13].

There are more than 30 different sexually transmissible bacteria, viruses and parasites but only 19 of these are listed as the main causative agents of STIs [4]. Bacterial pathogens include *Neisseria gonorrhoeae* (causes gonorrhoea or gonococcal infection), *Chlamydia trachomatis* (causes *Chlamydial* infections), *Treponema pallidum* (causes syphilis), *Haemophilus ducreyi* (causes chancroid), and *Klebsiella granulomatis* (previously known as *Calymatobacterium granulomatis* causes granuloma inguinale or donovanosis). Viral Sexually Transmitted Diseases (STDs) are caused by Human immunodeficiency virus (causes AIDS), HSV type 2 (causes genital herpes), HPV (causes genital warts and certain subtypes lead to cervical cancer in women), Hepatitis B virus (causes hepatitis and chronic cases may lead to cancer of the liver), HHV-8 causes Kaposi Sarcoma, and Cytomegalovirus

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(causes inflammation in a number of organs including the brain, the eye, and the bowel). Parasitic organisms include *Trichomonas vaginalis* (causes vaginal trichomoniasis), and *Candida albicans* which causes vulvovaginitis in women and inflammation of the glans penis and foreskin (balanoposthitis) in men [4].

RISK FACTORS

Cultural and Socio-Economic Factors

Two thirds of newly infected adolescents aged 15-19 in sub-Saharan Africa are female. Among women, the peak age for STI prevalence tends to be around age 25, 10 to 15 years younger than the peak age for men [2]. This is partly because sexually active adolescent women in Africa have partners 2-10 years their senior. STIs are usually the end-results of unprotected sex with a number of casual partners, but may also occur among those that have long-term unfaithful older partners or husbands. The risk of STIs is higher among adolescents that are poor and marginalized as they succumb to unprotected sex through coercion, force, violence and transactional reasons [2]. Some poor adolescent women engage in transactional sex, exchanging sex for money or gifts such as soap, perfume, meals, jewellery, school fees and help to their families [2]. Once in these relationships with teachers, drivers, shopkeepers or even policemen, girls have little power to negotiate the use of condoms.

Cognitive Factors

Cognitive development of adolescents may place them at increased risk of acquisition and transmission of STIs, as well as obstruct treatment and prevention efforts [5]. Adolescents are often at a higher risk for acquiring STIs because they are unable to conceptualize actions and their consequences thus many are unable to negotiate safer sex [5].

Biological Factors

Biologically, adolescent girls are at higher risk of contracting STIs. In adolescent girls, the cervix and vagina undergo dramatic histological changes due to estrogen exposure [12]. The epithelial lining of the vagina and cervix thicken and undergoes squamous metaplasia. The cervical columnar epithelium eventually recedes completely and is replaced by squamous epithelium. The replacement process is gradual and continues into adulthood. Hence the cervix in adolescent girls still displays areas of exposed columnar epithelium, a condition known as cervical ectopy [12]. Thus the cervix has an increased amount of ectropion (columnar epithelium that extrudes over the exocervix and into the vaginal vault) that makes adolescent girls more susceptible to gonorrhoea and *Chlamydia* [14, 15]. Columnar epithelium is more vulnerable than squamous epithelium to infection by *Chlamydia*. Adolescent females are also at greater risk of HSV-2 infections [16].

Sexual Behavior and Education

Specific sexual behaviours such as early sexual activity (38% of 9th graders and 42% of 10th graders in the USA have already tasted coitus), selection of older sexual partners, and inconsistent use of condoms increase adolescent susceptibility to STIs [5]. Other studies show that 55% and 49% of USA adolescent males and females, respectively,

were sexually active, with 19% of adolescent women reporting sexual debut at age 15 in 1995 [17]. Some 29% of USA adolescent men and 19% of adolescent women did not use condoms in their most recent sexual intercourse [17]. Most adolescents do not accurately perceive their susceptibility to STIs. For example, 81% of adolescent women diagnosed with gonorrhoea had perceived themselves to be at little or no risk of STIs [18]. Adolescents may also have inaccurate information regarding STIs.

A high prevalence of sexual intercourse was also observed among school-going adolescents in Namibia [19]. Using data from the Namibia Global School-Based Health Survey 2004, the overall prevalence of sexual intercourse in the preceding 12 months was 33.1% (43.9% males and 25.4% females). Sexual intercourse was higher among school-going adolescents that smoked cigarettes, drank alcohol, and used drugs. Parental supervision was negatively associated with sexual intercourse [19]. Sexual activity in Namibia begins at a very young age, often as low as 10 years. Data obtained from a cross-sectional survey conducted among adolescents aged 12-18 years, of median age 15 years, living in school-based hostels in Namibia, showed that 56% of the boys had already experienced sexual intercourse [20]. Among those that were sexually experienced, 29% had more than one sex partner in the preceding six months, and only 50% used a condom during their most recent intercourse [20]. Adolescents are more vulnerable to STIs because of a lack of sex education, yet in some instances, sex education in schools begins late when adolescents have already been initiated into sexual intercourse.

Limited Success of Preventive and Treatment Services

The higher prevalence of STIs among adolescents could be attributed to the many barriers to adolescent-sensitive STI prevention services, including non-compliant treatment seeking behaviours driven by the lack of health insurance or other inability to pay, lack of transportation to STI clinics, embarrassment with facilities and services designed for adults, and apprehensions about confidentiality [21]. Customized STI service delivery for adolescents is often lacking, and even in developed countries, many adolescents that have contracted STIs are still unreachable [22-24].

Demographic and Ecological Factors

Demographic and ecological variables (e.g. poor neighbourhoods) put certain groups of adolescents at greater risk of STIs, especially minorities, gay, lesbian and transgender youth, drug users (particularly parenteral), homeless, runaways, commercial sex workers, and pregnant or incarcerated (jailed) youths [21].

Co-Infection with HIV

The presence of syphilis, chancroid ulcers or genital herpes simplex virus infection greatly increases the risk of acquiring or transmitting HIV. This was more so after evidence from Mwanza, Tanzania, showed that rigorous syndromic management of STIs reduced new HIV infections by 40% [25]. These results demonstrated that STIs account for 40% of new HIV infections, hence STI treatment is an important strategy in the prevention of AIDS, especially in sub-Saharan Africa where 25% of adolescent girls are infected by HIV [26]. Bacterial vaginosis and physico-

chemical disturbances of the vaginal flora also increases acquisition of HIV [26].

EPIDEMIOLOGICAL EVIDENCE

There are overwhelming epidemiological data that demonstrate the heavy burden of STIs on adolescents. In 2007, WHO estimated that a third of the 333 million cases of curable STIs occurred among young people under the age of 25 [4]. The highest infection rates are in 20-24 year olds, followed by adolescents aged 15-19 years. Young people were also more likely than adults to be re-infected after having been treated [2, 4, 5]. More than 40% of adolescents are subsequently infected by at least one STI other than the initial infecting organism [27].

Adolescents and young people make up only 25% of the sexually active population but represent almost 50% of all new STIs [28]. About 60% of adolescent patients with one STI are concurrently infected with another [29], and new STIs are still detected in adolescents with low and high viral loads of HIV [30]. *C. trachomatis* is the most common cause of STDs worldwide, with highest infection rates among females aged 15-24 years [14]. One third of all *C. trachomatis* cases worldwide occur among adolescents [11]. *Chlamydia* has received significant attention as the most common bacterial STI and the primary aetiological culprit for epididymitis in males, PID, tubal infertility, and ectopic pregnancy in females [31].

The World Health Organization, United Nations Development Programme (UNDP) and the World Bank currently sponsor a program called the Sexually Transmitted Disease Diagnostics Initiative (SDI) [32]. The SDI was founded in 1990 in response to a widely-perceived need to improve care for patients with STIs in resource-limited settings through improved diagnostics. The SDI secretariat had been housed in various agencies since its inception and has most recently moved from UNAIDS to the WHO, where it is managed out of the Special Program for Research and Training in Tropical Diseases [32].

Developed Countries

Estimates indicate that 30 million curable STIs (syphilis, gonorrhoeae, *Chlamydia* and trichomoniasis) occurred every year in North America and Western Europe in the mid-1990s [33]. In an extensive review by Panchaud and others [33], 31% of USA adolescents had *Chlamydia* and gonorrhoeae in 1996; 24% of adolescents in Canada had gonorrhoeae in 1996; and 18% of adolescents in the Russian Federation had syphilis in 1994. The incidence of syphilis was 2-3 times higher among female adolescents than male adolescents in Canada, Finland, the Russian Federation and the USA [33].

The bulky of age-specific epidemiological data on STIs in adolescents are from the USA where widespread screening and reporting are undertaken by the Centres for Disease Control and Prevention (CDC). Table 1 shows the epidemiological burden of STIs in the USA. About 15 million cases of STIs occur annually in the USA, nearly 4 million among adolescents [34]; a quarter of STIs are found in adolescents aged 15-19 years [35]. As many as 26% of adolescent girls in the USA may be infected with at least one STD, according to a CDC study presented at the 2008

National STD Prevention Conference [36]. The STD prevalence among girls who reported three or more lifetime sex partners was approximately 50%. After controlling for sexual behavior, black girls were more than three times as likely to contract an STD compared with white girls. In this study, 48% of black girls had at least one STD compared with 20% of adolescent white girls. The two most common STDs among adolescent girls were HPV and *Chlamydia*. Approximately 18% of girls had HPV and 4% had *Chlamydia*. The CDC recommends annual *Chlamydia* screening for sexually active women aged 25 and younger. The CDC also recommends that girls and women aged between 11 and 26 years who have not been vaccinated or who have not completed the full series of shots be fully vaccinated against HPV.

Genital *C. trachomatis* infection is one of the most prevalent STIs in the USA, with a 43.5% infection rate in the general population, and a 3:1 ratio among women and men [28]. In adolescents, *Chlamydia* is more prevalent than gonorrhoea [37]. *Chlamydia* rates among USA adolescents are 20 times higher than among adolescents in France, five times higher than in England and Wales, and twice as high as in Canada [33]. African-American females and males aged 15-19 years were seven times and 12 times more likely to have *Chlamydia* than their white counterparts, respectively [38]. In Australian adolescents sampled from High Schools around Brisbane, the overall prevalence of *C. trachomatis* infection among adolescents was low; a finding that differed significantly from *Chlamydia* rates found in adolescents detached from formal schooling [31]. In western countries, adolescent females under the age of 20 are most susceptible to *C. trachomatis* [39]. Females under the age of 20 are more likely to be infected by *C. trachomatis* [39].

Gonorrhoea is the second most commonly reported STI in the USA with about 600,000 new cases as of 2004 [40]; this case load has come down to about 350,000 annual cases as of 2008; 30% of which involve 15-19 year olds [14]. While the overall USA rate of gonorrhoea was 129 per 100,000 in the general population, the rate among adolescent women aged 15-19 years was 703 per 100,000 [38]. Gonorrhoea rate among USA adolescents is 74 times higher than the rate in the Netherlands and France, 10 times higher than in Canada, and seven times higher than in England and Wales [33]. Overall, 75% of all USA reported gonorrhoea cases were in African-Americans (782 per 100,000 population) [38]. Gonorrhoea rates among 15-19 year-old whites were highest in the South; 325.0 cases per 100,000 population for white females and 124.4 cases per 100,000 population for white males [41]. Despite the fact that overall incidence of gonorrhoea has declined in the USA, the disease is now highest among 10-14 year olds [42].

From 1981-91, 24-30% of the reported morbidity from gonorrhoea and 10-12% of the reported morbidity from primary and secondary syphilis in the USA were from the adolescent age groups [21]. Over the 10-year period, gonorrhoea rates decreased among all age and sex groups except 10-14 year-old males (41%), 10-14 year-old females (51.2%), and 15-19 year-old males (1.6%) [21]. In 1991, some of the highest rates of gonorrhoea were among 15-19 year-olds; 882.6 cases per 100,000 population for males and

Table 1. Epidemiological Burden of STIs in the United States

STD/Aetiological Agent	Age Group	Infection Rate	Year/Years of Study	References
Human Papillomavirus	All adolescents, 14-19 years	35%	2000	[74]
Human Papillomavirus	Adolescent females, 14-19 years	18%	2003/04	[75]
Human Papillomavirus	Adolescent females that reported sexual intercourse	30%	1999	[76]
<i>Chlamydia</i>	Adolescent females that reported sexual intercourse	7%	1999	[76]
<i>Chlamydia</i>	Adolescent females, 15-19 years	2,796.6 cases per 100,000 persons	2003	[77]
<i>Chlamydia</i>	Adolescent females, 15-19 years	2,536 cases per 100,000 persons	2001	[38]
<i>Chlamydia</i>	Adolescent females, 15-19 years	2,483 cases per 100,000 persons	1999	[78]
<i>Chlamydia</i>	Adolescent males, 15-19 years	376 cases per 100,000 persons	2001	[38]
<i>Chlamydia</i>	Non-adolescent young men, 20-24 years	2,691 cases 100,000 persons	2003	[77]
<i>Chlamydia</i>	Adolescent males, 15-19 years	344 cases per 100,000 persons	1999	[78]
<i>Chlamydia</i>	Adolescent females, 10-19 years	29.1%	1998	[79]
<i>Chlamydia/gonorrhoeae</i>	All adolescents, 10-19 years	31%	1996	[33]
Gonorrhoea	Adolescent females, 15-19 years	624.7 cases per 100,000 adolescent females aged 15-19 years	2000	[74]
Gonorrhoea	Adolescent females, 10-14 years	35.1 cases per 100,000 females aged 10-14 years	2006	[80]
Gonorrhoea	Adolescent females, 15-19 years	625 cases per 100,000 females aged 15-19 years	2006	[80]
Gonorrhoea	Adolescent females, 15-19 years	703 cases per 100,00 females aged 15-19 years	2001	[38]
Gonorrhoea	Adolescent males, 10-14 years	41%	1981-91	[21]
Gonorrhoea	Adolescent females, 10-14 years	51.2%	1981-91	[21]
Gonorrhoea	Adolescent females, 15-19 years	1,043.6 cases per 100,000 population of females	1991	[33]
Primary and secondary syphilis	All adolescents, 10-19 years	10-12%	1981-91	[41]
Herpes Simplex Virus type 2	All adolescents, 10-19 years	5.6% seroprevalence rate	1976-94	[81]
Herpes Simplex Virus type 2	All adolescents, 10-19 years	12% seroprevalence	1997	[82]
<i>Trichomonas vaginalis</i>	Adolescent girls, 10-19 years	14%	unspecified	[15]

1,043.6 cases per 100,000 population for females, respectively [33]. In the United Kingdom (UK), gonorrhoea cases increased by 8% in males and 10% in females; among females, 40% of the cases were in adolescent girls [43]. *Chlamydial* and gonorrhoea infections are often transmitted together, and are usually asymptomatic [14]. Up to 84% of adolescent men infected with *N. gonorrhoeae* had no symptoms [14].

At least 50 million people in the USA have genital herpes simplex infection with one million new cases of HSV-2 diagnosed each year [44]. HSV infection results from exposure to infected oral or genital secretions. Both HSV-1 and HSV-2 are capable of causing oral or genital infection. However, almost all oral infections are caused by HSV-1. HSV-2 is almost exclusively sexually transmitted, hence its sero-detection is indicative of having acquired genital HSV-2 infection. HSV-2 seroprevalence in adolescents has been

reported in several studies, see Fig. (1). An 80% increase in the number of new cases of genital herpes were recorded in the decade leading to 2004 in the UK, with 17% of all primary HSV infections occurring in adolescent girls below 19 years [45].

Developing Countries

It is estimated that 80-90% of the global burden of STIs occurs in the developing world where there is limited or no access to diagnostics [4]. In particular, there is an urgent need for improved diagnostics for STIs in HIV endemic areas as studies in sub-Saharan Africa have shown that STIs are important cofactors in the transmission of HIV infection. The issues of concern for treating and preventing STIs are similar to those for HIV/AIDS. The focus of international discussion should remain focussed around three themes: (1) access to treatment, (2) increasing healthcare personnel to treat and test for STIs to reduce the risk of complications

from untreated infections, and (3) continued commitment on the part of member states to finance treatment and prevention programs sponsored by the World Health Organization.

Research on STIs of adolescents in developing countries is confronted by two basic methodological challenges. First, there is paucity of comprehensive age and sex-specific data on STIs (excluding HIV). Thus the true scale of the epidemiological burden of STIs among adolescents is not known because most surveys are done at specific health services such as family planning and antenatal clinics where adolescents are under-represented. Epidemiological surveys to determine prevalence of STIs among out-of-school adolescents are also lacking. Generally, STIs are more prevalent among African and Caribbean adolescents than in other regions of the world, partly because sexual debut comes as early as 10-11 years in some African and Caribbean countries [19]. Studies on gonorrhoea in selected Middle East and African countries found STI levels were highest among 15-19 year olds [46].

Second, the prevalence of STIs among adolescent boys has not been widely reported. This may be due to non-treatment seeking behaviour, or may partly reflect the lower disease burden in this group. A few studies [47, 48] report STI infections in males but do not mark out those for adolescents. But many adolescent boys in studies from Argentina, Botswana, Peru, the Phillipines, the Republic of Korea and Thailand have experienced symptoms of STIs [49]. Notwithstanding, there are a few age and sex-specific data on STIs other than HIV. Table 2 shows the epidemiological burden of STIs in some developing countries. In Dhaka, Bangladesh, the prevalence of STIs in 13 to 18-year old hotel-based female sex workers was 6.6% [50]. In Bangladeshi adolescents under the age of 15 years, no males reported having had an STI but 2.9% of females reported an STI in the past 12 months in the 15-19-year age group [50]. This low prevalence of STIs in Bangladeshi could be due to religious and cultural beliefs.

In South Africa, adolescent girls were 30% more likely to get STIs than their male counterparts, partly because of their older male partners who are more likely to have STIs [51]. In KwaZulu Natal, two-thirds of abused adolescents had one or more STIs [52]. In Younde, Cameroon, overall rates of STIs among adolescent boys ranged from 15-25% in the year 2000 and 14-18% in 2002 [53]. The burden of STIs among adolescent girls was notably higher, averaging 46-55% in the year 2000 and 34-36% in 2002 [53]. Such higher rates among adolescent girls raise the question whether STIs were lumped together with non-sexually transmitted reproductive tract infections [53].

In Dar es Salaam, Tanzania, the burden of STIs in the general adolescent population was high, especially for genital discharge and candidiasis [54]. More adolescent females (20.8%) were HIV infected than males (11.5%) [55]. There was a tendency towards genital ulcerative disease in HIV-infected than non-infected adolescents, 27 vs 19% in males, and 49 vs 23% in females, respectively [55]. In the Central African Republic, there is at least one STI in 34% of antenatal clinic attendees aged 14-22 years [56], with about

12% of those with STIs being HIV-positive. Almost a quarter of pregnant adolescents aged 15-19 years in Tanzania had *Trichomonas vaginalis* which places young adolescents at increased risk of contracting HIV [57].

Chlamydia is considered an adolescent infection, and its presence is a marker of recent onset of sexual activity. In Jamaica and the Democratic Republic of Congo, almost 50% of adolescents at high risk of STIs may have either gonorrhoea or *Chlamydia* or both [58, 59], respectively. However, in most developing countries, the prevalence of gonorrhoea is lower than *Chlamydia*, often below 10% [2] with a slight exception in Namibia where 11% of adolescent girls presented with gonorrhoea in 1998 [60]. In 2002, 4.1% of Namibian adolescent males and 4.5% of adolescent females self-reported STIs [61]. Of these, 3.9% of male adolescents and 6.3% of female adolescents indicated that they had genital discharge, while 3.6% of males and 3% of females had genital ulcers or sores [61]. Syphilis was reported among 5% of Namibian adolescents. The prevalence of gonorrhoea was low: <5% in Nigerian and Senegalese adolescents that live in villages, and about 6% in Kenyan adolescents attending Family Planning and antenatal clinics [2]. Adolescent sex workers were 2.5 times more likely to have cervicitis although it could not be attributed to gonorrhoea or *Chlamydia* [62]. STI prevalence in Brazilian adolescents was 2% for gonorrhoea [63], and 5-20% for *Chlamydia* [63-65].

Fig. (1) compares HSV-2 seroprevalence rates in developed and developing countries. The results show that the seroprevalence of HSV-2 is significantly higher in less developed countries (Uganda and Tanzania) than in the developed world (Spain and Sweden).

CLINICAL SYMPTOMS

The clinical presentation of STIs in adolescents is peculiar because various other symptoms can be mistaken for STIs [66]. In girls, endogenous vaginitis rather than an STI is the main cause of vaginal discharge among adolescent females. However, there may be vulval itching, minor discharge, urethritis or proctitis. In pre-pubescent girls, a purulent vulvo-vaginitis may occur. Similarly, *C. trachomatis* infection is asymptomatic in the majority of adolescent girls. Symptoms that may occur in the adolescent woman are inter-menstrual bleeding, post-coital bleeding and an increase in vaginal secretions [4].

C. albicans is uncommon in adolescent women prior to puberty. If present, the adolescent may have a discharge, vulval itching, dyspareunia, peri-anal soreness or a fissuring at the introitus [4, 66]. Attacks of candida vulvitis may be cyclical in nature and corresponds to menstruation [4]. Bacterial vaginosis does not produce vulvitis and the adolescent girl will not complain of itching or soreness [4]. The signs of acquired syphilis in children present with small chancres or mucocutaneous moist lesions either on the vulva or anus. Presentation of syphilis is the same in adolescent girls and adults [4]. In adolescent boys, gonorrhoea presents as proctitis, urethral discharge, asymptomatic pyuria, penile edema, epididymitis and testicular swelling. Disseminated gonorrhoea presents with multiple systemic manifestations. *Chlamydia* in adolescent males presents as urethritis [4].

Table 2. Epidemiological Burden of STIs in Some Developing Countries

Country	STD/Aetiological Agent	Age Group	Infection Rate	Year of Study - Reference
Tanzania	Genital discharge	Adolescents, 10-19 years	54% in males; 63% in females	2006 [54]
Tanzania	Candidiasis	Adolescent women, 10-19 years	27%	2006 [54]
Tanzania	Bacterial vaginosis	Adolescent women, 10-19 years	17%	2006 [54]
Tanzania	Trichomoniasis	Adolescent women, 10-19 years	11%	2006 [54]
Tanzania	<i>Trachomatis vaginalis</i>	Pregnant adolescents, 15-19 years	25%	1996 [57]
Tanzania	<i>Chlamydia trachomatis</i>	Adolescent men, 10-19 years	10%	2006 [54]
Tanzania	Genital warts	All adolescents, 10-19 years	3.3%	2008 [55]
Tanzania	Genital ulcer disease	All adolescents, 10-19 years	14%	2008 [55]
Tanzania	Herpes Simplex Virus type 2	Adolescent women in rural areas, 15-19 years	43% seroprevalence	1999 [83]
Tanzania	Herpes Simplex Virus type 2	Adolescent men in rural areas, 15-19 years	20% seroprevalence	1999 [83]
Central African Republic	Gonorrhoea	14-22 year old antenatal clinic attendees	3.1%	1999 [56]
Central African Republic	<i>Chlamydia</i>	14-22 year old antenatal clinic attendees	6.2%	1999 [56]
Central African Republic	Syphilis	14-22 year old antenatal clinic attendees	7%	1999 [56]
Central African Republic	Bacterial vaginosis	14-22 year old antenatal clinic attendees	29%	1999 [56]
Central African Republic	Candidiasis	14-22 year old antenatal clinic attendees	47%	1999 [56]
Uganda	<i>Chlamydia</i>	Adolescent men, 10-19 years	26%	1994 [84]
Uganda	<i>Chlamydia</i>	Adolescent women in village surveys, 10-19 years	6%	1996 [39, 45]
Uganda	<i>Chlamydia</i>	Adolescent women, antenatal clinic attendees, 10-19 years	10-20%	1995 [2]
Uganda	Herpes Simplex Virus type 2	All adolescents, 15-19 years	34% seroprevalence	1994 [84]
Uganda	Herpes Simplex Virus type 2	Adolescent women in rural areas, 15-19 years	27% seroprevalence	1994 [84]
Uganda	Herpes Simplex Virus type 2	Adolescent men in rural areas, 15-19 years	7.5% seroprevalence	1994 [84]
Senegal	<i>Chlamydia</i>	Adolescent women, sex workers, 10-19 years	>40%	1995 [2]
Nicaragua	<i>Chlamydia</i>	Adolescent women, antenatal clinic attendees, 10-19 years	6%	unclear [2]
Nigeria	<i>Chlamydia</i>	Adolescent women in village surveys, 10-19 years	10%	1996 [39, 45]
Nigeria	Genital warts	Adolescent women, 10-19 years	2%	1998 [85]
Nigeria	<i>Trichomonas vaginalis</i>	All adolescents, 15-19 years	25%	1995 [2]
Thailand	<i>Chlamydia</i>	Adolescent women, antenatal clinic attendees, 10-19 years	12%	unclear [2]
Brazil	<i>Chlamydia</i>	Adolescent women, 15-19 years	9%	2004 [63]
Brazil	Gonorrhoea	Adolescent women, 15-19 years	2%	2004 [63]
Brazil	<i>Chlamydia</i>	Adolescent women+ young women	20%	2006 [65]
Brazil	<i>Chlamydia</i>	Adolescent men, asymptomatic military conscripts	5%	2005 [64]
Zambia	Penile discharge caused by <i>Chlamydia</i> or gonorrhoea	Adolescent men, 10-19 years	3.3%	1996 [86]

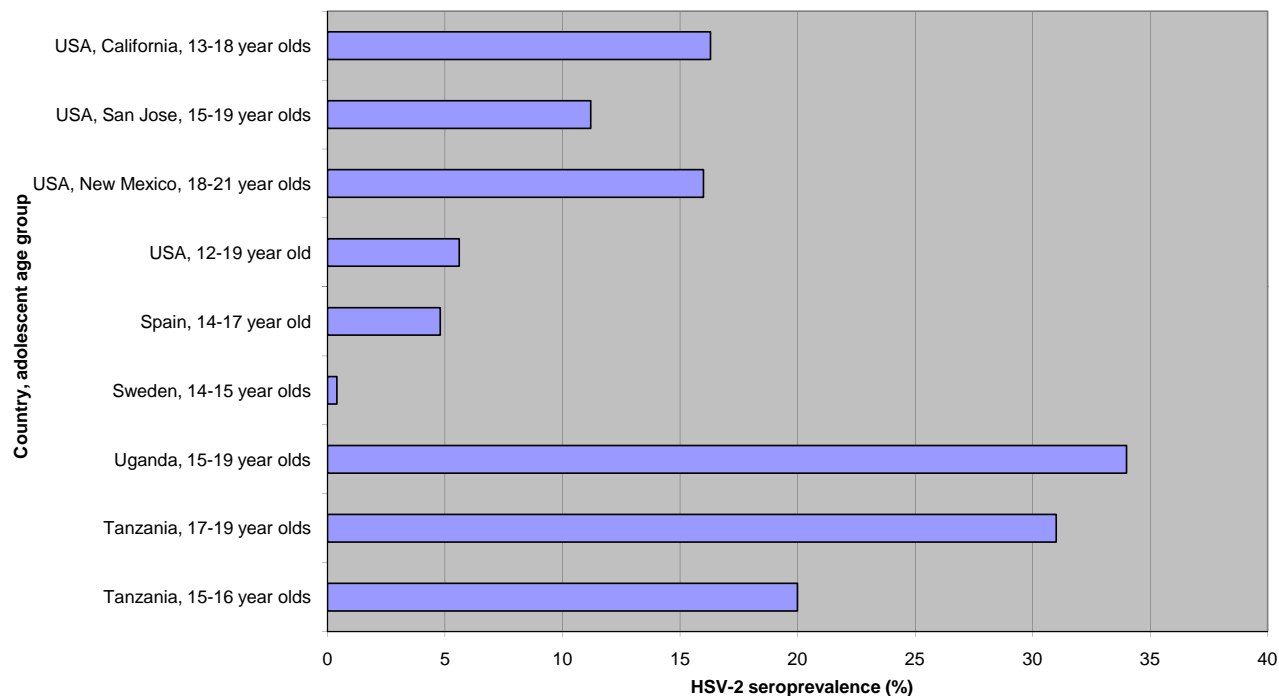


Fig. (1). HSV-2 seroprevalence in adolescents from different settings.

Some STIs usually exist without symptoms. For example, approximately 85% of gonococcal infections in females will be asymptomatic, and up to 70% of women and a significant proportion of men with gonococcal and/or *Chlamydial* infections may experience no symptoms at all [4]. Both symptomatic and asymptomatic infections can lead to the development of serious complications and sequelae [4]. Non-treatment of *Chlamydia* results in long-range sequelae such as PID, ectopic pregnancy and infertility [2]. PID was found in 15% of adolescents with untreated *Chlamydia* [67], and adolescence was highly associated with recurrent PID in the USA [68].

STIs are a bigger problem in pregnant adolescents where they cause more miscarriages than in older pregnant women [69]. In Malawi, for example, 52.3% of all nulliparae at antenatal clinics were adolescents, 25% were 16 years or younger, of which 4.5% were VDRL-positive [69]. Untreated syphilis in adolescent girls causes 25% of pregnancies to result in stillbirth and 14% in neonatal death, and an overall perinatal mortality of about 40% [4]. Approximately 35% of pregnancies among women with untreated gonococcal infection result in spontaneous abortions and premature deliveries, and up to 10% in perinatal deaths [4]. In the absence of prophylaxis, 30-50% of infants born to adolescent mothers with untreated gonorrhoea and up to 30% of infants born to adolescent mothers with untreated *Chlamydial* infection develop ophthalmia neonatorum, a condition that can lead to blindness if untreated [4]. Many asymptomatic adolescents are unaware of their being infected, and in addition to not seeking treatment, this 'silent reservoir' continues to spread STIs in the general adolescent population.

MANAGEMENT OF STIs IN ADOLESCENTS

Management of STIs is a major challenge in many countries because of the emergency of drug resistant strains of STIs and HIV. Drug resistance has contributed to many cases of STI treatment failures, besides making STI treatment more expensive [70]. Although effective STI patient management is the cornerstone of STI control, management of STIs remains one of the greatest challenges in health care delivery especially in developing countries. Several factors have contributed to the problem of STI management: stigma, societal attitudes towards sex, inadequate resources, high levels of drug resistance, lack of diagnostic facilities, and lack of trained person-power [71]. The key steps in the management of STI patients are: making the correct diagnosis, prescribing the correct and effective treatment, and equipping the patient with information to promote safer sex and personal prophylaxis through counseling, contact tracing, and condom promotion [71]. Traditionally, management of STIs is based on laboratory diagnosis and prescription of treatment tailored to the etiological diagnosis. This has remained the benchmark of medical practice for ages. However, due to non-availability of laboratory equipment in some settings, coupled with the time-lag in waiting for laboratory results, patients have to be managed by covering the common causes of the particular disease. This approach is now known as syndromic STI management where the diagnosis is based on a combination of symptoms and signs which the patient presents [71]. There are several advantages and disadvantages of both etiological and syndromic management but regardless of the approach, the management of STIs in adolescents should be based on the these principles: confidentiality; correct

diagnosis; correct drug, dosage and route; counseling; compliance; contact tracing; condom promotion; and clinical follow-up [71].

Treatment

Drugs for STI treatment should meet the following criteria: high efficacy, low cost, low toxicity, preferably single dose, given by oral administration, low or no resistance to target organism, and not contraindicated in pregnant women [12]. Practitioners recommend that since compliance can be a serious drawback among adolescents, single-dose therapy should be used whenever possible [5]. Further, practitioners should be sure that their adolescent patients understand the need to abstain from sexual

intercourse for at least 7 days following the completion of their therapy. It is recommended that patients with gonococcal infections be treated for *Chlamydia* as well, because of a coinfection in one third of cases of gonorrhoea. Dual treatment of co-infected adolescents is encouraged as it may reduce the development of resistant strains [72]; 30% of *N. gonorrhoeae* isolates were resistant to penicillin, tetracycline, or both [73]. On the other hand, syndromic management of *C. trachomatis* infection could be inadequate because this infection produces few or no symptoms at all in the majority of women and men. There are recommended and alternative regimens for treatment of STI organisms and syndromes as shown in Tables 3 and 4.

Table 3. Treatment of STIs, by Commonly Transmitted Organisms

Infection	Recommended Regimens	Alternative Regimens
<i>Chlamydia trachomatis</i>	Azithromycin 1g PO single dose or Doxycycline 100mg PO 2x/d for 7 days	Erythromycin base 500mg PO 4x/d for 7 days or Erythromycin ethylsuccinate 800mg PO 4x/d for 7 days or Ofloxacin 300mg PO 2x/d for 7 days
<i>Neisseria gonorrhoeae</i>		
Uncomplicated cervical, urethral, or rectal	Cefixime 400mg PO single dose or Ceftriaxone 125mg IM single dose or Ofloxacin 400mg single dose + Azithromycin 1g PO single dose or Doxycycline 100mg PO 2x/d for 7 days	Erythromycin base 500mg PO 4x/d for 7 days or Erythromycin ethylsuccinate 800mg PO or May be substituted for azithromycin or doxycycline
Pharyngeal	Ceftriaxone 125mg IM single dose or Ciprofloxacin 500mg PO single dose or Ofloxacin 400mg PO single dose + Azithromycin 1g PO single dose or Doxycycline 100mg PO 2x/day for 7 days	None
Syphilis		
No penicillin allergy, Early syphilis;	Procaine Penicillin 1.2 megaunit imi for 10 days or Benzathine Penicillin 2.4 megaunit imi for 3 weeks	Tetracycline 500mg orally 4x/d for 25 days or Erythromycin 500mg orally 4x/d for 15 days
No penicillin allergy, Late latent syphilis	Procaine Penicillin 1.2 megaunit and Probenecid 500mg for 15 days	
Penicillin allergy	Doxycycline 100mg bd for 2 weeks for early syphilis, and 4 weeks for late syphilis, respectively	
Chancroid	Erythromycin 500mg orally 4x/d for 7 days	None
Candidiasis	Nystatin 1000 IU intravaginally daily for 14 days or Miconazole 200mg intravaginally daily for 3 days	None
Genital herpes infections		
Primary first episode	Acyclovir 200mg Orally 5x/d for 5 days or Famciclovir 250mg tds for 5 days Valaciclovir 500mg bd for 5 days	None
Frequent and recurrent episodes	Prophylactic continuous antiviral therapies: Acyclovir 400mg bd for 6-12 months; then assess disease activity	None
Trichomoniasis	Metronidazole 2g PO single dose or Metronidazole 500mg PO 2x/d for 7 days	None

Adapted from references [5, 12].

Table 4. Treatment of STIs, by Common Syndromes

Syndrome	Recommended Regimens	Alternative Regimens
Urethritis	Cefixime 400mg PO single dose or Ceftriaxone 125mg IM single dose or Ofloxacin 1g PO single dose + Azithromycin 1g PO single dose or Doxycycline 100mg PO 2x/d for 7 days	None
Recurrent/persistent urethritis	Metronidazole 2g PO single dose + Erythromycin base 500mg PO 4x/d for 7 days or Erythromycin ethylsuccinate 800mg PO 4x/d for 7 days	None
Epididymitis	Ceftriaxone 250mg IM single dose + Doxycycline 100mg PO 2x/d for 10 days or Ofloxacin 300mg PO 2x/d for 10 days	None
Bacterial vaginosis	Metronidazole 500mg PO 2x/d for 7 days or Clindamycin cream 2%, one full applicator (5g) intravaginal at bedtime for 7 days or Metronidazole gel 0.75%, one full applicator (5g) intravaginal 2x/d for 5 days	Metronidazole 2g PO single dose or Clindamycin 300mg PO 2x/d
Prophylaxis after sexual attack	Ceftriaxone 125mg single dose + Metronidazole 2g PO single dose + Azithromycin 1g PO single or Doxycycline 100mg 2x/d for 7 days	None

Adapted from references [5, 12].

There are several challenges that face STI treatment in adolescents [2, 24]. Most STI treatment infrastructure and services are tailored towards adults, hence adolescents who think they may have an STI often delay or do not seek treatment due to lack of adolescent-friendly services. The fear of disapproval of their sexual behavior by health workers, peers and parents is a major obstacle to treatment. Other obstacles include the lack of confidentiality, non-adherence to treatment, and financial limitations in meeting costs for transport, diagnosis and treatment [2, 24]. Adolescent women may also be ignorant about STI symptoms and will oftentimes confuse normal and abnormal vaginal discharge. Others may be more concerned about pregnancy and menstrual problems than STIs, and therefore present late for treatment. For effective treatment, practitioners should be inquisitive about the adolescent patient's partner [5] because adolescents may be in denial, easily become irritated or even shocked that they have contracted an STI and therefore see no need to notify their partner [5]. However, sexual contact tracing among adolescents can be tricky as most adolescents with STIs do not want their parents to know [5]. In most adolescent STI treatment settings, parent notification remains a serious ethical challenge because it weighs against the ideals of confidentiality.

Prevention

STIs can be prevented by behavioural interventions [12] and increased awareness. Education on STIs can be done at home, school, and at the hospitals [5]. But education alone is not the panacea to STIs as it may not lead to behavioural changes that reduce the risk of STIs. Emphasis should be placed on the fact that adolescents will be able to recognize the STI symptoms, as well as to remember that many STIs are transmitted by asymptomatic partners. Health providers will need to focus on primary prevention (decreasing the number of new cases of STIs by avoiding exposure and preventing the infection through accurate information about STIs, postponing sexual involvement, encouraging consistent condom use, and development and implementation of appropriate vaccination approaches); secondary prevention

through decreasing the number of existing cases *via* early detection and screening, especially of asymptomatic carriers, and treatment; and tertiary prevention which entails the minimization of STI sequelae [5]. WHO has devised a global strategy to combat STIs from 2006-2015 [4].

CONCLUSION

STIs present a notorious and real health burden on adolescents, especially among females in developing countries. Although adolescents share many health characteristics with adults, their STI problems may be different in many aspects. For this reason, the WHO recommends the improvement of existing guidelines and algorithms to enable health workers meet the special needs of adolescents. Effective preventive and treatment strategies that influence adolescent health-seeking behaviour could have long-lasting and positive effects on young people's sexual and reproductive lives. However, due to inadequate and lack of adolescent-friendly health services, many STIs in adolescents remain undetected and untreated. This is especially worrisome because many STIs are asymptomatic. Few countries have screening and reporting systems for STIs other than HIV, especially in adolescent populations. There is need to increase the capture of age- and gender-specific data among school-going and out-of-school adolescents. The World Health Organization and other development partners have put in place initiatives to improve STI diagnostics and adolescent health especially in resource-limited areas. In the early days of the HIV epidemic when antiretroviral treatment was unaffordable, treatment of STIs received a lot of attention because of its impact on AIDS.

Recently, the focus has shifted so much onto HIV treatment that research on STIs has lost momentum and funding. Lack of surveillance data could be sweeping the STI problem under the carpet.

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