REVIEW

Viral hepatitis and human immunodeficiency virus co-infections in Asia

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Abstract

Hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV) affect many people in Asian countries, although there are geographic differences. Both HBV and HIV (HBV/HIV) and HCV/HIV co-infections are highly prevalent in Asia. Hetero- and homosexual, injection drug use, and geographic area are strong predictors of HBV, HCV, and HIV serostatus. In HBV endemic regions, the prevalence and genotype distribution of HBV/HIV co-infection is almost comparable with that in the general population. In Japan, where HBV has low endemicity, the prevalence of HBV/HIV co-infection is approximately 10-fold higher than that in the general population, and HBV Ae is the most common subgenotype among HIV infected individuals. Highly active antiretroviral therapy (HAART) is an effective treatment for HIV/Acquired Immune Deficiency Syndrome. Lamivudine, a component of HAART, is an effective treatment for HBV, HIV, and HBV/HIV co-infection; however, cost, emerging drug resistance, antiretroviral-associated liver toxicity and liver-related morbidity due to HCV progression are particular concerns. HCV/HIV co-infection may accelerate the clinical progression of both HCV and HIV. The high prevalence of HBV/HIV and HCV/HIV co-infections in Asia underscores the need to improve prevention and control measures, as fewer evidence-based prevention strategies are available (compared with Western countries). In this review, the most recent publications on the prevalence of HBV/HIV and HCV/HIV co-infections and related issues, such as therapy and problems in Asia, are updated and summarized.

Key words: Hepatitis B virus; Hepatitis C virus; Co-infection; Human immunodeficiency virus; Prevalence; Asia; Pathogenicity; Natural history; Problems; Drug resistance

Core tip: Hepatitis B virus (HBV) and hepatitis C virus (HCV), infections are common among human

immunodeficiency virus (HIV) positive individuals due to similar blood-borne transmission routes. Highly active antiretroviral therapy is an effective treatment for HIV/acquired immune deficiency syndrome; however, emerging drug-resistant viruses and drug-induced hepatotoxicity are particular concerns. The high prevalence of HBV/HIV and HCV/HIV co-infections in Asia highlights the need to improve prevention and control measures because, unlike in Western countries, few evidence-based prevention strategies are available. Here, we review the epidemiologically and clinically important aspects of HBV/HIV and HCV/HIV co-infections in Asian countries.

INTRODUCTION

An estimated 240 million people worldwide are chronically infected with hepatitis B virus (HBV), and 170 and 34 million people are infected with HCV and human immunodeficiency virus (HIV), respectively[1]. Although the prevalence of these viral infections varies according to geographic region, the majority of cases occur in developing Asian and African countries[2,3]. Co-infection with HBV or HCV is common among HIV-positive patients due to their similar blood-borne transmission routes (*e.g.*, sexual and perinatal for HBV[4], and percutaneous for HCV).

HIV co-infection has a deleterious effect on the outcome of patients with chronic viral hepatitis and greatly complicates their management. HIV-positive individuals with chronic hepatitis (caused by either HBV or HCV) have greater liver mortality than those infected with HIV alone. Moreover, the highest reported mortality is among those with multiple hepatitis infections[5]. Although the burden of HBV and HCV infection is greatest in Asia, the biological characteristics associated with either HBV or HCV infection among HIV-infected individuals are unclear. YMDD motif mutants in HBV and occult hepatitis virus infection were observed in Asia[6] and these were found to be related to severe liver diseases and resistance to treatment and prevention[7]. This article provides an overview of the epidemiology of hepatitis B and C virus infections among HIV-infected individuals in Asian countries.

HIV EPIDEMIOLOGY IN ASIA

In the early-to-mid 1980s, much of the world was dealing with serious HIV and acquired immune deficiency syndrome (AIDS) epidemics, although Asia remained relatively unaffected. However, by the early 1990s, AIDS epidemics had emerged in several Asian countries and, by the end of the decade, had spread rapidly across the continent. Today, almost 5 million people in South, East, and Southeast Asia are infected with HIV. The epidemiology of the disease in different Asian countries is unique. In fact, the epidemiology can be different among areas/districts/provinces within the same country. By 2010, between 3.0 and 3.9 million people in Southeast Asia were living with HIV/AIDS, which was up from 3.3 million in 2009. Women account for 37% of those infected, the majority of whom were infected by a partner. However, the HIV epidemic in Southeast Asia is now declining: the number of new infections has fallen by 34% (from 320000 in 2001 to 210000 in 2010). According to the Joint United Nations Program on the global HIV/AIDS epidemic, 2011, Southeast Asia recorded above-average declines in the number of new HIV infections[8]. The WHO Southeast Asia Region (SEAR) comprises 11 countries: Bangladesh, Bhutan, South Korea, India, Indonesia, the Maldives, Myanmar, Nepal, Sri Lanka, Thailand, and Timor-Leste. The region has a combined population of over 1.8 billion. Five countries (India, Indonesia, Myanmar, Nepal and Thailand) account for the majority (99%) of HIV cases. India has the second highest HIV burden of any country in the world. There are few reports of HIV cases in Korea, Bangladesh, Bhutan, the Maldives, Sri Lanka, or Timor-Leste, which together represent less than 1% of all HIV infections recorded in the SEAR. The annual number of new infections reported in four of the five countries with a high HIV burden (namely India, Myanmar, Nepal, and Thailand) is declining. However, the number of cases in Indonesia continues to rise, making the epidemic in this country one of the fastest growing in Asia[9,10].

HBV/HIV CO-INFECTION IN ASIA

Epidemiology and risk factors

Approximately 240 million people are chronically infected with HBV, approximately 600000 of whom die each year of HBV-related diseases or hepatocellular carcinoma (HCC)[11]. Although the global prevalence of HBV varies from region to region, approximately 5%-10% of HIV-infected individuals are chronically infected, which is defined as persistent detection of hepatitis B surface antigen (HBsAg) for more than 6 mo. In areas with a low HBV prevalence (< 2% of individuals are HBsAg-positive), such as Western countries and Japan, chronic HBV infection among HIV-positive individuals is approximately 10-fold higher than that in the general population[12]. On the other hand, the prevalence of HBV infection in some parts of Africa and Asia is approximately 10%-15%, regardless of HIV co-infection[13].

The major route of HBV infection, especially in HBV endemic regions, is mother-to-child transmission. In HBV endemic regions, the prevalence and genotype distribution of HBV in HIV-infected patients is comparable

Table 1 Prevalence, risk factors, and the main vital genotypes identified in hepatitis B virus/human immunodeficiency virus co-infected individuals in Asia

Country	Prevalence (%)	Risk factors	Main genotype	Ref.
Southeast Asia				
Indonesia	3.2	Sexual	B3	Anggorowati et al[15], 2012
	15.3	IDU	B3	Utsumi et al[6], 2013
	7.0	Men with IDU	B3, D1, B2, C1	Fibriani et al[16], 2014
Myanmar	8.7	Homosexual men		Zaw SK et al[17], 2013
Thailand	13.0	HB vaccination women		Aurpibul et al[18], 2012
	3.3			Peters et al[19], 2013
	11.9			Tsuchiya et al[20], 2013
Vietnam	28.0	IDU	B4, B2, C1,	Dunford et al[21], 2012
	15.2	CSW	C5	
	10.3			Sereno et al[22], 2012
East Asia				
China	4.9	Older children ethnicity		Zhou et al[23], 2010
	6.3	Sexual		He et al[24], 2011
	7.2	Sexual		Maimaiti[25], 2012
	6.1			Chen et al[26], 2013
Japan	8.8	Homosexual men		Gatanaga et al[27], 2007
	6.4	Homosexual men		Koike et al[28], 2008
	7.9	Homosexual men	Ae	Fujisaki et al[29], 2011
	6.0	Homosexual men		Yanagimoto et al[30], 2012
South Asia				
India	9.0	Hetero sexual		Saravanan et al[31], 2007
	11.3	Hetero sexual men		Saha et al[32], 2013
	1.5		D > A > C	Saravanan et al[33], 2014

IDU: Injecting drug user; CSW: Commercial sex worker.

with that in the general population[6,14]. Table 1 shows the prevalence of HBsAg and lists the risk factors and major HBV genotypes identified in HIV-infected individuals in Asia. Japan is the only country with low endemicity of HBV infection in Asia[7]; however, it is 10 times more prevalent among HIV-infected individuals. A higher prevalence of HBV/HIV co-infection compared with the prevalence of HBV infection alone is observed in Indonesia, Vietnam, and India. Interestingly, Ae (HBV/Ae), which originated in Europe and the United States, is the most common HBV genotype in HBV/HIV co-infected patients in Japan, even though HBV/B and HBV/C are indigenous[34]. An individual infected with HBV/Ae (as opposed to other HBV genotypes) is at a higher risk of co-infection with HIV. Furthermore, HBV/Ae (which tends to be chronic)[29] is detected almost exclusively in homosexual men[28-30]. Indeed, in Myanmar, homosexual men carry the greatest risk of being co-infected with HBV and HIV[17], and an increased prevalence of HBV/HIV infection is also observed in men with a history of IDU[26]. A substantial number of HBV-infected individuals in Indonesia, Vietnam, Thailand, and India are also infected with HIV (15.3%, 28.0%, 13.0% and 11.3%, respectively)[6,15,16,19,21,32,35]. Indonesia is currently experiencing an increasing HIV incidence and a high HBV burden[6,15,17]; however, no HBV/HIV co-infection cases have been identified in commercial sex workers (CSW)[35]. In Thailand, HBV/HIV co-infection is more common in HIV-infected adolescents who are negative for anti-HBV antibodies[18]. HBV/HIV co-infection is also common in China, where sexual transmission is

an independent risk factor, followed by ethnicity and occupation[24]. Additionally, the incidence of co-infection among HIV-infected children receiving antiretroviral therapy (ART) is high. Significant levels of co-infection by blood-borne viruses are observed among IDUs and CSWs in Vietnam[21]. The main risk factor for HBV/HIV co-infection in India is heterosexual sex, whereas it is homosexual sex and IDU in other Asian countries.

Treatment and drug resistance
Several of the antiretroviral drugs used to treat HIV infection can also be used to treat HBV infection; therefore, they can be used to treat some co-infected patients[36]. On the other hand, HBV/HIV co-infection may complicate the delivery of ART by increasing the risk of drug-related hepatotoxicity and impacting the selection of specific agents, such as drugs that are effective against both HBV and HIV[37].

Lamivudine, a component of highly active antiretroviral therapy (HAART), is used widely because it is easy to obtain, relatively cheap, and its clinical efficacy has been shown in long-term follow-up studies[36,38,39]. However, lamivudine often induces mutations within the RT domain of the viral polymerase region, resulting in multidrug-resistance and a poor prognoses for some HBV/HIV co-infected individuals. Table 2 shows the effects of ART on HBV/HIV co-infection and drug resistance in Asian countries. Because lamivudine is associated with the emergence of drug-resistant strains, the current recommended treatment for co-infected individuals is a tenofovir (TDF)-based regimen[22]. Drug-

Table 2 Antiretroviral therapies for hepatitis B virus/human immunodeficiency virus co-infection, and drug-resistant mutations in Asian countries

	Indonesia	Japan	Thailand	Vietnam	China	India
Recommendation for ART on HBV/HIV co-infection	Initiate with WHO clinical stage IV and/or a CD4 count less than 200/mm³[40]	TDF + 3TC/FTC-based regimen	Screening for HBV. Two antiretroviral regimen with anti-HBV/anti-HIV activity (*e.g.*, TDF, 3TC)	TDF-based regimen	Combination of TDF with FTC or 3TC	HBeAg positivity is indicator to initiate ART with combination of two dually-active drugs
Currently used therapy for HBV/HIV co-infection	Telbivudine (LDT) Lamivudine (3TC) Zidovudine (ZDV) Nevirapine (NVP) Efavirenz (EFV) Stavudine (d4T) Tenofovir (TDF)	3TC Entecavir (ETV) TDF Adefovir dipivoxil (ADV) Emtricitabine (FTC)	3TC Nevirapine (NVP) EFV Stavudine (d4T)	Stavudine (d4T) 3TC NVP	d4T ZDV 3TC NVP EFV[41]	ZDV 3TC NVP EFV d4T[42]
Drug-resistant mutation	Lamivudine M204I M204I + L180M	Lamivudine¹ *V173L + L180M + M204V* Lamivudine L180M, M204V, L217R M184V, I195M	Lamivudine M204V/I	Lamivudine L180M M204V		Lamivudine¹ *M204V* *L180M*

¹Lamibudin naïve case. WHO: World Health Organization; HBV: Hepatitis B virus; HIV: Human immunodeficiency virus; FTC: Emtricitabine; TDF: Tenofovir; LDT: Telbivudine; ETV: Entecavir; ZDV: Zidovudine; ADV:Adefovir dipivoxil; NVP: Nevirapine.

resistant mutations, particularly multidrug-resistant mutations, are the major concern for patients receiving long-term therapy with nucleoside analogues, such as lamivudine[7]. A high prevalence of lamivudine-resistant mutation has been reported in adolescents from Thailand (M204V/I)[18], Vietnam (L180M and M204V)[13], and Indonesia (M204I and M204I + L180M)[6]. However, V173L + L180M + M204V was identified in HBV/HIV co-infected patients who were not treated with lamivudine[29]; L217R, M184V, and I195M were identified in lamivudine-treated patients[43] in Japan; and L180M and M204V were identified in ART-naïve patients in India[32]. One study suggests that all patients should be screened for HBV prior to ART initiation, as this would enable the most appropriate regimen to be selected[18]. Combination treatment with TDF plus either emtricitabine or lamivudine is recommended for patients who are co-infected with HBV/HIV[25]. However, many countries/regions are experiencing difficulty in accessing effective drugs (even the drugs recommended in their own guidelines) due to the lack of availability and/or high cost. Moreover, some developing Asian countries/regions lack experienced hepatologists and HIV specialists who can manage HBV, HIV, and HBV/HIV co-infection effectively.

Antiretroviral-associated liver toxicity (due to use of nevirapine use) was reported in both Thailand and Indonesia, and in some cases, ART with lamivudine did not suppress HBV[6,19]. In Vietnam, the precore mutation, G1896A, which is highly associated with HCC, is more common in HBV/HIV co-infected individuals harboring the HBV genotype B (HBV/B) than in those harboring HBV/C[32]. HBV replication can occur in the absence of HBsAg [known as occult HBV (OHBV) infection]. OHBV has been reported in HIV-infected individuals, although the underlying mechanisms are unclear[6,44]. The majority of perinatally infected HIV-positive adolescents in Thailand do not produce HBV protective antibodies, even though hepatitis B vaccination coverage is high. Thus, the HBV seroprotection level is low despite childhood vaccination, suggesting that the populations at risk for HBV infection require a booster dose of an HBV vaccine[18]. The current recommendation in Japan is that all newborn babies are vaccinated against hepatitis B.

HCV/HIV CO-INFECTION IN ASIA

Epidemiology

HCV and HIV are among the top ten leading causes of death due to infectious disease worldwide. HCV accounts for an estimated 170 million chronic infections and HIV accounts for approximately 34 million infections[1]. These viruses, together with HBV, share transmission routes, although their prevalence differs according to the transmission efficiency and geographic region[4].

The overall prevalence of HCV/HIV co-infection ranges from 1.2% to 98.5% in South and Southeast Asia[45]. These estimates are influenced by several factors, including geographic differences in the prevalence of chronic infection in different age groups, transmission efficiency *via* certain routes, and the number of individuals at high risk for infection[4]. The HCV transmission risk is significantly higher among patients who acquired HIV infection *via* the parenteral route rather than the sexual route. Although the sexual route is a common mode of HIV transmission, it is less common for HCV[46]. Today approximately one-quarter of HIV-infected individuals in Europe and the USA are co-infected with HCV[47]. HCV infection outbreaks have been reported in HIV-positive men who have sex with men (MSM) in North America, Europe, and Asia.

Transmission is believed to be the result of exposure to blood during sexual contact[48]. HCV-RNA was detected in 38.2% of anti-HCV-negative samples in Indonesia[10]. Sexual contact is still the main HIV transmission route in Indonesia, whereas HCV is less easily transmitted via the sexual route. Thus, among the heterosexual transmission history, the HCV-seropositive rate (26.9%) was significantly higher compared with the HCV infection rate alone, which may be due to the HCV transmission mechanisms between sexual partners, particularly those who engage in practices that are associated with a high virus transmission risk[10]. Sulkovski *et al*[49] and others also reported HCV infection with sexual transmission between HIV-infected MSM and other individuals with abnormal sexual activities[49]. The European AIDS Clinical Society guidelines on co-infection suggest that patients who are beginning HIV therapy should be serologically tested for HCV. It also suggests that HCV RNA-negative and anti-HCV antibody-negative patients exhibiting an unexplained increase in alanine transaminase levels, and those at high risk for HCV infection (*e.g.*, IDU and those likely to suffer mucosal trauma during intercourse) should be tested annually thereafter[46].

A study regarding HIV and HCV infection among those receiving methadone maintenance treatment (MMT) in clinics in Yunnan, China, showed that the prevalence of HIV seropositivity in rural and urban areas was 27.7% and 10.0%, respectively, and the prevalence of HCV seropositivity was 75.6% and 46%, respectively; however, the prevalence of HIV/HCV co-infection was 20% and 7%, respectively. Over three-quarters (76.2%) of the HIV-infected participants in this study were also infected with HCV[50]. The majority of heroin is smuggled into Yunnan province from Myanmar. It then moves along drug trafficking routes to other areas of the country. Thus, high levels of illicit drug use and HIV and HCV epidemics are common in Yunnan[51-53]. Urban and rural MMT patients know little about HIV and HCV; therefore, education programs in MMT clinics must be improved. Studies performed in Beijing, Henan, Guangxi, Kunming, Sichuan, Hunan, Xinjiang, and Shanxi reveal that the prevalence of HCV co-infection among HIV-infected individuals ranges from 11.6% to 85.0%, depending on the area surveyed. The primary transmission route favored by each of these viruses may explain these differences. The co-infection rates in IDUs (58.2%-91.6%) and commercial blood donors (15.8%-71.6%) are significantly higher than those in individuals who become co-infected *via* sex (5.3%-20.0%)[54]. Another study from Central China shows that only 62.4% of HIV-infected individuals have anti-HCV antibodies[26]. In Vietnam, 89.8%-98.5% of HIV-positive IDUs are infected with HCV. A study in southern India found that 18 (15%) and 10 (8.3%) out of 120 HIV-infected patients were also positive for HBsAg and anti-HCV antibodies, respectively. The study, which was carried out in a tertiary care center, also found that the most common transmission routes were sexual promiscuity (79%), followed by sex with a positive spouse (15%), and a blood transfusion history (6%)[55]. A cross-sectional study performed in Mazandaran province, Iran, from 2008 to 2010 showed that of 80 HIV-positive patients, only 33.8% were co-infected with HCV, whereas 25% were co-infected with both HBV and HCV. Thus, 58.8% of HIV-positive patients were also infected with HCV[56]. A study of 33255 blood samples from in Kathmandu, Nepal, reported that the HIV seroprevalence was 0.19% and that 10.8% of the donors were co-infected with HCV[57]. Additionally, the study found similar HIV seroprevalence rates between first-time and repeat donors, and between volunteer and replacement donors, indicating the need for more effective donor recruitment, education, and counseling strategies.

Natural history
HCV and HIV co-infection enhances liver damage and increases the risk of developing end-stage liver disease and HCC. From a clinical perspective, HCV/HIV co-infection is the most common cause of liver cirrhosis in these patients; therefore, monitoring and treatment of these infections must be prioritized, even though this is more difficult to achieve than in HCV-monoinfected individuals[58,59]. A meta-analysis that examined the impact of HIV infection on HCV-infected individuals revealed that HCV/HIV co-infection was associated with a 6.14-fold increase in the relative risk for end-stage liver disease and a 2.07-fold increase in the relative risk for cirrhosis compared with HCV mono-infection[60,61]. On the other hand, HCV/HIV co-infected patients respond less well to antiviral therapy with peginterferon + ribavirin (pegIFN + RBV), resulting in a lower sustained virological response (SVR) after antiviral therapy. HIV/HCV co-infected individuals develop end-stage liver disease more quickly than either HIV- or HCV-monoinfected patients[26,55], particularly those receiving long-term immunosuppressive regimens. Thus, early HCV/HIV co-infection diagnosis may allow for prompt co-morbidity recognition of and prevent future complications.

Problems
Unsafe therapeutic injections performed by both professionals and non-professionals appear to be the predominant HCV transmission mode in countries/regions with moderate-to-high prevalence; indeed, such cases account for up to 40% of all HCV infections worldwide. The predominant transmission mode in most low prevalence areas is IDU[4,62-64]. Although transfusion- and transplant-associated HCV infections are minimized by routine testing of donors, and preventing a new generation of young injectors from becoming infected with HIV or HCV is paramount[65].

The introduction of HAART has meant that HCV infection is now considered the principal cause of morbidity and mortality among HIV-infected indi-

viduals[10,49,66,67]. Liver-related morbidity occurs due to the acceleration of HCV-related disease, drug-induced hepatotoxicity, and, possibly, direct damage caused by HIV itself. Chronic viral hepatitis accounts for > 80% of liver-related deaths. End-stage liver disease and HCC are common complications in HIV-infected patients. Co-infection may accelerate clinical progression in both of these diseases, which are caused by HCV and HIV, and successful treatment for one disease is undermined if the other is neglected[45]. The infectious diseases physicians that care for HIV-infected patients with advanced HCV-related liver disease need to know how to assess a patient for advanced fibrosis, when to refer a patient for endoscopic screening for varices, and when/how to enroll patients in an HCC screening program[67]. Data from The TREAT Asia HIV Observational Database, a multi-center cohort of HIV patients in the Asia-Pacific region, showed that the impact of hepatitis co-infection on immunological and virological responses to ART, and on AIDS progression, are similar among Asian and Western populations[68]. That said, the high prevalence of HIV/HCV co-infection in Asian countries underscores the need to implement improved prevention and control measures because, compared with Western nations, fewer evidence-based prevention strategies are available.

Medical management
Hepatitis C has a limited impact on HIV disease progression. However, HIV does affect HCV with regard to several important areas[69]. The hepatitis C treatment goal is to eradicate HCV infection. Only then can complications associated with HCV-related liver disease, including HCC, be prevented. The therapy endpoint is the achievement of SVR, defined as undetectable HCV RNA levels in the serum 24 wk after the completion of antiviral therapy. SVR is associated with an improved outcome in terms of liver fibrosis and reduced liver-related morbidity and mortality[59]. Similar results have been described in HIV/HCV co-infected patients[59].

The availability of Direct Acting Antivirals (DAAs) for the treatment of patients infected with HCV genotype 1 has markedly improved SVR[70]. The Asian Pacific Association for the Study of the Liver[69] and other studies[49,71] suggest that DAAs, either with or without pegIFN + RBV, show much higher HCV eradication rates in HCV/HIV co-infected individuals than conventional pegIFN + RBV, with manageable toxicity and pharmacologic interactions. However, the promise of new oral DAAs comes with a substantial up-front financial cost, particularly for poorer Asian countries. Indeed, the majority of HCV-infected patients in low- or middle-income countries remain untreated. The global rollout of ART for HIV shows us that it is possible to make these agents both widely available and affordable[72]. Robust efforts to ensure equitable access to these advanced drugs for co-infected patients are imperative.

In the past, HIV-individuals were not considered candidates for solid organ transplantation due to concerns about a heightened risk of opportunistic infection and malignancy. However, recent single- and multi-center studies show that liver transplantation can be performed in HIV-infected patients who satisfy commonly accepted eligibility criteria, including an undetectable HIV RNA load in the plasma, current treatment with a stable HAART regimen or the ability to tolerate ART after transplantation, a minimum CD4+ T-cell count of 100-200 cells/mm^3, and an absence of opportunistic infections[66].

HBV/HCV/HIV TRIPLE INFECTION IN ASIA
Few reports are available regarding the prevalence of HIV/HBV/HCV triple infection in Asia. The prevalence of triple infection in Chinese IDUs (19.1%) is a little bit higher than that in Burmese IDUs (10.4%) in the China-Myanmar border region, which is an important transfer station for drug trafficking from the "Golden Triangle"[53]. As we have seen in mainland Myanmar, triple infection is markedly low (0.35%)[17]. The other studies in mainland China show triple infection were 3.3% in a cohort study, that was carried out between 2010-2012[73] and 12.2% in central China[26]. Therefore, the endemicity of triple infection greatly varies even within the (China) country. Triple infection was not detected in North India[74], but it was manifested in 2.5% of subjects in South India[56], and in 4.8% in Indonesia[15].

HBV/HCV/HIV triple infection raised the chance of death, virological failure, and dropping out of care programs[73]. The incidence of hepatic decompensation was higher in patients with triple infection than in those with HIV/HCV co-infection[75].

CONCLUSION
Both HIV/HBV and HIV/HCV co-infection are highly prevalent in Asia. IDU, MSM, and geographic area are strong predictors for HBV, HCV, and HIV serostatus. Differences in the HBV and HCV co-infection rates among Asian countries may be due to the epidemiology of these viruses in specific countries/areas. Differences in the HBV/HIV co-infection rates. among countries are more pronounced than the differences in the HCV/HIV co-infection rates. The success of HBV vaccination programs and the HBV endemicity in a particular country may also play a role. Unlike HBV infection, the prevalence of which has been reduced by vaccination, HCV (which is mostly transmitted through the blood) cannot be tackled effectively in developing countries unless people are educated about the transmission routes and the dangers of certain practices. A detailed analysis of the progression and activity of liver disease in HIV co-infected patients is needed, along with the urgent implementation of comprehensive prevention

strategies, such as community education and control programs, for both HBV/HIV and HIV/HCV co-infected individuals.

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