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# Unmet Needs in Occupational Health Prevention and Management for Viral Hepatitis in Health Care Workers in Ho Chi Minh City, Vietnam: A Mixed-Methods Study

Tran Nguyen*[,2], Trang Pham*[,1,6], Hong K. Tang[5], Loc Phan[1], Gary Mize[1], William M. Lee[1,2], Robert G. Gish[1], Amy Trang[1], Anh Le[1], Hai T. Phan[3], Binh T. Nguyen[4], and Doan Y Dao[1,7]

*(*equal contribution)*

Author Affiliation:

1-Vietnam Viral Hepatitis Alliance, Reston, Virginia, USA

2-UT Southwestern Medical Center, Dallas, Texas, USA

3-Medic Medical Center, Ho Chi Minh City, Vietnam

4-Ho Chi Minh City Department of Health, Ho Chi Minh City, Vietnam

5-Pham Ngoc Thach University of Medicine, Ho Chi Minh City, Vietnam

6-University of Illinois at Chicago, Chicago, Illinois, USA

7-Johns Hopkins University School of Medicine, Baltimore, Maryland, USA

Correspondence to Doan Y Dao, MD: ddoa1@jhmi.edu.

## ABSTRACT

**Background**: Vietnam is an endemic area for hepatitis B virus and hepatitis C virus infection (HBV-HCV); yet its largest city, Ho Chi Minh City (HCMC), has no comprehensive policy to educate, screen, treat, and protect health care workers (HCWs) from viral hepatitis. We conducted a mixed-methods study to document HBV-HCV infection rates, risk factors, local barriers, and opportunities for providing education, screening, and medical care for HCWs.

**Methods**: HCWs with direct patient care and/or contact with medical devices at 3 hospitals in HCMC were invited for serological evaluation; asked to provide knowledge, attitude, and practice (KAP) about viral hepatitis; and participated in in-depth interviews. In-depth qualitative interviews were conducted with a subset of the participants (n=28) to explore current local best practices and the need for formal health policy regarding HBV-HCV in HCMC and Vietnam. A semi-constructed questionnaire was used to obtain information about existing policy and actual barriers or facilitators in HBV-HCV occupational exposure.

**Results**: Of the 210 invited HCWs, 203 were enrolled. Of the 203, 20 were hepatitis B surface antigen (HBsAg)-positive, 1 was anti-HCV Ab)-positive, 77 were anti-HBc Ab)-positive and 152 had adequate anti-HBs titer (≥10IU/mL). Only 50% of the infected HCWs reported always using gloves during a clinical activity involving handling of blood or bodily fluid. Approximately 50% of HCWs were still not vaccinated against HBV following 1 year of employment. In-depth interviews revealed 2 major concerns for most interviewees: the need for financial support for HBV-HCV screening and treatment in HCWs and the need for specific HBV-HCV guidelines to be independently developed.

**Conclusions**: The high HBV infection rate in HCWs coupled with inadequate preventive occupational practices among the population in HCMC highlight the urgent needs to establish formal policy and rigorous education, screening, vaccination, and treatment programs to protect HCWs from HBV in Vietnam.


**Key words:** Hepatitis B virus, Hepatitis C virus, Vaccination, Health care Workers, Vietnam

**Strengths and limitations of this study**

- This is the first mixed-method study to provide information regarding HBV-HCV infection and risk factors among healthcare workers (HCWs); as well as local practice and barriers in HBV-HCV prevention among HCWs in Ho Chi Minh City (HCMC), the largest city in Vietnam.
- HCWs from national tertiary-level, city-level, and district-level hospitals, which represent the three major healthcare system levels in Vietnam, were recruited, aiming to provide representative information regarding HBV-HCV for quantitative and qualitative data.
- The in-depth interviews were conducted with both infected and non-infected HCWs from multiple professional and administrative levels among the study participating hospitals to obtain diverse perspectives on local HBV-HCV practice and barriers.
- Data from in-depth interviews were analyzed using thematic content analysis approach; thus, results were more descriptive than explanatory.
- Data regarding HBV vaccine uptake among HCWs in this study was self-reported, which might be subject to recall bias.

## INTRODUCTION

Globally, there are more than 2 million occupational exposures to sharp injuries in the health care setting annually (1). The most common causes of post-exposure infections are hepatitis B virus (HBV), hepatitis C virus (HCV) and HIV (1-3). Owing to the high prevalence of viral hepatitis infections in the general population in Vietnam–a low- to middle-income country where an estimated 8.4% of the population are chronic HBV carriers and another 1.1% of the population are chronic HCV carriers, (4, 5)–it is expected that Vietnamese health care workers (HCWs) are at high risk for exposure and infection from these pathogens.

Vietnamese HCWs are at an increased risk of percutaneous injuries, especially in those with high frequency of contact with blood and bodily fluid, providing more opportunity for occupational exposure to HBV-HCV (6, 7). The incidence rates were 25 times higher for those acquiring HBV infection after exposure than in those exposed to HIV (50 cases per 100,000 person-year vs 0.2 cases per 100,000 person-year) (8). In a study involving occupational exposure in HCWs at multiple hospitals in Ha Noi, Vietnam, Duong and colleagues found that 64.8% of HCWs were exposed to sharp injuries at least once a year. This group of HCWs includes primarily nurses and physicians who worked directly with blood and bodily fluids or sharp instruments (8). In spite all of these statistics, Nguyen and colleagues revealed that 36.5% of nurses still did not have appropriate knowledge on prevention of occupational exposure to viral hepatitis and that about 10% of individuals did not follow the standard procedures for occupational exposure (9). Notably, most of the incidents were not reported to higher administrative levels. When these incidents occurred, they were not cared for in a timely and appropriate manner (7). Oftentimes, the sources of infection remained unknown (8).

In Vietnam, viral hepatitis is a reportable infectious disease, but this only applied to hospitals that are dedicated to infectious disease specialty care and at the central government level. National recommendations for occupational exposure for prevention and management of infectious diseases, including viral hepatitis, have been issued but not mandated. According to the Infectious Disease Control and Prevention Act, viral hepatitis is in category B, which is highly infectious and could lead to death (10). There is lack of guidelines or step-by-step guidance for implementation or monitoring of viral hepatitis in occupational health care settings. Moreover, funding to implement the national recommendations for infectious disease and viral hepatitis were not appropriated. As a result, procedures for pre-employment screening and post-exposure testing and management for viral hepatitis in HCWs were not uniformly or systematically implemented

across health care settings in Vietnam. Instead, the procedures were only implemented at the individual health care center's discretion. Furthermore, because of the lack of specific guidelines for viral hepatitis occupational health procedures, many hospitals in Vietnam adopted HIV guidelines instead. This approach resulted in low HBV-HCV awareness, prevention, and post-exposure management in Vietnam (11).

Pre-exposure vaccination for HBV has been highly successful in reducing HBV infection in HCWs. Rates of use in Vietnam are unknown, and no such intervention exists to prevent transmission. Similarly, hepatitis B immune globulin (HBIG) may be recommended as post-exposure prophylaxis (PEP), but there are no formal recommendations available for PEP for HCWs exposed to HBV or HCV in Vietnam, nor is there data on availability of HBIG in these resource-limited and highly heterogeneous care settings (8). Thus, it is necessary to further understand current practices with a mind towards the resource limitations of Vietnam and other developing regions.

In this study, we conducted a sero-survey of HBV-HCV; an assessment of viral hepatitis general knowledge, attitude, and risk behaviors; and in-depth interviews in a cohort of HCWs in Ho Chi Minh City (HCMC). The in-depth interviews focused on Vietnam national legal circular, in-house protocol and procedures relating to occupational exposure for HBV-HCV prevention and management in HCWs. The study aimed to better understand the local needs and barriers for screening, prevention, and linkage to care as well as best practices regarding occupational exposure to HBV-HCV in HCWs in HCMC. As a result, we propose effective interventions aimed at reduction of viral hepatitis disease burden in HCMC, Vietnam and would further support for better analyses of anti-viral gaps and elimination targets that have been set for 2030 by the World Health Organization (WHO) and Vietnam's National Action Plan for Viral Hepatitis Control and Prevention, Period 2015-2019.

## METHODS

1. Study setting

The study was conducted in 3 hospitals in HCMC, Vietnam (*Figure 1*). A developing country, Vietnam is located in Southeast Asia and has a population of 97 million. With a population of 12 million, HCMC has an estimated prevalence of 7.8% for HBV and 2.2 % for HCV in its community (12, 13).

The HCMC hospital system is divided into 3 levels: tertiary hospital (central government-level hospital), general hospital at city level, and general hospital at district level. In this study, we selected 1 hospital representing each of the hospital system levels to join the study. The study protocols were approved by institutional review committees (IRBs) at Pham Ngoc Thach University of Medicine, a local medical school in HCMC, and at each of the participating hospitals. The final study protocol was approved by the HCMC Department of Health.

2. Study design and methods

The study design comprised 2 parts: (1) an observational portion involving a knowledge, attitude, and practice (KAP) survey and serologic screening for HBV-HCV, and (2) in-depth interviews. For the former, a simple random sample of 210 participants, including 70 from each of the 3 hospitals representing 3 levels of hospital system in HCMC, were enrolled. The 210-person sample was derived based on several factors: an estimate of 4000 HCWs who worked at the 3 participating hospitals, a 0.05 margin of error at a 95% confidence level, and the reported prevalence of 15% for HBV and 2-5% for HCV in HCWs in Vietnam (11, 14).

The KAP questionnaire survey included demographics information (age, gender, educational level, type of clinical work, total years of clinical activity, and income levels) and questions related to HBV-HCV knowledge, risk factors outside of workplace, occupational exposures, HBV vaccination status, and overall health status.

The in-depth interviews (i.e., qualitative portion) were conducted within 2 weeks after the survey and screening. We applied a quota sampling approach to include participants with different levels of clinical experience (< 5 years vs > 5 years), level of administrative responsibility (chief attending physician or chief nurse), viral hepatitis infection status (infected or naïve), and professional levels (physicians, nurse/midwives, medical laboratory technician).

3. Participant recruitment and cascade of care follow-up

For participant recruitment in the serologic screening and survey questionnaire portion, invitations were sent to a maximum of 120 official full-time HCWs at each of the 3 selected hospitals or a total of 360 HCWs (expected response rate of 50-60%). To be included, HCWs needed to be 18 years or older and working in areas that required frequent contact with patients with viral hepatitis or exposure to bodily fluids. Upon completion of the screening tests and survey, an incentive of $5 USD was provided to participants. Within 2 weeks, results with written interpretation of

serologic testing and recommendations were returned to participants. Coupons offering free HBV vaccine were provided to HBV-naive individuals (negative for hepatitis B surface antigen [HBsAg], anti-HBc, and anti-HBs) and free follow-up coupons were provided to individuals who were HBsAg-positive and/or anti-HCV-positive. These follow-up coupons include free liver assessments (confirmatory HCV RNA, comprehensive metabolic panel, and complete blood count), free Fibroscan and hepatology consultation at an independent contracted medical center.

For the qualitative phase, participants were also invited to participate in a 1-hour, follow- up in-depth interview regarding barriers and facilitating factors in viral hepatitis prevention in the workplace and measurement of workplace occupational exposures. Twenty-eight participants were recruited (15, 16), reaching data saturation. Trained interviewers used a semi-structured questionnaire to collect data and provided interviewees $5 USD incentives after completing the session.

4. Viral hepatitis serologic testing

Participants were screened for HBV and HCV. HBsAg was tested using a fully multivalent assay with high sensitivity in detecting HBV mutants to determine those who were positive for HBsAg. ELISA assay was performed following the manufacturer's instructions including serum anti-hepatitis B surface antibody (anti-HBs), and serum anti-hepatitis B core antibody (anti-HBcAb). HCV was screened with serum anti-hepatitis C antibody (anti-HCV). All the screening tests for HBV-HCV were performed with Elecsys® (Roche Diagnostics Ltd). Results were certified by a physician before being provided to screening participants.

5. Data management and statistical analysis

All surveys were checked for completeness. Missing items were not included in data analysis. Data was stored in REDCap. Demographic characteristics and risk factors for HBV-HCV and KAP data were reported as mean and standard deviation for continuous variables and proportions for categorical variables, and subsequently compared between the groups with and without HBV or HCV.

For survey questionnaires, KAP variables were coded as True (Applicable for) or False (Not Applicable for) for HBV, HCV, or both HBV and HCV. Infection status was grouped as HBsAg (+) versus HBsAg(-) for HBV and anti-HCV(+) versus anti-HCV(+). Lab tests were merged with survey data, then cleaned and managed in STATA. Data analysis was performed with univariate

and bivariate statistics: the Cochran-Armitage trend test was used for continuous variables; the Chi-square was used for categorical data. Significance level of 0.05 was used. All analyses used SAS 9.4.

In-depth interview records were transcribed into Word documents, coded by 2 independent coders. Thematic content analysis using hybrid approach of inductive and deductive coding and theme development was performed in Excel.

6. Patient and public involvement

Patients or the public were not involved in this study.

## RESULTS

1. Sociodemographic characteristics of study participants (*Table 1)*

There were 210 HCWs invited from 3 hospitals. Seven HCWs were non clinical staffs and excluded from the study. Of 210 invited HCWs, 203 (96.7%) completed the demographics and KAP survey questionnaires and serological testing for HBV-HCV. Of the 203 HCWs, 39 were physicians, 140 were nurses and midwives, and 24 were technicians and nurse assistants. Overall, the age range was from 21 to 59 years old with a mean of 34.49. The majority of the 203 HCWs were female (83%). Approximately 95% of the enrolled HCWs completed at least a technical or vocational degree, and more than half (54.5%) worked in a clinical environment for less than 10 years. Among 3 groups of HCWs (physicians, nurses/midwives, and technicians/nurse assistants), most females (127/168) were nurses and midwives. All doctors graduated from university; and the majority of nurses, midwives, technicians, and nurse assistants competed high school and vocational school.

2. Serological characteristics of the study participant

Twenty (9.8%) of 203 HCWs were positive for HBsAg. Of 20, 17 (85%) knew their viral hepatitis status; this included 4 doctors, 15 nurses, and 1 technician. Nurses had similar rate of HBV infection at 10.7% (15 of 140) compared to doctors at 10.2% (4 of 39). Technician and nurse assistant had the lowest rate of HBV infection with 1 infected person of 24 (4.2%). Four (1.97%) were indeterminate with only positive anti-HBc Ab and required follow-up testing. There were 27 (13.3%) who were suceptible to HBV infection with negative HBsAg, anti-HBs, and anti-HBc. Among those who were naive, there were 3 physicians (7.7%, 3/39), 18 nurses and midwives

(12.9%, 18/140), and 6 technicians (25%, 6/24). Ninety-nine (48.77%) were immune from HBV vaccination with positive anti-HBs, and 53 (26.11%) were with positive anti-HBs and anti-HBc. Among those who were vaccinated, there were 19 physicians (58%, 19/39), 69 nurses and midwives (49%, 69/140), and 11 technicians (46%, 11/24). Interestingly, 10 of these 99 HCWs reported never receiving HBV vaccine. Regarding HCV, there was only 1 person (0.5%) who tested positive for anti-HCV and negative HCV RNA. This person later reported already having HCV treatment 10 years prior.

3. Comparison between HBV seropositive and HBV seronegative groups (*Table 2 and 3*)

We divided the participants into 2 groups: 20 HCWs that were HBsAg-positive and 193 HCWs that were HBsAg-negative. As shown in *Table 2*, there were no significant difference in demographic characteristics between the 2 groups. Both groups were approximately 80% female, and the mean age was 34-38 years old (range, 21-59). The majority (at least 70%) of participants in the 1 groups were nurses and midwives. There was no difference in educational level or length of clinical work between the 2 groups. Regarding risk factors for HBV infection, a higher percentage of the HBV seropositive group had family members with HBV infection (60% vs 18%, $P < 0.0001$). Seventy percent (70%) of the seronegative group reported no family member with either HBV or HCV, compared to 30% in the seropositive group. The seropositive group had a higher percentage of participants with daily exposure to blood and bodily fluid compared to the seronegative group (90% vs 69%). However, the difference was not significant ($P = 0.054$). There was no difference in the time since last check-up with HBV screening. However, rate of vaccine uptake was higher in the seronegative groups (76% vs 30%, $P = 0.0001$). There was no difference in risks of hepatitis transmission, including prior blood transfusion, tattoo, addictive drug use, or unprotected sex; except that 2 of the 20 with HBV (10%) reported sharing needles in the past compared to none in the seronegative group ($P < 0.0001$).

4. Assessment of KAP

According to the KAP survey (*Table B* in supplement), the majority of HCWs demonstrated good knowledge of modes of HBV-HCV transmission including sharing toothbrushes, sharing needles, sexual intercourse, and during birth. However, 17% (35 of 203) of HCWs believed that smoking could cause hepatitis, including 7 physicians, 23 nurses and midwives, and 5 other HCWs. Moreover, almost half (44%, 90 of 203) thought that hepatitis could be spread by sharing utensils; this group included 19 physicians, 63 nurses and midwives, and 8 other HCWs. Twenty-nine percent (58 of 203) also believed that sneezing could spread hepatitis, including 10 physicians,

41 nurses and midwives, and 7 other HCWs. Regarding knowledge on natural course of HBV-HCV, the majority believed that healthy people can be carriers (89%) and that HBV-HCV are life-long infections which can cause liver cancer (95%) and can be lethal (86%). However, 21% (43 of 203) of HCWs believed that hepatitis is not treatable; this group included 4 physicians, 34 nurses and midwives, and 5 other HCWs. The majority (83%, 169 of 203) thought that they do not need to avoid contact with people infected with HBV-HCV. Answers regarding the hepatitis B vaccine revealed that most HCWs (93%, 189 of 203) believed that the HBV vaccine is effective, though 21% (42 of 203) perceived that the HBV vaccine has harmful side effects. Overall, physicians exhibit better knowledge compared to the 2 other groups.

5. In-depth interview results (*Table 4*)

The in-depth interviews were conducted with 28 HCWs, focusing on the following themes: "prevention and management policy and protocol in place," "local actual post-exposure management," "screening and vaccination policy and annual health check," and "stigma and support." All respondents were aware of the Ministry of Health's policy on prevention and control of occupational injuries in HCWs, and the local policy was similar to the national circular. Also, they stated that the major focus of post-exposure incident reporting was HIV, so HBV-HCV pathogens were not included in checks for post-exposure incidents (93%, 26 of 28). When asked about post-exposure management, focusing on the local financial assistance program for occupational exposure, 47% (7 of15) reported receiving financial aid from the hospital for testing and medication for HIV exposure whereas 33% (5 of 15) denied such support at their hospitals and had to self-pay the co-pay amount for examination and medication under their health insurance plan. Almost all interviewees (93%, 14 of 15) agreed that hospital should pay for follow-up and/or treatment for hepatitis infection from occupational exposure, while 1 did not agree due to belief that hepatitis infection is not serious. When asked about annual health check-ups for viral hepatitis, 48% (13 of 27) had only the HBV screening with HBsAg in their annual check-up organized and paid by their hospitals. Only 9 of 27 (33%) had both HCV and HBV screening annually, which was paid by hospitals. Additionally, regarding testing requirements for new staff prior to start clinical work, 55% (11 of 20) received screening and vaccination recommendations during training or at the beginning of work, while 40% (8 of 20) reported that there was no such requirement. Furthermore, regarding HBV vaccination, 75% of interviewees (21 of 28) paid for their own vaccination, while 21% (6 of 28) had cost covered by hospital. Most interviewees (79%, 11 of 14) agreed that HBV vaccination should be free for all HCWs whereas 21% (3 of 14) believed

that vaccination should be self-paid due to financial constraint of the public health system and the affordability of vaccination when compared to HCWs' salaries.

Most interviewees identified 3 major barriers to implementing an effective prevention for occupational viral hepatitis transmission procedure: (1) lack of an independent post-exposure protocol, guidelines for management and counseling for viral hepatitis separate from the HIV guidelines; (2) lack of a specific financial support policy to supplement the co-pay for HBV/HCV occupational post-exposure management; and (3) lack of frequent viral hepatitis prevention training courses. Regarding "stigma and support," 79% (22 of 28) of interviewees were willing to reveal their viral hepatitis status to coworkers whereas 21% (6 of 21) would like to keep it personal. Of those 6, 3 interviewees voiced concern about stigma, and 2 reported that knowing their status would not change anything as they took measures to decrease transmission risk in the workplace. Alternatively, when asked if they would want to know their coworkers' viral hepatitis status, 52% (14 of 27) would like to know, 7% (2 of 27) would not, and 41% (11 of 27) did not have strong opinions. Among those who would like to know, some voiced reasons including knowing risk of transmission with close contact, educating each other about preventive measures, and offering support to those with viral hepatitis infection. For those who would not want to know, they believed viral hepatitis status is private health information and should not be shared. Eleven interviewees reported that knowing coworkers' hepatitis status does not change their interactions. When asked if hepatitis infection could result in position reassignment, 36% (9 of 25) said *no* due to already high prevalance of viral hepatitis among HCWs, concern about discrimination, and the fact that taking preventive measures is adequate to prevent tramission. Some voiced factors that could lead to reassignment, including HCWs' declining health status due to hepatitis infection (6 of 25), type of clinical work that has high risk of tramitting to patients (8 of 25), and supervisors' decisions (4 of 25).

## DISCUSSION

In this mixed-methods study, we documented the local best practices of occupational exposure and infection rates for HBV-HCV in HCWs in HCMC. Importantly, in-depth interviews revealed 2 major concerns for most interviewees. First, participants expressed the need for a specific guideline on HBV-HCV occupational exposure and prevention. This guideline should be independent from HIV guidelines. Second, policy on financial support for post-exposure management for viral hepatitis in HCWs should be allocated.

In the observational portion, the study estimated a high HBsAg-positive rate (9.85%) among HCWs working in HCMC. Compared to recent data on HBV prevalence of HCWs in other low- to middle-income countries in Southeast Asia, HCWs in HCMC may have a higher rate of HBV than that of Thailand (5.3%), Indonesia (6.2%), and Laos (8%) (17-19). We found that HBV infection among HCWs may be associated with family history of HBV, low vaccine uptake, and needle sharing practice. There was no difference regarding types of clinical work and duration of practice between 2 groups: HBsAg-positive versus HBsAg-negative. Regarding HCV, rate of anti-HCV-positive was much lower than HBV infection in this study (0.5% vs 9.85%). Prior review also revealed lower average HCV prevalence of 1.6% in Southwest Asia, which ranges from 0.8% in Indonesia to 2.7% in Thailand (20). Although the most common scenario for both HBV and HCV exposure in HCWs is percutaneous injuries, HBV can survive outside the human body for at least 7 days and is many times more infectious than HCV or HIV (21-23). Moreover, HBV is the most easily transmitted bloodborne virus with a 6% to 30% risk of infection from percutaneous exposure. Risk of acquiring HCV is lower, with a range from 2% to 4% (23).

Although 71% of HCWs reported HBV immunization, test results showed a low rate of vaccination (49%) among 3 levels of HCWs with the uptake rate highest in physicians (58%), followed by nurses (49%) and technicians (46%). The reported rate of vaccination is similar to a recent study done in Northern Vietnam (68.8%) (24) and other studies in South Africa (64.5%) (25, 26). Low vaccine uptake may also be associated with HBV infection as demontrated here and in previous studies (17, 27). There are several reasons to explain the low rate of vaccination.

First, the population of HCWs in our study did not generally get vaccination during early childhood. HBV vaccine, part of Vietnam's Expanded Program on Immunization, was first introduced in 1997 as a trial and was officially implemented in 70% of provinces of Vietnam only in 2004 (28). Therefore, national HBV vaccination for infants has only been active for 22 years. Since the average age of surveyed HCWs was 38 years old and the age range was from 25 to 54 years, the majority of HCWs was likely not vaccinated in their first year of life.

Second, most health care facilities in Vietnam do not require pre-employment testing and vaccination against HBV, and do not incorporate viral hepatitis screening in annual check-up as demonstrated in the in-depth interviews. There were 10 HCWs who reported never receiving HBV vaccine but they had lab results consistent with immunity from vaccination. On the other hand, there were 6 HCWs who reported previous vaccination but were HBsAg-positive. It is unclear if

this is recall bias, that the initiation of vaccination was after HBV infection, or that the immunity from HBV vaccination had waned prior to HBV acquisition. The latter is less likely because HBV vaccine may confer protection from HBV infection for 30 years (29). Taken together, it is important for pre-employment testing and annual testing to avoid false assurance of vaccination in people who had acquired HBV infection prior to vaccine, especially in those who work in the health care settings with greater occupational risks. It is equally important to identify naive individuals for prompt vaccination to prevent HBV infection from occupational exposures.

Third, HBV vaccination was reported to be self-paid. Although several HCWs admitted the affordability of the HBV vaccine, they also mentioned free vaccination could encourage higher vaccine uptake. Besides financial barrier, other barriers, including unavailability of vaccine and busy work schedules, were also demonstrated in prior study (30).

We also identified high occupational risks: 71.5% of HCWs have daily exposure to blood and bodily fluid. Although almost all interviewees reported available protocol for occupational exposures from the in-depth interview, only 1 interviewee had dedicated hepatitis protocol and the remaining interviewees followed HIV protocol. There was no available PEP for HBV exposure and no guidelines on follow-up testing and/or treatment. Most interviewees also voiced the need for an assistance program for testing and/or treatment for hepatitis infection from occupational exposure. Therefore, there is a need for guidelines for occupational exposure of viral hepatitis and dedicated protocol for PEP, monitoring, and treatment.

Similar to a recent study in Northern Vietnam, there was good overall knowledge of hepatitis transmission including parenteral, sexual, and perinatal transmission (24). It seemed that the knowledge in these 203 HCWs in HCMC was better than that of previous studies conducted in Africa (27, 31). However, gaps of knowledge were identified in smoking, sharing foods, and sneezing, which are not risk factors for hepatitis acquisition. Although there was no significant difference in knowledge score between the HBV-infected and non-infected groups, knowledge of hepatitis transmission is still important as HCWs are at a higher risk of contracting hepatitis via blood and bodily fluid exposure. Good knowledge regarding the clinical course of hepatitis (including an asymptomatic course), life-long infection, consequence of liver cancer and death, was also demonstrated. However, a considerable proportion of HCWs did not believe viral hepatitis is treatable. This might be due to the lack of access to treatment knowledge as not everyone worked in the Hepatology department. From the in-depth interview, interviewees were

aware of the inadequate knowledge of hepatitis and called for further education. Therefore, we suggest expanding annual training to include basic viral hepatitis core knowledge, testing, and treatment as well as sequalae if unrecognized. As a result, this will facilitate vaccination uptake, awareness of modes of transmission, and a proactive approach to follow-up testing, especially after occupational exposure.

This mixed-methods study reveals several gaps in hepatitis practice among HCWs in HCMC. First is the lack of pre-employment screening and routine surveillance for hepatitis. Second is inadequate guidelines for measures to be taken after hepatitis exposure. Therefore, we propose that hospitals should have mandatory pre-employment hepatitis screening for all prospective employees. This would help identify naive individuals who should be required to get HBV vaccination prior to starting their jobs to limit HBV infection from occupational exposures. This would also serve as an opportunity for those with hepatitis infection to know about their status. Additionally, for employees who will be at high risk of exposure to blood or body fluids on the job, post-vaccination anti-HBs testing should be offered to identify individuals who did not achieve immunity with the standard HBV series. Those individuals who have documented prior HBV vaccination and negative anti-HBsAb should receive a booster dose of HBV vaccine and be retested for immunity afterwards. We also propose that dedicated guidelines for HBV-HCV post-exposure management will be available at the workplace for HCWs. Published guidelines should be at designated places, such as nursing stations or workrooms, for prompt access after occupational exposures. Following occupational exposure, skin sites that have been in contact with blood or bodily fluids should be washed with soap and water, and mucous membranes should be flushed with water. For HBV, prompt administration of HBIG or initiation of HBV vaccination should be initiated, depending on the HBV status of source patient and the exposed HCW. Appropriate HCWs should have follow-up serologic testing (*Table A* in supplement) (32). For HCV, testing of source patient and exposed HCWs should be done as soon as possible. HCV PEP is not recommended. Schedules for follow-up serologic testing after exposure for HCWs depends on HCV status of source patient and exposed HCW (*Figure A* in supplement) (33).

Although this mixed-methods study was the first in Vietnam to provide more information about HBV-HCV in HCWs, there were several limitations. First, we do not intend to estimate the prevalence of HBV-HCV among HCWs in HCMC. Second, data regarding vaccine uptake was self-reported, which might be subject to recall bias. Also, there was no data regarding timing of vaccination in relation to timing of infection to determine vaccine efficacy. Despite these

limitations, we still believe that this mixed-methods study offered insights into the needs for policy change to facilitate HBV vaccination, hepatitis surveillance, education, and post-exposure guideline changes.

## CONCLUSION

In conclusion, we documented that there are few guidelines for testing and treatment or best practices for occupational exposure to viral hepatitis in HCWs working in HCMC. Despite the high rate and risk of HBV infection in this population, only half of HCWs were vaccinated against HBV. A knowledge gap was also identified with the KAP survey that continuous medical education is crucial to improve the knowledge and to protect HCWs. This study is a call for an effort to enforce mandatory pre-employment testing, routine surveillance, HBV vaccination, and dedicated HBV-HCV post-exposure guidelines and treatment for HCWs.

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**Data availability statement**: Deidentified data are stored in internal database and are available upon request to the corresponding author. All data relevant to the study are included in the article or uploaded as supplementary material.

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**TABLES AND FIGURES**

# Table 1

**Baseline demographic characteristics of 203 HCWs**

| | Total n | Physicians n (%) | Nurses & Midwives n (%) | Other HCWs n (%) |
|---|---|---|---|---|
| | **(N=203)** | **(N=39)** | **(N=140)** | **(N=24)** |
| **Gender** | | | | |
| Female | 168 | 27 (16.07) | 127 (75.60) | 14 (8.33) |
| **Age groups** | | | | |
| ≤ 29 | 74 | 13 (17.57) | 50 (67.57) | 11 (14.86) |
| 30-39 | 72 | 15 (20.83) | 52 (72.22) | 5 (6.94) |
| 40-49 | 39 | 8 (20.51) | 26 (66.67) | 5 (12.82) |
| ≥ 50 | 18 | 3 (16.67) | 12 (66.67) | 3 (16.66) |
| **Age** | | | | |
| Median (IQR) / range | 32 (14) / 21-59 | 34 (13.5) / 24-59 | 32 (13.25) / 21-56 | 30 (17.5) / 23-56 |
| **Educational level** | | | | |
| At most high school | 10 | 0 | 5 (50) | 5 (50) |
| Technical or vocational degree | 111 | 0 | 99 (89.19) | 12 (10.81) |
| University and post-university | 81 | 39 (48.15) | 36 (44.44) | 6 (7.41) |
| **Length of clinical activity** | (n=193) | (n=39) | (n=133) | (n=21) |
| 0-9 years | 105 | 23 (21.91) | 69 (65.71) | 13 (12.38) |
| 10-19 years | 52 | 10 (19.23) | 38 (73.08) | 4 (7.69) |
| 20+ years | 36 | 6 (16.67) | 26 (72.22) | 4 (11.11) |

HCW, health care workers; IQR, interquartile range.

## Table 2

**Demographic characteristics between HBsAg (+) and HBsAg (-) groups**

| | Total | HBsAg (+) | HBsAg (-) | *P* value |
|---|---|---|---|---|
| | (n=203) | (n=20) | (n=183) | |
| **Gender, n (%)** | | | | 0.731 |
| Female | 168 (82.76) | 16 (80) | 152 (83.06) | |
| **Age** | | | | |
| Median (IQR) | 32 (14) | 35 (13.5) | 31 (14) | |
| Range | 21-59 | 25-54 | 21-59 | |
| Means (std) | 34.49 (9.14) | 38.05 (8.59) | 34.10 (9.13) | 0.067 |
| **Educational level, n (%)** | (n=202) | | (n=182) | 0.4188 |
| High school or lower | 10 (4.95) | 0 | 10 (5.49) | |
| Technical or vocational Degree | 111 (54.95) | 10 (50) | 101 (55.49) | |
| University and post-university | 81 (40.10) | 10 (50) | 71 (39.01) | |
| **Clinical works, n (%)** | (n=199) | | (n=179) | 0.728 |
| Physicians | 39 (19.60) | 4 (20) | 35 (19.55) | |
| Nurses & midwives | 140 (70.35) | 15 (75) | 125 (69.83) | |
| Other HCWs | 20 (10.05) | 1 (5) | 19 (10.61) | |
| **Length of clinical work, n (%)** | (n=193) | (n=19) | (n=174) | 0.269 |
| 0-9 years | 105 (54.40) | 7 (36.84) | 98 (56.32) | |
| 10-19 years | 52 (26.94) | 7 (36.84) | 45 (25.86) | |
| 20+ years | 36 (18.65) | 5 (26.32) | 31 (17.82) | |

HBsAg, hepatitis B surface antigen; HCW, health care workers; IQR, interquartile range.

## Table 3

**Risk factors between HBsAg (+) and HBsAg (-) groups**

| | Total | HBsAg (+) | HBsAg (-) | *P* value |
|---|---|---|---|---|
| | **(n=203)** | **(n=20)** | **(n=183)** | |
| **Frequency of exposure to blood & bodily fluids, n (%)** | (n=197) | (n=20) | (n=177) | 0.054 |
| Every day | 141 (71.57) | 18 (90) | 123 (69.49) | |
| Not every day | 56 (28.4) | 2 (10) | 54 (30.51) | |
| **Family member with viral hepatitis, n (%)** | (n=203) | (n=20) | (n=183) | **<0.0001** |
| Only HBV | 39 (19.21) | 12 (60) | 27 (14.75) | |
| Only HCV | 3 (1.48) | 0 | 3 (1.64) | |
| Both HBV and HCV | 6 (2.96) | 0 | 6 (3.28) | |
| None | 135 (66.50) | 6 (30) | 129 (70.49) | |
| Don't know and didn't answer | 20 (9.85) | 2 (10) | 18 (9.84) | |
| **Family with HBV vaccination, n (%)** | (n=185) | (n=18) | (n=167) | 0.297 |
| Yes | 147 (79.46) | 16 (88.89) | 131 (78.44) | |
| **Last time of health check-up with HBV screening, n (%)** | (n=201) | (n=20) | (n=181) | 0.750 |
| Last 6 months | 106 (52.74) | 10 (50) | 96 (53.04) | |
| 6 months to 1 year | 30 (14.93) | 3 (15) | 27 (14.92) | |
| More than 1 year | 32 (15.92) | 5 (25) | 27 (14.92) | |
| Health check without HBV screening | 29 (14.43) | 2 (10) | 27 (14.92) | |
| No health check-up | 4 (1.99) | 0 | 4 (2.21) | |
| **Health check-up with HBV screening paid by, n (%)** | (n=166) | (n=18) | (n=148) | 0.130 |
| Self | 33 (19.88) | 6 (33.33) | 27 (18.24) | |
| Employer | 133 (80.12) | 12 (66.67) | 121 (81.76) | |
| **Any medical conditions, n (%)** | (n=199) | (n=) | (n=179) | |
| Yes | 30 (15.08) | 6 (30) | 24 (13.41) | **0.0492** |

| | Total | HBsAg (+) | HBsAg (-) | *P* value |
|---|---|---|---|---|
| | **(n=203)** | **(n=20)** | **(n=183)** | |
| **History of transfusion, n (%)** | (n=199) | (n=20) | (n=179) | 0.8383 |
| Yes | 12 (6.03) | 1 (5) | 11 (6.15) | |
| **Having tattoo, n (%)** | (n=199) | (n=20) | (n=179) | 0.9133 |
| Yes | 11 (5.53) | 1 (5) | 10 (5.59) | |
| **Use of addictive drugs, n (%)** | (n=199) | (n=20) | (N=179) | 0.6347 |
| Yes | 2 (1.01) | 0 | 2 (1.12) | |
| **Sharing needles, n (%)** | (n=201) | (n=20) | (N=181) | **<0.0001** |
| Yes | 2 (1) | 2 (10) | 0 | |
| **Use of immuno-suppressants or steroids, n (%)** | (n=201) | (n=19) | (n=182) | 0.5137 |
| Yes | 2 (1) | 0 | 2 (1.10) | |
| No | 189 (94.03) | 19 (100) | 170 (93.41) | |
| Not sure | 10 (4.97) | 0 | 10 (5.49) | |
| **Contact with sex workers, n (%)** | (n=202) | (n=20) | (n=182) | |
| Often | 1 (0.5) | 0 | 1 (0.55) | |
| Sometimes | 0 | 0 | 0 | |
| Never | 201 (99.5) | 20 (100) | 181 (99.45) | |
| **In LGBT community, n (%)** | (n=202) | (n=20) | (n=182) | |
| Yes | 1 (0.5) | 0 | 1 (0.55) | |
| **Use of condoms, n (%)** | (n=183) | (n=18) | (n=165) | 0.2172 |
| Always | 34 (18.58) | 2 (11.11) | 32 (19.39) | |
| Sometimes | 42 (22.95) | 7 (38.89) | 35 (21.21) | |
| Never | 107 (58.47) | 9 (50) | 98 (59.39) | |
| **Partners were screened for HBV/HCV, n (%)** | (n=191) | (n=18) | (n=173) | 0.1218 |
| Yes | 128 (67.02) | 15 (83.33) | 113 (65.32) | |

| | Total | HBsAg (+) | HBsAg (-) | *P* value |
|---|---|---|---|---|
| | **(n=203)** | **(n=20)** | **(n=183)** | |
| **Received hepatitis B vaccination, n (%)** | (n=200) | (n=20) | (n=180) | **0.0001** |
| Yes | 142 (71) | 6 (30) | 136 (75.56) | |

HBsAg, hepatitis B surface antigen; HBV, hepatitis B virus; HCV, hepatitis C virus; HCW, health care workers; LGBT, lesbian, gay, bisexual, and transgender.

## Table 4

**In-Depth Interviews Summary**

| Semi-Structured Questions | Total | Agree n (%) | Disagree n (%) | Not Sure n (%) |
|---|---|---|---|---|
| My workplace has protocol for occupationalexposure. | 28 | 27 (96.4) | 0 | 1 (3.6) |
| My workplace has separate hepatitisprotocol for occupational exposure. | 28 | 1 (3.6) | 26 (92.8) | 1 (3.6) |
| My workplace has an assistance programfor occupational exposure. | 15 | 7 (46.7) | 5 (33.3) | 3 (20) |
| My workplace organizes routine screeningfor viral hepatitis. | 27 | 22 (81.5) | 4 (14.8) | 1 (3.7) |
| Hepatitis testing is required before starting clinical work at my workplace. | 20 | 11 (55) | 8 (40) | 1 (5) |
| I paid for my own HBV vaccination. | 28 | 21 (75) | 6 (21.4) | 1 (3.6) |
| My employer paid for HBV vaccination. | 28 | 6 (21.4) | 21 (75) | 1 (3.6) |
| I am willing to reveal my hepatitis infection status to my coworkers. | 28 | 22 (78.6) | 6 (21.4) | 0 |
| I would like to know my coworkers' viral hepatitis infection status. | 27 | 14 (51.9) | 2 (7.4) | 11 (40.7) |
| Hospital should pay for testing and/or treatment for viral hepatitis caused by occupational exposure. | 15 | 14 (93.3) | 1 (6.7) | 0 |
| My workplace should test new employees for viral hepatitis prior to employment. | 12 | 12 (100) | 0 | 0 |
| HBV vaccination should be free for health care workers. | 14 | 11 (78.6) | 3 (21.4) | 0 |

HBV, hepatitis B virus.

**Figure 1: Vietnam, red S shape, is located in Southeast Asia. Ho Chi Minh City, enlarging circle, is located in Southern Vietnam.**

## SUPPLEMENTS

**Table A: Post-exposure management of health care workers after occupational percutaneous and mucosal exposure to blood and body fluids, by health care workers' hepatitis B vaccination and response status.**

| Health care worker status | Post-exposure testing | | Post-exposure prophylaxis | | Post-vaccination serologic testing[b] |
|---|---|---|---|---|---|
| | Source patient (HbsAg) | HCW testing (anti-HBs) | HBIG[a] | Vaccination | |
| Documented responder[c] after complete series | No action needed | | | | |
| Documented non-responder[d] after 2 complete series | Positive/ unknown | Not indicated | HBIG x2 separated by 1 month | — | No |
| | Negative | No action needed | | | |
| Response unknown after complete series | Positive/ unknown | < 10 mIU/mL[e] | HBIG x1 | Initiate revaccination | Yes |
| | Negative | < 10 mIU/mL | None | | |
| | Any result | ≥ 10 mIU/mL | No action needed | | |
| Unvaccinated / incompletely vaccinated or vaccine refusers | Positive/ unknown | —[e] | HBIG x1 | Complete vaccination | Yes |
| | Negative | — | None | Complete vaccination | Yes |

anti-HBs, antibody to hepatitis B surface antigen; HBsAg, hepatitis B surface antigen; HBIG, hepatitis B immune globulin; HCW, health care workers.

[a] HBIG should be administered intramuscularly as soon as possible after exposure when indicated. The effectiveness of HBIG when administered >7 days after percutaneous, mucosal, or nonintact skin exposures is unknown. HBIG dosage = 0.06 mL/kg.

[b] Should be performed 1–2 months after the last dose of the hepatitis B vaccine series (and 6 months after administration of HBIG to avoid detection of passively administered anti-HBs) using a quantitative method that allows detection of the protective concentration of anti-HBs (≥10 mIU/mL).

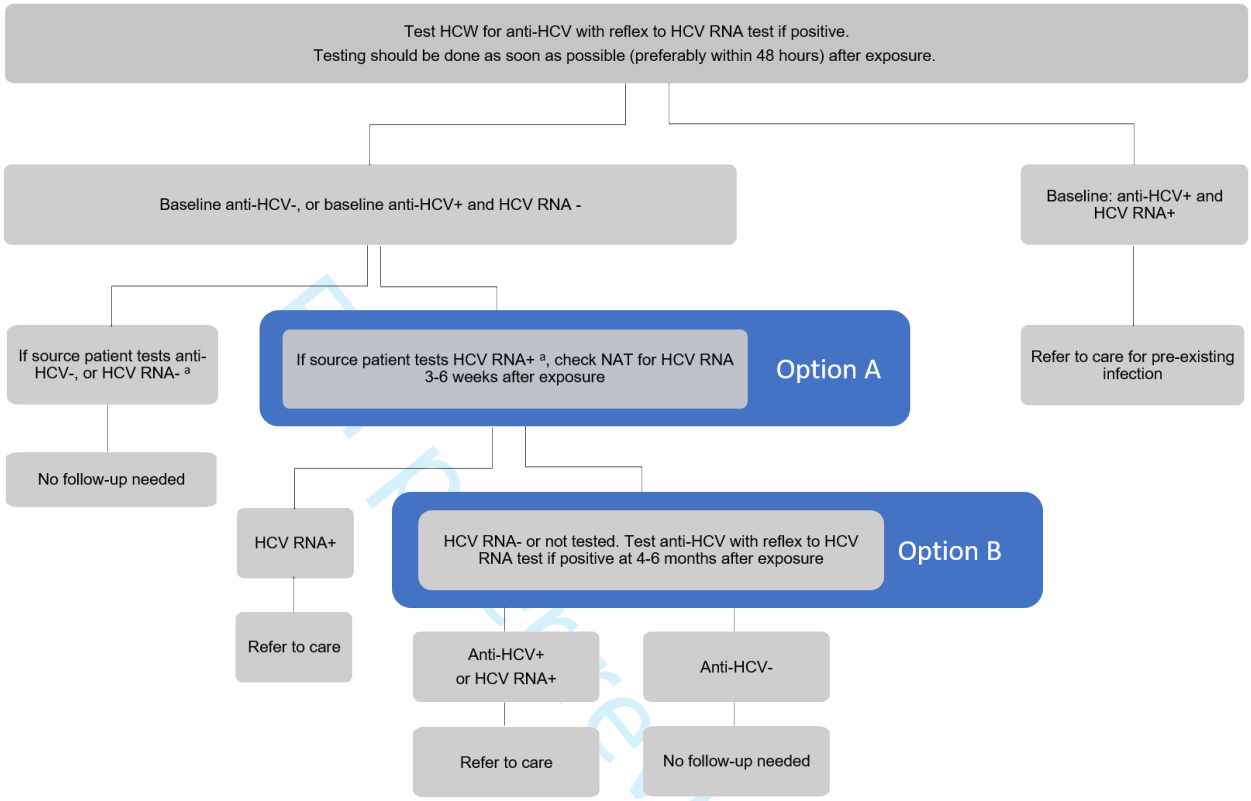
[c] A responder is defined as a person with anti-HBs ≥10 mIU/mL after ≥1 complete series of hepatitis B vaccine.

[d] A nonresponder is defined as a person with anti-HBs <10 mIU/mL after 2 complete series of hepatitis B vaccine.

[e] HCW who have anti-HBs <10 mIU/mL, or who are unvaccinated or incompletely vaccinated, and sustain an exposure to a source patient who is HBsAg (+) or has unknown HBsAg status, should undergo baseline testing for HBV infection as soon as possible after exposure, and follow-up testing approximately 6 months later. Initial baseline tests consist of total anti-HBc; testing at ~6 months consists of HBsAg and total anti-HBc.

**Adapted from** Schillie S, Murphy TV, Sawyer M, et al. CDC Guidance for evaluating health-care personnel for hepatitis B virus protection and for administering postexposure management. Published December 20, 2013 Accessed April 1, 2021. https://www.cdc.gov/mmwr/preview/mmwrhtml/rr6210a1.htm

**Figure A: Hepatitis C virus post-exposure management of health care workers after occupational percutaneous and mucosal exposure to blood and body fluids**




HCV, hepatitis C virus; HCW, health care workers; NAT, nucleic acid test.
[a] Testing of the source patient may follow option A (preferred) or option B.
**Adapted from** Moorman AC, de Perio MA, Goldschmidt R, et al. Testing and clinical management of health care personnel potentially exposed to hepatitis C virus - CDC Guidance, United States, 2020. Published July 24, 2020. Accessed April 1, 2021. https://www.cdc.gov/mmwr/volumes/69/rr/rr6906a1.htm?s_cid=rr6906a1_w

**Table B: KAP survey results stratified among types of clinical work**

| Statements about HBV or HCV | Total n (N=203) | Physicians n (%) (n=39) | Nurses & midwives n (%) (n=140) | Other HCWs n (%) (n=24) |
|---|---|---|---|---|
| Smoking can cause hepatitis | 35 | 7 (20) | 23 (65.71) | 5 (14.29) |
| Don't know if smoking can cause hepatitis | 9 | 0 | 8 (88.89) | 1 (11.11) |
| Hepatitis can be spread by sharing eating utensils | 90 | 19 (21.11) | 63 (70) | 8 (8.89) |

| Statements about HBV or HCV | Total n (N=203) | Physicians n (%) (n=39) | Nurses & midwives n (%) (n=140) | Other HCWs n (%) (n=24) |
|---|---|---|---|---|
| Don't know if hepatitis can be spread by sharing eating utensils | 8 | 0 | 6 (75) | 2 (25) |
| Either HBV or HCV can not be spread by sharing toothbrushes | 22 | 4 (18.18) | 16 (72.73) | 2 (9.09) |
| Don't know if hepatitis can be spread by sharing toothbrushes | 4 | 0 | 2 (50) | 2 (50) |
| Hepatitis can be spread by sneezing | 58 | 10 (17.24) | 41 (70.69) | 7 (12.07) |
| Don't know if hepatitis can be spread by sneezing | 10 | 1 (10) | 7 (70) | 2 (20) |
| Hepatitis can not be spread via sexual intercourse | 9 | 0 | 7 (77.78) | 2 (22.22) |
| Don't know if hepatitis can be spread via sexual intercourse | 1 | 0 | 1 (100) | 0 |
| Hepatitis can not be spread by sharing needles | 1 | 0 | 0 | 1 (100) |
| Don't know if hepatitis can be spread by sharing needles | 1 | 0 | 1 (100) | 0 |
| Neonates can not acquire hepatitis at birth | 0 | 0 | 0 | 0 |
| Don't know if neonates can acquire hepatitis at birth | 4 | 0 | 3 (75) | 1 (25) |
| Hepatitis can not be spread by someone who looks healthy | 6 | 0 | 5 (83.33) | 1 (16.67) |
| Don't know if hepatitis can be spread by someone who looks healthy | 16 | 1 (6.25) | 13 (81.25) | 2 12.5) |
| Hepatitis can not cause life-long infection | 29 | 7 (24.14) | 18 (62.07) | 4 (13.79) |
| Don't know if hepatitis can cause life-long infection | 13 | 0 | 11 (84.62) | 2 (15.38) |
| Hepatitis can not cause liver cancer | 6 | 0 | 6 (100) | 0 |
| Don't know if hepatitis can cause liver cancer | 5 | 0 | 4 (80) | 1 (20) |

| Statements about HBV or HCV | Total n (N=203) | Physicians n (%) (n=39) | Nurses & midwives n (%) (n=140) | Other HCWs n (%) (n=24) |
|---|---|---|---|---|
| Hepatitis cannot be lethal | 14 | 1 (7.14) | 8 (57.14) | 5 (35.72) |
| Don't know if hepatitis can be lethal | 14 | 0 | 14 (100) | 0 |
| Hepatitis is not treatable | 43 | 4 (9.30) | 34 (79.07) | 5 (11.63) |
| Don't know if hepatitis is treatable | 7 | 0 | 6 (85.71) | 1 (14.29) |
| People with hepatitis should be avoided | 29 | 5 (17.24) | 20 (68.97) | 4 (13.79) |
| Don’t know if need to avoid people with hepatitis | 5 | 2 (40) | 2 (40) | 1 (20) |
| I do not have a life-long risk of contracting hepatitis | 8 | 1 (12.5) | 5 (62.5) | 2 (25) |
| Don't know if I have a life-long risk of contracting hepatitis | 24 | 3 (12.5) | 15 (62.5) | 6 (25) |
| Hepatitis B vaccine is not effective | 8 | 1 (12.5) | 7 (87.5) | 0 |
| Don't know if vaccine is effective | 6 | 0 | 3 (50) | 3 (50) |
| Hepatitis B vaccine has harmful side effects | 42 | 11 (26.19) | 28 (66.67) | 3 (7.14) |
| Don't know if hepatitis B vaccine has harmful side effects | 40 | 2 (5) | 30 (75) | 8 (20) |

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

| | Item No | Recommendation | Page No |
|---|---|---|---|
| **Title and abstract** | 1 | (*a*) Indicate the study's design with a commonly used term in the title or the abstract | 2 |
| | | (*b*) Provide in the abstract an informative and balanced summary of what was done and what was found | 2 |
| **Introduction** | | | |
| Background/rationale | 2 | Explain the scientific background and rationale for the investigation being reported | 4&5 |
| Objectives | 3 | State specific objectives, including any prespecified hypotheses | 5 |
| **Methods** | | | |
| Study design | 4 | Present key elements of study design early in the paper | 6 |
| Setting | 5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection | 5&6 |
| Participants | 6 | (*a*) Give the eligibility criteria, and the sources and methods of selection of participants | 6&7 |
| Variables | 7 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable | 6&7 |
| Data sources/ measurement | 8* | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | 7 |
| Bias | 9 | Describe any efforts to address potential sources of bias | 7 |
| Study size | 10 | Explain how the study size was arrived at | 6 |
| Quantitative variables | 11 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why | 7&8 |
| Statistical methods | 12 | (*a*) Describe all statistical methods, including those used to control for confounding | 7&8 |
| | | (*b*) Describe any methods used to examine subgroups and interactions | 7&8 |
| | | (*c*) Explain how missing data were addressed | 7 |
| | | (*d*) If applicable, describe analytical methods taking account of sampling strategy | NA |
| | | (*e*) Describe any sensitivity analyses | NA |
| **Results** | | | |
| Participants | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed | 8 |
| | | (b) Give reasons for non-participation at each stage | NA |
| | | (c) Consider use of a flow diagram | Text in page 8 |
| Descriptive data | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders | 8&9 |
| | | (b) Indicate number of participants with missing data for each variable of interest | 20-24 |
| Outcome data | 15* | Report numbers of outcome events or summary measures | 9 |

| | | | |
|---|---|---|---|
| Main results | 16 | (*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included | NA |
| | | (*b*) Report category boundaries when continuous variables were categorized | 20-24 |
| | | (*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period | NA |
| Other analyses | 17 | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses | NA |
| **Discussion** | | | |
| Key results | 18 | Summarise key results with reference to study objectives | 11&12 |
| Limitations | 19 | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias | 14 |
| Interpretation | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence | 11-13 |
| Generalisability | 21 | Discuss the generalisability (external validity) of the study results | 14 |
| **Other information** | | | |
| Funding | 22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based | 15 |

NA, not applicable

*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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# Unmet Needs in Occupational Health Prevention and Management for Viral Hepatitis in Health Care Workers in Ho Chi Minh City, Vietnam: A Mixed-Methods Study



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# Unmet Needs in Occupational Health Prevention and Management for Viral Hepatitis in Health Care Workers in Ho Chi Minh City, Vietnam: A Mixed-Methods Study

Tran Nguyen*[,2], Trang Pham*[,1,6], Hong K. Tang[5], Loc Phan[1], Gary Mize[1], William M. Lee[1,2], Robert G. Gish[1], Amy Trang[1], Anh Le[1], Hai T. Phan[3], Binh T. Nguyen[4], and Doan Y Dao[1,7]

*(*equal contribution)*

Author Affiliation:

1-Vietnam Viral Hepatitis Alliance, Reston, Virginia, USA

2-UT Southwestern Medical Center, Dallas, Texas, USA

3-Medic Medical Center, Ho Chi Minh City, Vietnam

4-Ho Chi Minh City Department of Health, Ho Chi Minh City, Vietnam

5-Pham Ngoc Thach University of Medicine, Ho Chi Minh City, Vietnam

6-University of Illinois at Chicago, Chicago, Illinois, USA

7-Johns Hopkins University School of Medicine, Baltimore, Maryland, USA

Correspondence to Doan Y Dao, MD: ddoa1@jhmi.edu.

## ABSTRACT

**Objectives**: Vietnam is an endemic area for hepatitis B virus and hepatitis C virus infection (HBV-HCV); yet its largest city, Ho Chi Minh City (HCMC), has no comprehensive policy to educate, screen, treat, and protect health care workers (HCWs) from viral hepatitis. We conducted a mixed-methods study to document HBV-HCV infection rates, risk factors, local barriers, and opportunities for providing education, screening, and medical care for HCWs.

**Design**: This mixed-methods study involved HBV and HCV serological evaulation, knowledge, attitude, and practice (KAP) survery about viral hepatitis, and in-depth interviews. Descriptive statistics and thematic content analysis using inductive and deductive approaches were used.

**Setting**: Ho Chi Minh City, Vietnam

**Participants**: HCWs at risk of viral hepatitis exposure at 3 hospitals in HCMC

**Results**: Of the 210 invited HCWs, 203 were enrolled. Of the 203, 20 were hepatitis B surface antigen (HBsAg)-positive, 1 was anti-HCV Ab-positive, 77 were anti-HBc Ab-positive and 152 had adequate anti-HBs titer (≥10IU/mL). Only 50% of the infected HCWs reported always using gloves during a clinical activity involving handling of blood or bodily fluid. Approximately 50% of HCWs were still not vaccinated against HBV following 1 year of employment. In-depth interviews revealed 2 major concerns for most interviewees: the need for financial support for HBV-HCV screening and treatment in HCWs and the need for specific HBV-HCV guidelines to be independently developed.

**Conclusions**: The high HBV infection rate in HCWs coupled with inadequate preventive occupational practices among the population in HCMC highlight the urgent needs to establish formal policy and rigorous education, screening, vaccination, and treatment programs to protect HCWs from HBV acquisition or to manage those living with chronic HBV in Vietnam.


**Key words:** Hepatitis B virus, Hepatitis C virus, Vaccination, Health care Workers, Vietnam

**Strengths and limitations of this study**

- This is the first mixed-method study to provide information regarding HBV-HCV infection and risk factors among healthcare workers (HCWs); as well as local practice and barriers in HBV-HCV prevention among HCWs in Ho Chi Minh City (HCMC), the largest city in Vietnam.
- HCWs from national tertiary-level, city-level, and district-level hospitals, which represent the three major healthcare system levels in Vietnam, were recruited, aiming to provide representative information regarding HBV-HCV for quantitative and qualitative data.
- The in-depth interviews were conducted with both infected and non-infected HCWs from multiple professional and administrative levels among the study participating hospitals to obtain diverse perspectives on local HBV-HCV practice and barriers.
- Data from in-depth interviews were analyzed using thematic content analysis approach; thus, results were more descriptive than explanatory.
- Data regarding HBV vaccine uptake among HCWs in this study was self-reported, which might be subject to recall bias.

## INTRODUCTION

Globally, there are more than 2 million occupational exposures to sharp injuries in the health care setting annually (1). The most common causes of post-exposure infections are hepatitis B virus (HBV), hepatitis C virus (HCV) and HIV (1-3). Owing to the high prevalence of viral hepatitis infections in the general population in Vietnam–a low- to middle-income country where an estimated 8.4% of the population are living with chronic HBV and another 1.1% of the population have chronic HCV, (4, 5)–it is expected that Vietnamese health care workers (HCWs) are at greater risk for exposure and infection from these pathogens.

Vietnamese HCWs are at risk of percutaneous needle stick injuries, especially in those with high frequency of contact with blood and bodily fluid, providing more opportunity for occupational exposure to HBV-HCV (6, 7). The incidence rate of acquiring HBV infection after exposure was 25 times higher than that of acquiring HIV after exposure (50 cases per 100,000 person-year vs 0.2 cases per 100,000 person-year) (8). In a study involving occupational exposure in HCWs at multiple hospitals in Ha Noi, Vietnam, Duong and colleagues found that 64.8% of HCWs were exposed to sharp injuries at least once a year. This group of HCWs includes primarily nurses and physicians who worked directly with blood and bodily fluids or sharp instruments (8). In spite all of these statistics, Nguyen and colleagues revealed that 36.5% of nurses still did not have appropriate knowledge on prevention of occupational exposure to viral hepatitis and that about 10% of individuals did not follow the standard procedures for occupational exposure (9). Notably, most of the incidents were not reported to higher administrative levels. When these incidents occurred, they were not cared for in a timely and appropriate manner (7). Oftentimes, the sources of infection remained unknown (8).

In Vietnam, viral hepatitis is a reportable infectious disease, but this only applied to hospitals that are dedicated to infectious disease specialty care and at the central government level. National recommendations for occupational exposure for prevention and management of infectious diseases, including viral hepatitis, have been issued but not mandated. According to the Infectious Disease Control and Prevention Act, viral hepatitis is in category B, which is highly infectious and could lead to death (10). There is lack of guidelines or step-by-step guidance for implementation or monitoring of viral hepatitis in health care settings. Moreover, funding to implement the national recommendations for infectious disease and viral hepatitis were not appropriated. As a result, procedures for employment screening and post-exposure testing and management for viral hepatitis in HCWs were not uniformly or systematically implemented across health care settings

in Vietnam (8). Instead, the procedures were only implemented at the individual health care center's discretion. Furthermore, because of the lack of specific guidelines for viral hepatitis occupational health procedures, many hospitals in Vietnam adopted HIV guidelines instead. This approach resulted in low HBV-HCV awareness, prevention, and post-exposure management in Vietnam (11).

Pre-exposure vaccination for HBV has been highly successful in reducing HBV infection in HCWs. Rates of use in Vietnam are unknown, and no such intervention exists to prevent transmission. Similarly, hepatitis B immune globulin (HBIG) may be recommended as post-exposure prophylaxis (PEP), but there are no formal recommendations available for PEP for HCWs exposed to HBV or HCV in Vietnam, nor is there data on availability of HBIG in these resource-limited and highly heterogeneous care settings (8). Thus, it is necessary to further understand current practices with a mind towards the resource limitations of Vietnam and other developing regions.

In this study, we conducted a sero-survey of HBV-HCV; an assessment of viral hepatitis general knowledge, attitude, and risk behaviors; and in-depth interviews in a cohort of HCWs in Ho Chi Minh City (HCMC). The in-depth interviews focused on Vietnam national legal circular, in-house protocol and procedures relating to occupational exposure for HBV-HCV prevention and management in HCWs. The study aimed to better understand the local needs and barriers for screening, prevention, and linkage to care as well as best practices regarding occupational exposure to HBV-HCV in HCWs in HCMC.

## METHODS

1. Study setting

The study was conducted in 3 hospitals in HCMC, Vietnam (*Figure 1*). A developing country, Vietnam is located in Southeast Asia and has a population of 97 million. With a population of 12 million, HCMC has an estimated prevalence of 7.8% for HBV and 2.2 % for HCV in its community (12, 13).

The HCMC hospital system, with 91 public hospitals as of 2016, is divided into 3 levels: tertiary hospital (central government-level hospital), general hospital at city level, and general hospital at district level (14). In this study, we purposefully selected 1 hospital representing each of the hospital system levels to join the study. The study protocols were approved by institutional review

committees (IRBs) at Pham Ngoc Thach University of Medicine, a local medical school in HCMC, and at each of the participating hospitals. The final study protocol was approved by the HCMC Department of Health.

## 2. Study design and methods

The study design comprised 2 parts: (1) an observational portion involving a knowledge, attitude, and practice (KAP) survey and serologic screening for HBV-HCV, and (2) in-depth interviews. For the former, a simple random sample of 210 participants, including 70 from each of the 3 hospitals representing 3 levels of hospital system in HCMC, were enrolled. The 210-person sample was derived based on several factors: an estimate of 4,000 HCWs who worked at the 3 participating hospitals (unpublished data), a 0.05 margin of error at a 95% confidence level, and the reported rate of infection of 15% for HBV and 2-5% for HCV in HCWs in Vietnam (11, 15). To achieve the sample size of 210 and assume 70% response rate from invitees, each participating hospital selected 120 participants based on their staff directories and provided the study team the list of participants. Next, random selection of prospective participants from the lists was performed in Excel using the RAND function. Potential participants generated from this random selection process were invited to participate in the study. Participant recruitment took about 3 days to get 70 out of 120 prospective participants.

The KAP questionnaire survey included demographics information (age, gender, educational level, type of clinical work, total years of clinical activity, and income levels) and questions related to HBV-HCV knowledge, risk factors outside of workplace, occupational exposures, HBV vaccination status, and overall health status. The questionnaires were initially developed based on the Behavioral Theory Framework and subsequently validated Vietnamese in the US and Vietnam (16).

The in-depth interviews (i.e., qualitative portion) were conducted within 2 weeks after the survey and screening. All participants were assigned a study ID. Participants who took the survey questionnaires and agreed to phlebotomy were invited to participate in the in-depth interviews. Those who agreed to in-depth interviews were stratified into seniority status, viral hepatitis infection status, administrative role in the participating hospitals. Specifically, we applied a quota sampling approach to include participants with different levels of clinical experience (< 5 years vs > 5 years), level of administrative responsibility (chief attending physician or chief nurse), viral hepatitis infection status (infected or naïve), and professional levels (physicians, nurse/midwives,

medical laboratory technician). In-depth interview was organized on a rolling basis, with each hospital having a maximum of ten interviewees. We ended the interview when information saturation was saturated. This information saturation was at the sample size of 30 interviewees. In-depth interview was conducted by trained interviewers in Vietnamese. All interviewees information was de-identified. A semi-structured questionnaire was used to guide the in-depth interview.

3. Participant recruitment and cascade of care follow-up

To recruit participants into the serologic screening and survey questionnaire portion, each of the 3 participating sent invitations internally to a maximum of 120 official full-time HCWs. We aimed to reach 210 HCWs (expected response rate of approximately 70%). To be included, HCWs needed to be 18 years or older and working in areas that required frequent contact with blood or bodily fluid. Upon completion of the screening tests and survey, a thank you gift card having the value of $5USD was provided to participants. Within 2 weeks, results with written interpretation of serologic testing and recommendations were returned to participants. Coupons offering free HBV vaccine were provided to HBV-naive individuals (negative for hepatitis B surface antigen [HBsAg], anti-HBc, and anti-HBs) and free follow-up coupons were provided to individuals who were HBsAg-positive and/or anti-HCV-positive. These follow-up coupons include free liver assessments (confirmatory HCV RNA, comprehensive metabolic panel, and complete blood count), free Fibroscan and hepatology consultation at an independent contracted medical center. If treatment for HBV or HCV is indicated, the costs of treatment were reimbursed by national public health insurance. All the study participants had public health insurance coverage.

For the qualitative phase, participants were also invited to participate in a 1-hour, follow- up in-depth interview regarding barriers and facilitating factors in viral hepatitis prevention in the workplace and measurement of workplace occupational exposures. Twenty-eight participants were recruited (17, 18), reaching data saturation. Trained interviewers used a semi-structured questionnaire to collect data and provided interviewees $5 USD incentives after completing the session.

4. Viral hepatitis serologic testing

Participants were screened for HBV and HCV. HBsAg was tested using a fully multivalent assay with high sensitivity in detecting HBV mutants to determine those who were positive for HBsAg. ELISA assay was performed following the manufacturer's instructions including serum anti-

hepatitis B surface antibody (anti-HBs), and serum anti-hepatitis B core antibody (anti-HBcAb). HCV was screened with serum anti-hepatitis C antibody (anti-HCV). All the screening tests for HBV-HCV were performed with Elecsys® (Roche Diagnostics Ltd). Results were certified by a physician before being provided to screening participants.

5. Data management and statistical analysis

All surveys, interviews, transcriptions, and coding of the qualitative data were done in Vietnamese. All surveys were checked for completeness. Missing items were not included in data analysis. Data was stored in REDCap. Demographic characteristics and risk factors for HBV-HCV and KAP data were reported as mean and standard deviation for continuous variables and proportions for categorical variables, and subsequently compared between the groups with and without HBV or HCV.

For survey questionnaires, KAP variables were coded as True (Applicable for) or False (Not Applicable for) for HBV, HCV, or both HBV and HCV. Infection status was grouped as HBsAg (+) versus HBsAg(-) for HBV and anti-HCV(+) versus anti-HCV(+). Lab tests were merged with survey data, then cleaned and managed in STATA. Data analysis was performed with univariate and bivariate statistics: the Cochran-Armitage trend test was used for continuous variables; the Chi-square was used for categorical data. Significance level of 0.05 was used. All analyses used SAS 9.4.

In-depth interviews were recorded and then transcribed into Word documents, coded by 2 independent coders. Thematic content analysis using hybrid approach of inductive and deductive coding and theme development was performed in Excel. Initial codes were generated deductively and fitted into a preexisting coding framework based on the structured of the questionnaire and defined each label based on the transcripts. We summarized the transcripts and outlined the key points addressed by the participants (which were pre-specified before the interview or newly occurred in the conversation) to identify themes and patterns in the data. Themes were further clustered and assigned succinct phrases to describe the underpinning meanings.

6. Patient and public involvement

Patients or the public were not involved in this study.

## RESULTS

1. Sociodemographic characteristics of study participants (*Table 1)*

There were 210 HCWs invited from 3 hospitals. Seven HCWs were non-clinical staffs and excluded from the study. Of 210 invited HCWs, 203 (96.7%) completed the demographics and KAP survey questionnaires and serological testing for HBV-HCV. Of the 203 HCWs, 39 were physicians, 140 were nurses and midwives, and 24 were technicians and nurse assistants. Overall, the age range was from 21 to 59 years old with a mean of 34.49. The majority of the 203 HCWs were female (83%). Approximately 95% of the enrolled HCWs completed at least a technical or vocational degree, and more than half (54.5%) worked in a clinical environment for less than 10 years. Among 3 groups of HCWs (physicians, nurses/midwives, and technicians/nurse assistants), most females (127/168) were nurses and midwives. All doctors graduated from university; and the majority of nurses, midwives, technicians, and nurse assistants competed high school and vocational school.

2. Serological characteristics of the study participant

Twenty (9.8%) of 203 HCWs were positive for HBsAg. Of 20, 17 (85%) knew their viral hepatitis status; this included 4 doctors, 15 nurses, and 1 technician. Nurses had similar rate of HBV infection at 10.7% (15 of 140) compared to doctors at 10.2% (4 of 39). Technician and nurse assistant had the lowest rate of HBV infection with 1 infected person of 24 (4.2%). Four (1.97%) were indeterminate with only positive anti-HBc Ab and required follow-up testing. There were 27 (13.3%) who were suceptible to HBV infection with negative HBsAg, anti-HBs, and anti-HBc. Among those who were naive, there were 3 physicians (7.7%, 3/39), 18 nurses and midwives (12.9%, 18/140), and 6 technicians (25%, 6/24). Ninety-nine (48.77%) were immune from HBV vaccination with positive anti-HBs, and 53 (26.11%) were with positive anti-HBs and anti-HBc. Among those who were vaccinated, there were 19 physicians (58%, 19/39), 69 nurses and midwives (49%, 69/140), and 11 technicians (46%, 11/24). Interestingly, 10 of these 99 HCWs reported never receiving HBV vaccine. Regarding HCV, there was only 1 person (0.5%) who tested positive for anti-HCV and negative HCV RNA. This person later reported already having HCV treatment 10 years prior.

3. Comparison between HBV seropositive and HBV seronegative groups (*Table 2 and 3*)

We divided the participants into 2 groups: 20 HCWs that were HBsAg-positive and 193 HCWs that were HBsAg-negative. As shown in *Table 2*, there were no significant difference in

demographic characteristics between the 2 groups. Both groups were approximately 80% female, and the age range was 25-54 and 21-59 years old. The majority of participants in both groups were nurses and midwives, then to physicians. There was no difference in educational level or length of clinical work between the 2 groups. Regarding risk factors for HBV infection, a higher percentage of the HBV seropositive group had family members with HBV infection (60% vs 18%, $P < 0.0001$). Seventy percent (70%) of the seronegative group reported no family member with either HBV or HCV, compared to 30% in the seropositive group. The seropositive group had a higher percentage of participants with daily exposure to blood and bodily fluid compared to the seronegative group (90% vs 69%). However, the difference was not significant ($P = 0.054$). There was no difference in the time since last check-up with HBV screening. However, rate of vaccine uptake was higher in the seronegative groups (76% vs 30%, $P = 0.0001$). There was no difference in risks of hepatitis transmission, including prior blood transfusion, tattoo, illicit drug use, or unprotected sex; except that 2 of the 20 with HBV (10%) reported sharing needles in the past compared to none in the seronegative group ($P < 0.0001$).

4. Assessment of KAP

According to the KAP survey (*Table 1* in Supplement), the majority of HCWs provided correct answers to questions on modes of HBV-HCV transmission including sharing toothbrushes, sharing needles, sexual intercourse, and during birth. However, 17% (35 of 203) of HCWs believed that smoking could cause hepatitis, including 7 physicians, 23 nurses and midwives, and 5 other HCWs. Moreover, almost half (44%, 90 of 203) thought that hepatitis could be spread by sharing utensils; this group included 19 physicians, 63 nurses and midwives, and 8 other HCWs. Twenty-nine percent (58 of 203) also believed that sneezing could spread hepatitis, including 10 physicians, 41 nurses and midwives, and 7 other HCWs. Regarding knowledge on natural course of HBV-HCV, the majority believed that asymptomatic people can have chronic HBV or HCV infection (89%) and that HBV-HCV are life-long infections which can cause liver cancer (95%) and can be lethal (86%). However, 21% (43 of 203) of HCWs believed that hepatitis is not treatable; this group included 4 physicians, 34 nurses and midwives, and 5 other HCWs. The majority (83%, 169 of 203) thought that they do not need to avoid contact with people infected with HBV-HCV. Answers regarding the hepatitis B vaccine revealed that most HCWs (93%, 189 of 203) believed that the HBV vaccine is effective, though 21% (42 of 203) perceived that the HBV vaccine has harmful side effects. Overall, physicians exhibit better knowledge compared to the 2 other groups.

5. In-depth interview results (*Table 4*)

The in-depth interviews were conducted with 28 HCWs at 3 hospitals. The four main themes identified from the data were: “awareness and the present of prevention and management policy and protocol for viral hepatitis in place,” the local actual “post-exposure management,” how did “HBV-HCV were screened and managed during annual health check,” and “stigma and support.”

**Available of occupational exposure policy and/or protocol**

All respondents were aware of the Ministry of Health’s policy on prevention and control of occupational injuries in HCWs, and the local policy was similar to the national circular. Also, they stated that the major focus of post-exposure incident reporting was HIV, so HBV-HCV pathogens were not included in checks for post-exposure incidents (93%, 26 of 28).

“The Ministry of Health did issue the guidelines for prevention of occupational exposure of needle sticks, so we applied it to our practice”, “I don’t think viral hepatitis is much different from HIV, that’s why we can use the HIV protocol though”

The national guidelines for prevention occupational exposure were more for needle bricks or HIV and the HCWs applied it to viral hepatitis.

**Actual occupational exposure management**

When asked about post-exposure management, focusing on the local financial assistance program for occupational exposure, 47% (7 of 15) reported receiving financial aid from the hospital for testing and medication for HIV exposure whereas 33% (5 of 15) denied such support at their hospitals and had to self-pay the co-pay amount for examination and medication under their health insurance plan. Almost all interviewees (93% or 14 of 15) agreed that hospital should pay for follow-up and/or treatment for hepatitis infection from occupational exposure, while 1 did not agree due to belief that hepatitis infection is not serious.

Most of the HCWs reported that they thought of HIV post exposure rather than HBV (100%) and the post-exposure reporting form did not ask whether the source of exposure had HBsAg or anti-HCV (100%). All of the HCWs agreed that HBV and HCV should be mentioned in the accident reporting form and in the post exposure testing for HCWs. Some HCWs said they had to pay for their HBV-HCV treatment because they didn’t want to use the national public health insurance’s medications as it was not highly efficient, and demand the hospital to cover their treatment fee.

“I should think of HBV and HCV after being exposed to needle sticks, at that time, I reported only the HIV status of the patient”, “Nothing in the accident reporting form related to HBV or HCV”

“I realize that we need to check for HBV and HCV post exposure after talking with you” “I had to request to be tested for HBV and HCV post afterwards”

"I just paid for my HBV treatment, I wanted to use better medication that were not in the public insurance's medication list" "I think it was OK for me to pay, but if the hospital can pay it, it would be a relief".

**Screening and vaccination policy and the annual health check**

When asked about annual health check-ups for viral hepatitis, 48% (13 of 27) had only the HBV screening with HBsAg in their annual check-up organized and paid by their hospitals. Only 9 of 27 (33%) had both HCV and HBV screening annually, which was paid by hospitals. Additionally, regarding testing requirements for new staff prior to start clinical work, 55% (11 of 20) received screening and vaccination recommendations during training or at the beginning of work, while 40% (8 of 20) reported that there was no such requirement. Before starting clinical works, about 55% (11/20) interviewees reported that their hospitals required HBV and HCV to be tested, and 81.5% (22/27) respondents stated that HBV and HCV were included in their annual health check. "HBV and HCV were included in my health report when applying for a job in this hospital", "I got HBsAg and anti-HCV testing every year in the hospital health check day"

If HBV vaccination is needed, 75% (21/28) HCWs paid for their own vaccination and only 21.4% (6/28) confirmed they got free vaccination from their hospitals. However, they agreed that

"I got my vaccination during my medical training and I paid for it", "I got free vaccination at the hospital pharmacy department"

"I think new employees should be tested for viral hepatitis before employment" "It would be the best if the screening and treatment fee can be covered by the hospitals"

**Stigma and support**

Regarding "stigma and support," 79% (22 of 28) of interviewees were willing to reveal their viral hepatitis status to coworkers whereas 21% (6 of 21) would like to keep it personal. Of those 6, 3 interviewees voiced concern about stigma, and 2 reported that knowing their status would not change anything as they took measures to decrease transmission risk in the workplace. Alternatively, when asked if they would want to know their coworkers' viral hepatitis status, 52% (14 of 27) would like to know, 7% (2 of 27) would not, and 41% (11 of 27) did not have strong opinions.

"I think it's OK to know other's status, so we can easily allocate the work and prevent spreading to the patient"

Furthermore, regarding HBV vaccination, 75% of interviewees (21 of 28) paid for their own vaccination, while 21% (6 of 28) had cost covered by hospital. Most interviewees (79%, 11 of 14) agreed that HBV vaccination should be free for all HCWs whereas 21% (3 of 14) believed that

vaccination should be self-paid due to financial constraint of the public health system and the affordability of vaccination when compared to HCWs' salaries.

Among those who would like to know, some voiced reasons including knowing risk of transmission with close contact, educating each other about preventive measures, and offering support to those with viral hepatitis infection. For those who would not want to know, they believed viral hepatitis status is private health information and should not be shared. Eleven interviewees reported that knowing coworkers' hepatitis status does not change their interactions. When asked if hepatitis infection could result in position reassignment, 36% (9 of 25) said *no* due to already high prevalance of viral hepatitis among HCWs, concern about discrimination, and the fact that taking preventive measures is adequate to prevent tramission.

## DISCUSSION

In this mixed-methods study, we documented the local best practices of occupational exposure and infection rates for HBV-HCV in HCWs in HCMC. Importantly, in-depth interviews revealed 2 major concerns for most interviewees. First, participants expressed the need for a specific guideline on HBV-HCV occupational exposure and prevention. This guideline should be independent from HIV guidelines. Second, policy on financial support for post-exposure management for viral hepatitis in HCWs should be allocated.

In the observational portion, the study estimated a rate of HBsAg-positivity of 9.85% among HCWs working in HCMC. Compared to recent data on HBV prevalence of HCWs in other low- to middle-income countries in Southeast Asia, HCWs in HCMC may have a higher rate of HBV than that of Thailand (5.3%), Indonesia (6.2%), and Laos (8%) (19-21). Regarding HCV, rate of anti-HCV-positive was much lower than HBV infection in this study (0.5% vs 9.85%). Prior review also revealed lower average HCV prevalence of 1.6% in Southwest Asia, which ranges from 0.8% in Indonesia to 2.7% in Thailand (22). Although the most common scenario for both HBV and HCV exposure in HCWs is percutaneous injuries, HBV can survive outside the human body for at least 7 days and is many times more infectious than HCV or HIV (23-25). Moreover, HBV is the most easily transmitted bloodborne virus with a 6% to 30% risk of infection from percutaneous exposure. Risk of acquiring HCV is lower, with a range from 2% to 4% (25).

Although 71% of HCWs reported HBV immunization, test results showed a low rate of vaccination (49%) among 3 levels of HCWs with the uptake rate highest in physicians (58%), followed by nurses (49%) and technicians (46%). The reported rate of vaccination is similar to a recent study

done in Northern Vietnam (68.8%) (26) and other studies in South Africa (64.5%) (27, 28). Low vaccine uptake may also be associated with HBV infection as demontrated here and in previous studies (19, 29). There are several reasons to explain the low rate of vaccination.

First, the population of HCWs in our study did not generally get vaccination during early childhood. HBV vaccine, part of Vietnam's Expanded Program on Immunization, was first introduced in 1997 as a trial and was officially implemented in 70% of provinces of Vietnam only in 2004 (30). Therefore, national HBV vaccination for infants has only been active for 22 years. Since the average age of surveyed HCWs was 38 years old and the age range was from 25 to 54 years, the majority of HCWs was likely not vaccinated in their first year of life.

Second, most health care facilities in Vietnam do not require pre-employment testing and vaccination against HBV, and do not incorporate viral hepatitis screening in annual check-up as demonstrated in the in-depth interviews. There were 10 HCWs who reported never receiving HBV vaccine but they had lab results consistent with immunity from vaccination. On the other hand, there were 6 HCWs who reported previous vaccination but were HBsAg-positive. It is unclear if this is recall bias, that the initiation of vaccination was after HBV infection, or that the immunity from HBV vaccination had waned prior to HBV acquisition. The latter is less likely because HBV vaccine may confer protection from HBV infection for 30 years (31). Taken together, during employment process, it is important for viral hepatitis screening before starting work and that annual testing to avoid false assurance of vaccination in people who had acquired HBV infection prior to vaccine, especially in those who work in the health care settings with greater occupational risks. It is equally important to identify naive individuals for prompt vaccination to prevent HBV infection from occupational exposures.

Third, HBV vaccination was reported to be self-paid. Although several HCWs admitted the affordability of the HBV vaccine, they also mentioned free vaccination could encourage higher vaccine uptake. Besides financial barrier, other barriers, including unavailability of vaccine and busy work schedules, were also demonstrated in prior study (32).

We also identified high occupational risks: 71.5% of HCWs have daily exposure to blood and bodily fluid. Although almost all interviewees reported available protocol for occupational exposures from the in-depth interview, only 1 interviewee had dedicated hepatitis protocol and the remaining interviewees followed HIV protocol. There was no available PEP for HBV exposure

and no guidelines on follow-up testing and/or treatment. Most interviewees also voiced the need for an assistance program for testing and/or treatment for hepatitis infection from occupational exposure. Therefore, there is a need for guidelines for occupational exposure of viral hepatitis and dedicated protocol for PEP, monitoring, and treatment.

Similar to a recent study in Northern Vietnam, there was good overall knowledge of hepatitis transmission including parenteral, sexual, and perinatal transmission (26). It seemed that the knowledge in these 203 HCWs in HCMC was better than that of previous studies conducted in Africa (29, 33). However, gaps of knowledge were identified in smoking, sharing foods, and sneezing, which are not risk factors for hepatitis acquisition. Although there was no significant difference in knowledge score between the HBV-infected and non-infected groups, knowledge of hepatitis transmission is still important as HCWs are at a higher risk of contracting hepatitis via blood and bodily fluid exposure. However, a considerable proportion of HCWs did not believe viral hepatitis is treatable. This might be due to the lack of access to treatment knowledge as not everyone worked in the Hepatology department. From the in-depth interview, interviewees were aware of the inadequate knowledge of hepatitis and called for further education. Therefore, we suggest expanding annual training to include basic viral hepatitis core knowledge, testing, and treatment as well as sequalae if unrecognized. As a result, this will facilitate vaccination uptake, awareness of modes of transmission, and a proactive approach to follow-up testing, especially after occupational exposure.

This mixed-methods study reveals several gaps in hepatitis practice among HCWs in HCMC. First is the lack of pre-employment screening and routine surveillance for hepatitis. Second is inadequate guidelines for measures to be taken after hepatitis exposure. Therefore, we propose that hospitals should have mandatory pre-employment hepatitis screening for all prospective employees. This would help identify naive individuals who should be required to get HBV vaccination prior to starting their jobs to limit HBV infection from occupational exposures. This would also serve as an opportunity for those with hepatitis infection to know about their status. Additionally, for employees who will be at high risk of exposure to blood or body fluids on the job, post-vaccination anti-HBs testing should be offered to identify individuals who did not achieve immunity with the standard HBV series. Those individuals who have documented prior HBV vaccination and negative anti-HBsAb should receive a booster dose of HBV vaccine and be retested for immunity afterwards. We also propose that dedicated guidelines for HBV-HCV post-exposure management will be available at the workplace for HCWs. Published guidelines should

be at designated places, such as nursing stations or workrooms, for prompt access after occupational exposures. Following occupational exposure, skin sites that have been in contact with blood or bodily fluids should be washed with soap and water, and mucous membranes should be flushed with water. For HBV, prompt administration of HBIG or initiation of HBV vaccination should be initiated, depending on the HBV status of source patient and the exposed HCW. Appropriate HCWs should have follow-up serologic testing (*Table 2* in Supplement) (34). For HCV, testing of source patient and exposed HCWs should be done as soon as possible. HCV PEP is not recommended. Schedules for follow-up serologic testing after exposure for HCWs depends on HCV status of source patient and exposed HCW (*Figure 1* in Supplement) (35).

Although this mixed-methods study was the first in Vietnam to provide more information about HBV-HCV in HCWs, there were several limitations. First, we do not intend to estimate the prevalence of HBV-HCV among HCWs in HCMC. Second, data regarding vaccine uptake was self-reported, which might be subject to recall bias. Also, there was no data regarding timing of vaccination in relation to timing of infection to determine vaccine efficacy. Despite these limitations, we still believe that this mixed-methods study offered insights into the needs for policy change to facilitate HBV vaccination, hepatitis surveillance, education, and post-exposure guideline changes. Furthermore, we propose effective interventions aimed at reduction of viral hepatitis disease burden in HCMC, Vietnam and would further support for better analyses of anti-viral gaps and elimination targets that have been set for 2030 by the World Health Organization (WHO) and Vietnam's National Action Plan for Viral Hepatitis Control and Prevention, Period 2015-2019.

## CONCLUSION

In conclusion**,** we documented that there are few guidelines for testing and treatment or best practices for occupational exposure to viral hepatitis in HCWs working in HCMC. Despite the high rate and risk of HBV infection in this population, only half of HCWs were vaccinated against HBV. A knowledge gap was also identified with the KAP survey that continuous medical education is crucial to improve the knowledge and to protect HCWs. This study is a call for an effort to enforce mandatory pre-employment testing, routine surveillance, HBV vaccination, and dedicated HBV-HCV post-exposure guidelines and treatment for HCWs.

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**Data availability statement**: Deidentified data are stored in internal database and are available upon request to the corresponding author. All data relevant to the study are included in the article or uploaded as supplementary material.

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**TABLES AND FIGURES**

# Table 1

**Baseline demographic characteristics of 203 HCWs**

| | Total n | Physicians n (%) | Nurses & Midwives n (%) | Other HCWs n (%) |
|---|---|---|---|---|
| | **(N=203)** | **(N=39)** | **(N=140)** | **(N=24)** |
| **Gender** | | | | |
| Female | 168 | 27 (16.07) | 127 (75.60) | 14 (8.33) |
| **Age groups** | | | | |
| ≤ 29 | 74 | 13 (17.57) | 50 (67.57) | 11 (14.86) |
| 30-39 | 72 | 15 (20.83) | 52 (72.22) | 5 (6.94) |
| 40-49 | 39 | 8 (20.51) | 26 (66.67) | 5 (12.82) |
| ≥ 50 | 18 | 3 (16.67) | 12 (66.67) | 3 (16.66) |
| **Age** | | | | |
| Median (IQR) / range | 32 (14) / 21-59 | 34 (13.5) / 24-59 | 32 (13.25) / 21-56 | 30 (17.5) / 23-56 |
| **Educational level** | | | | |
| At most high school | 10 | 0 | 5 (50) | 5 (50) |
| Technical or vocational degree | 111 | 0 | 99 (89.19) | 12 (10.81) |
| University and post-university | 81 | 39 (48.15) | 36 (44.44) | 6 (7.41) |
| **Length of clinical activity** | (n=193) | (n=39) | (n=133) | (n=21) |
| 0-9 years | 105 | 23 (21.91) | 69 (65.71) | 13 (12.38) |
| 10-19 years | 52 | 10 (19.23) | 38 (73.08) | 4 (7.69) |
| 20+ years | 36 | 6 (16.67) | 26 (72.22) | 4 (11.11) |

HCW, health care workers; IQR, interquartile range.

## Table 2

**Demographic characteristics between HBsAg (+) and HBsAg (-) groups**

| | Total | HBsAg (+) | HBsAg (-) | *P* value |
|---|---|---|---|---|
| | (n=203) | (n=20) | (n=183) | |
| **Gender, n (%)** | | | | 0.731 |
| Female | 168 (82.76) | 16 (80) | 152 (83.06) | |
| **Age** | | | | |
| Median (IQR) | 32 (14) | 35 (13.5) | 31 (14) | |
| Range | 21-59 | 25-54 | 21-59 | |
| Means (std) | 34.49 (9.14) | 38.05 (8.59) | 34.10 (9.13) | 0.067 |
| **Educational level, n (%)** | (n=202) | | (n=182) | 0.4188 |
| High school or lower | 10 (4.95) | 0 | 10 (5.49) | |
| Technical or vocational Degree | 111 (54.95) | 10 (50) | 101 (55.49) | |
| University and post-university | 81 (40.10) | 10 (50) | 71 (39.01) | |
| **Clinical works, n (%)** | (n=199) | | (n=179) | 0.728 |
| Physicians | 39 (19.60) | 4 (20) | 35 (19.55) | |
| Nurses & midwives | 140 (70.35) | 15 (75) | 125 (69.83) | |
| Other HCWs | 20 (10.05) | 1 (5) | 19 (10.61) | |
| **Length of clinical work, n (%)** | (n=193) | (n=19) | (n=174) | 0.269 |
| 0-9 years | 105 (54.40) | 7 (36.84) | 98 (56.32) | |
| 10-19 years | 52 (26.94) | 7 (36.84) | 45 (25.86) | |
| 20+ years | 36 (18.65) | 5 (26.32) | 31 (17.82) | |

HBsAg, hepatitis B surface antigen; HCW, health care workers; IQR, interquartile range.

## Table 3

**Risk factors between HBsAg (+) and HBsAg (-) groups**

| | Total | HBsAg (+) | HBsAg (-) | *P* value |
|---|---|---|---|---|
| | **(n=203)** | **(n=20)** | **(n=183)** | |
| **Frequency of exposure to blood & bodily fluids, n (%)** | (n=197) | (n=20) | (n=177) | 0.054 |
| Every day | 141 (71.57) | 18 (90) | 123 (69.49) | |
| Not every day | 56 (28.4) | 2 (10) | 54 (30.51) | |
| **Family member with viral hepatitis, n (%)** | (n=203) | (n=20) | (n=183) | **<0.0001** |
| Only HBV | 39 (19.21) | 12 (60) | 27 (14.75) | |
| Only HCV | 3 (1.48) | 0 | 3 (1.64) | |
| Both HBV and HCV | 6 (2.96) | 0 | 6 (3.28) | |
| None | 135 (66.50) | 6 (30) | 129 (70.49) | |
| Don't know and didn't answer | 20 (9.85) | 2 (10) | 18 (9.84) | |
| **Family with HBV vaccination, n (%)** | (n=185) | (n=18) | (n=167) | 0.297 |
| Yes | 147 (79.46) | 16 (88.89) | 131 (78.44) | |
| **Last time of health check-up with HBV screening, n (%)** | (n=201) | (n=20) | (n=181) | 0.750 |
| Last 6 months | 106 (52.74) | 10 (50) | 96 (53.04) | |
| 6 months to 1 year | 30 (14.93) | 3 (15) | 27 (14.92) | |
| More than 1 year | 32 (15.92) | 5 (25) | 27 (14.92) | |
| Health check without HBV screening | 29 (14.43) | 2 (10) | 27 (14.92) | |
| No health check-up | 4 (1.99) | 0 | 4 (2.21) | |
| **Health check-up with HBV screening paid by, n (%)** | (n=166) | (n=18) | (n=148) | 0.130 |
| Self | 33 (19.88) | 6 (33.33) | 27 (18.24) | |
| Employer | 133 (80.12) | 12 (66.67) | 121 (81.76) | |
| **Any medical conditions, n (%)** | (n=199) | (n=) | (n=179) | |
| Yes | 30 (15.08) | 6 (30) | 24 (13.41) | **0.0492** |

| | Total | HBsAg (+) | HBsAg (-) | *P* value |
|---|---|---|---|---|
| | **(n=203)** | **(n=20)** | **(n=183)** | |
| **History of transfusion, n (%)** | (n=199) | (n=20) | (n=179) | 0.8383 |
| Yes | 12 (6.03) | 1 (5) | 11 (6.15) | |
| **Having tattoo, n (%)** | (n=199) | (n=20) | (n=179) | 0.9133 |
| Yes | 11 (5.53) | 1 (5) | 10 (5.59) | |
| **Use of addictive drugs, n (%)** | (n=199) | (n=20) | (N=179) | 0.6347 |
| Yes | 2 (1.01) | 0 | 2 (1.12) | |
| **Sharing needles, n (%)** | (n=201) | (n=20) | (N=181) | **<0.0001** |
| Yes | 2 (1) | 2 (10) | 0 | |
| **Use of immuno-suppressants or steroids, n (%)** | (n=201) | (n=19) | (n=182) | 0.5137 |
| Yes | 2 (1) | 0 | 2 (1.10) | |
| No | 189 (94.03) | 19 (100) | 170 (93.41) | |
| Not sure | 10 (4.97) | 0 | 10 (5.49) | |
| **Contact with sex workers, n (%)** | (n=202) | (n=20) | (n=182) | |
| Often | 1 (0.5) | 0 | 1 (0.55) | |
| Sometimes | 0 | 0 | 0 | |
| Never | 201 (99.5) | 20 (100) | 181 (99.45) | |
| **In LGBT community, n (%)** | (n=202) | (n=20) | (n=182) | |
| Yes | 1 (0.5) | 0 | 1 (0.55) | |
| **Use of condoms, n (%)** | (n=183) | (n=18) | (n=165) | 0.2172 |
| Always | 34 (18.58) | 2 (11.11) | 32 (19.39) | |
| Sometimes | 42 (22.95) | 7 (38.89) | 35 (21.21) | |
| Never | 107 (58.47) | 9 (50) | 98 (59.39) | |
| **Partners were screened for HBV/HCV, n (%)** | (n=191) | (n=18) | (n=173) | 0.1218 |
| Yes | 128 (67.02) | 15 (83.33) | 113 (65.32) | |

| | Total | HBsAg (+) | HBsAg (-) | *P* value |
|---|---|---|---|---|
| | **(n=203)** | **(n=20)** | **(n=183)** | |
| **Received hepatitis B vaccination, n (%)** | (n=200) | (n=20) | (n=180) | **0.0001** |
| Yes | 142 (71) | 6 (30) | 136 (75.56) | |

HBsAg, hepatitis B surface antigen; HBV, hepatitis B virus; HCV, hepatitis C virus; HCW, health care workers; LGBT, lesbian, gay, bisexual, and transgender.

## Table 4

**In-Depth Interviews Summary**

| Semi-Structured Questions | Total | Agree n (%) | Disagree n (%) | Not Sure n (%) |
|---|---|---|---|---|
| My workplace has protocol for occupationalexposure. | 28 | 27 (96.4) | 0 | 1 (3.6) |
| My workplace has separate hepatitisprotocol for occupational exposure. | 28 | 1 (3.6) | 26 (92.8) | 1 (3.6) |
| My workplace has an assistance programfor occupational exposure. | 15 | 7 (46.7) | 5 (33.3) | 3 (20) |
| My workplace organizes routine screeningfor viral hepatitis. | 27 | 22 (81.5) | 4 (14.8) | 1 (3.7) |
| Hepatitis testing is required before starting clinical work at my workplace. | 20 | 11 (55) | 8 (40) | 1 (5) |
| I paid for my own HBV vaccination. | 28 | 21 (75) | 6 (21.4) | 1 (3.6) |
| My employer paid for HBV vaccination. | 28 | 6 (21.4) | 21 (75) | 1 (3.6) |
| I am willing to reveal my hepatitis infection status to my coworkers. | 28 | 22 (78.6) | 6 (21.4) | 0 |
| I would like to know my coworkers' viral hepatitis infection status. | 27 | 14 (51.9) | 2 (7.4) | 11 (40.7) |
| Hospital should pay for testing and/or treatment for viral hepatitis caused by occupational exposure. | 15 | 14 (93.3) | 1 (6.7) | 0 |
| My workplace should test new employees for viral hepatitis prior to employment. | 12 | 12 (100) | 0 | 0 |
| HBV vaccination should be free for health care workers. | 14 | 11 (78.6) | 3 (21.4) | 0 |

HBV, hepatitis B virus.

## Figure 1:

**Vietnam, red S shape, is located in Southeast Asia. Ho Chi Minh City, enlarging circle, is located in Southern Vietnam.**

## SUPPLEMENTS

**Table 1: KAP survey results stratified among types of clinical work**

| Statements about HBV or HCV | Total n (N=203) | Physicians n (%) (n=39) | Nurses & midwives n (%) (n=140) | Other HCWs n (%) (n=24) |
|---|---|---|---|---|
| Smoking can cause hepatitis | 35 | 7 (20) | 23 (65.71) | 5 (14.29) |
| Don't know if smoking can cause hepatitis | 9 | 0 | 8 (88.89) | 1 (11.11) |
| Hepatitis can be spread by sharing eating utensils | 90 | 19 (21.11) | 63 (70) | 8 (8.89) |
| Don't know if hepatitis can be spread by sharing eating utensils | 8 | 0 | 6 (75) | 2 (25) |
| Either HBV or HCV can not be spread by sharing toothbrushes | 22 | 4 (18.18) | 16 (72.73) | 2 (9.09) |
| Don't know if hepatitis can be spread by sharing toothbrushes | 4 | 0 | 2 (50) | 2 (50) |
| Hepatitis can be spread by sneezing | 58 | 10 (17.24) | 41 (70.69) | 7 (12.07) |
| Don't know if hepatitis can be spread by sneezing | 10 | 1 (10) | 7 (70) | 2 (20) |
| Hepatitis can not be spread via sexual intercourse | 9 | 0 | 7 (77.78) | 2 (22.22) |
| Don't know if hepatitis can be spread via sexual intercourse | 1 | 0 | 1 (100) | 0 |
| Hepatitis can not be spread by sharing needles | 1 | 0 | 0 | 1 (100) |
| Don't know if hepatitis can be spread by sharing needles | 1 | 0 | 1 (100) | 0 |
| Neonates can not acquire hepatitis at birth | 0 | 0 | 0 | 0 |
| Don't know if neonates can acquire hepatitis at birth | 4 | 0 | 3 (75) | 1 (25) |
| Hepatitis can not be spread by someone who looks healthy | 6 | 0 | 5 (83.33) | 1 (16.67) |
| Don't know if hepatitis can be spread by someone who looks healthy | 16 | 1 (6.25) | 13 (81.25) | 2 12.5) |

| Statements about HBV or HCV | Total n (N=203) | Physicians n (%) (n=39) | Nurses & midwives n (%) (n=140) | Other HCWs n (%) (n=24) |
|---|---|---|---|---|
| Hepatitis can not cause life-long infection | 29 | 7 (24.14) | 18 (62.07) | 4 (13.79) |
| Don't know if hepatitis can cause life-long infection | 13 | 0 | 11 (84.62) | 2 (15.38) |
| Hepatitis can not cause liver cancer | 6 | 0 | 6 (100) | 0 |
| Don't know if hepatitis can cause liver cancer | 5 | 0 | 4 (80) | 1 (20) |
| Hepatitis cannot be lethal | 14 | 1 (7.14) | 8 (57.14) | 5 (35.72) |
| Don't know if hepatitis can be lethal | 14 | 0 | 14 (100) | 0 |
| Hepatitis is not treatable | 43 | 4 (9.30) | 34 (79.07) | 5 (11.63) |
| Don't know if hepatitis is treatable | 7 | 0 | 6 (85.71) | 1 (14.29) |
| People with hepatitis should be avoided | 29 | 5 (17.24) | 20 (68.97) | 4 (13.79) |
| Don’t know if need to avoid people with hepatitis | 5 | 2 (40) | 2 (40) | 1 (20) |
| I do not have a life-long risk of contracting hepatitis | 8 | 1 (12.5) | 5 (62.5) | 2 (25) |
| Don't know if I have a life-long risk of contracting hepatitis | 24 | 3 (12.5) | 15 (62.5) | 6 (25) |
| Hepatitis B vaccine is not effective | 8 | 1 (12.5) | 7 (87.5) | 0 |
| Don't know if vaccine is effective | 6 | 0 | 3 (50) | 3 (50) |
| Hepatitis B vaccine has harmful side effects | 42 | 11 (26.19) | 28 (66.67) | 3 (7.14) |
| Don't know if hepatitis B vaccine has harmful side effects | 40 | 2 (5) | 30 (75) | 8 (20) |

**Table 2: Post-exposure management of health care workers after occupational percutaneous and mucosal exposure to blood and body fluids, by health care workers' hepatitis B vaccination and response status.**

| Health care worker status | Post-exposure testing | | Post-exposure prophylaxis | | Post-vaccination serologic testing[b] |
|---|---|---|---|---|---|
| | Source patient (HbsAg) | HCW testing (anti-HBs) | HBIG[a] | Vaccination | |
| Documented responder[c] after complete series | No action needed | | | | |
| Documented non-responder[d] after 2 complete series | Positive/ unknown | Not indicated | HBIG x2 separated by 1 month | — | No |
| | Negative | No action needed | | | |
| Response unknown after complete series | Positive/ unknown | < 10 mIU/mL[e] | HBIG x1 | Initiate revaccination | Yes |
| | Negative | < 10 mIU/mL | None | | |
| | Any result | ≥ 10 mIU/mL | No action needed | | |
| Unvaccinated / incompletely vaccinated or vaccine refusers | Positive/ unknown | —[e] | HBIG x1 | Complete vaccination | Yes |
| | Negative | — | None | Complete vaccination | Yes |

anti-HBs, antibody to hepatitis B surface antigen; HBsAg, hepatitis B surface antigen; HBIG, hepatitis B immune globulin; HCW, health care workers.

[a] HBIG should be administered intramuscularly as soon as possible after exposure when indicated. The effectiveness of HBIG when administered >7 days after percutaneous, mucosal, or nonintact skin exposures is unknown. HBIG dosage = 0.06 mL/kg.

[b] Should be performed 1–2 months after the last dose of the hepatitis B vaccine series (and 6 months after administration of HBIG to avoid detection of passively administered anti-HBs) using a quantitative method that allows detection of the protective concentration of anti-HBs (≥10 mIU/mL).

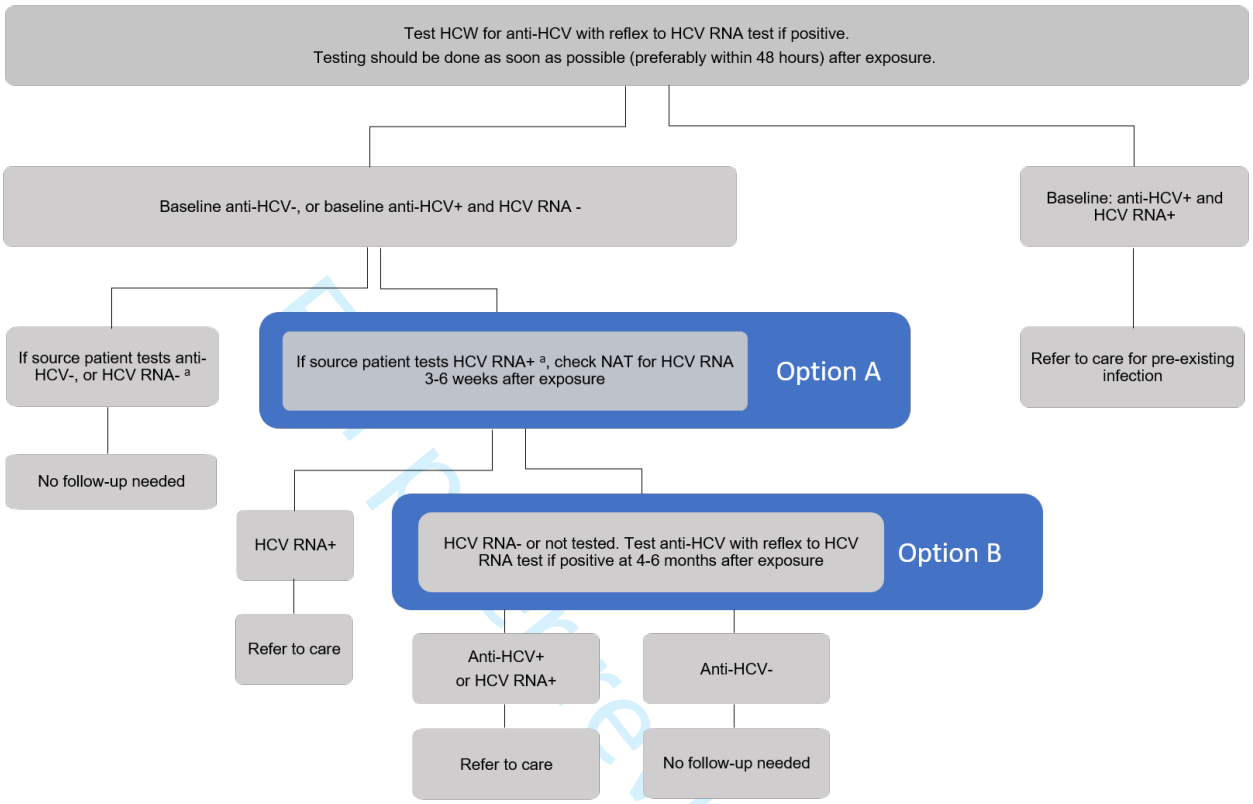
[c] A responder is defined as a person with anti-HBs ≥10 mIU/mL after ≥1 complete series of hepatitis B vaccine.

[d] A nonresponder is defined as a person with anti-HBs <10 mIU/mL after 2 complete series of hepatitis B vaccine.

[e] HCW who have anti-HBs <10 mIU/mL, or who are unvaccinated or incompletely vaccinated, and sustain an exposure to a source patient who is HBsAg (+) or has unknown HBsAg status, should undergo baseline testing for HBV infection as soon as possible after exposure, and follow-up testing approximately 6 months later. Initial baseline tests consist of total anti-HBc; testing at ~6 months consists of HBsAg and total anti-HBc.

**Adapted from** Schillie S, Murphy TV, Sawyer M, et al. CDC Guidance for evaluating health-care personnel for hepatitis B virus protection and for administering postexposure management. Published December 20, 2013 Accessed April 1, 2021. https://www.cdc.gov/mmwr/preview/mmwrhtml/rr6210a1.htm

**Figure 1: Hepatitis C virus post-exposure management of health care workers after occupational percutaneous and mucosal exposure to blood and body fluids**




HCV, hepatitis C virus; HCW, health care workers; NAT, nucleic acid test.
[a] Testing of the source patient may follow option A (preferred) or option B.
**Adapted from** Moorman AC, de Perio MA, Goldschmidt R, et al. Testing and clinical management of health care personnel potentially exposed to hepatitis C virus - CDC Guidance, United States, 2020. Published July 24, 2020. Accessed April 1, 2021. https://www.cdc.gov/mmwr/volumes/69/rr/rr6906a1.htm?s_cid=rr6906a1_w

SURVEY FOR HEALTHCARE PROVIDERS

A. GENERAL INFORMATION

A1. Name:

A2. ID number:

A3. Date of birth:

(Year of birth or age if you forget your date of birth)

A4. Sex:

- Male
- Female

A5. Place of birth:

A6. Address of residence:

- House number & street:
- Ward:
- District:

Is this a private residential or a rental house?

- Private
- Rental

A7. Please provide your phone number (landline and mobile)

- Phone number 1:
- Phone number 2:
- Phone number 3:

A8. Email (if any):

A9. The most convenient way to contact (you can choose ALL THAT APPLY):

- Landline phone
- Mobile phone
- Email
- Meet in person at home

A10. Ethnicity

- Kinh
- Chinese
- Other, please specify

A11.Your role in clinical work:

- Clinical Physician
- Nurse
- Midwife
- Public Health Specialist
- Clinical Laboratory Technician

A12. How many years have you been in clinical practice since graduation? year

A13. How often are you in direct contact with the patient's blood or bodily fluid:

- Almost every day
- Several times a week
- Several times a month
- Rarely or hardly

A14. Personal income per month:

SURVEY FOR HEALTHCARE PROVIDERS

- Under 5 million VND
- 5 -10 million VND
- 10-20 million VND
- 20-50 million VND
- Over 50 million VND
- (1USD=23,000 VND as of xx)

A15. With this income, how many people can you support, including yourself:

- Alone
- 2 or more, please specify the number:

A16. Education level (highest level of education completed)

- Elementary School
- Middle School (grade 9)
- High School (grade 12)
- Intermediate or technician
- College Bachelor
- University
- Graduate school

A17. Marital status

- Single
- Living together but not married
- Single in a relationship
- Currently married
- Separation/divorce
- Widow

**B. KNOWLEDGE, ATTITUDE, BEHAVIOR**

Below are some questions about hepatitis B and C. The questions apply to both hepatitis B and C viruses unless it's clearly stated that they are referring to any specific type of viral hepatitis. Please choose the most appropriate answer.

B1. Do you think it is possible to get viral hepatitis from smoking?

- Yes for HBV
- Yes for HCV
- Yes for both HBV and HCV
- No
- Don't know

B2. Do you think it is possible to get viral hepatitis from eating or drinking together or sharing spoons, chopsticks and forks?

- Yes for HBV
- Yes for HCV
- Yes for both HBV and HCV
- No
- Don't know

B3. Do you think it is possible to get viral hepatitis from sharing toothbrushes?

- Yes for HBV

SURVEY FOR HEALTHCARE PROVIDERS

- Yes for HCV
- Yes for both HBV and HCV
- No
- Don't know

B4. Do you think it is possible to get a viral infection from being around someone who is sneezing or coughing?

- Yes for HBV
- Yes for HCV
- Yes for both HBV and HCV
- No
- Don't know

B5. Do you think it is possible to get viral hepatitis from sex?

- Yes for HBV
- Yes for HCV
- Yes for both HBV and HCV
- No
- Don't know

B6. Do you think it is possible to get viral hepatitis from sharing or reusing needles such as acupuncture, tattooing, or injecting with used needles?

- Yes for HBV
- Yes for HCV
- Yes for both HBV and HCV
- No
- Don't know

B7. Do you think that the baby can get viral hepatitis due to transmission from the mother during birth?

- Yes for HBV
- Yes for HCV
- Yes for both HBV and HCV
- No
- Don't know

B8. Do you think that an asymptomatic person with viral hepatitis can still transmit the hepatitis virus?

- Yes for HBV
- Yes for HCV
- Yes for both HBV and HCV
- No
- Don't know

B9. Do you think that people who have been infected with viral hepatitis will be infected for life?

- Yes for HBV
- Yes for HCV
- Yes for both HBV and HCV
- No

SURVEY FOR HEALTHCARE PROVIDERS

- Don't know

B10. Do you think viral hepatitis can lead to liver cancer?
- Yes for HBV
- Yes for HCV
- Yes for both HBV and HCV
- No
- Don't know

B11. Do you think a person can die from viral hepatitis?
- Yes for HBV
- Yes for HCV
- Yes for both HBV and HCV
- No
- Don't know

B12. Do you think viral hepatitis can be cured?
- Yes for HBV
- Yes for HCV
- Yes for both HBV and HCV
- No
- Don't know

B13. Do you think contact with people infected with hepatitis virus should be avoided?
- Yes for HBV
- Yes for HCV
- Yes for both HBV and HCV
- No
- Don't know

B14. How would you rate the possibility that you MAY BE INSPIRED with viral hepatitis during your lifetime?
- Yes for HBV
- Yes for HCV
- Yes for both HBV and HCV
- No
- Don't know

B15. Have you discussed with family members or friends about screening for viral hepatitis?
- There is discussion, but only about HBV
- There is discussion, but only about HCV
- There is a discussion about HBV and HCV
- None

B16. Does anyone in the family living with Brother/Sister (such as father, mother, wife, children, brother, sister, brother...) have hepatitis virus infection?
- Yes, HBV
- Yes, HCV
- Yes, both HBV and HCV

SURVEY FOR HEALTHCARE PROVIDERS

- No
- Don't know

B17. Do you think homeless people or immigrants are more susceptible to viral hepatitis than Ho Chi Minh City residents?

- Yes for HBV
- Yes for HCV
- Yes for both HBV and HCV
- No
- Don't know

B18. Do you think the hepatitis B vaccine is effective in preventing hepatitis B?

- Yes
- No
- Don't know

B19. Do you believe that the hepatitis B vaccine (vaccine) can cause harmful side effects in many people?

- Yes
- No
- Don't know

B20. Do you believe the hepatitis B vaccine is safe?

- Yes
- No
- Don't know

B21. For hepatitis B vaccination in healthcare workers,do you think the public health insurance plan should cover it or who else?

- No. Should be paid by
- Yes, public health insurance should cover it
- Don't know

B22. Have other members of your household been vaccinated against hepatitis B?

- Yes
- No
- Don't know

B23. Do you know where you can get the hepatitis B vaccine?

- Yes, please specify:
- Don't know

B24. How long ago was the last time you had a general health check?

B25. When was your health checkup, including a hepatitis B screening test?

- Within 6 months
- 6 months - 1 year ago
- Over 1 year
- Have a health check but do not have a hepatitis B screening test
- No health check (did not participate in required annual occupational health check or self-paid)

B26. Is this HBV screening part of a routine health checkup or per your own request?

SURVEY FOR HEALTHCARE PROVIDERS

- Self-request
- According to health agencies

B27. When was your health checkup, including a hepatitis C screening test?

- Within 6 months
- 6 months - 1 year ago
- Over 1 year
- Have a health check but do not have a hepatitis C screening test
- No health check (did not participate in required annual occupational health check or self-paid)

B28. Is this HCV screening part of a routine health checkup or per your request?

- Self-request
- According to health agencies

B29. Do you have liver disease AND are infected with hepatitis B or C virus?

- Yes, liver disease and HBV
- Yes, liver disease and HCV
- Yes, liver disease and have both HBV and HCV
- Have liver disease but not related to HBV or HCV
- No liver disease

B30. Are you infected with hepatitis B virus or C virus?

- Infected with HBV
- Infected with HCV
- Infected with both HBV and HCV
- Infected with another virus, not HBV or HCV → GO TO PART C.
- No → GO TO PART C
- Don't know → GO TO PART C

B31. Do you have test results or a doctor's confirmation of this infection?

- No
- Yes

-- END OF PART B --

C1. Are you currently infected with hepatitis B, C or both?

- Yes
- No → SKIP TO QUESTION C4.

C2. Do you remember when did you discover that you were infected with hepatitis B, C or both?

- Don't remember
- Hepatitis B since ...
- Hepatitis C since ...

C3. How did you know your infection status?

- Annual health check
- Self-paid health check
- Blood donation or health check for other condition

SURVEY FOR HEALTHCARE PROVIDERS

- Detected when I had symptoms of liver disease
- Don't remember

C4. Do you have any diseases (excluding hepatitis B, C)?

- Yes
- No

C5. Have you ever had a blood transfusion?

- Yes, please specify
- Never

C6. Have you ever had a tattoo (including a cosmetic tattoo)?

- Yes
- No

C7. Have you ever used narcotics?

- Yes
- No

C8. Have you ever shared needles with others?

- Yes
- No

C9. Are you taking immunosuppressive drugs or chemotherapy or steroids?

- Yes, specifically
- No
- Unknown

C10. Have you ever been in a relationship with a prostitute?

- Never
- Rarely
- Usually

C11. Are you in the LGBT group (gay, bisexual, transgender)?

- Yes
- No

C12. Do you often use condoms when having sex?

- No
- Occasionally
- Regularly

C13. Has the person who lived with you been tested for hepatitis B and C?

- Tested
- Haven't done it yet

C14. Have you had the full dose of hepatitis B vaccine (3 doses)?

- Already
- Never injected
- In between shots

C15. How long ago did you get the hepatitis B vaccine?

C16. How long have you been in clinical practice? five

C17. Please name up to 5 tasks with direct contact with the patient's blood, secretions or body fluids... that you do most often (eg: injection, using sharp instruments or performing procedures)

SURVEY FOR HEALTHCARE PROVIDERS

invasive surgery, direct blood-removal cleanup, etc.), how often are this contact and gloves are used?

| Task | Frequency of task | Frequency of using glove when performing a task |
|---|---|---|
| | • Everyday<br>• 2-3 times/week<br>• 2-3 times/month<br>• once/month or none | • Always<br>• Sometimes<br>• None |

C18. What position do you work in the department/room/hospital?

C19. What is your opinion about the following statement: “Medical staff MUST KNOW the hepatitis B and C infection status of the patients they come into contact with”?

- Totally agree
- Agree
- No opinion
- Disagree
- Totally disagree

C20. What is your opinion about the following statement: “The hospital MUST KNOW the status of its employees with hepatitis B and C virus infection”?

- Totally agree
- Agree
- No opinion
- Disagree
- Totally disagree

-- END OF SECTION C –

**Semi-structured focus group discussion:**

1. Healthcare workers are at high risk of being exposed to diseases transmitted through blood and secretions in their occupation, including hepatitis B-C. With HIV, there are regulations and procedures for exposure prevention and post-exposure treatment. I would like to ask if you know that the Ministry of Health or the Department of Health or your hospital has a policy on prevention. Exposure of hepatitis B or hepatitis C to healthcare workers?
(You can be specific or give real examples.)
(Don't know → why don't you know? It's not disseminated or not of your interested)
(Know → How did you know?)

2. Speaking of prevention, how did you get screened for hepatitis B-C infection? (hint: Self testing or per request of the hospital? Or health check due to any health issue)
(If self-testing → why screen?)
(Did you often get screened for HBV, HCV? How? If yes, who paid)

3. Talking about being infected with hepatitis B-C virus, how would you feel if your colleagues in the hospital knew your infection status? (Hint: Do you want to disclose or not disclose your infection at work?)
(Continued: What if the board of directors -not your colleagues- know? What are your thoughts on this? Should the infected person be transferred to another work area?)

4. On the contrary, do you feel the need to know the infection status of your colleagues? Why?

5. What do you think about the possibility of exposure to hepatitis B-C when interacting with patients in clinical practice? (hint: maybe it's the fear of getting infected, or not paying attention to the infection, or just worrying about getting HIV and everything else is fine...)

(continue: Do you actively check the patient's infection status before performing examination or procedure?)

(Continue: Is HIV your first worry? Is it good to be aware of HBV and HCV?)

6. When you come into contact with a patient infected with hepatitis B-C, how do you feel? Is it necessary to screen all patients for hepatitis B-C on admission and have warning signs for healthcare workers before exposure?

7. Regarding hepatitis B vaccination, have you ever been encouraged or asked by the hospital for vaccination before clinical practice?

How do you think about this statement: “People should be encouraged or requested or provided free HBV vaccination before clinical practice”?

8. If/When exposed to hepatitis B or C, not to mention HIV, what would you or did you do?

Is there a procedure at your hospital for this? (clarify: not known due to lack of popularity or don’t have one in place?)

What is the hospital's response to this exposure? (hint: financial support for post-exposure prophylaxis or treatment...)

9. When you are exposed to hepatitis B or C or both and there is an indication for treatment, what is the treatment? (Hints: where did you get treated, is it covered by health insurance, who pays, what is the financial source, the leave to go to the doctor, what medicine that you used?)

10. In your opinion, at your hospital and in the health sector in general, what are the difficulties in terms of pre- and post-exposure prophylaxis as well as post-exposure treatment?

11. So, according to you, what improvements should be made to benefit or match the needs of medical staff? (Can suggest such as free and mandatory vaccination for everyone, or hepatitis B screening in the annual health check package, support for disease treatment if post-exposure disease...)

12. How are people in your family vaccinated against hepatitis B? (hint: are there injections? Who pays? Do you feel the burden?)

====/====
** FOR PERSONS CONFIRMED WITH HEPATITIS B, C:
13. You have been infected with hepatitis B, C. Do you know how you got infected? (hint: exposed after being pricked by a needle or splashed in the eye by secretions...)
(If it was an exposure and how exposure occurred --> what did you do at that time and what were the hospital and colleagues like? Time to access post-exposure prophylaxis, cost of treatment. Post-exposure prophylaxis, how is the psychology...)

14. With family members, after knowing you were infected, how did you feel? (suggestions: self-isolate, ask family members to get vaccinated, or publicize or hide information, or family has been infected before...)
(If hiding information continues, does such “hiding information” mean not going to diagnose, treat and monitor infection and disease?)

15. Please share your thoughts on exposure to hepatitis B, C when clinical work is based on your actual experience, from prevention, to treatment, support when exposed, mental and

physical support... all of which do you think needs more attention to protect medical staff's peace of mind?

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

| | Item No | Recommendation | Page No |
|---|---|---|---|
| **Title and abstract** | 1 | (*a*) Indicate the study's design with a commonly used term in the title or the abstract | 2 |
| | | (*b*) Provide in the abstract an informative and balanced summary of what was done and what was found | 2 |
| **Introduction** | | | |
| Background/rationale | 2 | Explain the scientific background and rationale for the investigation being reported | 4&5 |
| Objectives | 3 | State specific objectives, including any prespecified hypotheses | 5 |
| **Methods** | | | |
| Study design | 4 | Present key elements of study design early in the paper | 6 |
| Setting | 5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection | 5&6 |
| Participants | 6 | (*a*) Give the eligibility criteria, and the sources and methods of selection of participants | 6&7 |
| Variables | 7 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable | 6&7 |
| Data sources/ measurement | 8* | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | 7 |
| Bias | 9 | Describe any efforts to address potential sources of bias | 7 |
| Study size | 10 | Explain how the study size was arrived at | 6 |
| Quantitative variables | 11 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why | 7&8 |
| Statistical methods | 12 | (*a*) Describe all statistical methods, including those used to control for confounding | 7&8 |
| | | (*b*) Describe any methods used to examine subgroups and interactions | 7&8 |
| | | (*c*) Explain how missing data were addressed | 7 |
| | | (*d*) If applicable, describe analytical methods taking account of sampling strategy | NA |
| | | (*e*) Describe any sensitivity analyses | NA |
| **Results** | | | |
| Participants | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed | 8 |
| | | (b) Give reasons for non-participation at each stage | NA |
| | | (c) Consider use of a flow diagram | Text in page 8 |
| Descriptive data | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders | 8&9 |
| | | (b) Indicate number of participants with missing data for each variable of interest | 20-24 |
| Outcome data | 15* | Report numbers of outcome events or summary measures | 9 |

| | | | |
|---|---|---|---|
| Main results | 16 | (*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included | NA |
| | | (*b*) Report category boundaries when continuous variables were categorized | 20-24 |
| | | (*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period | NA |
| Other analyses | 17 | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses | NA |
| **Discussion** | | | |
| Key results | 18 | Summarise key results with reference to study objectives | 11&12 |
| Limitations | 19 | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias | 14 |
| Interpretation | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence | 11-13 |
| Generalisability | 21 | Discuss the generalisability (external validity) of the study results | 14 |
| **Other information** | | | |
| Funding | 22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based | 15 |

NA, not applicable

*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

# Unmet Needs in Occupational Health Prevention and Management for Viral Hepatitis in Health Care Workers in Ho Chi Minh City, Vietnam: A Mixed-Methods Study



| | |
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| Complete List of Authors: | Nguyen, Tran; The University of Texas Southwestern Medical Center, Pham, Trang; Vietnam Viral Hepatitis Alliance; University of Illinois at Chicago<br>Tang, Hong Kim; Pham Ngoc Thach University of Medicine, Department of Epidemiology, Faculty of Public Health<br>Phan, Loc; Vietnam Viral Hepatitis Alliance<br>Mize, Gary; Vietnam Viral Hepatitis Alliance<br>Lee, William; The University of Texas Southwestern Medical Center; Vietnam Viral Hepatitis Alliance<br>Gish, Robert ; Vietnam Viral Hepatitis Alliance<br>Trang, Amy; Vietnam Viral Hepatitis Alliance<br>Le, Anh; Vietnam Viral Hepatitis Alliance<br>Phan, Hai; Medic Medical Center<br>Nguyen, Binh; Ho Chi Minh City Department of Health<br>Dao, Doan; Vietnam Viral Hepatitis Alliance; Johns Hopkins University |
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# Unmet Needs in Occupational Health Prevention and Management for Viral Hepatitis in Health Care Workers in Ho Chi Minh City, Vietnam: A Mixed-Methods Study

Tran Nguyen*[,2], Trang Pham*[,1,6], Hong K. Tang[5], Loc Phan[1], Gary Mize[1], William M. Lee[1,2], Robert G. Gish[1], Amy Trang[1], Anh Le[1], Hai T. Phan[3], Binh T. Nguyen[4], and Doan Y Dao[1,7]

*(*equal contribution)*

Author Affiliation:

1-Vietnam Viral Hepatitis Alliance, Reston, Virginia, USA

2-UT Southwestern Medical Center, Dallas, Texas, USA

3-Medic Medical Center, Ho Chi Minh City, Vietnam

4-Ho Chi Minh City Department of Health, Ho Chi Minh City, Vietnam

5-Pham Ngoc Thach University of Medicine, Ho Chi Minh City, Vietnam

6-University of Illinois at Chicago, Chicago, Illinois, USA

7-Johns Hopkins University School of Medicine, Baltimore, Maryland, USA

Correspondence to Doan Y Dao, MD: ddoa1@jhmi.edu.

## ABSTRACT

**Objectives**: Vietnam is an endemic area for hepatitis B virus and hepatitis C virus infection (HBV-HCV), yet its largest city, Ho Chi Minh City (HCMC), has no comprehensive policy to educate, screen, treat, and protect health care workers (HCWs) from viral hepatitis. We conducted a mixed-methods study to document HBV-HCV infection rates, risk factors, local barriers, and opportunities for providing education, screening, and medical care for HCWs.

**Design**: This mixed-methods study involved an HBV and HCV serological evaulation, knowledge, attitude, and practice (KAP) survey about viral hepatitis and many in-depth interviews. Descriptive statistics and thematic content analysis using inductive and deductive approaches were used.

**Setting**: Ho Chi Minh City, Vietnam

**Participants**: HCWs at risk of viral hepatitis exposure at 3 hospitals in HCMC

**Results**: Of the 210 invited HCWs, 203 were enrolled. Of the 203 HCWs enrolled, 20 were hepatitis B surface antigen (HBsAg)-positive, 1 was anti-hepatitis C antibody (anti-HCV Ab)-positive, 77 were anti-hepatitis B core antibody (anti-HBc Ab)-positive, and 152 had adequate anti-hepatitis B surface (anti-HBs) titer (≥10IU/mL). Only 50% of the infected HCWs reported always using gloves during a clinical activity involving handling of blood or bodily fluid. Approximately 50% of HCWs were still not vaccinated against HBV following 1 year of employment. In-depth interviews revealed 2 major concerns for most interviewees: the need for financial support for HBV-HCV screening and treatment in HCWs and the need for specific HBV-HCV guidelines to be independently developed.

**Conclusions**: The high HBV infection rate in HCWs coupled with inadequate preventive occupational practices among the population in HCMC highlight the urgent needs to establish formal policy and rigorous education, screening, vaccination, and treatment programs to protect HCWs from HBV acquisition or to manage those living with chronic HBV in Vietnam.


**Key words:** Hepatitis B virus, Hepatitis C virus, Vaccination, Health Care Workers, Vietnam

**Strengths and limitations of this study**

- This is the first mixed-method study to investigate hepatitis B virus and hepatitis C virus infection (HBV-HCV) infection and risk factors among healthcare workers (HCWs); as well as local practice and barriers in HBV-HCV prevention among HCWs in Ho Chi Minh City (HCMC), the largest city in Vietnam.
- HCWs from national tertiary-level, city-level, and district-level hospitals, which represent the 3 major healthcare system levels in Vietnam, were recruited, aiming to provide representative information regarding HBV-HCV for quantitative and qualitative data.
- The in-depth interviews were conducted with both infected and non-infected HCWs from multiple professional and administrative levels among the participating hospitals to obtain diverse perspectives on local HBV-HCV practice and barriers.
- Data from in-depth interviews were analyzed using a thematic content analysis approach; thus, results were more descriptive than explanatory.
- Data regarding HBV vaccine uptake among HCWs in this study was self-reported, which might be subject to recall bias.

## INTRODUCTION

Globally, there are more than 2 million occupational exposures to sharp injuries in the health care setting annually (1). The most common causes of post-exposure infections are hepatitis B virus (HBV), hepatitis C virus (HCV), and HIV (1-3). Owing to the high prevalence of viral hepatitis infections in the general population in Vietnam–a low- to middle-income country where an estimated 8.4% of the population are living with chronic HBV and another 1.1% of the population have chronic HCV, (4, 5)–it is expected that Vietnamese health care workers (HCWs) are at greater risk for exposure and infection from these pathogens.

Vietnamese HCWs are at risk of percutaneous needle stick injuries, especially in those with high frequency of contact with blood and bodily fluid, providing more opportunity for occupational exposure to HBV-HCV (6, 7). The incidence rate of acquiring HBV infection after exposure was 25 times higher than that of acquiring HIV after exposure (50 cases per 100,000 person-year vs 0.2 cases per 100,000 person-year) (8). In a study involving occupational exposure in HCWs at multiple hospitals in Ha Noi, Vietnam, Duong and colleagues found that 64.8% of HCWs were exposed to sharp injuries at least once a year. This group of HCWs includes primarily nurses and physicians who worked directly with blood and bodily fluids or sharp instruments (8). In spite all of these statistics, Nguyen and colleagues revealed that 36.5% of nurses still did not have appropriate knowledge on prevention of occupational exposure to viral hepatitis and that about 10% of individuals did not follow the standard procedures for occupational exposure (9). Notably, most of the incidents were not reported to higher administrative levels. When these incidents occurred, they were not cared for in a timely and appropriate manner (7). Oftentimes, the sources of infection remained unknown (8).

In Vietnam, viral hepatitis is a reportable infectious disease, but this only applied to hospitals that are dedicated to infectious disease specialty care and at the central government level. National recommendations for occupational exposure for prevention and management of infectious diseases, including viral hepatitis, have been issued but not mandated. According to the Infectious Disease Control and Prevention Act, viral hepatitis is in category B, which is highly infectious and could lead to death (10). There is a lack of guidelines or step-by-step guidance for implementation or monitoring of viral hepatitis in health care settings. Moreover, funding to implement the national recommendations for infectious disease and viral hepatitis were not appropriated. As a result, procedures for employment screening and post-exposure testing and management for viral hepatitis in HCWs were not uniformly or systematically implemented across health care settings

in Vietnam (8). Instead, the procedures were only implemented at the individual health care center's discretion. Furthermore, because of the lack of specific guidelines for viral hepatitis occupational health procedures, many hospitals in Vietnam adopted HIV guidelines instead. This approach resulted in low HBV-HCV awareness, prevention, and post-exposure management in Vietnam (11).

Pre-exposure vaccination for HBV has been highly successful in reducing HBV infection in HCWs. Rates of use in Vietnam are unknown, and no such intervention exists to prevent transmission. Similarly, hepatitis B immune globulin (HBIG) may be recommended as post-exposure prophylaxis (PEP), but there are no formal recommendations available for PEP for HCWs exposed to HBV or HCV in Vietnam, nor is there data on availability of HBIG in these resource-limited and highly heterogeneous care settings (8). Thus, it is necessary to further understand current practices with a mind toward the resource limitations of Vietnam and other developing regions.

In this study, we conducted a sero-survey of HBV-HCV; an assessment of viral hepatitis general knowledge, attitude, and risk behaviors; and in-depth interviews in a cohort of HCWs in Ho Chi Minh City (HCMC). The in-depth interviews focused on Vietnam national circular, in-house protocol and procedures relating to occupational exposure for HBV-HCV prevention and management in HCWs. The study aimed to better understand the local needs and barriers for screening, prevention, and linkage to care as well as best practices regarding occupational exposure to HBV-HCV in HCWs in HCMC.

## METHODS

1. Study setting

The study was conducted in 3 hospitals in HCMC, Vietnam (*Figure 1*). A developing country, Vietnam is located in Southeast Asia and has a population of 97 million. With a population of 12 million, HCMC has an estimated prevalence of 7.8% for HBV and 2.2 % for HCV in its community (12, 13).

The HCMC hospital system, with 91 public hospitals as of 2016, is divided into 3 levels: tertiary hospital (central government-level hospital), general hospital at city level, and general hospital at district level (14). In this study, we purposefully selected 1 hospital representing each of the hospital system levels to join the study. The study protocols were approved by institutional review

committees (IRBs) at Pham Ngoc Thach University of Medicine, a local medical school in HCMC, and at each of the participating hospitals. The final study protocol was approved by the HCMC Department of Health.

## 2. Study design and methods

The study design comprised 2 parts: (1) an observational portion involving a knowledge, attitude, and practice (KAP) survey and serologic screening for HBV-HCV and (2) in-depth interviews. For the former, a simple random sample of 210 participants, including 70 from each of the 3 hospitals representing 3 levels of hospital system in HCMC, were enrolled. The 210-person sample was derived based on several factors: an estimate of 4,000 HCWs who worked at the 3 participating hospitals (unpublished data), a 0.05 margin of error at a 95% confidence level, and the reported rate of infection of 15% for HBV and 2-5% for HCV in HCWs in Vietnam (11, 15). To achieve the sample size of 210 and assume 70% response rate from invitees, each participating hospital selected 120 participants based on their staff directories and provided the study team the list of participants. Next, random selection of prospective participants from the lists was performed in Excel using the RAND function. Potential participants generated from this random selection process were invited to participate in the study. Participant recruitment took about 3 days to get 70 of 120 prospective participants.

The KAP questionnaire survey included demographics information (age, gender, educational level, type of clinical work, total years of clinical activity, and income levels) and questions related to HBV-HCV knowledge, risk factors outside of the workplace, occupational exposures, HBV vaccination status, and overall health status. The questionnaires were initially developed based on the Behavioral Theory Framework and subsequently validated for Vietnamese in the US and Vietnam (16).

The in-depth interviews (i.e., qualitative portion) were conducted within 2 weeks after the survey and screening. All participants were assigned a study ID. Participants who took the survey questionnaires and agreed to phlebotomy were invited to participate in the in-depth interviews. Those who agreed to in-depth interviews were stratified into seniority status, viral hepatitis infection status, and administrative role in the participating hospitals. Specifically, we applied a quota sampling approach to include participants with different levels of clinical experience (< 5 years vs > 5 years), level of administrative responsibility (chief attending physician or chief nurse), viral hepatitis infection status (infected or naive), and professional levels (physicians,

nurse/midwives, medical laboratory technician). In-depth interview was organized on a rolling basis, with each hospital having a maximum of 10 interviewees. We ended the interview at information saturation. This information saturation was at the sample size of 30 interviewees. In-depth interview was conducted by trained interviewers in Vietnamese. All interviewee information was de-identified. A semi-structured questionnaire was used to guide the in-depth interview.

3. Participant recruitment and cascade of care follow-up

To recruit participants into the serologic screening and survey questionnaire portion, each of the 3 participating hospitals sent invitations internally to a maximum of 120 official full-time HCWs. We aimed to reach 210 HCWs (expected response rate of approximately 70%). To be included, HCWs needed to be 18 years or older and working in areas that required frequent contact with blood or bodily fluid. Upon completion of the screening tests and survey, a thank you gift card having the value of $5USD was provided to participants. Within 2 weeks, results with written interpretation of serologic testing and recommendations were returned to participants. Coupons offering free HBV vaccine were provided to HBV-naive individuals (negative for hepatitis B surface antigen [HBsAg], anti-hepatitis B core antibody [anti-HBcAb], and anti-hepatitis B surface [anti-HBs]) and free follow-up coupons were provided to individuals who were HBsAg-positive and/or anti-HCV-positive. These follow-up coupons include free liver assessments (confirmatory HCV RNA, comprehensive metabolic panel, and complete blood count) and free Fibroscan and hepatology consultation at an independent contracted medical center. If treatment for HBV or HCV is indicated, the costs of treatment were reimbursed by national public health insurance. All the study participants had public health insurance coverage.

For the qualitative phase, participants were also invited to participate in a 1-hour, follow-up in-depth interview regarding barriers and facilitating factors in viral hepatitis prevention in the workplace and measurement of workplace occupational exposures. Twenty-eight participants were recruited (17, 18), reaching data saturation. Trained interviewers used a semi-structured questionnaire to collect data and provided interviewees $5USD incentives after completing the session.

4. Viral hepatitis serologic testing

Participants were screened for HBV and HCV. HBsAg was tested using a fully multivalent assay with high sensitivity in detecting HBV mutants to determine those who were positive for HBsAg. ELISA assay was performed following the manufacturer's instructions including serum anti-HBs,

and anti-HBcAb. HCV was screened with serum anti-hepatitis C antibody (anti-HCV). All the screening tests for HBV-HCV were performed with Elecsys® (Roche Diagnostics Ltd). Results were certified by a physician before being provided to screening participants.

5. Data management and statistical analysis

All surveys, interviews, transcriptions, and coding of the qualitative data were done in Vietnamese. All surveys were checked for completeness. Missing items were not included in data analysis. Data was stored in REDCap. Demographic characteristics and risk factors for HBV-HCV and KAP data were reported as mean and standard deviation for continuous variables and proportions for categorical variables, and subsequently compared between the groups with and without HBV or HCV.

For survey questionnaires, KAP variables were coded as True (Applicable for) or False (Not Applicable for) for HBV, HCV, or both HBV and HCV. Infection status was grouped as HBsAg-positive versus HBsAg-negative for HBV and anti-HCV-positive versus anti-HCV-negative for HCV. Lab tests were merged with survey data, then cleaned and managed in STATA. Data analysis was performed with univariate and bivariate statistics: the Cochran-Armitage trend test was used for continuous variables; the Chi-square was used for categorical data. Significance level of 0.05 was used. All analyses used SAS 9.4.

In-depth interviews were recorded and then transcribed into Word documents, coded by 2 independent coders. Thematic content analysis using hybrid approach of inductive and deductive coding and theme development was performed in Excel. Initial codes were generated deductively and fitted into a preexisting coding framework based on the structure of the questionnaire and each label was defined based on the transcripts. We summarized the transcripts and outlined the key points addressed by the participants (which were pre-specified before the interview or newly occurred in the conversation) to identify themes and patterns in the data. Themes were further clustered and assigned succinct phrases to describe the underpinning meanings.

6. Patient and public involvement

Patients or the public were not involved in this study.

## RESULTS

1. Sociodemographic characteristics of study participants

There were 210 HCWs invited from 3 hospitals. Seven HCWs were non-clinical staff and excluded from the study. Of 210 invited HCWs, 203 (96.7%) completed the demographics and KAP survey questionnaires and serological testing for HBV-HCV (*Table 1*). Of the 203 HCWs, 39 were physicians, 140 were nurses and midwives, and 24 were technicians and nurse assistants. Overall, the age range was from 21 to 59 years old with a mean of 34.49. The majority of the 203 HCWs were female (83%). Approximately 95% of the enrolled HCWs completed at least a technical or vocational degree, and more than half (54.5%) worked in a clinical environment for less than 10 years. Among 3 groups of HCWs (physicians, nurses/midwives, and technicians/nurse assistants), most females (127 of 168) were nurses and midwives. All doctors graduated from university; and the majority of nurses, midwives, technicians, and nurse assistants competed high school and vocational school.

2. Serological characteristics of the study participant

Twenty (9.8%) of 203 HCWs were positive for HBsAg. Of 20, 17 (85%) knew their viral hepatitis status; this included 4 doctors, 15 nurses, and 1 technician. Nurses had similar rate of HBV infection at 10.7% (15 of 140) compared to doctors at 10.2% (4 of 39). Technician and nurse assistant had the lowest rate of HBV infection with 1 infected person of 24 (4.2%) HCWs. Four (1.97%) were indeterminate with only positive anti-HBc Ab and required follow-up testing. There were 27 (13.3%) who were susceptible to HBV infection with negative HBsAg, anti-HBs, and anti-HBc. Among those who were naive, there were 3 physicians (7.7%, 3 of 39), 18 nurses and midwives (12.9%, 18 of 140), and 6 technicians (25%, 6 of 24). Ninety-nine (48.77%) were immune from HBV vaccination with positive anti-HBs, and 53 (26.11%) were with positive anti-HBs and anti-HBc. Among those who were vaccinated, there were 19 physicians (58%, 19 of 39), 69 nurses and midwives (49%, 69 of 140), and 11 technicians (46%, 11 of 24). Interestingly, 10 of these 99 HCWs reported never receiving HBV vaccine. Regarding HCV, there was only 1 person (0.5%) who tested positive for anti-HCV and negative for HCV RNA. This person later reported already having HCV treatment 10 years prior.

3. Comparison between HBV seropositive and HBV seronegative groups

We divided the participants into 2 groups: 20 HCWs that were HBsAg-positive and 193 HCWs that were HBsAg-negative. As shown in *Table 2*, there were no significant difference in

demographic characteristics between the 2 groups. Both groups were approximately 80% female, and the age range was 25-54 years old and 21-59 years old. The majority of participants in both groups were nurses and midwives, the second most populous group was physicians. There was no difference in educational level or length of clinical work between the 2 groups. Regarding risk factors for HBV infection, a higher percentage of the HBV seropositive group had family members with HBV infection (60% vs 15%, $P < 0.0001$) (*Table 3*). Seventy percent (70%) of the seronegative group reported no family member with either HBV or HCV, compared to 30% in the seropositive group. The seropositive group had a higher percentage of participants with daily exposure to blood and bodily fluid compared to the seronegative group (90% vs 69%). However, the difference was not significant ($P = 0.054$). There was no difference in the time since last check-up with HBV screening. However, rate of vaccine uptake was higher in the seronegative groups (76% vs 30%, $P = 0.0001$). There was no difference in risks of hepatitis transmission, including prior blood transfusion, tattoo, illicit drug use, or unprotected sex; except that 2 of the 20 the seropositive group (10%) reported sharing needles in the past compared to none in the seronegative group ($P < 0.0001$).

4. Assessment of KAP

According to the KAP survey (*Table 1* in Supplement), the majority of HCWs provided correct answers to questions on modes of HBV-HCV transmission including sharing toothbrushes, sharing needles, sexual intercourse, and during birth. However, 17% (35 of 203) of HCWs believed that smoking could cause hepatitis, including 7 physicians, 23 nurses and midwives, and 5 other HCWs. Moreover, almost half (44%, 90 of 203) thought that hepatitis could be spread by sharing utensils; this group included 19 physicians, 63 nurses and midwives, and 8 other HCWs. Twenty-nine percent (58 of 203) also believed that sneezing could spread hepatitis, including 10 physicians, 41 nurses and midwives, and 7 other HCWs. Regarding knowledge on natural course of HBV-HCV, the majority believed that asymptomatic people can have chronic HBV or HCV infection (89%) and that HBV-HCV are life-long infections which can cause liver cancer (95%) and can be lethal (86%). However, 21% (43 of 203) of HCWs believed that hepatitis is not treatable; this group included 4 physicians, 34 nurses and midwives, and 5 other HCWs. The majority (83%, 169 of 203) thought that they do not need to avoid contact with people infected with HBV-HCV. Answers regarding the hepatitis B vaccine revealed that most HCWs (93%, 189 of 203) believed that the HBV vaccine is effective, though 21% (42 of 203) perceived that the HBV vaccine has harmful side effects. Overall, physicians exhibit better knowledge compared to the 2 other groups.

5. In-depth interview results

The in-depth interviews were conducted with 28 HCWs at 3 hospitals (*Table 4*). The 4 main themes identified from the data were "awareness of prevention and management policy and protocol for viral hepatitis in place," the local "post-exposure management," how "HBV-HCV were screened and managed during annual health check," and "stigma, disclosure, and support."

**Awareness of occupational exposure policy and/or protocol**

All respondents were aware of the Ministry of Health's policy on prevention and control of occupational injuries in HCWs, and the local policy was similar to the national circular. Also, they stated that the major focus of post-exposure incident reporting was HIV, so HBV-HCV pathogens were not included in checks for post-exposure incidents (93%, 26 of 28).

Quotes from in-depth interviews:

- "The Ministry of Health did issue the guidelines for prevention of occupational exposure of needle sticks, so we applied it to our practice."
- "I don't think viral hepatitis is much different from HIV; that's why we can use the HIV protocol though."

The national guidelines for prevention occupational exposure were more for needle sticks and HIV, but the HCWs applied it to viral hepatitis.

**Local occupational exposure management**

When asked about post-exposure management, focusing on the local financial assistance program for occupational exposure, 47% (7 of 15) reported receiving financial aid from the hospital for testing and medication for HIV exposure whereas 33% (5 of 15) denied such support at their hospitals and had to self-pay the co-pay amount for examination and medication under their health insurance plan. Almost all interviewees (93%, or 14 of 15) agreed that the hospital should pay for follow-up and/or treatment for hepatitis infection from occupational exposure, while 1 did not agree due to belief that hepatitis infection is not serious.

Most of the HCWs reported that they thought of HIV after exposure rather than HBV (100%), and the post-exposure reporting form did not ask whether the source of exposure was HBsAg or anti-HCV (100%). All of the HCWs agreed that HBV and HCV should be mentioned in the post-

exposure reporting form and in the testing done after exposure for HCWs. Some HCWs said they had to pay for their HBV-HCV treatment because they did not want to use the national public health insurance's medications as it was not highly efficient, and demand the hospital to cover their treatment fee.

Quotes from in-depth interviews:

- "I should think of HBV and HCV after being exposed to needle sticks, at that time, I reported only the HIV status of the patient.""Nothing in the accident reporting form related to HBV or HCV."
- "I just paid for my HBV treatment; I wanted to use better medication that were not in the public insurance's medication list."
- "I think it was OK for me to pay, but if the hospital can pay it, it would be a relief."

**Screening and vaccination policy and the annual health check**

When asked about annual health check-ups for viral hepatitis, 48% (13 of 27) had only the HBV screening with HBsAg in their annual check-up organized and paid by their hospitals. Only 9 of 27 (33%) had both HCV and HBV screening annually, which was paid by hospitals. Additionally, regarding testing requirements for new staff prior to start clinical work, 55% (11 of 20) received screening and vaccination recommendations during training or at the beginning of work, while 40% (8 of 20) reported that there was no such requirement. Before starting clinical work, about 55% (11 of 20) of interviewees reported that their hospitals required HBV and HCV tests, and 81.5% (22 of 27) of respondents stated that HBV and HCV were included in their annual health check.

Quotes from in-depth interviews:

- "HBV and HCV were included in my health report when applying for a job in this hospital."
- "I got HBsAg and anti-HCV testing every year in the hospital health check day."

If HBV vaccination is needed, 75% (21 of 28) HCWs paid for their own vaccination, and only 21.4% (6 of 28) confirmed they got free vaccination from their hospitals.

However, they agreed that:

- "I got my vaccination during my medical training and I paid for it."
- "I got free vaccination at the hospital pharmacy department."

- "I think new employees should be tested for viral hepatitis before employment."
- "It would be the best if the screening and treatment fee can be covered by the hospitals."

**Stigma, disclosure, and support**

Regarding "stigma and support," 79% (22 of 28) of interviewees were willing to reveal their viral hepatitis status to coworkers whereas 21% (6 of 21) would like to keep it personal. Of those 6 interviewees, 3 interviewees voiced concern about stigma, and 2 reported that knowing their status would not change anything as they took measures to decrease transmission risk in the workplace. Alternatively, when asked if they would want to know their coworkers' viral hepatitis status, 52% (14 of 27) would like to know, 7% (2 of 27) would not like to know, and 41% (11 of 27) did not have strong opinions.

Quotes from in-depth interviews:

- "I think it's OK to know other's status, so we can easily allocate the work and prevent spreading to the patient."

Among those who would like to know, some voiced reasons including knowing risk of transmission with close contact, educating each other about preventive measures, and offering support to those with viral hepatitis infection. For those who would not want to know, they believed viral hepatitis status is private health information and should not be shared. Eleven interviewees reported that knowing coworkers' hepatitis status does not change their interactions. When asked if hepatitis infection could result in position reassignment, 36% (9 of 25) said *no* due to already high prevalance of viral hepatitis among HCWs, concern about discrimination, and the fact that taking preventive measures is adequate to prevent tramission.

Furthermore, regarding HBV vaccination, 75% of interviewees (21 of 28) paid for their own vaccination, while 21% (6 of 28) had cost covered by hospital. Most interviewees (79%, 11 of 14) agreed that HBV vaccination should be free for all HCWs whereas 21% (3 of 14) believed that vaccination should be self-paid due to financial constraint of the public health system and the affordability of vaccination when compared to HCWs' salaries.

## DISCUSSION

In this mixed-methods study, we documented the local best practices of occupational exposure and infection rates for HBV-HCV in HCWs in HCMC. Importantly, in-depth interviews revealed 2

major concerns for most interviewees. First, participants expressed the need for a specific guideline on HBV-HCV occupational exposure and prevention. This guideline should be independent from HIV guidelines. Second, policy on financial support for post-exposure management for viral hepatitis in HCWs should be allocated.

In the observational portion, the study estimated a rate of HBsAg-positivity of 9.85% among HCWs working in HCMC. Compared to recent data on HBV prevalence of HCWs in other low- to middle-income countries in Southeast Asia, HCWs in HCMC may have a higher rate of HBV than that of Thailand (5.3%), Indonesia (6.2%), and Laos (8%) (19-21). Regarding HCV, rate of anti-HCV-positive was much lower than HBV infection in this study (0.5% vs 9.85%). Prior review also revealed lower average HCV prevalence of 1.6% in Southwest Asia, which ranges from 0.8% in Indonesia to 2.7% in Thailand (22). Although the most common scenario for both HBV and HCV exposure in HCWs is percutaneous injuries, HBV can survive outside the human body for at least 7 days and is many times more infectious than HCV or HIV (23-25). Moreover, HBV is the most easily transmitted bloodborne virus with a 6% to 30% risk of infection from percutaneous exposure. Risk of acquiring HCV is lower, with a range from 2% to 4% (25).

Although 71% of HCWs reported HBV immunization, test results showed a low rate of vaccination (49%) among 3 levels of HCWs with the uptake rate highest in physicians (58%), followed by nurses (49%) and technicians (46%). The reported rate of vaccination is similar to a recent study done in Northern Vietnam (68.8%) (26) and other studies in South Africa (64.5%) (27, 28). Low vaccine uptake may also be associated with HBV infection as demontrated here and in previous studies (19, 29). There are several reasons to explain the low rate of vaccination.

First, the population of HCWs in our study did not generally get vaccination during early childhood. HBV vaccine, part of Vietnam's Expanded Program on Immunization, was first introduced in 1997 as a trial and was officially implemented in 70% of provinces of Vietnam only in 2004 (30). Therefore, national HBV vaccination for infants has only been active for 22 years. Since the average age of surveyed HCWs was 38 years old and the age range was from 25 to 54 years, the majority of HCWs was likely not vaccinated in their first year of life.

Second, most health care facilities in Vietnam do not require testing before starting work and vaccination against HBV, and do not incorporate viral hepatitis screening in annual check-up as demonstrated in the in-depth interviews. There were 10 HCWs who reported never receiving HBV

vaccine but they had lab results consistent with immunity from vaccination. On the other hand, there were 6 HCWs who reported previous vaccination but were HBsAg-positive. It is unclear if this is recall bias, that the initiation of vaccination was after HBV infection, or that the immunity from HBV vaccination had waned prior to HBV acquisition. The latter is less likely because HBV vaccine may confer protection from HBV infection for 30 years (31). Taken together, during employment process, it is important for viral hepatitis screening before starting work and that annual testing to avoid false assurance of vaccination in people who had acquired HBV infection prior to vaccine, especially in those who work in the health care settings with greater occupational risks. It is equally important to identify naive individuals for prompt vaccination to prevent HBV infection from occupational exposures.

Third, HBV vaccination was reported to be self-paid. Although several HCWs admitted the affordability of the HBV vaccine, they also mentioned free vaccination could encourage higher vaccine uptake. Besides financial barrier, other barriers, including unavailability of vaccine and busy work schedules, were also demonstrated in a prior study (32).

We also identified high occupational risks: 71.5% of HCWs have daily exposure to blood and bodily fluid. Although almost all interviewees reported available protocols for occupational exposures, only 1 interviewee had a dedicated hepatitis protocol and the remaining interviewees followed HIV protocol. There was no available PEP for HBV exposure and no guidelines on follow-up testing and/or treatment. Most interviewees also voiced the need for an assistance program for testing and/or treatment for hepatitis infection from occupational exposure. Therefore, there is a need for guidelines for occupational exposure of viral hepatitis and dedicated protocol for PEP, monitoring, and treatment.

Similar to a recent study in Northern Vietnam, there was good overall knowledge of hepatitis transmission including parenteral, sexual, and perinatal transmission (26). It seemed that the knowledge in these 203 HCWs in HCMC was better than that of previous studies conducted in Africa (29, 33). However, gaps of knowledge were identified in smoking, sharing foods, and sneezing, which are not risk factors for hepatitis acquisition. Although there was no significant difference in knowledge score between the HBV-infected and non-infected groups, knowledge of hepatitis transmission is still important as HCWs are at a higher risk of contracting hepatitis via blood and bodily fluid exposure. However, a considerable proportion of HCWs did not believe viral hepatitis is treatable. This might be due to the lack of access to treatment knowledge as not

everyone worked in the Hepatology department. From the in-depth interview, interviewees were aware of the inadequate knowledge of hepatitis and called for further education. Therefore, we suggest expanding annual training to include basic viral hepatitis core knowledge, testing, and treatment as well as sequalae if unrecognized. As a result, this will facilitate vaccination uptake, awareness of modes of transmission, and a proactive approach to follow-up testing, especially after occupational exposure.

This mixed-methods study reveals several gaps in hepatitis practice among HCWs in HCMC. First is the lack of pre-employment screening and routine surveillance for hepatitis. Second is inadequate guidelines for measures to be taken after hepatitis exposure. Therefore, we propose that hospitals should have mandatory pre-employment hepatitis screening for all prospective employees. This would help identify naive individuals who should be required to get HBV vaccination prior to starting their jobs to limit HBV infection from occupational exposures. This would also serve as an opportunity for those with hepatitis infection to know about their status. Additionally, for employees who will be at high risk of exposure to blood or body fluids on the job, post-vaccination anti-HBs testing should be offered to identify individuals who did not achieve immunity with the standard HBV series. Those individuals who have documented prior HBV vaccination and negative anti-HBsAb should receive a booster dose of HBV vaccine and be retested for immunity afterwards. We also propose that dedicated guidelines for HBV-HCV post-exposure management will be available at the workplace for HCWs. Published guidelines should be at designated places, such as nursing stations or workrooms, for prompt access after occupational exposures. Following occupational exposure, skin sites that have been in contact with blood or bodily fluids should be washed with soap and water, and mucous membranes should be flushed with water. For HBV, prompt administration of HBIG or initiation of HBV vaccination should be initiated, depending on the HBV status of source patient and the exposed HCW. Appropriate HCWs should have follow-up serologic testing (*Table 2* in Supplement) (34). For HCV, testing of source patient and exposed HCWs should be done as soon as possible. HCV PEP is not recommended. Schedules for follow-up serologic testing after exposure for HCWs depends on HCV status of source patient and exposed HCW (*Figure 1* in Supplement) (35).

Although this mixed-methods study was the first in Vietnam to provide more information about HBV-HCV in HCWs, there were several limitations. First, we do not intend to estimate the prevalence of HBV-HCV among HCWs in HCMC. Second, data regarding vaccine uptake was self-reported, which might be subject to recall bias. Also, there was no data regarding timing of

vaccination in relation to timing of infection to determine vaccine efficacy. Despite these limitations, we still believe that this mixed-methods study offered insights into the needs for policy change to facilitate HBV vaccination, hepatitis surveillance, education, and post-exposure guideline changes. Furthermore, we propose effective interventions aimed at reduction of viral hepatitis disease burden in HCMC, Vietnam and would further support for better analyses of anti-viral gaps and elimination targets that have been set for 2030 by the World Health Organization (WHO) and Vietnam's National Action Plan for Viral Hepatitis Control and Prevention, Period 2015-2019.

## CONCLUSION

In conclusion, we documented that there are few guidelines for testing and treatment or best practices for occupational exposure to viral hepatitis in HCWs working in HCMC. Despite the high rate and risk of HBV infection in this population, only half of HCWs were vaccinated against HBV. A knowledge gap was also identified with the KAP survey that continuous medical education is crucial to improve the knowledge and to protect HCWs. This study is a call for an effort to enforce mandatory pre-employment testing, routine surveillance, HBV vaccination, and dedicated HBV-HCV post-exposure guidelines and treatment for HCWs.

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**Data availability statement**: Deidentified data are stored in internal database and are available upon request to the corresponding author. All data relevant to the study are included in the article or uploaded as supplementary material.

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**TABLES AND FIGURES**

# Table 1

**Baseline demographic characteristics of 203 HCWs**

| | Total n | Physicians n (%) | Nurses & Midwives n (%) | Other HCWs n (%) |
|---|---|---|---|---|
| | **(N=203)** | **(N=39)** | **(N=140)** | **(N=24)** |
| **Gender** | | | | |
| Female | 168 | 27 (16.07) | 127 (75.60) | 14 (8.33) |
| **Age groups** | | | | |
| ≤ 29 | 74 | 13 (17.57) | 50 (67.57) | 11 (14.86) |
| 30-39 | 72 | 15 (20.83) | 52 (72.22) | 5 (6.94) |
| 40-49 | 39 | 8 (20.51) | 26 (66.67) | 5 (12.82) |
| ≥ 50 | 18 | 3 (16.67) | 12 (66.67) | 3 (16.66) |
| **Age** | | | | |
| Median (IQR) / range | 32 (14) / 21-59 | 34 (13.5) / 24-59 | 32 (13.25) / 21-56 | 30 (17.5) / 23-56 |
| **Educational level** | | | | |
| At most high school | 10 | 0 | 5 (50) | 5 (50) |
| Technical or vocational degree | 111 | 0 | 99 (89.19) | 12 (10.81) |
| University and post-university | 81 | 39 (48.15) | 36 (44.44) | 6 (7.41) |
| **Length of clinical activity** | (n=193) | (n=39) | (n=133) | (n=21) |
| 0-9 years | 105 | 23 (21.91) | 69 (65.71) | 13 (12.38) |
| 10-19 years | 52 | 10 (19.23) | 38 (73.08) | 4 (7.69) |
| 20+ years | 36 | 6 (16.67) | 26 (72.22) | 4 (11.11) |

HCW, health care workers; IQR, interquartile range.

## Table 2

**Demographic characteristics between HBsAg (+) and HBsAg (-) groups**

| | Total | HBsAg (+) | HBsAg (-) | *P* value |
|---|---|---|---|---|
| | **(n=203)** | **(n=20)** | **(n=183)** | |
| **Gender, n (%)** | | | | 0.731 |
| Female | 168 (82.76) | 16 (80) | 152 (83.06) | |
| **Age** | | | | |
| Median (IQR) | 32 (14) | 35 (13.5) | 31 (14) | |
| Range | 21-59 | 25-54 | 21-59 | |
| Means (std) | 34.49 (9.14) | 38.05 (8.59) | 34.10 (9.13) | 0.067 |
| **Educational level, n (%)** | (n=202) | (n=20) | (n=182) | 0.4188 |
| High school or lower | 10 (4.95) | 0 | 10 (5.49) | |
| Technical or vocational Degree | 111 (54.95) | 10 (50) | 101 (55.49) | |
| University and post-university | 81 (40.10) | 10 (50) | 71 (39.01) | |
| **Clinical works, n (%)** | (n=199) | (n=20) | (n=179) | 0.728 |
| Physicians | 39 (19.60) | 4 (20) | 35 (19.55) | |
| Nurses & midwives | 140 (70.35) | 15 (75) | 125 (69.83) | |
| Other HCWs | 20 (10.05) | 1 (5) | 19 (10.61) | |
| **Length of clinical work, n (%)** | (n=193) | (n=19) | (n=174) | 0.269 |
| 0-9 years | 105 (54.40) | 7 (36.84) | 98 (56.32) | |
| 10-19 years | 52 (26.94) | 7 (36.84) | 45 (25.86) | |
| 20+ years | 36 (18.65) | 5 (26.32) | 31 (17.82) | |

HBsAg, hepatitis B surface antigen; HCW, health care workers; IQR, interquartile range.

## Table 3

**Risk factors between HBsAg (+) and HBsAg (-) groups**

| | Total | HBsAg (+) | HBsAg (-) | *P* value |
|---|---|---|---|---|
| | **(n=203)** | **(n=20)** | **(n=183)** | |
| **Frequency of exposure to blood & bodily fluids, n (%)** | (n=197) | (n=20) | (n=177) | 0.054 |
| Every day | 141 (71.57) | 18 (90) | 123 (69.49) | |
| Not every day | 56 (28.4) | 2 (10) | 54 (30.51) | |
| **Family member with viral hepatitis, n (%)** | (n=203) | (n=20) | (n=183) | **<0.0001** |
| Only HBV | 39 (19.21) | 12 (60) | 27 (14.75) | |
| Only HCV | 3 (1.48) | 0 | 3 (1.64) | |
| Both HBV and HCV | 6 (2.96) | 0 | 6 (3.28) | |
| None | 135 (66.50) | 6 (30) | 129 (70.49) | |
| Don't know and did not answer | 20 (9.85) | 2 (10) | 18 (9.84) | |
| **Family with HBV vaccination, n (%)** | (n=185) | (n=18) | (n=167) | 0.297 |
| Yes | 147 (79.46) | 16 (88.89) | 131 (78.44) | |
| **Last time of health check-up with HBV screening, n (%)** | (n=201) | (n=20) | (n=181) | 0.750 |
| Last 6 months | 106 (52.74) | 10 (50) | 96 (53.04) | |
| 6 months to 1 year | 30 (14.93) | 3 (15) | 27 (14.92) | |
| More than 1 year | 32 (15.92) | 5 (25) | 27 (14.92) | |
| Health check without HBV screening | 29 (14.43) | 2 (10) | 27 (14.92) | |
| No health check-up | 4 (1.99) | 0 | 4 (2.21) | |
| **Health check-up with HBV screening paid by, n (%)** | (n=166) | (n=18) | (n=148) | 0.130 |
| Self | 33 (19.88) | 6 (33.33) | 27 (18.24) | |
| Employer | 133 (80.12) | 12 (66.67) | 121 (81.76) | |
| **Any medical conditions, n (%)** | (n=199) | (n=) | (n=179) | |
| Yes | 30 (15.08) | 6 (30) | 24 (13.41) | **0.0492** |

| | Total | HBsAg (+) | HBsAg (-) | *P* value |
|---|---|---|---|---|
| | **(n=203)** | **(n=20)** | **(n=183)** | |
| **History of transfusion, n (%)** | (n=199) | (n=20) | (n=179) | 0.8383 |
| Yes | 12 (6.03) | 1 (5) | 11 (6.15) | |
| **Having tattoo, n (%)** | (n=199) | (n=20) | (n=179) | 0.9133 |
| Yes | 11 (5.53) | 1 (5) | 10 (5.59) | |
| **Use of addictive drugs, n (%)** | (n=199) | (n=20) | (N=179) | 0.6347 |
| Yes | 2 (1.01) | 0 | 2 (1.12) | |
| **Sharing needles, n (%)** | (n=201) | (n=20) | (N=181) | **<0.0001** |
| Yes | 2 (1) | 2 (10) | 0 | |
| **Use of immuno-suppressants or steroids, n (%)** | (n=201) | (n=19) | (n=182) | 0.5137 |
| Yes | 2 (1) | 0 | 2 (1.10) | |
| No | 189 (94.03) | 19 (100) | 170 (93.41) | |
| Not sure | 10 (4.97) | 0 | 10 (5.49) | |
| **Contact with sex workers, n (%)** | (n=202) | (n=20) | (n=182) | |
| Often | 1 (0.5) | 0 | 1 (0.55) | |
| Sometimes | 0 | 0 | 0 | |
| Never | 201 (99.5) | 20 (100) | 181 (99.45) | |
| **In LGBT community, n (%)** | (n=202) | (n=20) | (n=182) | |
| Yes | 1 (0.5) | 0 | 1 (0.55) | |
| **Use of condoms, n (%)** | (n=183) | (n=18) | (n=165) | 0.2172 |
| Always | 34 (18.58) | 2 (11.11) | 32 (19.39) | |
| Sometimes | 42 (22.95) | 7 (38.89) | 35 (21.21) | |
| Never | 107 (58.47) | 9 (50) | 98 (59.39) | |
| **Partners were screened for HBV/HCV, n (%)** | (n=191) | (n=18) | (n=173) | 0.1218 |
| Yes | 128 (67.02) | 15 (83.33) | 113 (65.32) | |

| | Total | HBsAg (+) | HBsAg (-) | *P* value |
|---|---|---|---|---|
| | **(n=203)** | **(n=20)** | **(n=183)** | |
| **Received hepatitis B vaccination, n (%)** | (n=200) | (n=20) | (n=180) | **0.0001** |
| Yes | 142 (71) | 6 (30) | 136 (75.56) | |

HBsAg, hepatitis B surface antigen; HBV, hepatitis B virus; HCV, hepatitis C virus; HCW, health care workers; LGBT, lesbian, gay, bisexual, and transgender.

## Table 4

**In-Depth Interviews Summary**

| Semi-Structured Questions | Total | Agree n (%) | Disagree n (%) | Not Sure n (%) |
|---|---|---|---|---|
| My workplace has protocol for occupational exposure. | 28 | 27 (96.4) | 0 | 1 (3.6) |
| My workplace has separate hepatitis protocol for occupational exposure. | 28 | 1 (3.6) | 26 (92.8) | 1 (3.6) |
| My workplace has an assistance program for occupational exposure. | 15 | 7 (46.7) | 5 (33.3) | 3 (20) |
| My workplace organizes routine screening for viral hepatitis. | 27 | 22 (81.5) | 4 (14.8) | 1 (3.7) |
| Hepatitis testing is required before starting clinical work at my workplace. | 20 | 11 (55) | 8 (40) | 1 (5) |
| I paid for my own HBV vaccination. | 28 | 21 (75) | 6 (21.4) | 1 (3.6) |
| My employer paid for HBV vaccination. | 28 | 6 (21.4) | 21 (75) | 1 (3.6) |
| I am willing to reveal my hepatitis infection status to my coworkers. | 28 | 22 (78.6) | 6 (21.4) | 0 |
| I would like to know my coworkers' viral hepatitis infection status. | 27 | 14 (51.9) | 2 (7.4) | 11 (40.7) |
| Hospital should pay for testing and/or treatment for viral hepatitis caused by occupational exposure. | 15 | 14 (93.3) | 1 (6.7) | 0 |
| My workplace should test new employees for viral hepatitis prior to employment. | 12 | 12 (100) | 0 | 0 |
| HBV vaccination should be free for health care workers. | 14 | 11 (78.6) | 3 (21.4) | 0 |

HBV, hepatitis B virus.

## Figure 1

**Vietnam, red S shape, is located in Southeast Asia. Ho Chi Minh City, enlarging circle, is located in Southern Vietnam**

## SUPPLEMENTS

**Table 1: KAP survey results stratified among types of clinical work**

| Statements about HBV or HCV | Total n (N=203) | Physicians n (%) (n=39) | Nurses & midwives n (%) (n=140) | Other HCWs n (%) (n=24) |
|---|---|---|---|---|
| Smoking can cause hepatitis | 35 | 7 (20) | 23 (65.71) | 5 (14.29) |
| Don't know if smoking can cause hepatitis | 9 | 0 | 8 (88.89) | 1 (11.11) |
| Hepatitis can be spread by sharing eating utensils | 90 | 19 (21.11) | 63 (70) | 8 (8.89) |
| Don't know if hepatitis can be spread by sharing eating utensils | 8 | 0 | 6 (75) | 2 (25) |
| Either HBV or HCV can not be spread by sharing toothbrushes | 22 | 4 (18.18) | 16 (72.73) | 2 (9.09) |
| Don't know if hepatitis can be spread by sharing toothbrushes | 4 | 0 | 2 (50) | 2 (50) |
| Hepatitis can be spread by sneezing | 58 | 10 (17.24) | 41 (70.69) | 7 (12.07) |
| Don't know if hepatitis can be spread by sneezing | 10 | 1 (10) | 7 (70) | 2 (20) |
| Hepatitis can not be spread via sexual intercourse | 9 | 0 | 7 (77.78) | 2 (22.22) |
| Don't know if hepatitis can be spread via sexual intercourse | 1 | 0 | 1 (100) | 0 |
| Hepatitis can not be spread by sharing needles | 1 | 0 | 0 | 1 (100) |
| Don't know if hepatitis can be spread by sharing needles | 1 | 0 | 1 (100) | 0 |
| Neonates can not acquire hepatitis at birth | 0 | 0 | 0 | 0 |
| Don't know if neonates can acquire hepatitis at birth | 4 | 0 | 3 (75) | 1 (25) |
| Hepatitis can not be spread by someone who looks healthy | 6 | 0 | 5 (83.33) | 1 (16.67) |
| Don't know if hepatitis can be spread by someone who looks healthy | 16 | 1 (6.25) | 13 (81.25) | 2 12.5) |

| Statements about HBV or HCV | Total n (N=203) | Physicians n (%) (n=39) | Nurses & midwives n (%) (n=140) | Other HCWs n (%) (n=24) |
|---|---|---|---|---|
| Hepatitis can not cause life-long infection | 29 | 7 (24.14) | 18 (62.07) | 4 (13.79) |
| Don't know if hepatitis can cause life-long infection | 13 | 0 | 11 (84.62) | 2 (15.38) |
| Hepatitis can not cause liver cancer | 6 | 0 | 6 (100) | 0 |
| Don't know if hepatitis can cause liver cancer | 5 | 0 | 4 (80) | 1 (20) |
| Hepatitis cannot be lethal | 14 | 1 (7.14) | 8 (57.14) | 5 (35.72) |
| Don't know if hepatitis can be lethal | 14 | 0 | 14 (100) | 0 |
| Hepatitis is not treatable | 43 | 4 (9.30) | 34 (79.07) | 5 (11.63) |
| Don't know if hepatitis is treatable | 7 | 0 | 6 (85.71) | 1 (14.29) |
| People with hepatitis should be avoided | 29 | 5 (17.24) | 20 (68.97) | 4 (13.79) |
| Don’t know if need to avoid people with hepatitis | 5 | 2 (40) | 2 (40) | 1 (20) |
| I do not have a life-long risk of contracting hepatitis | 8 | 1 (12.5) | 5 (62.5) | 2 (25) |
| Don't know if I have a life-long risk of contracting hepatitis | 24 | 3 (12.5) | 15 (62.5) | 6 (25) |
| Hepatitis B vaccine is not effective | 8 | 1 (12.5) | 7 (87.5) | 0 |
| Don't know if vaccine is effective | 6 | 0 | 3 (50) | 3 (50) |
| Hepatitis B vaccine has harmful side effects | 42 | 11 (26.19) | 28 (66.67) | 3 (7.14) |
| Don't know if hepatitis B vaccine has harmful side effects | 40 | 2 (5) | 30 (75) | 8 (20) |

**Table 2: Post-exposure management of health care workers after occupational percutaneous and mucosal exposure to blood and body fluids, by health care workers' hepatitis B vaccination and response status.**

| Health care worker status | Post-exposure testing | | Post-exposure prophylaxis | | Post-vaccination serologic testing[b] |
|---|---|---|---|---|---|
| | Source patient (HbsAg) | HCW testing (anti-HBs) | HBIG[a] | Vaccination | |
| Documented responder[c] after complete series | No action needed | | | | |
| Documented non-responder[d] after 2 complete series | Positive/ unknown | Not indicated | HBIG x2 separated by 1 month | — | No |
| | Negative | No action needed | | | |
| Response unknown after complete series | Positive/ unknown | < 10 mIU/mL[e] | HBIG x1 | Initiate revaccination | Yes |
| | Negative | < 10 mIU/mL | None | | |
| | Any result | ≥ 10 mIU/mL | No action needed | | |
| Unvaccinated / incompletely vaccinated or vaccine refusers | Positive/ unknown | —[e] | HBIG x1 | Complete vaccination | Yes |
| | Negative | — | None | Complete vaccination | Yes |

anti-HBs, antibody to hepatitis B surface antigen; HBsAg, hepatitis B surface antigen; HBIG, hepatitis B immune globulin; HCW, health care workers.

[a] HBIG should be administered intramuscularly as soon as possible after exposure when indicated. The effectiveness of HBIG when administered >7 days after percutaneous, mucosal, or nonintact skin exposures is unknown. HBIG dosage = 0.06 mL/kg.

[b] Should be performed 1–2 months after the last dose of the hepatitis B vaccine series (and 6 months after administration of HBIG to avoid detection of passively administered anti-HBs) using a quantitative method that allows detection of the protective concentration of anti-HBs (≥10 mIU/mL).

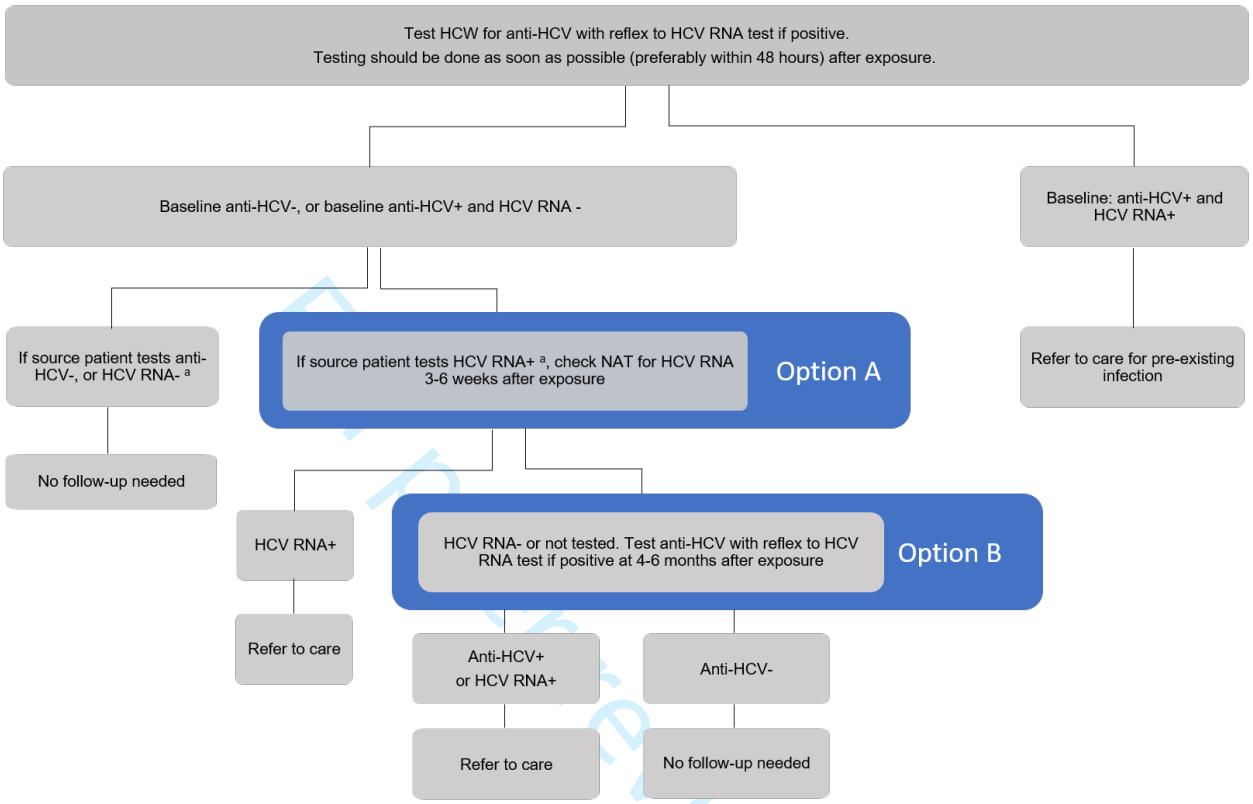
[c] A responder is defined as a person with anti-HBs ≥10 mIU/mL after ≥1 complete series of hepatitis B vaccine.

[d] A nonresponder is defined as a person with anti-HBs <10 mIU/mL after 2 complete series of hepatitis B vaccine.

[e] HCW who have anti-HBs <10 mIU/mL, or who are unvaccinated or incompletely vaccinated, and sustain an exposure to a source patient who is HBsAg (+) or has unknown HBsAg status, should undergo baseline testing for HBV infection as soon as possible after exposure, and follow-up testing approximately 6 months later. Initial baseline tests consist of total anti-HBc; testing at ~6 months consists of HBsAg and total anti-HBc.

**Adapted from** Schillie S, Murphy TV, Sawyer M, et al. CDC Guidance for evaluating health-care personnel for hepatitis B virus protection and for administering postexposure management. Published December 20, 2013 Accessed April 1, 2021. https://www.cdc.gov/mmwr/preview/mmwrhtml/rr6210a1.htm

**Figure 1: Hepatitis C virus post-exposure management of health care workers after occupational percutaneous and mucosal exposure to blood and body fluids**




HCV, hepatitis C virus; HCW, health care workers; NAT, nucleic acid test.
[a] Testing of the source patient may follow option A (preferred) or option B.
**Adapted from** Moorman AC, de Perio MA, Goldschmidt R, et al. Testing and clinical management of health care personnel potentially exposed to hepatitis C virus - CDC Guidance, United States, 2020. Published July 24, 2020. Accessed April 1, 2021. https://www.cdc.gov/mmwr/volumes/69/rr/rr6906a1.htm?s_cid=rr6906a1_w

SURVEY FOR HEALTHCARE PROVIDERS

A. GENERAL INFORMATION

A1. Name:

A2. ID number:

A3. Date of birth:

(Year of birth or age if you forget your date of birth)

A4. Sex:

- Male
- Female

A5. Place of birth:

A6. Address of residence:

- House number & street:
- Ward:
- District:

Is this a private residential or a rental house?

- Private
- Rental

A7. Please provide your phone number (landline and mobile)

- Phone number 1:
- Phone number 2:
- Phone number 3:

A8. Email (if any):

A9. The most convenient way to contact (you can choose ALL THAT APPLY):

- Landline phone
- Mobile phone
- Email
- Meet in person at home

A10. Ethnicity

- Kinh
- Chinese
- Other, please specify

A11.Your role in clinical work:

- Clinical Physician
- Nurse
- Midwife
- Public Health Specialist
- Clinical Laboratory Technician

A12. How many years have you been in clinical practice since graduation? year

A13. How often are you in direct contact with the patient's blood or bodily fluid:

- Almost every day
- Several times a week
- Several times a month
- Rarely or hardly

A14. Personal income per month:

SURVEY FOR HEALTHCARE PROVIDERS

- Under 5 million VND
- 5 -10 million VND
- 10-20 million VND
- 20-50 million VND
- Over 50 million VND
- (1USD=23,000 VND as of xx)

A15. With this income, how many people can you support, including yourself:

- Alone
- 2 or more, please specify the number:

A16. Education level (highest level of education completed)

- Elementary School
- Middle School (grade 9)
- High School (grade 12)
- Intermediate or technician
- College Bachelor
- University
- Graduate school

A17. Marital status

- Single
- Living together but not married
- Single in a relationship
- Currently married
- Separation/divorce
- Widow

**B. KNOWLEDGE, ATTITUDE, BEHAVIOR**

Below are some questions about hepatitis B and C. The questions apply to both hepatitis B and C viruses unless it's clearly stated that they are referring to any specific type of viral hepatitis. Please choose the most appropriate answer.

B1. Do you think it is possible to get viral hepatitis from smoking?

- Yes for HBV
- Yes for HCV
- Yes for both HBV and HCV
- No
- Don't know

B2. Do you think it is possible to get viral hepatitis from eating or drinking together or sharing spoons, chopsticks and forks?

- Yes for HBV
- Yes for HCV
- Yes for both HBV and HCV
- No
- Don't know

B3. Do you think it is possible to get viral hepatitis from sharing toothbrushes?

- Yes for HBV

SURVEY FOR HEALTHCARE PROVIDERS

- Yes for HCV
- Yes for both HBV and HCV
- No
- Don't know

B4. Do you think it is possible to get a viral infection from being around someone who is sneezing or coughing?

- Yes for HBV
- Yes for HCV
- Yes for both HBV and HCV
- No
- Don't know

B5. Do you think it is possible to get viral hepatitis from sex?

- Yes for HBV
- Yes for HCV
- Yes for both HBV and HCV
- No
- Don't know

B6. Do you think it is possible to get viral hepatitis from sharing or reusing needles such as acupuncture, tattooing, or injecting with used needles?

- Yes for HBV
- Yes for HCV
- Yes for both HBV and HCV
- No
- Don't know

B7. Do you think that the baby can get viral hepatitis due to transmission from the mother during birth?

- Yes for HBV
- Yes for HCV
- Yes for both HBV and HCV
- No
- Don't know

B8. Do you think that an asymptomatic person with viral hepatitis can still transmit the hepatitis virus?

- Yes for HBV
- Yes for HCV
- Yes for both HBV and HCV
- No
- Don't know

B9. Do you think that people who have been infected with viral hepatitis will be infected for life?

- Yes for HBV
- Yes for HCV
- Yes for both HBV and HCV
- No

SURVEY FOR HEALTHCARE PROVIDERS

- Don't know

B10. Do you think viral hepatitis can lead to liver cancer?
- Yes for HBV
- Yes for HCV
- Yes for both HBV and HCV
- No
- Don't know

B11. Do you think a person can die from viral hepatitis?
- Yes for HBV
- Yes for HCV
- Yes for both HBV and HCV
- No
- Don't know

B12. Do you think viral hepatitis can be cured?
- Yes for HBV
- Yes for HCV
- Yes for both HBV and HCV
- No
- Don't know

B13. Do you think contact with people infected with hepatitis virus should be avoided?
- Yes for HBV
- Yes for HCV
- Yes for both HBV and HCV
- No
- Don't know

B14. How would you rate the possibility that you MAY BE INSPIRED with viral hepatitis during your lifetime?
- Yes for HBV
- Yes for HCV
- Yes for both HBV and HCV
- No
- Don't know

B15. Have you discussed with family members or friends about screening for viral hepatitis?
- There is discussion, but only about HBV
- There is discussion, but only about HCV
- There is a discussion about HBV and HCV
- None

B16. Does anyone in the family living with Brother/Sister (such as father, mother, wife, children, brother, sister, brother...) have hepatitis virus infection?
- Yes, HBV
- Yes, HCV
- Yes, both HBV and HCV

SURVEY FOR HEALTHCARE PROVIDERS

- No
- Don't know

B17. Do you think homeless people or immigrants are more susceptible to viral hepatitis than Ho Chi Minh City residents?

- Yes for HBV
- Yes for HCV
- Yes for both HBV and HCV
- No
- Don't know

B18. Do you think the hepatitis B vaccine is effective in preventing hepatitis B?

- Yes
- No
- Don't know

B19. Do you believe that the hepatitis B vaccine (vaccine) can cause harmful side effects in many people?

- Yes
- No
- Don't know

B20. Do you believe the hepatitis B vaccine is safe?

- Yes
- No
- Don't know

B21. For hepatitis B vaccination in healthcare workers,do you think the public health insurance plan should cover it or who else?

- No. Should be paid by
- Yes, public health insurance should cover it
- Don't know

B22. Have other members of your household been vaccinated against hepatitis B?

- Yes
- No
- Don't know

B23. Do you know where you can get the hepatitis B vaccine?

- Yes, please specify:
- Don't know

B24. How long ago was the last time you had a general health check?

B25. When was your health checkup, including a hepatitis B screening test?

- Within 6 months
- 6 months - 1 year ago
- Over 1 year
- Have a health check but do not have a hepatitis B screening test
- No health check (did not participate in required annual occupational health check or self-paid)

B26. Is this HBV screening part of a routine health checkup or per your own request?

SURVEY FOR HEALTHCARE PROVIDERS

- Self-request
- According to health agencies

B27. When was your health checkup, including a hepatitis C screening test?

- Within 6 months
- 6 months - 1 year ago
- Over 1 year
- Have a health check but do not have a hepatitis C screening test
- No health check (did not participate in required annual occupational health check or self-paid)

B28. Is this HCV screening part of a routine health checkup or per your request?

- Self-request
- According to health agencies

B29. Do you have liver disease AND are infected with hepatitis B or C virus?

- Yes, liver disease and HBV
- Yes, liver disease and HCV
- Yes, liver disease and have both HBV and HCV
- Have liver disease but not related to HBV or HCV
- No liver disease

B30. Are you infected with hepatitis B virus or C virus?

- Infected with HBV
- Infected with HCV
- Infected with both HBV and HCV
- Infected with another virus, not HBV or HCV → GO TO PART C.
- No → GO TO PART C
- Don't know → GO TO PART C

B31. Do you have test results or a doctor's confirmation of this infection?

- No
- Yes

-- END OF PART B --

C1. Are you currently infected with hepatitis B, C or both?

- Yes
- No → SKIP TO QUESTION C4.

C2. Do you remember when did you discover that you were infected with hepatitis B, C or both?

- Don't remember
- Hepatitis B since ...
- Hepatitis C since ...

C3. How did you know your infection status?

- Annual health check
- Self-paid health check
- Blood donation or health check for other condition

SURVEY FOR HEALTHCARE PROVIDERS

- Detected when I had symptoms of liver disease
- Don't remember

C4. Do you have any diseases (excluding hepatitis B, C)?

- Yes
- No

C5. Have you ever had a blood transfusion?

- Yes, please specify
- Never

C6. Have you ever had a tattoo (including a cosmetic tattoo)?

- Yes
- No

C7. Have you ever used narcotics?

- Yes
- No

C8. Have you ever shared needles with others?

- Yes
- No

C9. Are you taking immunosuppressive drugs or chemotherapy or steroids?

- Yes, specifically
- No
- Unknown

C10. Have you ever been in a relationship with a prostitute?

- Never
- Rarely
- Usually

C11. Are you in the LGBT group (gay, bisexual, transgender)?

- Yes
- No

C12. Do you often use condoms when having sex?

- No
- Occasionally
- Regularly

C13. Has the person who lived with you been tested for hepatitis B and C?

- Tested
- Haven't done it yet

C14. Have you had the full dose of hepatitis B vaccine (3 doses)?

- Already
- Never injected
- In between shots

C15. How long ago did you get the hepatitis B vaccine?

C16. How long have you been in clinical practice? five

C17. Please name up to 5 tasks with direct contact with the patient's blood, secretions or body fluids... that you do most often (eg: injection, using sharp instruments or performing procedures)

SURVEY FOR HEALTHCARE PROVIDERS

invasive surgery, direct blood-removal cleanup, etc.), how often are this contact and gloves are used?

| Task | Frequency of task | Frequency of using glove when performing a task |
|---|---|---|
| | • Everyday<br>• 2-3 times/week<br>• 2-3 times/month<br>• once/month or none | • Always<br>• Sometimes<br>• None |

C18. What position do you work in the department/room/hospital?

C19. What is your opinion about the following statement: “Medical staff MUST KNOW the hepatitis B and C infection status of the patients they come into contact with”?

- Totally agree
- Agree
- No opinion
- Disagree
- Totally disagree

C20. What is your opinion about the following statement: “The hospital MUST KNOW the status of its employees with hepatitis B and C virus infection”?

- Totally agree
- Agree
- No opinion
- Disagree
- Totally disagree

-- END OF SECTION C –

**Semi-structured focus group discussion:**

1. Healthcare workers are at high risk of being exposed to diseases transmitted through blood and secretions in their occupation, including hepatitis B-C. With HIV, there are regulations and procedures for exposure prevention and post-exposure treatment. I would like to ask if you know that the Ministry of Health or the Department of Health or your hospital has a policy on prevention. Exposure of hepatitis B or hepatitis C to healthcare workers?
(You can be specific or give real examples.)
(Don't know → why don't you know? It's not disseminated or not of your interested)
(Know → How did you know?)

2. Speaking of prevention, how did you get screened for hepatitis B-C infection? (hint: Self testing or per request of the hospital? Or health check due to any health issue)
(If self-testing → why screen?)
(Did you often get screened for HBV, HCV? How? If yes, who paid)

3. Talking about being infected with hepatitis B-C virus, how would you feel if your colleagues in the hospital knew your infection status? (Hint: Do you want to disclose or not disclose your infection at work?)
(Continued: What if the board of directors -not your colleagues- know? What are your thoughts on this? Should the infected person be transferred to another work area?)

4. On the contrary, do you feel the need to know the infection status of your colleagues? Why?

5. What do you think about the possibility of exposure to hepatitis B-C when interacting with patients in clinical practice? (hint: maybe it's the fear of getting infected, or not paying attention to the infection, or just worrying about getting HIV and everything else is fine...)

(continue: Do you actively check the patient's infection status before performing examination or procedure?)

(Continue: Is HIV your first worry? Is it good to be aware of HBV and HCV?)

6. When you come into contact with a patient infected with hepatitis B-C, how do you feel? Is it necessary to screen all patients for hepatitis B-C on admission and have warning signs for healthcare workers before exposure?

7. Regarding hepatitis B vaccination, have you ever been encouraged or asked by the hospital for vaccination before clinical practice?

How do you think about this statement: “People should be encouraged or requested or provided free HBV vaccination before clinical practice”?

8. If/When exposed to hepatitis B or C, not to mention HIV, what would you or did you do?

Is there a procedure at your hospital for this? (clarify: not known due to lack of popularity or don’t have one in place?)

What is the hospital's response to this exposure? (hint: financial support for post-exposure prophylaxis or treatment...)

9. When you are exposed to hepatitis B or C or both and there is an indication for treatment, what is the treatment? (Hints: where did you get treated, is it covered by health insurance, who pays, what is the financial source, the leave to go to the doctor, what medicine that you used?)

10. In your opinion, at your hospital and in the health sector in general, what are the difficulties in terms of pre- and post-exposure prophylaxis as well as post-exposure treatment?

11. So, according to you, what improvements should be made to benefit or match the needs of medical staff? (Can suggest such as free and mandatory vaccination for everyone, or hepatitis B screening in the annual health check package, support for disease treatment if post-exposure disease...)

12. How are people in your family vaccinated against hepatitis B? (hint: are there injections? Who pays? Do you feel the burden?)

====/====
** FOR PERSONS CONFIRMED WITH HEPATITIS B, C:
13. You have been infected with hepatitis B, C. Do you know how you got infected? (hint: exposed after being pricked by a needle or splashed in the eye by secretions...)
(If it was an exposure and how exposure occurred --> what did you do at that time and what were the hospital and colleagues like? Time to access post-exposure prophylaxis, cost of treatment. Post-exposure prophylaxis, how is the psychology...)

14. With family members, after knowing you were infected, how did you feel? (suggestions: self-isolate, ask family members to get vaccinated, or publicize or hide information, or family has been infected before...)
(If hiding information continues, does such “hiding information” mean not going to diagnose, treat and monitor infection and disease?)

15. Please share your thoughts on exposure to hepatitis B, C when clinical work is based on your actual experience, from prevention, to treatment, support when exposed, mental and

physical support... all of which do you think needs more attention to protect medical staff's peace of mind?

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

| | Item No | Recommendation | Page No |
|---|---|---|---|
| **Title and abstract** | 1 | (*a*) Indicate the study's design with a commonly used term in the title or the abstract | 2 |
| | | (*b*) Provide in the abstract an informative and balanced summary of what was done and what was found | 2 |
| **Introduction** | | | |
| Background/rationale | 2 | Explain the scientific background and rationale for the investigation being reported | 4&5 |
| Objectives | 3 | State specific objectives, including any prespecified hypotheses | 5 |
| **Methods** | | | |
| Study design | 4 | Present key elements of study design early in the paper | 6 |
| Setting | 5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection | 5&6 |
| Participants | 6 | (*a*) Give the eligibility criteria, and the sources and methods of selection of participants | 6&7 |
| Variables | 7 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable | 6&7 |
| Data sources/ measurement | 8* | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | 7 |
| Bias | 9 | Describe any efforts to address potential sources of bias | 7 |
| Study size | 10 | Explain how the study size was arrived at | 6 |
| Quantitative variables | 11 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why | 7&8 |
| Statistical methods | 12 | (*a*) Describe all statistical methods, including those used to control for confounding | 7&8 |
| | | (*b*) Describe any methods used to examine subgroups and interactions | 7&8 |
| | | (*c*) Explain how missing data were addressed | 7 |
| | | (*d*) If applicable, describe analytical methods taking account of sampling strategy | NA |
| | | (*e*) Describe any sensitivity analyses | NA |
| **Results** | | | |
| Participants | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed | 8 |
| | | (b) Give reasons for non-participation at each stage | NA |
| | | (c) Consider use of a flow diagram | Text in page 8 |
| Descriptive data | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders | 8&9 |
| | | (b) Indicate number of participants with missing data for each variable of interest | 20-24 |
| Outcome data | 15* | Report numbers of outcome events or summary measures | 9 |

| | | | |
|---|---|---|---|
| Main results | 16 | (*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included | NA |
| | | (*b*) Report category boundaries when continuous variables were categorized | 20-24 |
| | | (*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period | NA |
| Other analyses | 17 | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses | NA |
| **Discussion** | | | |
| Key results | 18 | Summarise key results with reference to study objectives | 11&12 |
| Limitations | 19 | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias | 14 |
| Interpretation | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence | 11-13 |
| Generalisability | 21 | Discuss the generalisability (external validity) of the study results | 14 |
| **Other information** | | | |
| Funding | 22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based | 15 |

NA, not applicable

*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.