

# Bacterial and Mycotic Infections in Immunocompromised Hosts: Clinical and Microbiological Aspects

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# Sexually Transmitted Diseases

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Sexually transmitted disease (STD) is the term used for diseases that are transmitted through human sexual activity. However, some STDs are also transmitted through body fluids, such as blood and through contaminated IV drug needles. Sometimes STDs are also referred to as Sexually Transmitted Infections (STI), but STI is a broader term than STD. STI includes asymptomatic infections, where persons are infected with the organism, but do not show any symptoms or signs of an illness or a disease. STI have been well known for hundreds of years in medicine. The branch of the medicine that studies treatment and prevention of STD or STI is called venereology.

Sexually transmitted diseases remain a major public health problem around the globe, including underdeveloped countries in Asia or Africa and developed countries like the United States. In the U.S., STDs are one of the most critical health challenges with estimated 19 million new infections every year with the health care cost of \$17 billion [1]. STDs indeed lack easy solutions since they are primarily associated with human behavior. However, prevention of spread of STDs has been studied well and has shown to be effective in a various population. STDs are most commonly caused by viruses and bacteria, but some fungi or parasites can cause STD as well.

## STD caused by Viruses

There are several viruses that transmit through human sexual behavior, such as human immunodeficiency virus (HIV), *herpes simplex virus* (HSV), and human papilloma virus (HPV), and hepatitis B virus (HBV). Since the STDs transmitted through viruses are not the focus here we will not discuss each of them. However, HIV infection is very much interlinked with other STIs and STDs and so we will discuss HIV and how it is related to other STDs.

### Human Immunodeficiency Virus (HIV) Infection

HIV is a member of retrovirus family that causes Acquired Immunodeficiency Syndrome (AIDS). In AIDS the hosts' immune system gets weakened and so the hosts easily acquire life-threatening opportunistic infections and sometimes cancer. In the United States, approximately 1.2 million people are living with HIV infection. One in five (20%) of those people, however, are unaware of their infection. Furthermore, approximately 50,000 Americans become infected with HIV each year [1]. HIV represents a global challenge as well. At the end of 2010, an estimated 34 million people were living with HIV globally, including 3.4 million children less than 15. There were 2.7 million new HIV infections in 2010, including 390,000 among children less than 15. Thus, HIV represents a major health and economic burden to the global society.

HIV renders the host immunocompromised and more susceptible to get other STIs. Both STDs and HIV infection are behaviorally and biologically intertwined and facilitate the sexual transmission of one another. Such interrelationship is known as epidemiologic synergy and has been studied previously. It has been shown that HIV infection increases the prevalence of some STDs at the community level and prior STI/STD increases HIV transmission risk by approximately 3-5 folds [2-4]. People with some bacterial STIs, such as Gonorrhea, Chlamydia, or Syphilis are at increased risk for HIV as well. Prevalent *herpes simplex virus-2* (HSV-2) infection is also known to be associated with a 3 fold increased risk of HIV acquisition among both men and women in the general population [5]. Some STDs may promote HIV transmission by a variety of biological mechanisms that affect both HIV infectiousness and susceptibility. For example, other STDs facilitate HIV shedding in the genital tract, which probably promotes HIV infectiousness. This has been demonstrated by testing genital secretions for the presence and concentrations of HIV. Moreover, STDs potentially increase the HIV susceptible inflammatory cells in the genital tract and disrupt mucosal barriers that may increase the susceptibility to HIV [6]. Given the increase in such epidemiological synergy, it is particularly important to diagnose, treat, and prevent such STIs or STDs.

## STD caused by Bacteria

Some of the most common bacteria that cause STD or STI are *Chlamydia trachomatis* that causes Chlamydia, *Neisseria gonorrhoeae* that causes Gonorrhea, and *Treponema pallidum* that causes Syphilis. An estimated 78 to 330 million new cases of genitourinary tract infections due to *Chlamydia trachomatis*, *Neisseria gonorrhoeae*, *Ureaplasma urealyticum* and *Mycoplasma genitalium* are diagnosed each year worldwide<sup>1</sup>. Of these, 5 to 12 million are diagnosed in North America alone [7].

### Chlamydia

*C. trachomatis* infection is the most commonly reported notifiable disease worldwide including developed countries

like the United States (U.S.) [1], United Kingdom [8], and Australia [9]. It is among the most prevalent of all STDs, and since 1994, has comprised the largest proportion of all STDs reported to CDC. Studies also demonstrate the high prevalence of chlamydial infections in the general population especially sexually active younger females [1,8-11]. Based on estimates from national surveys, Chlamydia accounts for more than 50% of all reported cases of infectious disease in Canada and the U.S. [9,12]. Chlamydia can lead to serious health consequences in females, such as pelvic inflammatory disease, infertility, ectopic pregnancy and chronic pelvic pain [13,14]. It also causes increased risks of HIV transmission and acquisition [1,6,15], eye and lung disease in newborn infants [16,17], and epididymo-orchitis in men [9]. In some cases, *C. trachomatis* may also cause pneumonia in adult immunocompromised and HIV positive hosts [18,19].

## Syphilis

Syphilis is a genital ulcerative disease that is caused by Gram-negative bacteria, *Treponema pallidum*, and is categorized into primary, secondary, and tertiary stages. Syphilis causes significant complications if untreated and facilitates the transmission and acquisition of HIV infection [2,4]. Many individuals with early syphilis are either truly asymptomatic or undiagnosed; in the absence of diagnosis and treatment, approximately one-third of individuals will progress to neurological complications, visual and hearing loss, psychiatric disease, cardiovascular disease and other forms of systemic disease [20]. Untreated early syphilis in pregnant women results in perinatal death in up to 40% of cases and, if acquired during the 4 years before pregnancy, can lead to infection of the fetus in 80% of cases [1]. In 2010, the rate of primary and secondary syphilis was highest among younger population especially persons aged 20–24 years. In recent years, younger men and men who have sex with men (MSM) have accounted for an increasing number of syphilis cases in the United States [21]. According to a recent CDC report, majority of U.S. syphilis cases have occurred among MSM, however, syphilis among men who have sex with women (MSW) continues to be a problem [1].

Syphilis infection is particularly important for its strong epidemiological synergy with HIV infection, acquisition, and prognosis. Syphilis has been associated with significant increase in the HIV viral load and significant decrease in the CD4 cell count [22]. Thus it is important to prevent and promptly treat syphilis in HIV-infected and uninfected individuals for HIV control and prevention.

## Gonorrhea

Gonorrhea is a sexually transmitted infection caused by Gram-negative bacteria, *Neisseria gonorrhoeae*. Gonorrhea is one of the most common STIs in developing countries and the second most commonly reported notifiable disease in the United States [1,23]. Gonorrhea is a treatable STI, but if left untreated, then can lead to serious outcomes in women, such as tubal infertility, ectopic pregnancy, and chronic pelvic pain. Furthermore, epidemiologic and biologic studies provide strong evidence that gonococcal infections facilitate the transmission of HIV infection [6]. The individual's sexual behavior can increase the risk of acquiring gonorrhea; however, previous studies have shown that social determinants of health, such as poverty, may contribute to the burden of gonorrhea in a community [24,25].

## *Mycoplasma genitalium* Infection

*Mycoplasma genitalium* is a small parasitic bacterium that infects the mucous membrane of urethra, cervix, throat, and anus. So it is transmitted by vaginal, anal, and oral sex. It is one of the smallest organisms with the genome size of 580 kb. It is a fastidious organism and difficult to culture in the laboratory and takes several weeks or even months to grow, and so nucleic acid amplifications tests are used for detection of this pathogen. *M. genitalium* is associated with acute and chronic urethritis in men, but its role in women was not very clear [26]. A recent review, however, suggest that *M. genitalium* may also be associated with urethritis, cervicitis, pelvic inflammatory disease, and possibly infertility in females [27]. Furthermore, it has also been associated with increased risks of HIV acquisition in females [28,29].

## Management and Prevention of STDs

The number of STIs in women is increasing in several countries, and young population, especially people aged 15–24 years account for 41% of new HIV infections in sub-Saharan Africa [30]. Thus, the need for effective prevention of HIV and other STIs remains a high priority, both internationally and domestically. Since STIs and STDs are dependent on human sexual behavior, they will certainly reduce with the improved sexual behavior. Preventive emerging scientific interventions, however, are also as important to reduce the risks of STIs and STDs. Below we describe both behavioral and emerging scientific interventions to control STDs.

### Behavioral interventions

Human sexual behavior is the key for prevention and control of STIs and STDs. This includes practicing monogamy, reducing the number of sexual partners, using appropriate protection methods, getting tested and adhering to the treatment plan. Since many of the STIs are now shown in young population, sex education in school can help prevent such infections. According to a WHO report, a large majority of school-based sex education and HIV education interventions reduced the number of reported risky sexual behaviors in developing countries [31]. Furthermore, comprehensive mass media, such as radio, television, etc. are also valuable in teaching young population about appropriate sexual behavior and preventive measures [32].

### Emerging scientific interventions

Historically, STDs and STIs have been managed through various behavioral interventions methods mentioned above. With

the new advances in science, however, we have developed several potential emerging technologies, including microbicides and prophylactic vaccines to fight against some STIs. The vaccine against hepatitis B and Human Papillomavirus (HPV) are currently available and are recommended by the U.S. Centers for Disease Control and Prevention. However, many research efforts are underway to develop vaccines against other bacterial and viral pathogens, such as *N. gonorrhoea*, *C. trachomatis*, herpes simplex virus (HSV), and HIV [33,34].

The development of effective STI vaccines has been particularly difficult because STI pathogenesis generally does not involve hematogenous spread of the organism similar to those for measles and hepatitis B virus. The pathogenesis of most STIs involves local replication with spread, when it occurs, along contiguous surfaces (e.g., spread from the vagina to the uterus and fallopian tubes) or by non-hematogenous routes (e.g., intraneuronal spread of HSV) [35]. Traditionally, vaccines have not been very effective at providing durable protection against mucosal infection. New advances in immunology, however, may overcome this hurdle and develop more effective vaccines against such infections and reduce their occurrence. Due to high health and economic costs of these STIs, development of such vaccines will be a valuable source in prevention and controls of such infections and diseases.

## Acknowledgement

We thank Janet Petty at Miami Valley Hospital, Dayton, OH for providing library support and help find some manuscripts and books.

## References

1. Sexually transmitted disease surveillance 2010 (2011) Centers for Disease Control and Prevention, Department of Health and Human Services, Atlanta, USA.
2. Wasserheit JN (1992) Epidemiological synergy. interrelationships between human immunodeficiency virus infection and other sexually transmitted diseases. *Sex Transm Dis* 19: 61-77.
3. Pepin J, Plummer FA, Brunham RC, Piot P, Cameron DW, et al. (1989) The interaction of HIV infection and other sexually transmitted diseases: An opportunity for intervention. *AIDS* 1989 3: 3-9.
4. Farhi D, Dupin N (2010) Management of syphilis in the HIV-infected patient: Facts and controversies. *Clin Dermatol* 28: 539-545.
5. Freeman EE, Weiss HA, Glynn JR, Cross PL, Whitworth JA, et al. (2006) Herpes simplex virus 2 infection increases HIV acquisition in men and women: Systematic review and meta-analysis of longitudinal studies. *AIDS* 20: 73-83.
6. Fleming DT, Wasserheit JN (1999) From epidemiological synergy to public health policy and practice: The contribution of other sexually transmitted diseases to sexual transmission of HIV infection. *Sex Transm Infect* 75: 3-17.
7. Lee SR, Chung JM, Kim YG (2007) Rapid one step detection of pathogenic bacteria in urine with sexually transmitted disease (STD) and prostatitis patient by multiplex PCR assay (mPCR). *J Microbiol* 45: 453-459.
8. Adams EJ, Charlett A, Edmunds WJ, Hughes G (2004) *Chlamydia trachomatis* in the united kingdom: A systematic review and analysis of prevalence studies. *Sex Transm Infect* 80: 354-362.
9. Lewis D, Newton DC, Guy RJ, Ali H, Chen MY, et al. (2012) The prevalence of *Chlamydia trachomatis* infection in australia: A systematic review and meta-analysis. *BMC Infect Dis* 14: 113.
10. NNDSS Annual Report Writing Group, Newman L, Stirzaker S, Knuckey D, Robinson K, et al. (2010) Australia's notifiable disease status, 2008: annual report of the National Notifiable Diseases Surveillance System. *Commun Dis Intell Q Rep* 34: 157-224.
11. Fisman DN, Laupland KB (2011) Sexually transmitted infections in canada: A sticky situation. *Can J Infect Dis Med Microbiol* 22: 80-82.
12. Public Health Agency of Canada (2008) Canadian guidelines on sexually transmitted infections. Public Health Agency of Canada, Ottawa, Canada.
13. Land JA, Van Bergen JE, Morre SA, Postma MJ (2010) Epidemiology of *Chlamydia trachomatis* infection in women and the cost-effectiveness of screening. *Hum Reprod Update* 16: 189-204.
14. Westrom L, Joesoef R, Reynolds G, Hagdu A, Thompson SE (1992) Pelvic inflammatory disease and fertility. A cohort study of 1,844 women with laparoscopically verified disease and 657 control women with normal laparoscopic results. *Sex Transm Dis* 19:185-192.
15. Rottingen JA, Cameron DW, Garnett GP (2001) A systematic review of the epidemiologic interactions between classic sexually transmitted diseases and HIV: How much really is known? *Sex Transm Dis* 28: 579-597.
16. Rours IG, Hammerschlag MR, Ott A, De Faber TJ, Verbrugh HA, et al. (2008) *Chlamydia trachomatis* as a cause of neonatal conjunctivitis in dutch infants. *Pediatrics* 121: 321-326.
17. Ratelle S, Keno D, Hardwood M, Etkind PH (1997) Neonatal chlamydial infections in massachusetts, 1992-1993. *Am J Prev Med* 13: 221-224.
18. Ito JI, Comess KA, Alexander ER, Harrison HR, Ray CG, et al. (1982) Pneumonia due to *Chlamydia trachomatis* in an immunocompromised adult. *N Engl J Med* 307: 95-98.
19. Monno R, Maggi P, Carbonara S, Sibilio G, D'Aprile A, et al. (2001) *Chlamydia trachomatis* and mycobacterium tuberculosis lung infection in an HIV-positive homosexual man. *AIDS Patient Care STDS* 15: 607-610.
20. Singh AE, Romanowski B (1999) Syphilis: Review with emphasis on clinical, epidemiologic, and some biologic features. *Clin Microbiol Rev* 12: 187-209.
21. Heffelfinger JD, Swint EB, Berman SM, Weinstock HS (2007) Trends in primary and secondary syphilis among men who have sex with men in the united states. *Am J Public Health* 97: 1076-1083.

22. Buchacz K, Patel P, Taylor M, Kerndt PR, Byers RH, et al. (2004) Syphilis increases HIV viral load and decreases CD4 cell counts in HIV-infected patients with new syphilis infections. *AIDS* 18: 2075-2079.
23. Manju Bala, Jhinuk Basu Mullick, Sumathi Muralidhar, Joginder Kumar, V. Ramesh (2011) Gonorrhoea & its co-infection with other ulcerative, non-ulcerative sexually transmitted & HIV infection in a regional STD centre. *Indian Journal of Medical Research* 133: 346-349.
24. Sullivan AB, Gesink DC, Brown P, Zhou L, Kaufman JS, et al. (2011) Are neighborhood sociocultural factors influencing the spatial pattern of gonorrhea in north carolina? *Ann Epidemiol* 21: 245-252.
25. Quinn TC (1996) Association of sexually transmitted diseases and infection with the human immunodeficiency virus: Biological cofactors and markers of behavioural interventions. *Int J STD AIDS* 7: 17-24.
26. Manhart LE, Broad JM, Golden MR (2011) *Mycoplasma genitalium*: Should we treat and how? *Clin Infect Dis* 53: 129-142.
27. McGowin CL, Anderson-Smits C (2011) *Mycoplasma genitalium*: An emerging cause of sexually transmitted disease in women. *PLoS Pathog* 7: 1001324.
28. Vandepitte J, Muller E, Bukenya J, Nakubulwa S, Kyakuwa N, et al. (2012) Prevalence and correlates of *Mycoplasma genitalium* infection among female sex workers in kampala, uganda. *J Infect Dis* 205: 289-296.
29. Mavedzenge SN, Van Der Pol B, Weiss HA, Kwok C, Mambo F, et al. (2012) The association between *Mycoplasma genitalium* and HIV-1 acquisition in african women. *AIDS* 26: 617-624.
30. Marrazzo JM, Cates W (2011) Interventions to prevent sexually transmitted infections, including HIV infection. *Clin Infect Dis* 53: 64-78.
31. Kirby D, Obasi A, Laris B (2006) The effectiveness of sex education and HIV education interventions in schools in developing countries. *World Health Organ Tech Rep Ser* 938: 103-150.
32. Bertrand JT, Anhang R (2006) The effectiveness of mass media in changing HIV/AIDS-related behaviour among young people in developing countries. *World Health Organ Tech Rep Ser* 938: 205-241.
33. Zimet GD, Mays RM, Fortenberry DJ (2000) Vaccines against sexually transmitted infections: Promise and problems of the magic bullets for prevention and control. *Sex Transm Dis* 27: 49-52.
34. Jovanović M, Karadaglić Đ, Golušin Z, Brkić S, Poljački M (2009) Experimental vaccines for sexually transmitted infections. *Med Pregl* 62: 42-48.
35. Liddon N, Zimet G, Stanberry L (2007) STI vaccines: Status of development, potential impact, and important factors for implementation. Springer, USA.

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