

# Immunity to Hepatitis B Virus as a Fitness for Duty Program for Health Workers at the University Hospital in Thailand

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**Background:** Health workers (HWs) are at high risk for hepatitis B virus (HBV) infection; especially those with no immunity to HBV. Notwithstanding, no prior Thai studies regarding HBV immunity as a fitness for duty program have been published.

**Objective:** This study aimed to describe the status of HBV immunity as related to an occupational health program for new health workers.

**Materials and Methods:** This was a descriptive study in which 1,302 samples were collected from existing data recorded by the Occupational Health and Safety (OH&S) Office between 2013 and 2016. Descriptive statistics were used to describe proportions.

**Results:** The immunity to HBV amongst persons with direct contact to blood-borne pathogens (BBPs) between 2013 and 2016 represented the majority who had immunity to HBV. The number with HBV immunity rose every year between 2013 and 2016 (50.0% to 84.7%) whereas those actually infected with HBV declined (4.3% to 0.6%). When assessing fitness for duty, 95.4% were fit for duty with BBPs.

**Conclusion:** The trend of BBPs-sero-protected against hepatitis B virus among HWs is increasing. Occupational health programs for health workers were used to ensure fitness for duty with BBPs, and specifically HBV.

**Keywords:** Hepatitis B, Health workers, Fitness for duty, Preplacement, Hospital

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Chronic hepatitis B virus (HBV) infection is one of the most serious infections and a major risk factor for death from cirrhosis and liver cancer. Globally, more than 240 million persons have chronic HBV infection with an estimated 650,000 deaths from chronic hepatitis B each year<sup>(1-3)</sup>. The prevalence of HBV infection varies geographically, with the highest rates in Africa and Asia<sup>(1)</sup>. In Thailand, the prevalence ranges from intermediate to high (5 to 7% of the population is HBsAg positive)<sup>(2)</sup>. Health workers (HWs) are at high risk for HBV infection because of exposure to potentially infectious blood products or body fluids<sup>(4)</sup>. The prevalence of HBV among HWs is approximately 10 times greater than that of the general population<sup>(5,6)</sup>.

The Occupational Safety and Health Administration (OSHA) advises that HBV is one of the hazards in hospitals and the hospital should have policies to provide

the vaccine to all HWs who have occupational exposure to blood-borne pathogens. At the pre-placement examination, potential HWs should be assessed for fitness for duty (i.e., no restriction or limitation of their duties) or fit with conditions (i.e., non-responders and active HBV infection are restrictions for performing invasive (exposure-prone) duties. Those with active HBV infection should only be allowed to perform duties under supervision and patients should be notified regarding the HW's seropositivity<sup>(7)</sup>.

In Thailand since 1992, HBV vaccination for newborns (Expanded Program of Immunization; EPI) was implemented at all hospitals but some HWs born before 1992 were not included in the program so they might not have HBV immunity (anti-HBs negative)<sup>(8)</sup>. Since 2011, the Ministry of Public Health (MOPH) in Thailand has recommended that all new HWs born before the vaccination era be tested for HBV markers for antibody to the core antigen (anti-HBc), and for those born in the vaccination era be tested for the antibody to surface antigen (anti-HBs), and be prescribed any necessary vaccination if they have no immunity against HBV<sup>(9)</sup>.

The current study which studied 410 hospitals in Thailand showed that only 57.3% (235 hospitals) were tested for HBV markers and only 38.0% (156 hospitals) provided an HBV vaccination program if the results were negative for

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HBsAg and the HWs had no immunity<sup>(10)</sup>. Some local hospitals-such as Srinagarind Hospital, Faculty of Medicine, Khon Kaen University-implemented this program in 2007 before this policy was implemented and tested for HBV markers (i.e., anti-HBs, anti-HBc, hepatitis B surface antigen (HBsAg)), and thereby achieved 100 percent coverage of a HBV vaccination program<sup>(11)</sup>.

A 2012 report by the Infection Control Unit, Srinagarind Hospital, Khon Kaen University showed that HWs were disappointed with the HBV vaccination program because of (a) an incomplete course of vaccination, and/or (b) the lack of an immunity blood test after completing the vaccination (Bourpoern, personal communication, 2013). Although HWs did not have to pay for the HBV vaccine, there was poor compliance due to the long course duration of the HBV vaccination course<sup>(12)</sup>.

The aims of our study were to (a) describe the HBV immunity status vis-a-vis the occupational health program for new HWs, and (b) estimate the proportion of HWs fit for duty with BBPs.

## Materials and Methods

The current descriptive study was conducted at Srinagarind Hospital, Faculty of Medicine, Khon Kaen University for the period 2013 to 2016. The inclusion criteria were 1) new HWs examined between 2013 and 2016, and 2) had been tested for hepatitis B virus markers (viz., hepatitis B surface antigen (HBsAg), antibody to core antigen (anti-HBc), and antibody to surface antigen (anti-HBs)). A total of 1,353 cases met the inclusion criteria. The required sample size was calculated to be 1,302 cases, according to the finite population proportion described by Ngamjarus et al<sup>(13)</sup>.

Our data were collected from existing data recorded by the Occupational Health and Safety (OH&S) Office

between 2013 and 2016. The data included sex, occupation, date of birth, and blood test for hepatitis B markers (i.e., at the pre-placement examination and after the 3-dose series of HBV vaccination program).

Data were recorded using a double data entry program (Epi-info version 3.4.3) then analyzed using SPSS version 19.0 (IBM, Armonk, NY). Descriptive statistics were used to analyze characteristics of the sample (i.e., sex, date of birth, and hepatitis B immunization status). Our study results were presented as percentages, means, and medians based on the nature of the data.

The study was approved by Khon Kaen University Ethics Committee for Human Research (Ref No: HE601441).

## Results

Participants (1,302) were enrolled between 2013 and 2016. The majority were female (72.4%) and 57.5% (n = 748) were born after 1992. Most participants had direct contact to HBV (68.1%, n = 887); the top three occupations at risk of direct contact to HBV were medical doctors (41.9%, n = 372), followed by nursing professionals (40.5%, n = 359), and paramedical practitioners (6.5%, n = 58) (Table 1). The detailed data from the pre-placement examination for the direct contact group revealed that the majority (74.7%, n = 663) had immunity to HBV, 23.0% (n = 204) had no immunity to HBV, and the remaining 2.3% (n = 20) were currently HBV infected. Between 2013 and 2016, immunity to HBV amongst HWs having direct contact with BBPs trended upward. Those having immunity to HBV at their pre-placement examination rose every year from 2013 to 2016 (57.9% to 85.3%) whereas there was a decline in non-HBV-immunized and HBV infection from 2013 to 2016 (38.1% to 14.0% and 4.0% to 0.6%, respectively). No one in

**Table 1.** General characteristics of participants between 2013 to 2016

Characteristics	2013 n = 376 n (%)	2014 n = 286 n (%)	2015 n = 471 n (%)	2016 n = 169 n (%)	2013 to 2016 total = 1,302 n (%)
Sex					
Male	83 (22.1)	78 (27.3)	149 (31.6)	50 (29.6)	360 (27.6)
Female	293 (77.9)	208 (72.7)	322 (68.4)	119 (70.4)	942 (72.4)
Date of birth					
Before 1992	209 (55.6)	135 (47.2)	181 (38.4)	29 (17.2)	554 (42.5)
After 1992	167 (44.4)	151 (52.8)	290 (61.6)	140 (82.8)	748 (57.5)
Occupation					
Direct contact	273 (72.6)	197 (68.9)	261 (55.4)	156 (92.3)	887 (68.1)
Medical doctor	81 (29.7)	70 (35.5)	125 (47.9)	96 (61.5)	372 (41.9)
Nursing professional	123 (4.5)	95 (48.2)	87 (33.3)	54 (34.6)	359 (40.5)
Nursing associate professional	27 (9.9)	4 (2.0)	22 (8.4)	2 (1.3)	55 (6.2)
Paramedical practitioner	23 (8.4)	14 (7.1)	18 (6.9)	3 (1.9)	58 (6.5)
Medical technologist	4 (1.5)	0.0 (0)	0.0 (0)	0.0 (0)	4 (0.5)
Physiotherapist	2 (0.7)	2 (1.0)	1 (0.4)	0.0 (0)	5 (0.6)
Cleaner	13 (4.8)	9 (4.6)	7 (2.7)	0.0 (0)	29 (3.3)
Dentist	0.0 (0)	3 (1.5)	1 (0.4)	0.6 (1)	5 (0.9)
Non-direct contact	103 (27.4)	89 (31.1)	210 (44.6)	13 (7.7)	415 (31.9)

our study had isolated hepatitis B core antibody (HbsAg negative, anti-HBs negative and anti-HBc positive) (Table 2).

The proportional immunity to HBV among HWs at pre-placement examination showed that of those born before 1992, 39.8% (n = 125) had immunity to HBV, 54.5% (n = 171) had no immunity to HBV, and 5.7% (n = 18) had HBV infection. Of those born after 1992 (n = 573), 93.9% (n = 538) had immunity to HBV, and 0.3% (n = 2) had HBV infection (Table 3).

The number of HWs who completed full doses (i.e., the 3-dose series) vaccination program was 204 cases. The respective number of HWs who received their first, second, and third dose vaccination on-time vs. delayed was 78.9% (n = 161) vs. 21.1% (n = 43). After receiving the complete vaccination series, the proportion of HWs who responded to the HBV vaccine (anti-HBs positive) was 89.7% (n = 183); among whom most received the vaccine on-time (86.8%, n = 183). The proportion who did not respond to the vaccine (anti-HBs negative) was 9.5% (n = 21) among whom most underwent delayed vaccination (90.5%, n = 19) (Table 4).

When assessing fit for work status, 95.4% (n = 846 cases) were fit for duty for exposure to BBPs (i.e., a rising trend from 90.8% to 96.8% over the period studied) while 4.6% (n = 41 cases) were fit for work albeit with conditions (i.e., a decline from 4.6% to 3.2% over the study

period) (Table 5).

## Discussion

HWs are at a greater risk of various blood-borne infections, including hepatitis B virus (HBV). Vaccination is effective in protecting 90-95% of adults<sup>(12)</sup>. To our knowledge, no prior studies in Thailand have investigated HBV immunity status as a fitness for duty program, and for management of HBV vaccination.

Most HWs in our study were female, as with previous studies<sup>(14,15)</sup>. According to 1992 Thai public health policy, an Expanded Program on Immunization (EPI) was implemented to ensure all newborns were given HBV vaccination<sup>(9)</sup>. Most of our participants were born during the vaccination era<sup>(16)</sup>.

We determined the overall immunity to HBV status at the pre-placement examination amongst HWs. The frequency of seroprevalence of hepatitis B surface antigen (HBsAg positive) was 2% (n = 20), which was lower than two previous studies in Thailand-i.e., at Lampang Cancer Hospital and a large governmental hospital (Lerdsin Hospital)-which found that the overall proportion of HBsAg positives amongst HWs was 9.5% and 3.4%, respectively<sup>(17,18)</sup>.

In our study, the reasons why the frequency of seroprevalence of hepatitis B surface antigen was lower than the studies by Luksamijarulkul et al. and Kunchaiwong et al is because most of the new HWs in our study were medical

**Table 2.** Proportion of hepatitis B virus immunization status amongst group with direct contact to HBV between 2013 to 2016

HBV immunization status	Group with direct contact to HBV				
	2013 n = 273 n (%)	2014 n = 197 n (%)	2015 n = 261 n (%)	2016 n = 156 n (%)	2013 to 2016 total = 887 n (%)
Immunized against HBV (anti-HBs +ve) (HBsAg -ve/anti-HBc +ve/anti-HBs +ve) or (HBsAg -ve/anti-HBc -ve/anti-HBs +ve)	158 (57.9)	156 (79.2)	216 (82.8)	133 (85.3)	663 (74.7)
Non-HBV-immunized (anti-HBs -ve) (HBsAg -ve/anti-HBc -ve/anti-HBs -ve)	104 (38.1)	37 (18.8)	41 (15.7)	22 (14.1)	204 (23.0)
HBV infected (HBsAg +ve) (HBsAg +ve/anti-HBc -ve/anti-HBs -ve)	11 (4.0)	4 (2.0)	4 (1.6)	1 (0.6)	20 (2.3)

**Table 3.** Proportion of hepatitis B virus immunization status at pre-placement examination between 2013 and 2016 vis-a-vis date of birth

Date of birth	HBV immunization status at pre-placement examination		
	immunized against HBV (anti-HBs +ve) n/total (%)	Non-HBV-immunized (anti-HBs -ve) n/total (%)	HBV infection (HBsAg +ve) n/total (%)
Born before 1992 (n = 314)	125/314 (39.8)	171/314 (54.5)	18/314 (5.7)
Born after 1992 (n = 573)	538/573 (93.9)	33/573 (5.8)	2/573 (0.3)

**Table 4.** Hepatitis B immunization status after completion of 3-dose HBV vaccination amongst HWs with direct contact to HBV not immunize at pre-placement

Hepatitis B immunization status after vaccination	Group of direct contact to HBV not immune to HBV at pre-placement				
	2013 total = 104 n (%)	2014 total = 37 n (%)	2015 total = 41 n (%)	2016 total = 22 n (%)	2013 to 2016 total = 204 n (%)
Responders to HBV vaccination	90 (86.5)	36 (97.3)	39 (95.1)	18 (81.8)	183 (89.7)
Compliance					
On-time	85/90 (94.4)	27/36 (75.0)	32/39 (82.1)	15/18 (83.3)	159/183 (86.8)
Delay	5/90 (5.6)	9/36 (25.0)	7/39 (17.9)	3/18 (16.7)	24/183 (13.2)
Non-responders to HBV vaccination	14 (13.5)	1 (2.7)	2 (4.9)	4 (18.2)	21 (10.3)
Compliance					
On-time	2/14 (14.3)	0/1 (0)	0/2 (0)	0/4 (0.0)	2/21 (9.5)
Delay	12/14 (85.7)	1/1 (100.0)	2/2 (100.0)	4/4 (100.0)	19/21 (90.5)

**Table 5.** Pre-placement assessment in group with direct contact to HBV between 2013 and 2016

Pre-placement assessment	Group of direct contact to HBV				
	2013 total = 273 n (%)	2014 total = 197 n (%)	2015 total = 261 n (%)	2016 total = 156 n (%)	2013 to 2016 total = 887 n (%)
Fit for duty	248 (90.8)	192 (97.5)	255 (97.7)	151 (96.8)	846 (95.4)
Fit with restrictions for performing invasive (exposure-prone) duties	25 (9.2)	5 (2.5)	6 (2.3)	5 (3.2)	41 (4.6)

students from the Faculty of Medicine or nursing students from the Faculty of Nursing, Khon Kaen University [Lerdrumpattana S, pers. comm., 2017], where most of them received the HBV vaccination after they passed their pre-clinical classes. This program has been implemented since 2006. By contrast, Luksamijarulkul et al and Kunchaiwong et al randomly studied immunity to HBV periodically and without knowing the baseline immunity to HBV<sup>(16,17)</sup>. Thus, HWs would, moreover, have no immunity to HBV and did not undergo a 3-dose series vaccination due to discrepancy of immune information.

In the current study, at the pre-placement examination, 74.7% (663 cases) of those who had direct contact with BBPs had immunity to HBV while the remaining of 23.0% (204 cases) had none. Thus, 23.0% of the direct contact group remained at high risk of acquiring HBV infection<sup>(19)</sup>. Our study, however, found that sero-protection against HBV has trended higher every year from 2013 to 2016, whereas those lacking immunity to HBV but infected declined. In the first phase of a pilot project by the Occupational Health & Safety (OH&S) Office at the Faculty of Medicine, Khon Kaen University provided HBV vaccine to HWs who had no HBV immunization. This policy was inconsistent with the ministerial regulation (2004) requiring employers provide a pre-placement examination for employees, as it did not cover the cost of HBV vaccination. As such, the hospital management focused on a post-exposure

vaccination program. In 2007, a pre-placement examination policy at Srinagarind Hospital was introduced requiring that all new HWs without any HBV immunity or those working on high-risk units (i.e., surgery, semi intensive care, medical laboratory) be vaccinated. After the period 2013 to 2015, a budget providing for a pre-placement examination and HBV vaccines was supported. The budget provision was reduced in 2016, so that fewer HWs were examined in 2016. An occupational health program under a well-managed organization together with law enforcement affected the proportional immunity to HBV (Table 2).

Further analysis revealed the majority of HWs who were born before 1992 had no HBV immunity at the pre-placement examination, while HWs who were born after 1992 did. A similar result was reported in a previous study<sup>(20)</sup>. Meanwhile Chongsrisawat et al and Jutavijittum et al reported that coverage of HBV vaccination given to newborns varies (65.7% to 98.3%) as does completion of the HBV vaccination series (urban 89.1% vs. rural 46.9%)<sup>(16,21)</sup>. Our study revealed that HWs born before the vaccination era had a higher proportion of not having HBV immunity at pre-placement; thus, HWs should have a blood test for HBsAg, anti-HBc, anti-HBs before starting work (a) in endemic areas, and with (b) intravenous drug users, (c) persons having multiple sexual partners, (d) those who are immune-compromised host and (e) those requiring hemodialysis<sup>(15,22-25)</sup>.

Our study found that seroprotection (anti-HBs positive) achieved after HBV vaccination was 89.0%. This is similar to levels reported internationally<sup>(26)</sup> and in Thailand<sup>(27)</sup>. In our study, we found that higher seroprotection was found in 2014 and 2015 (under the accelerated vaccination program delivered at 0, 7, and 21 days)<sup>(3,27)</sup> compared to 2013 (the standard hepatitis B vaccination program delivered at 0, 1, and 6 months)<sup>(4,27)</sup>, and 2016 (when both programs were used). As with the previous study, Simarugumpai et al reported that the accelerated 3-dose HBV vaccination program was effective and had good compliance (viz., 100%, 83%, 87%) compared to the standard HBV vaccination program (70%, 73%, 83%)<sup>(27)</sup>. Bosnak and colleagues showed that the accelerated HBV vaccination program evoked an anti-HB titer more rapidly than the standard vaccination program, without any significant difference in the seroprotection rate after one year<sup>(28)</sup>. These studies show that the accelerated HBV vaccination program against hepatitis B virus induces a high rate of seroconversion and that it is suitable for new HWs not immune to HBV at high risk for HBV infection<sup>(15,22-25,29)</sup>.

From the point of view of the occupational medicine, fitness for duty is a medical assessment done by an occupational medicine doctor for evaluation of a worker's capacity to work without risk to him/herself or others<sup>(30)</sup>. Although our study found that 21 HWs were non-responders to the vaccine and 20 HWs had HBV infection, the policy on how to manage this is unclear (i.e., whether to restrict or limit their work) varies between countries even those that follow the CDC guideline (i.e., non-responders are fit for duty albeit with restrictions on performing invasive (exposure-prone) duties. Those with seroprevalence HBsAg should know their hepatitis B e-antigen (HBeAg) status and if they are seroprevalence HBeAg, they need to seek counsel from and perform duties under the guidance of an expert review panel and should notify patients in advance regarding the provider's seropositivity<sup>(19)</sup>.

Effective management through an occupational health program is needed to reduce the risk of exposure to blood-borne pathogens. We thus recommend that all hospitals require both a pre-placement examination and a HBV vaccination program.

## Conclusion

Following the national occupational health recommendation, the trend in seroprotected against hepatitis B virus has been increasing annually such that there is a growing proportion of health workers fit for duty with BBPs.

## What is already known on this topic?

In Thailand, the prevalence of hepatitis B virus infection patterns are intermediate to high and hepatitis B virus vaccination is not compulsory for health workers. A Hepatitis B vaccination program is available on a voluntary basis. Even though Occupational and Safety Management was mandated in 2006, some government hospital administrators do not seem to be aware of this regulation.

## What this study adds?

An occupational health program under a well-managed organization together with law enforcement affected the proportional immunity to HBV. As HWs are a high-risk occupation, assessment for fitness for duty is necessary.

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## Potential conflicts of interests

The authors declare no conflicts of interest.

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