Emerging and re-emerging sexually transmitted diseases: A review of epidemiological evidences

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Abstract
Substantial increase in the outbreaks of sexually transmitted infections (STIs) and associated mortalities have raised international concerns. Concurrent with the escalation of established STIs, developing epidemics and outbreaks of newly emerging sexually transmissible pathogens pose serious problems for people and added burden and challenges for public health practitioners and researchers. Importantly, most of the emerging STIs are frequently found among vulnerable groups, such as men having sex with men and human immunodeficiency virus patients, which may result in large outbreaks in the near future. Furthermore, enhanced spread of antimicrobial resistance among these pathogens ever more limits treatment options for STIs. Thus, it is the optimal time to consider whether an infectious agent is sexually transmissible and develop treatment protocol for handling new STIs with pandemic potential. In this review, we explore emerging STIs, their current epidemiological status, and future perspective.

Key words: Antimicrobial resistance, emerging sexually transmitted infections, human immunodeficiency virus, men having sex with men group, re-emerging sexually transmitted infections, sexually transmitted infections

Introduction
Sexually transmitted infections (STIs) remain prevalent in the 21st century and constitute a health and economic burden globally. As a long-term goal, the WHO has endorsed the global STI strategy that targets to eliminate the STIs by 2030.[1] Regrettably, more than 50% of new STI cases are found among adolescents, and 80% of the infections are widespread in developing countries which have limited resources. To this point, about 30 types of known infectious agents such as bacteria, viruses, fungi, parasites, and insects have been reported to cause STIs worldwide.[2] The new infectious agents include diseases which are primarily transmitted by food, water, and vector but are now predicted to be disseminated through sexual contacts. These newly emerging STIs would be more dangerous than the typical STIs because of their unique methodologic and epidemiologic challenges for public health experts and research scientists.[3,4] This puts forth the need for development of immediate action plans to anticipate, identify, and contain the emerging STIs which may become endemic and epidemics at the global level. This review has been envisaged to elicit the newly emerging STIs and their current epidemiological status. In addition, we explored the challenges which lie ahead with respect to future perspective.

Newly Emerging Sexually Transmitted Infections
Increased international travel, unprecedented connectivity between people, and social networking have enhanced the dissemination of existing as well as newly emerging STIs at the global level. Due to these factors, and changes in sexual and behavioral practices, several diseases are found to be sexually transmitted or at risk to be so, which had previously been unknown. This includes Shigella flexneri, Mycoplasma genitalium, Neisseria meningitidis, methicillin-resistant Staphylococcus aureus (MRSA), hepatitis C, Ebola, Zika, and dengue [Table 1].[5-9] In addition, as genital fluids are the major reservoir for microorganisms, they could disseminate from infected person to their partner through contacts. According to recent research, about 29 viral agents have been found from human semen.[9] These pathogens are at a high risk of becoming STIs in the near future, whereas some of them are already recognized as sexually transmissible.
Shigella flexneri
Shigella causes severe gastroenteritis called shigellosis, often causing bloody dysentery, especially in children in developing countries. Among the four Shigella species identified, S. flexneri is more important because of its higher mortality rate.\[10\] The primary route of Shigella transmission is food and water resources which are either directly or indirectly contaminated with feces of an infected human. However, in the late 1970s, the sexual transmission of S. flexneri was found for the first time among men having sex with men (MSM) community, who were involved in anal and/or oral sex.\[11\] At the end of the 20th century, this infection was frequently found among human immunodeficiency virus (HIV) patients as this may enhance the susceptibility or duration of the disease.\[12\] Currently, S. flexneri is rapidly emerging as a STI in the MSM community, women, and children across the globe as per the epidemiological surveillances conducted in various countries. In addition, evolution of azithromycin and ciprofloxacin multidrug-resistant (MDR) S. flexneri strains poses a public health threat and has attracted the global level concerns. In the past 5 years, sexual transmission of MDR S. flexneri strains among MSM has increased exponentially in Europe, Australia, Asia, and North America.\[13\] Thus, the case incidence of newly occurring S. flexneri and other species from this genus must be investigated carefully by clinicians and health-care experts to impede the potential of this species in emerging as a STIs.

Lymphogranuloma venereum
Lymphogranuloma venereum (LGV) is a chronic ulcerative, progressively destructive anogenital and systemic disease caused by the bacterium Chlamydia trachomatis. It is also responsible for causing several other STDs such as nongonococcal urethritis, cervicitis, pelvic inflammatory disease, and trachoma.\[14\] The rectal involvement of LGV among MSM might cause colorectal strictures and fistulae if not treated properly. The first LGV infection among MSM was found in 1980 in the USA.\[15\] The STI surveillance program launched in the UK reported about 2000 cases of LGV between 2003 and 2012. About 10,000 cases were reported from 15 countries between 2004 and 2016.\[16\] In India, LGV cases were not predominant until the beginning of the 21st century.\[17\] However, according to a recent study by Juyal et al., LGV cases increased from 4.5% to 18.3% between 2011 and 2019, especially in patients attending a HIV clinic. Before these new outbreaks, LGV was predominant in heterosexual adults belonging to selected tropical and subtropical countries. Thus, sensitive LGV diagnostic assays must be included for rectal swabs and rectal biopsies of MSM patients who have participated in the receptive anal intercourses as an active approach for the diagnosis of anorectal chlamydia-like infection.\[18\]

Entamoeba histolytica
Entamoeba histolytica, responsible for the amebic dysentery, is more common in the countries of the tropical region having poor hygienic circumstance.\[19\] Primarily, this parasite spreads through the ingestion of water or food contaminated with feces containing cysts of E. histolytica and through fecal–oral transmission within household. Amebic colitis is a severe form of the disease which often causes bloody dysentery and febrile illness in some people. In the early 1980s, the sexual transmission of E. histolytica was noticed in MSM group who were involved in oral and anal sex.\[20\] Since then, it is considered an emerging STI. Several evidences, especially in the last decade, have exposed the signs of sexual transmissibility of E. histolytica. Studies conducted from various countries have revealed the increased prevalence of E. histolytica among MSM, HIV-negative, and HIV-positive groups. In addition, recent outbreaks have occurred in North America and certain Europe.\[21\] Thus, E. histolytica has emerged as a major public health problem and has raised global level concerns.

Hepatitis A
Hepatitis A virus (HAV) causes an acute liver disease. Its primary mode of transmission is through anal/oral route.\[22\] Evidence for sexual transmission of HAV was first found among MSM group in the USA during 1980. The prevalence of infection was about 30% in homosexuals, which was significantly higher than 12% of heterosexual group. Recently, large-scale outbreaks of HAV among MSM have been reported from various countries raising an alarm regarding their re-emergence, with a potential impact on high-risk sex network. Further, genotypic analysis has revealed the intercontinental dissemination of three HAV lineages among MSM group. About 1400 cases of HAV have been identified from June 2016 to May 2017 across 16 European countries.\[23\] According to seroprevalence studies conducted in various Asian countries from 2000 to 2013, 15%–50% of HAV incidence was found in HIV-positive MSM people.\[24\] Based on seroprevalence studies conducted in various parts such as Eastern India, Punjab, and Delhi, in India, high endemicity of HAV was found in MSM community.\[25\]

Group B Streptococcus
Group B Streptococcus (GBS) is a significant cause of neonatal sepsis and meninitis in the people of low- and middle-income countries.\[26\] This devastating pathogen generally inhabits the vagina and gut lumen of the healthy female. However, the problem arises when infected female is pregnant, which enhances the chance for developing invasive neonatal disease.\[27\] Recent studies emphasize that the vaginal microbiome and STIs are inter-connected. In a few cases of neonatal diseases, concurrent vaginal (mother) and urethral (father) colonization of GBS has been documented.\[28\] Accordingly, several authors stated that GBS can be transmitted through sexual intercourses as higher colonization rate of GBS was detected from male urethra and sexually active adolescents attending STI clinics.\[29\] On the contrary, certain researchers argue that sexual connections do not possibly seem to be the effective route of GBS circulation. However, frequent detection of GBS among people carrying STIs, especially prevalence of hypervirulent GBS strain ST17, needs to be considered seriously.\[30\] Thus, further intensive studies are needed to authenticate the sexual transmission of GBS.

Neisseria meningitidis
N. meningitidis commonly colonizes the mucosal surface of the oropharynx. Its systemic spread leads to life-threatening meningitis and septicemia. The primary route of transmission happens via inhalation of respiratory droplets and contact with saliva of a carrier.\[31\] There is an argument among the scientific community, whether N. meningitidis is a potential STI or not. Pieces of evidence suggest that the occurrence of N. meningitidis in the human urogenital tract could be the result of oral-genital sexual contact.\[32\] Recently, invasive meningococcal disease outbreaks have occurred among MSM group members living in various continents, thereby raising more concerns toward this issue.\[33\] Based on the study conducted by...
Table 1. Key characteristics of emerging and re-emerging selected sexually transmitted infections.

| Pathogens | Year of identification | Year of recognition as STI | Diagnosis method | Geography | Most vulnerable group | Clinical syndrome | Type of disease | Primary mode of transmission | Whether associated with any co-infection? | Deadly? | Is vaccine available? |
|-----------|------------------------|-----------------------------|------------------|-----------|----------------------|------------------|----------------|-----------------------------|------------------------------------------|---------|---------------------|
| Shigella flexneri | 1900. | First identified among MSM in 1974 in USA. | Bacterial culturing and genome-based detections | All over the world | Young children (less than 5). People practising unsafe sexual activities, especially MSM | Acute gastroenteritis. If untreated may lead to chronic colorectal fistulas and strictures | Extra genital | Food and water resources contaminate with feces from an infected person | Yes. Infections are frequently seen in HIV infected patients. | No (Curable with antibiotics) | No |
| Chlamydia trachomatis (Lymphogranuloma venereum) | 1833. | First LGV infection found among MSM in USA in 1980. | Genome-based detection of genital lesions, rectal and lymph node specimens. | Spread all over the world. But, endemic in Africa, Asia, South America and Caribbean. | Can occur at any age but, predominant among sexually active population of the age group between 15 to 40. | Proctitis, proctocolitis, lymphadenopathy, strictures and fistulae | Genital and systemic | Transmits during unprotected anal, vaginal and oral sex. | Yes. Significant association between HIV infected patients. In addition, increased risk of contracting hepatitis B, syphilis etc., | Yes. But rarely. (Curable with antibiotics such as doxycycline, erythromycin base or azithromycin) | No |
| Hepatitis A | 1973. | Found among homosexual couples who attended sex clinic in USA in 1980. | Serological and genome-based assays | Central and South America, Africa, Asia | Affects all age groups | Acute live disease, but seldom causes acute live failure | Extra genital | Food and water contaminated with the faecal and body fluids of an infected person | Yes | No (But, rarely fatal) | Yes |
| Group B Streptococcus (GBS) | 1930. | Not widely recognised as STI | Bacteriological and genomic based analysis | All over the world | Pregnant women, neonates and elder people. | Neonatal sepsis, meningitis, miscarriage or stillbirth | Genital and gastrointestinal tract | Vertical transmission (either in utero or during passage through the birth canal) | Yes. PLWHIV are at increased risk for not early but late-onset neonatal GBS disease. | Yes | (GBS-MOPA under clinical trial) |
| Entamoeba histolytica | Early 20th century. | Outbreak among MSM community in USA during 1960s. | Bacteriological and genomic based analysis | All over the world | All age group | Dysentery, liver abscess and cerebral amoebiasis | Extra genital | Ingestion of food or water contaminated with faeces of an infected person. | Yes. HIV is significantly associated with higher prevalence of E. histolytica infection. | Yes (Responsible for 1 million deaths per year) | Under clinical trials. |
| Neisseria meningitides | 1942. | Isolated from genitourinary tract of patients in USA in 1942 | Bacteriological and genome-based analysis | Observed worldwide | People who executes unsafe sex | Nonspecific urethritis and invasive meningococcal disease | Genital as well as systemic | Through unprotected sexual activities and nasal droplet from an infected person | Yes. Increased incidence of meningococcal disease among PLWHIV. | Yes (permanent disabilities (such as brain damage, hearing loss, and learning disabilities also can happen)) | Yes (Meningococcal conjugate and MenACWY) |

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| Pathogens | Year of identification | Year of recognition as STI | Diagnosis method | Geography | Most vulnerable group | Clinical syndrome | Type of disease | Primary mode of transmission | Whether associated with any co-infection? | Deadly? | Is vaccine available? |
|-----------|------------------------|-----------------------------|------------------|-----------|----------------------|------------------|----------------|-------------------------------|------------------------------------------|---------|----------------------|
| *Mycoplasma genitalium* | 1981. | Detected among male patients with who attended sexual clinic in USA in 1981. | Genome based diagnosis | All over the world | People who executes unsafe sex | Non-gonococcal urethritis | Localized to reproductive parts | Through unprotected sexual activities | Yes. *M. genitalium* is positive association with HIV and *Chlamydia trachomatis*. | No (If left untreated may damage the immune system and make susceptible to other pathogens) | No |
| Hepatitis C | 1974. | Found among homosexual couples who attended the county health department in USA in 1989. | Serological test | All over the world | All age groups | Cirrhosis and liver cancer | Systemic | Transmitted through blood and blood related products | Yes. Strong correlation between HIV and HCV. | Yes (But, 95% curable with antiviral drugs) | No |
| Methicillin-Resistant *Staphylococcus Aureus* (MRSA) | 1961. | Detected in the 35 years old man who attended a sex clinic in USA in 2007. | Bacteriological test with cefoxitin and oxacillin antibiotics | All over the world | Elderly people especially the age of 60 and above | Pneumonia and Sepsis | Extra genital (Become systemic if untreated) | Skin to skin contact and sharing of infected things like clothes, equipments etc., | Yes. HIV-infected people are at increased risks of acquiring MRSA | Yes, If untreated | No |
| Ebola virus | 1976. | Detected in the heterosexual couple in Liberia in 2015. | Serological and genome based testing | All age groups in more than 15countries | | Ebola virus disease or Ebola haemorrhagic fever | Systemic | Close contact with body fluids of an infected person. | Unknown | Yes | rVSV-ZEBOV is under clinical trial. |
| Zika virus | 1947. | Detected in the heterosexual couple in America in 2008. | Virological, serological and genome based testing | Spread over 86 countries | Pregnant women and Infants | Congenital Zika syndrome | Systemic | Mosquito bite | Unknown | No (With lifelong morbidity) | No |
| Dengue virus | 1789. | Reported in the MSM pair in Spain in 2019. | Virological, serological and genome based testing | Endemic in more than 100 countries | All age groups | Dengue virus infection and severe Dengue | Systemic | Mosquito bite | Unknown | Yes (If untreated) | Dengvaxia vaccine is available in some endemic countries. |
Johnson et al.,[29] N. meningitidis urethritis has increased from 2.78% in 2011 to 8.93% in 2015, especially in male patients. Both biochemical and high-throughput genomic studies have confirmed the existence of N. meningitidis among MSM community.[30] These proofs authenticate the potential increase of sexually transmitted meningococcal urogenital infections.

**Mycoplasma genitalium**

M. genitalium causes nongonococcal urethritis in men. The Centers for Disease Control and Prevention has updated the STI guidelines very recently, in which M. genitalium has been highlighted as an emerging STI.[31] It is estimated that more than 25% of nongonococcal urethritis is caused by M. genitalium. After the first case of M. genitalium-associated nongonococcal urethritis found in MSM during 1981, the influence of this bacterium in affecting the genital part has increased and reached their peak in recent times.[32] A large study conducted among MSM group in Norway revealed 91 patients infected with M. genitalium out of 1778 samples screened.[33] Furthermore, the ratio of M. genitalium infection is increasing over the years as compared to other STIs.[34] The primary concerns about this bacterium have been both diagnosis and treatment. Nucleic acid amplification test is the only diagnostic tool available since it is challenging to cultivate at the laboratory. In addition, the growing antimicrobial resistance against azithromycin and moxifloxacin, there emerges an urgent need for effective control protocols.[35] The availability of diagnostic facilities for M. genitalium among various sexual networks would identify more positive cases than we suspect as oral and anal sex has increased over the past decades.

**Methicillin-resistant Staphylococcus aureus**

The well-known hospital-acquired MRSA infection has also started spreading at the community level. Community-acquired MRSA is responsible for cutaneous and systemic infection, which is now not only predominant among a day-care center, sports teams, and military camp but also becoming prevalent in sexual communities such as sex workers and MSM groups. In the USA, a high prevalence of S. aureus was found among people visiting the STI clinic from October 2010 to April 2011.[36] The high prevalence of MRSA was found among HIV-positive patients visiting the STI clinic at Atlanta in the USA between September 2007 and April 2008 indicating the emerging MRSA transmission in HIV community.[37] Besides, several studies have reported the possible transmission of MRSA through oral sex as well.[38,39] Apart from its STI-related manifestations, MRSA is a potential agent for causing infertility in both males and females. Hence, it is essential to be cognizant that sexually acquired MRSA is making its presence felt as a STI.

**Ebola virus**

Since its discovery in 1976, the largest outbreak happened in West Africa between 2014 and 2016, where more than 28,000 cases were reported, and over 11,000 deaths occurred.[40] The transmission of fluids or skin contact from an infected person serves as a primary route of viral dissemination. Interestingly, the identification of Ebola’s genomic material in the semen of the 2014–2016 Ebola epidemic’s survivor raised the concern about the risk of their sexual transmission.[41] The detection of Ebola infection in a woman who does not have symptomatic or recently diseased patients nearby indicated the possibility of other routes of transmission, especially through sexual contact. As expected, the patients’ husband was an Ebola survivor, and evidently, traces of virus were detected in his semen. Moreover, the high homology of Ebola’s RNA sequence between this couple authenticated the sexual transmission of this virus.[42,43] Hence, initial reports indicate the possibility of the emergence of Ebola as one of the established causes of STI in future.

**Zika virus**

The first large outbreak of Zika occurred in French Polynesia during 2013, followed by a second outbreak in Brazil.[7] This infection leads to microcephaly and other congenital abnormalities in the developing fetus and infants. Aedes aegypti and Aedes albopictus are the two crucial mosquito species that predominantly transmit Zika virus.[44] The detection of this virus in the testis, male genital tract, and semen made the possibility of their sexual transmission.[45]

Although the earlier studies predicted the traces of Zika virus in human semen, live viral particles were recently detected in semen samples of infected people, which was mostly absent after 30 days of illness onset. This finding authenticated the possibility of sexual transmission of Zika virus from an infected person to their sexual partners. The first suspected case of sexual transmission happened in America during 2008, followed by the second recorded case from French Polynesia in 2013. Currently, the sexual transmission of Zika has been reported at least from 13 countries, where the endemicity of the virus was not previously reported.[46,47] Thus, to prevent the life-threatening difficulties associated with Zika virus, their sexual way of transmissions must be considered during management of the disease.

**Dengue virus**

Dengue is another vector-borne disease that is majorly disseminated by A. aegypti and A. albopictus mosquitoes. Several other routes of transmissions, including blood transfusion, organ transplantation, and breastfeeding, have been reported.[48] In addition, detection of this virus in semen and vaginal fluids may find the way of their transmission through sexual intercourses from an infected person to an uninfected one.[49,50] Although the traces of dengue virus have been detected in the genital secretions, their sexual transmissions are poorly reported. The first case of sexual transmission was reported from Spain in 2019. This case was confirmed by viral sequencing of samples collected from two males who recently had sex.[51] Strains from both males were identical and matched to the currently circulating strain of Cuba, where only one among them visited the country in their entire lifetime. This confirms the sexual transmission of dengue virus and may pose significant public health importance soon. More epidemiological and genomic studies are needed before establishing dengue as a STI.

**Challenges and Future Perspective**

The mechanism of developing definitions and approaches to inspect the emerging sexually transmitted infectious agents for considering as an STI pathogen to be sexually transmissible must be developed. As per the assessment, the incidence of these STIs would continue to arise owing to enhanced human interconnectedness such as international travel and extensive use of social networks meant for sexual activities. Timely testing and treatment are mandatory at least for people from the vulnerable group like MSM and sexual workers. Special attention must be given to HIV patients as most of the emerging STIs are highly prevalent in this group. Thus, it is essential.
to develop a robust surveillance system that comprises organism identification (both culture and genomic based) and treatment facilities at the primary health-care level for the newly emerging STIs.

The recent documentation of numerous viruses from semen made the obligation of investigating vaginal, anal, and even oral fluids of high-risk sexual network group by employing next-generation sequencing for the identification of pathogens with epidemic potential. This would help the health system to identify the possible emergence of these pathogens as STIs, which are commonly found in genitals. Evolving drug resistance in these emerging STIs raises public health concerns as it removes the possibility of curing diseases with available antibiotics. Lessons learned from “global HIV epidemics” is applicable to STI control as well, which encourage the significant cooperation among government, nongovernment, and private organization together with community contribution and engagement is crucial for the battle against emerging STI and related diseases.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

References

1. World Health Organization (WHO). Global Health Sector Strategy on Sexually Transmitted Infections 2016-2021. World Health Organization (WHO); 2016.
2. National Institutes of Health. Understanding Emerging and Re-Emerging Infectious Diseases. Biological Sciences Curriculum Study. NIH Curriculum Supplement Series. Bethesda, MD: National Institutes of Health; 2007.
3. Bernstein K, Bowen VB, Kim CR, Counotte MJ, Kirkcaldy RD, Kara E, et al. Re-emerging and newly recognized sexually transmitted infections: Can prior experiences shed light on future identification and control? PLoS Med 2017;14:e1002474.
4. Williamson DA, Chen MY. Emerging and reemerging sexually transmitted infections. N Engl J Med 2020;382:2023-32.
5. Decker CF. Emerging sexually transmitted diseases: Hepatitis C, lymphogranuloma venereum (LGV), and Mycoplasma genitalium infections. Dis Mon 2016;62:314-8.
6. Wilson AP, Wolff J, Atia W. Acute urethritis due to Neisseria meningitidis group A acquired by orogenital contact: Case report. Genitourin Med 1989;65:122-3.
7. Kindhauser MK, Allen T, Frank V, Santhana RS, Dye C. Zika: The origin and spread of a mosquito-borne virus. Bull World Health Organ 2016;94:675-686C.
8. Mildvan D, Gelb AM, William D. Venereal transmission of enteric pathogens in male homosexuals. Two case reports. JAMA 1977;238:1387-9.
9. Salam AP, Horby PW. The breadth of viruses in human semen. Emerg Infect Dis 2017;23:1922-4.
10. Taneka N, Mewara A. Shigellosis: Epidemiology in India. Indian J Med Res 2016;143:565.
11. Allen H, Mitchell HD, Simms I, Baker KS, Foster K, Hughes G, et al. Evidence for reinfection and persistent carriage of Shigella species in adult males reporting domestically-acquired infection in England. Clin Microbiol Infect 2020; 27: 126.e7-126.e13.
12. Malhotra M, Sood S, Mukherjee A, Muralidhar S, Bala M. Genital Chlamydia trachomatis: An update. Indian J Med Res 2013;138:303.
13. Conte I, Mistrangelo M, Cariti C, Chiriotti M, Lucchini A, Vigna M, et al. An old, forgotten re-emerging systemic disease. Panninerva Med 2014;56:73-83.
14. European Centre for Disease Prevention and Control. Lymphogranuloma venereum. In: Annual Epidemiological Report for 2016. Stockholm: ECDC; 2018. Available form: https://www.ecdc.europa.eu/sites/default/files/documents/AER_for_2016-lymphogranuloma-venereum.pdf. [Last accessed on 2021 May 26].
15. Thappa DM, Kaimal S. Sexually transmitted infections in India: Current status (except human immunodeficiency virus/acquired immunodeficiency syndrome). Indian J Dermatol 2007;52:78.
16. Juyal D, Rawre J, Dharwan B. Under diagnosis of the lymphogranuloma venereum serovars in the Indian population. Indian J Med Microbiol 2019;37:595-7.
17. Kardos S, Tóthpál A, Laub K, Kristóf K, Ostorházi E, Rozgonyi F, et al. High prevalence of group B streptococcus ST17 hypervirulent clone among non-pregnant patients from a Hungarian venereology clinic. BMC Infect Dis 2019;19:1009.
18. Burnham WR, Reeve RS, Finch RG. Entamoeba histolytica infection in male homosexuals. Gut 1980;21:1097-9.
19. Escóla-Vergé L, Arando M, Vall M, Rovira R, Espasa M, Sulleiro E, et al. Outbreak of intestinal amoebiosis among men who have sex with men, Barcelona (Spain), October 2016 and January 2017. Euro Surveill 2017;22:30581.
20. Lin AW, Sridhar S, Wong KH, Lau SK, Woo PC. Epidemiology of sexually transmitted viral hepatitis in human immunodeficiency virus-positive men who have sex with men in Asia. J Formos Med Assoc 2015;114:1154-61.
21. Sarangi G, Dash M, Mahapatra D, Paty BP, Mohanty DP, Chayani N. Fecal-oral-transmitted hepatitis A and E prevalence in Eastern India: A 3-year retrospective study. J Med Soc 2019;33:86.
22. Patras KA, Nizet V. Group B streptococcal maternal colonization and neonatal disease: Molecular mechanisms and preventative approaches. Front Pediatr 2018;6:27.
23. Shet A, Ferrieri P. Neonatal & maternal group B streptococcal infections: A comprehensive review. Indian J Med Res 2004;120:141-50.
24. Dougherty C, Pastorek J. Sexually Transmitted infections and Miscellaneous Pelvic Infections. Glob Lib Womens Med 2008. (ISSN: 1756-2228) [Doi: 10.3843/GLWWM.10027].
25. Yamamoto T, Nagasawa I, Nojima M, Yoshida K, Kuwabara Y. Sexual transmission and reinfection of group B streptococci between spouses. J Obstet Gynaecol Res 1999;25:215-9.
26. Beitune P, Duarte G, Maffei CM, Quintana SM, Rosa AC, Silva E, et al. Group B Streptococcus carriers among HIV-1 infected pregnant women: Prevalence and risk factors. Eur J Obstet Gynecol Reprod Biol 2006;128:54-8.
27. Caughtan DA, Bynildsrud OB. Neisseria meningitidis: Using genomics to understand diversity, evolution and pathogenesis. Nat Rev Microbiol 2020;18:84-96.
28. Marcus U, Vogel U, Schubert A, Baetz-Feigenbaum J, Hellenbrand W, et al. A cluster of invasive meningococcal disease in young men who have sex with men in Berlin, October 2012 to May 2013. Euro Surveill 2013;18:20523.
29. Johnson L, Weberman B, Parker N, Hackert P. Neisseria meningitidis: An emerging sexually transmitted infection. Open Forum Infect Dis 2016;3:1301.
30. Nickmans S, De Beenhouwer H, Vernelen K, Ide L. Is Neisseria meningitidis a new cause of sexually transmitted disease? Clin Microbiol News! 2014;1:6-7.
31. Ona S, Molina RL, Diouf K. Mycoplasma genitalium: An overlooked sexually transmitted pathogen in women? Infect Dis Obstet Gynecol 2016;2016:4513089.
32. Workowski KA, Bolan GA. Sexually transmitted diseases treatment guidelines. MMWR Recomm Rep 2015;64:1.
33. Reinton N, Moi H, Olsen AO, Zarabany N, Bjermer J, Tønseth TM, et al. Anatomical distribution of Neisseria gonorrhoeae, Chlamydia trachomatis and Mycoplasma genitalium infections in men who have sex with men. Sex Health 2013;10:199-203.
34. Munoz JL, Goje OJ. Mycoplasma genitalium: An emerging sexually transmitted infection. Scientifica 2016;2016:7537338.
35. Cina M, Baumann L, Egli-Gany D, Halbeisen FS, Ali H, Scott P, et al.
Mycoplasma genitalium incidence, persistence, concordance between partners and progression: Systematic review and meta-analysis. Sex Transm Infect 2019;95:328-35.

36. Ugarte Torres A, Chu A, Read R, MacDonald J, Gregson D, Louie T, et al. The epidemiology of *Staphylococcus aureus* carriage in patients attending inner city sexually transmitted infections and community clinics in Calgary, Canada. PLoS One 2017;12:e0178557.

37. Miko BA, Uhlemann AC, Gelman A, Lee CJ, Hafer CA, Sullivan SB, et al. High prevalence of colonization with *Staphylococcus aureus* clone USA300 at multiple body sites among sexually transmitted disease clinic patients: An unrecognized reservoir. Microbes Infect 2012;14:1040-3.

38. Peters PJ, Brooks JT, McAllister SK, Limbago B, Lowery HK, Fosheim G, et al. Methicillin-resistant *Staphylococcus aureus* colonization of the groin and risk for clinical infection among HIV-infected adults. Emerg Infect Dis 2013;19:623-9.

39. Hernandez M, Gofman Y, Termotto G. Acquisition of MRSA through sexual transmission and treatment of carrier status: A case report. J Infec Dis 2010;8:1-2.

40. Rogstad KE, Tunbridge A. Ebola virus as a sexually transmitted infection. Curr Opin Infect Dis 2015;28:83-5.

41. Deen GF, Broutet N, Xu W, Knust B, Sesay FR, McDonald SL, et al. Ebola RNA persistence in semen of Ebola virus disease survivors. N Engl J Med 2017;377:1428-37.

42. Christie A, Davies-Wayne GJ, Cordier-Lassalle T, Blackley DJ, Laney AS, Williams DE, et al. Possible sexual transmission of Ebola virus – Liberia, 2015. MMWR Morb Mortal Wkly Rep 2015;64:479.

43. Mate SE, Kugelman JR, Nyenswah TG, Ladner JT, Wiley MR, Cordier-Lassalle T, et al. Molecular evidence of sexual transmission of Ebola virus. N Engl J Med 2015;373:2448-54.

44. Cunze S, Kochmann J, Koch LK, Genthner E, Klimpel S. Vector distribution and transmission risk of the Zika virus in South and Central America. PeerJ 2019;7:e7920.

45. Barzon L, Lavezzo E, Palù G. Zika virus infection in semen: Effect on human reproduction. Lancet Infect Dis 2017;17:1107-9.

46. Counotte MJ, Kim CR, Wang J, Bernstein K, Deal CD, Broutet NJ, et al. Sexual transmission of Zika virus and other flaviviruses: A living systematic review. PLoS Med 2018;15:e1002611.

47. Mead PS, Duggal NK, Hook SA, Delorey M, Fischer M, Olzenak McGuire D, et al. Zika virus shedding in semen of symptomatic infected men. N Engl J Med 2018;378:1377-85.

48. Wilder-Smith A. Can dengue virus be sexually transmitted? J Travel Med 2019;26:tay157.

49. Lalle E, Colavita F, Iannetta M, Gebremeskel Teklé S, Carletti F, Scorzolini L, et al. Prolonged detection of dengue virus RNA in the semen of a man returning from Thailand to Italy, January 2018. Euro Surveill 2018;23:18-00197.

50. Iannetta M, Lalle E, Musso M, Carletti F, Scorzolini L, D’Abramo A, et al. Persistent detection of dengue virus RNA in vaginal secretion of a woman returning from Sri Lanka to Italy, April 2017. Euro Surveill 2017;22:30600.

51. Liew CH. The first case of sexual transmission of dengue in Spain. J Travel Med 2020;27:taz087.