Seroprevalence of Sexually Transmitted Diseases among Overseas Job Seekers in Nepal

Arun Bahadur Chand[1], Ajaya Basnet[2], Bindu Sen[3], Dev Raj Joshi[4]*, Shiba Kumar Rai[2,5]

[1]Department of Microbiology, KIST Medical College and Teaching Hospital, Lalitpur, Nepal

[2]Department of Medical Microbiology, Shi-Gan International College of Science and Technology, Kathmandu, Nepal

[3]Department of Dentistry, Shree Samaj Dental Clinic, Kathmnadu, Nepal

[4]Central Department of Microbiology, Tribhuwan University, Kathmandu, Nepal

***Corresponding author:** Dev Raj Joshi, Central Departments of Microbiology, Tribhuwan University, Kathmandu, Nepal; E-mail**:** dev.joshi@cdmi.tu.edu.np

ABSTRACT

Objectives: Migration is one of the socioeconomic factors that contribute to the acquisition and dissemination of sexually transmitted disease/s (STDs), a long-recognized major global health issue. This study aimed to determine the seroprevalence of STDs among Nepalese overseas job seekers.

Methods: Retrospective **s**erological data of Nepalese overseas job seekers (n=14,980), who were tested for Hepatitis B (HB), Hepatitis C (HC) and Acquired Immune Deficiency Syndrome (AIDS) with an enzyme-linked immunosorbent assay, and syphilis with *Treponema pallidum* hemagglutination assay, were extracted (January and December 2021) from the electronic database of a diagnostic center and analyzed using SPSS version 17.0.

Results: Syphilis seroprevalence was 0.59% among overseas job seekers, while HB, AIDS, and HC seroprevalences were 0.32%, 0.15%, and 0.11%, respectively. Unlike syphilis, which was predominated in the age group of 31-40 years, viral hepatitis and AIDS were prevalent in the age group of 21-30 years. Males had higher incidences of HB (n=48), HC (n=17), AIDS (n=23), and syphilis (n=86) compared with females. Co-prevalence of HIV-syphilis and HIV-HBV occurred in 0.020% (n=3) and 0.013% (n=2) of individuals, respectively, whereas both HIV-HCV and HBV-HCV co-prevalence was observed in 0.007% (n=1) of individuals.

Conclusion: Syphilis is the most common STD among Nepalese overseas job seekers, with the highest co-occurrence with AIDS.

Keywords: Overseas job seekers, seroprevalence, sexually transmitted diseases, Nepal

INTRODUCTION

Sexually transmitted diseases (STDs) are a group of infectious diseases spread either vertically from mothers to children or horizontally through sexual contact and blood and blood products [Ito et al, 2019; MoHP 2014; Kellerman et al, 2003]. Despite medical advancements, STDs remain a threat to the health and welfare of individuals [Gerbase et al, 2003]. In 2019, the WHO estimated that 58 million people worldwide had chronic Hepatitis C (HC) virus infection and 296 million had chronic hepatitis B (HB) virus infection [WHO, 2022].

Date of Submission: September 02, 2022
Date of Acceptance: October 25, 2022
Published Online: December 31, 2022
DOI: https://doi.org/10.3126/tujm.v9i1.50389

Moreover, by the end of 2021, an estimated 38.4 million people were infected with the Human immune deficiency virus (HIV), with 0.65 million people dying as a result of the infection [WHO, 2019]. Furthermore, approximately 5.6 million new cases of syphilis are reported worldwide each year [Peeling et al, 2017]. In Nepal, the estimated prevalence of HC was 0.6% and the prevalence of HB was 0.9% [Shrestha et al, 2017]. Approximately 64000 people are living with acquired immune deficiency syndrome (AIDS) in Nepal [NCASC, 2009].

Migration for work has always been an important feature of the country's economy and society [Seddon, 1995]. Socio-economic inequality due to economic deprivation, especially in low and middle-income countries, including Nepal, has forced adults to seek employment away from home, resulting in increased mobility, which has been linked to an increased risk of acquiring STDs [Bloom et al, 2002]. Such migrants have poor knowledge concerning safe sex practices, and even if they have, they might hesitate to implement the practice [Gurubacharya, 1996], nevertheless, leading to the acquisition of STDs.

In Nepal, the prevalence of STDs as well as on co-occurrences of such diseases among overseas job seekers is rarely understood. Therefore, this study aimed to determine the seroprevalence of major STDs, including HB, HC, AIDS, and syphilis, and investigated the co-occurrences of several STDs among Nepalese overseas job seekers in the year 2021.

MATRIALS AND METHODS

Study site and participants

This is a retrospective single-centered study conducted on Nepalese overseas job seekers attending Life Trust Medi Diagnostic, Kathmandu, Nepal, between January and December 2021.

Ethical consideration

This study was carried out after receiving approval from the Institutional Review Committee (IRC) of Shi-Gan Health Foundation, Kathmandu, Nepal.

Inclusion and exclusion criteria

This study included all Nepalese overseas job seekers attending the diagnostic center for testing STDs. Individual with missing findings and who had attended the study site beyond the study duration were excluded from the study.

Data collection

The demographic details (age, gender) and the laboratory finding of STDs (for Hepatitis B, Hepatitis C, AIDS, and syphilis) among the enrolled participants were collected from an electronic database (midas Dr. Home V 3.2). After obtaining complete information, it was rechecked, anonymized, and entered into Microsoft Excel 2010.

Laboratory diagnosis

Three milliliters of the whole blood sample were collected aseptically into a serum separating tube and centrifuged at 3,500 rpm for 5 minutes to separate the serum. In any case of delay, the serum was stored in refrigerator at 2-8°C. The HBsAg test for hepatitis B, as well as anti-HCV and anti-HIV I & II antibody tests for hepatitis C and AIDS, are performed using commercially available diagnostic enzyme linked immunosorbent assays (ELISA). Similarly, antibodies for syphilis was screened by using a rapid plasma reagin (RPR) test and confirmed by using *Treponema pallidum* hemagglutination (TPHA) assay.

Briefly the immunoassays were performed as;

a. Hepatitis B test: For Hepatitis B diagnosis, a solid phase HBsAg ELISA kit based on the sandwich principle was used.
b. Hepatitis C test: For in vitro qualitative detection and screening assay of Hepatitis C virus infection in human serum, a solid phase ELISA kit based on the Peroxidase conjugated Double Antibody/Antigen Direct Sandwich principle Anti-HCV ELISA kit was used.
c. HIV I and II test: For in-vitro qualitative detection and screening assay of HIV infection in human serum, a solid phase ELISA kit based on the sandwich principle Anti-HIV 1+2 ELISA kit was used.
d. Syphilis test

i. RPR screening test: The RPR test is a flocculation slide test in which antigens coated with carbon particles are allowed to react with the sample. In the test, we placed one drop of serum on the slide followed by one drop of RPR antigen suspension. Then, thoroughly combine and spread the liquid over the entire area of the circle. Later, we gently rock the slide for 8 minutes and look for the appearance of carbon particle clumping under a bright light source. If syphilis antibodies are present in serum, flocculation will occur on the slide due to carbon particle aggression indicating a positive reaction. If the sample does not contain the antibody,

there will be no flocculation and a clear background, indicating a negative reaction.

ii. TPHA confirmative test: A rapid TPHA diagnostic test kit was used for the diagnosis of syphilis from each serum sample. In this test, one drop of serum (25 microliters) followed by one drop of buffer were added to the sample port. After 15 minutes, the result was observed. Positive results were indicated by the appearance of two distinct pinks to deep purple color bands on the device.

Statistical analyses

Statistical analyses were done using SPSS software version 17. Descriptive statistics including, median [Interquartile range (IQR)], *n*, and %, were used to characterize the study variables.

RESULTS

A total of 14,980 overseas job seekers were tested for the presence of STDs. Majority of overseas job seekers belonged to the age group 21-30 years (n=9040, 60.51%), followed by the age group 31-40 years (n=5,049, 33.7%) and 41-50 years (n=759, 5.07%). Among the total individuals, 14,856 (98.85%) were males (Table 1).

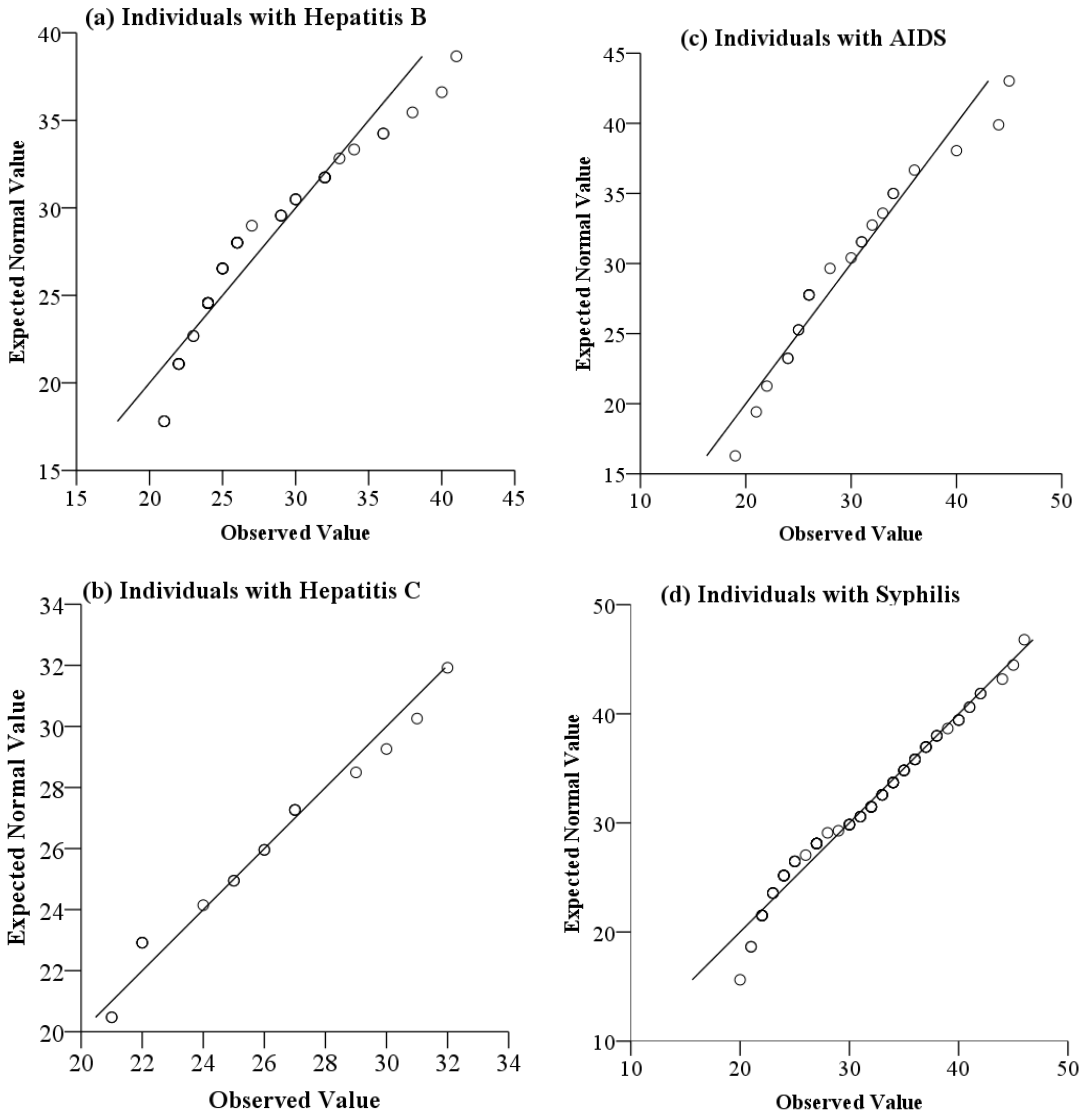

Figure 1: Q-Q plot of age of individuals with STDs

Table 1: Detail of individuals with sexually transmitted disease

Parameters		Individuals with							
		Hepatitis B		Hepatitis C		AIDS		Syphilis	
		NR (*n*=14,932)	R (*n*=48)	NR (*n*=14,963)	R (*n*=17)	NR (*n*=14,957)	R (*n*=23)	NR (*n*=14,892)	R (*n*=88)
Age (years)	Median [IQR]	28 (24-34)	25.5 (24-30)	28 (24-34)	26 (22-28)	28 (24-34)	28 (25-34)	28 (24-34)	32 (25.25-36)
	11-20	99	0	99	0	98	1	98	1
	21-30	9,003	37	9,025	15	9,028	12	9,002	38
	31-40	5,039	10	5,047	2	5,041	8	5,007	42
	4150	758	1	759	0	757	2	752	7
	51-60	33	0	33	0	33	0	33	0
Gender	Female	124	0	124	0	124	0	122	2
	Male	14,808	48	14,839	17	14,833	23	14,770	86
Individuals with co-occurrence of STDs	Ind. no. X_1	−	−	−	−	−	+	−	+
	Ind. no. X_2	−	−	−	−	−	+	−	+
	Ind. no. X_3	−	+	−	−	−	+	−	−
	Ind. no. X_4	−	+	−	−	−	+	−	−
	Ind. no. X_5	−	−	−	−	−	+	−	+
	Ind. no. X_6	−	−	−	+	−	+	−	−
	Ind. no. X_7	−	+	−	+	−	−	−	+
Seroprevalence	-	0.32		0.11		0.15		0.59	

AIDS = Acquired immunodeficiency syndrome, NR = Non-reactive, R = Reactive, IQR = Interquartile range, STDs = Sexually transmitted diseases, Ind. no. = Individual number, + = Present, − = Absent, X_1-X_7: *Anonymize* individual code

The median age (IQR) for individual with HB was 25.5 years (24-30), and for HC was 26 years (22-28). Similarly, median age (IQR) for individual with AIDS was 28 years (25-38), and for syphilis was 32 years (25.25-36) (Table 1). While the Q-Q plot for both HC and syphilis was approximately normally distributed, as indicated by data points; the Q-Q plot for HB and AIDS were not normally distributed (Figure 1).

Individuals with syphilis (n=88, 0.59%) predominated the infected group, followed by individuals with HB (n=48, 0.32%), AIDS (n=23, 0.15%), and HC (n=17, 0.11%). The higher incidences of HB (77.08%, 37/48), HC (88.24%, 15/17), and AIDS (52.17%, 12/23) were observed in the individuals belonging to the age group 21-30 years. However, a higher incidence of syphilis (47.73%, 42/88) was observed in the individuals belonging to the age group 31-40 years. There were also varying incidences of co-occurrences of HIV-syphilis (0.020%, 3/14,980), HBV-HIV (0.013%, 2/14,980), HCV-HIV (0.007%, 1/14,980), and HBV-HCV-syphilis (0.007%, 1/14,980) among the overseas job seekers (Table 1).

DISCUSSION

Sexually transmitted infections (STDs) continue to be a major public health problem in most countries around the world. Co-occurrences of HB and HC in individuals with AIDS are common, presumably due to the shared route of transmission of sexually transmitted pathogens. Information on evaluation and trends in STDs prevalence among job seekers can help Nepal keep track of its STDs trends and provide specifics on the effectiveness of preventive and control efforts. This study helps to estimate the seroprevalences of HB, HC, AIDS, and syphilis in Nepalese overseas job seekers and identify the rates of co-occurrence/s of such diseases among individuals.

In this study, the seroprevalence of HBV, HCV and HIV was 0.32%, 0.11%, 0.15%, respectively among the study participants. Gurung et al. [Gurung et al, 2018] reported a higher prevalence of hepatitis B (1.65%), a lower prevalence of hepatitis C (0.03%), and a similar prevalence of AIDS (O.13%). The study conducted in Western Region of Nepal reported, the seroprevalence of hepatitis B was 1.1%, hepatitis C was 0.3%, and AIDs was 0.5% [Shrestha et al, 2016]. A study conducted by Khanal et al. [Khanal et al, 2012] in two different places of Eastern part of Nepal reported the varying seroprevalence (0.52-0.64%) of HBV. Another study by Karki et al reported the seroprevalence of HCV and HIV was 0.66% and 0.19% among blood donors in Kathmandu valley, Nepal, respectively [Karki et al, 2008; Karki et al, 2009]. This study found a 0.59 % seroprevalence of syphilis, which was slightly lower than a previous study of high-risk groups in Kathmandu and nearby cities, which found that 0.7% of female sex workers had active syphilis and 2.5 % had a previous infection [IBBS, 2011]. The estimated prevalence of syphilis for women in Southeast Asia is 0.37% [Newman et al, 2015]. The increase in unprotected sex is one of the causes behind the increased incidence of syphilis [Shilaih et al, 2017]. The seroprevalence of Hepatitis B, Hepatitis C, AIDs, and syphilis was higher in the male group in this study, but this could be attributed to the larger number of males migration from Nepal [NLMP, 2020], who was screened for STDs. Totally in associate to our study, higher seroprevalence of HCV infection was observed in male donors than in female donors [Karki et al, 2008]. As of 2011, male labor migrants accounted for 27% of total estimated HIV infections in Nepal. The reason behind high number of male might be males are more vulnerable to unsafe sexually active and use more injectable drugs than females.

In this study, the majority of individuals with syphilis were between the ages of 31-40, while other STDs were between the ages of 21-30. Similarly, to our study, the seroprevalence of HC was highest (0.82%) in the age group of 21-30 years [Karki et al, 2008]. Previous research found that the positive rate for Hepatitis B infection was higher among patients aged 46-55 years and that for Hepatitis C infection was higher among patients aged 36-45 years. [Pokharel, 2017]. The Joint United Nations Programme on HIV/AIDS reported that, in 2019, 50% of new syphilis infections in adult women and 30% in adult men were among those aged 15–24 years [UNAIDS, 2020]. In 2018, the highest syphilis rates among females were observed among those aged 20–24 years and 15–19 years, among males, the rate was highest among those aged 20–24 years and 25–29 years [CDC, 2018]. The causes for the increased frequency of STDs among adults are low levels of education, not being married, multiple sex partners, alcohol and drug use, and early sexual debut, males who have sex with men.

In this study, Co-occurrences of HIV-syphilis were more common, followed by HBV-HIV co-occurrences, HBV-HCV-syphilis co-occurrences, and HCV-HIV co-occurrences. Approximately 5% to 10% of people with HIV in the United States also have chronic HBV infection [Spradling et al, 2010]. The prevalence of HBV co-occurrences with HIV infection is estimated to be approximately 5% to 7% because of both HIV and the hepatitis B virus share similar transmission routes [Alter, 2006]. The prevalence of HIV co-occurrences with syphilis in this study was 16.2%, higher than that observed in studies with seropositive population conducted in Rio de Janeiro (2.7%) [Signorini et al, 2007] and Londrina (8.7%) [Morimoto et al, 2005].

In the United States, approximately 5% of adults with hepatitis C virus (HCV) infection have co-occurrences with HIV [Bosh et al, 2018]. HCV–HIV co-occurrences among intravenous drug abusers were 11.3% [Ruan et al, 2004]. Co-occurrences with HIV and HCV is common (62%–80%) among injection-drug users who have HIV [Yehia et al, 2014; Spradling et al, 2010; DCd, 2017] including those who participate in unprotected anal intercourse, use sex toys, and use non-injection drugs. About 4–5 million people have HCV-HIV co-occurrences. In the United States and Western countries, HCV is found in 72–95 % of intravenous drug users (IVDUs), 1–12% of men who have sex with men, and 9–27% of heterosexuals [Akhtar et al, 2022]. Co-occurrences occur because infections have comparable transmission pathways [NLMP, 2020].

This is preliminary study just to provide the glimpse of the situation, however broader study would be required to identify the most vulnerable young people acquiring the STDs, and also to determine transmission.

CONCLUSIONS

This study confirms the higher syphilis seroprevalence among 30-37 years male overseas job seekers in Nepal, as well as a higher rate of HIV-syphilis co-occurrences. Thus, scaling up of the screening of overseas job seekers for STDs and provision of health education about the risk factors, the mode of transmissions and prevention is recommended.

CONFLICT OF INTEREST

The authors declared no conflict of interest.

REFERENCES

Ito H, Yamamoto T, Morita S. Demography of sexually transmitted infections with vertical transmission. Applied Mathematics and Computation. 2019; 348: 363-70.

Case Management of Sexually Transmitted Infections National Guidelines on 2014. Government of Nepal, Ministry of Health and Population, National Centre for AIDS and STD Control. Available at: https://mohp.gov.np/downloads/National%20STI%20Guidelines%202014.pdf

Kellerman SE, Hanson DL, McNaghten AD, Fleming PL. Prevalence of chronic hepatitis B and incidence of acute hepatitis B infection in human immunodeficiency virus–infected subjects. Journal of Infectious Diseases. 2003; 188: 571-7.

Gerbase AC, Rowley JT, Mertens TE. Global epidemiology of sexually transmitted diseases. Lancet 1998; 351: S2-S4.

World Health Organization. Fact Sheet, Hepatitis B, Available at: https://www.who.int/news-room/fact-sheets/detail/hepatitis-b

World Health Organization. Fact Sheet, Hepatitis C. Available at: https://www.who.int/news-room/fact-sheets/detail/hepatitis-c

World Health Organization. Fact Sheet, HIV. Available at: https://www.who.int/news-room/fact-sheets/detail/hiv-aids

Peeling, R.W., Mabey, D., Kamb, M.L., Chen, X.S., Radolf, J.D. and Benzaken, A.S., Syphilis Nat Rev Dis Primers. 2017; 3: 17073.

Shrestha A. Viral hepatitis in Nepal: Past, present, and future. Euroasian Journal of Hepato-gastroenterology 2016; 6: 59.

Seddon JD. Migration India and Nepal. In Cohen R edit, The Cambridge Survey of International Migration (Cambridge: Cambridge University Press, 1995).

Bulletin of Concerned Asian Scholars. DIV-AIDS in Nepal: The coming Crisis. Available at: https://www.tandfonline.com/doi/pdf/10.1080/14672715.1998.10411032

Bloom DE. River Path Associates and Jaypee Seviall, 'Health, Wealth, AIDS and Poverty'. Mimeo. Harvard School of Public Health 2002.

Bloom DE. Asia's economies and the challenge of AIDS. Asian Development Bank 2004.

Gurubacharya, V.L., 1996. HIV/AIDS–Everybody's Concern. *ABC/Nepal*.

Gurung K, Poudel TP, Shah GJ, Mishra D. Seroprevalence of Human Immunodeficiency Virus, Hepatitis B Virus and Hepatitis C Virus in Nepalgunj Medical College, Nepal. Journal of Nepalgunj Medical College 2018; 16: 63-6.

Shrestha UK, Bhatta BD. Seroprevalence of hepatitis B virus, hepatitis C virus and human immunodeficiency virus in the western region of Nepal. Journal of Advances in Internal Medicine 2016; 5: 6-10.

Khanal H, Bhatta, DR Tiwari BR, Joshi DR. Seroprevalence of Hepatitis B among blood donors in Jhapa, Nepal. Sunsari Technical College Journal 2012; 1: 33-7.

Karki, S., Ghimire, P., Tiwari, B.R. and Rajkarnikar, M., 2008. Seroprevalence of anti HCV antibodies among blood donors in Kathmandu valley, Nepal. Kathmandu University Medical Journal, 6(4), pp.491-496.

Karki, S., Ghimire, P., Tiwari, B.R., Shrestha, A.C., Gautam, A. and Rajkarnikar, M., 2009. Seroprevalence of HIV and hepatitis C co-infection among blood

donors in Kathmandu Valley, Nepal. Southeast asian j trop med public health, 40(1), pp.66-70.

NCASC and ASHA Project. Integrated Biological and Behavioral Surveillance (IBBS) Survey among Female Sex Workers in Kathmandu Valley, Nepal, Round IV-2011. http://www.fhi360.org/, accessed June 16, 2017.

Newman, L., Rowley, J., Vander Hoorn, S., Wijesooriya, N.S., Unemo, M., Low, N., Stevens, G., Gottlieb, S., Kiarie, J. and Temmerman, M., 2015. Global estimates of the prevalence and incidence of four curable sexually transmitted infections in 2012 based on systematic review and global reporting. PloS one, 10(12), p.e0143304.

Shilaih, M., Marzel, A., Braun, D.L., Scherrer, A.U., Kovari, H., Young, J., Calmy, A., Darling, K., Battegay, M., Hoffmann, M. and Bernasconi, E., 2017. Factors associated with syphilis incidence in the HIV-infected in the era of highly active antiretrovirals. *Medicine*, *96*(2).

Nepal Labour Migration Report-2020. Migration-Report-2020-English.pdf https://moless.gov.np/wp-content/uploads/2020/03/Migration-Report-2020-English.pdf

THE WORLD BANK. HIV/ AIDS in Nepal. Available at: https://www.worldbank.org/en/news/feature/2012/07/10/hiv-aids-nepal.

Pokharel, N., 2017. Pattern of hepatitis B and C infections among patients attending a tertiary care hospital in Kathmandu, Nepal. Journal of Institute of Medicine, 40(2).

UNAIDS. Seizing the moment: tackling entrenched inequalities to end epidemics. https://www.unaids.org/en/. Date: 2020 Date accessed: September 2, 2020

CDC. Sexually Transmitted Disease Surveillance 2018. www.cdc.gov/nchhstp/newsroom/2019/2018-STD-surveillance-report.html

Spradling, P.R., Richardson, J.T., Buchacz, K., Moorman, A.C., Brooks, J.T. and HIV Outpatient Study (HOPS) Investigators, 2010. Prevalence of chronic hepatitis B virus infection among patients in the HIV Outpatient Study, 1996–2007. Journal of viral hepatitis, 17(12), pp.879-886.

Alter, M.J., 2006. Epidemiology of viral hepatitis and HIV co-infection. Journal of hepatology, 44, pp.S6-S9.

Signorini, D.J.H.P., Monteiro, M.C.M., Sá, C.A.M.D., Sion, F.S., LeitãoNeto, H.G., Lima, D.P. and Machado, J.D.D.C., 2007. Prevalência da co-infecção HIV-sífilisem um hospital universitário da cidade do Rio de Janeiro no ano de 2005. Revista da SociedadeBrasileira de Medicina Tropical, 40, pp.282-285.

Morimoto, H.K., Caterino-De-Araujo, A., Morimoto, A.A., Reiche, E.M., Ueda, L.T., Matsuo, T., Stegmann, J.W. and Reiche, F.V., 2005. Seroprevalence and risk factors for human T cell lymphotropic virus type 1 and 2 infection in human immunodeficiency virus-infected patients attending AIDS referral center health units in Londrina and other communities in Parana, Brazil. AIDS Research & Human Retroviruses, 21(4), pp.256-262.

Bosh, K.A., Coyle, J.R., Hansen, V., Kim, E.M., Speers, S., Comer, M., Maddox, L.M., Khuwaja, S., Zhou, W., Jatta, A. and Mayer, R., 2018. HIV and viral hepatitis coinfection analysis using surveillance data from 15 US states and two cities. Epidemiology & Infection, 146(7), pp.920-930.

Ruan, Y.H., Hong, K.X., Liu, S.Z., He, Y.X., Zhou, F., Qin, G.M., Chen, K.L., Xing, H., Chen, J.P. and Shao, Y.M., 2004. Community-based survey of HCV and HIV coinfection in injection drug abusers in Sichuan Province of China. World journal of gastroenterology: WJG, 10(11), p.1589.

Yehia, B.R., Herati, R.S., Fleishman, J.A., Gallant, J.E., Agwu, A.L., Berry, S.A., Korthuis, P.T., Moore, R.D., Metlay, J.P., Gebo, K.A. and HIV Research Network, 2014. Hepatitis C virus testing in adults living with HIV: a need for improved screening efforts. PLoS One, 9(7), p.e102766.

Spradling, P.R., Richardson, J.T., Buchacz, K., Moorman, A.C., Finelli, L., Bell, B.P. and Brooks, J.T., 2010. Trends in hepatitis C virus infection among patients in the HIV Outpatient Study, 1996–2007. JAIDS Journal of Acquired Immune Deficiency Syndromes, 53(3), pp.388-396.

Centers for Disease Control and Prevention. Viral Hepatitis Surveillance—United States, 2015pdf icon. Atlanta: US Department of Health and Human Services, Centers for Disease Control and Prevention; 2017.

Panel on Opportunistic Infections in HIV-Infected Adults and Adolescents. Guidelines for the prevention and treatment of opportunistic infections in HIV-infected adults and adolescents: recommendations from the Centers for Disease Control and Prevention, the National Institutes of Health, and the HIV Medicine Association of the Infectious Diseases Society of America.

Akhtar, A., Fatima, S., Saeed, H., Soo, C.T. and Khan, A.H., 2022. HIV-HCV Coinfection: Prevalence and Treatment Outcomes in Malaysia. Intervirology, 65(2), pp.87-93.