

# An Estimation of The Occupational Risk of HBV, HCV and HIV Infection Among Indonesian Health-care Workers

**Dwi Agustian\***, **Sri Yusnita\*\***, **Herman Susanto\*\***, **Hadyana Sukandar\***,  
**Antoon De Schryver\*\*\***, **Andre Meheus\*\*\***

\* Department of Epidemiology and Biostatistics, Faculty of Medicine, Padjadjaran University. Jl. Pasirkaliki no. 190, Bandung, Indonesia. \*\* Health Research Unit, Hasan Sadikin Hospital-Faculty of Medicine, Padjadjaran University, \*\*\* Department of Obstetrics and Gynecology, Hasan Sadikin Hospital, Bandung, Indonesia, \*\*\* Department Epidemiology & Social Medicine, University of Antwerpen, Belgium.

Correspondence mail to: [dwiagustian@yahoo.com](mailto:dwiagustian@yahoo.com)

## ABSTRACT

**Aim:** to estimate the occupational risk of HBV, HCV and HIV infections among Indonesian HCWs.

**Methods:** the model developed by WHO was used to calculate the risk. The input parameters were selected from the best available evidence in Indonesia through a literature review.

**Results:** in 2005, sharps injuries led to an estimated 1445 infections with HBV, 399 with HCV and 18 with HIV among health-care workers (HCWs) in Indonesia. The attributable fractions of these infections due to sharps injuries among HCWs in Indonesia were estimated to be approximately 44%, 47%, and 11% for HBV, HCV and HIV, respectively.

**Conclusion:** those data show that HCWs in Indonesia may face significant occupational risks of contracting viral hepatitis due to sharps injuries. In order to produce better estimates prospective studies in different health care settings are urgently needed.

**Key words:** sharps injuries, health care workers, Indonesia, HBV, HCV, HIV, bloodborne infections.

## INTRODUCTION

Health-care workers (HCWs) are at substantial risk of acquiring bloodborne pathogen infections through exposure to blood or infectious body fluids, including HBV, HCV and HIV infections. A study estimated that sixty-three percent of HCWs report at least 1 percutaneous injury (PI) with a mean number of 2.3 injuries annually and 4.2 injuries during their working lifetime.<sup>1</sup> Up to 1991, at least 33 HCWs had been reported to have contracted an HIV infection at work.<sup>2</sup> It was also estimated that about 66,000 HBV, 16,000 HCV and 1000 HIV infections may have occurred among HCWs worldwide in the year 2000 due to sharps injuries and that these infections would cause 1,132 premature deaths of HCWs by 2030.<sup>3</sup>

Transmission of bloodborne infections occurs among patients (unsafe injections), from patients to HCWs and, to a lesser extent, from HCWs to patients. In a recent review, the authors mentioned 26 viruses and 18 bacteria and rickettsia that have caused documented occupational infection following exposure to blood and body fluids, the most prominent being HBV, HCV and HIV.<sup>4</sup> Therefore, in this article, we will focus on the occupational risk of HBV, HCV and HIV. More than 90% of these infections are occurring in low-income countries, and most are preventable.

Sharps injuries and diseases transmission to HCWs is one of the occupational health problems, which are not a priority on the agenda of policy makers in most countries, especially in developing countries including Indonesia. The issue of bloodborne diseases due to sharps injuries to HCWs, including the size and nature of the problem, has not been adequately studied and reported, neither qualitatively nor quantitatively. Therefore, this

study was designed to estimate the occupational risk of HBV, HCV and HIV infections among Indonesian HCWs.

## METHODS

### Models Used

This study uses an estimation model of WHO, which allows to estimate the burden of disease from sharps injuries in HCWs.<sup>5</sup>

A first equation calculates the incidence of infection from sharps injuries to HCWs ( $I_{n(HCWs)} = 1 - (1 - p_s p_t p_v)^n$ )

The input parameters for the equation are the following:

- the number of HCWs at risk for a sharps injury ( $N(HCWs)$ )
- the proportion of HCWs susceptible to the infection ( $p_s$ )
- the rate of transmission of the infection following a sharps injury ( $p_t$ )
- the prevalence of active infection in the patient population ( $p_v$ )
- the average number of sharps injuries per HCW per year ( $n$ )

A second equation calculates the attributable fraction (AF) of occupational infection:

$$AF = \frac{I_{n(HCW)}}{I_{n(HCW)} + I_{b(HCW)}}$$

### where:

- AF = Attributable fraction.
- $I_n(HCW)$  = Incidence of infection from sharps injuries, for all health-care workers.
- $I_b(HCW)$  = Baseline incidence of infection in health-care workers.

### Parameters Sources

To give the best estimates, parameters used were chosen from the best evidence available, which were collected through an exhaustive literature searching conducted from October 2008 to January 2009 through the electronic bibliographic journal database Pub Med, various (e-) journals provided by the Library of Maastricht University, Maastricht, The Netherlands, and various relevant official websites for electronic reports and documents. Keywords from Mesh term were used for searching relevant studies published from 1987 to 2008. The following keywords were used: health care workers, immunization, HBV, transmission rate, HIV, HCV, sharps injuries, prevalence, patients, population,

incidence, hospital, post-exposure prophylaxis, Indonesia, South East Asia, Asia, developing countries. Keywords were combined by the Boolean operators “AND” and “OR” to search for the best references.

The number of HCWs in Indonesia was collected from Indonesia Health Profile Year 2005 which is an electronic official document provided by the website of Ministry of Health. The proportion of the HCW population specifically susceptible for HBV was determined using the regional estimates by WHO.<sup>5</sup> For providing the prevalence of the disease in the population or patients, scientific articles were screened for available data from Indonesia and 95 % confidence intervals for prevalence were calculated. The needle stick injuries rate was collected from a seminar presentation given in March 2007 at Hasan Sadikin General Hospital. The post exposure prophylaxis was considered not available in Indonesia. The transmission rates for each virus were derived from WHO estimates.

### Definition

Some terms related with the parameters are predetermined before to provide clarity and avoid ambiguity in literature searching. The number of health-care workers or  $N(HCW)$  was defined as the number of HCWs risk: those whose activities expose them to patients, or to blood or other body fluids from patients, in a health-care laboratory or public-safety setting. These include janitory staff, nurses and clinicians. Sharps injuries are injuries involving syringe needles, scalpels, broken glass and other objects contaminated with blood from a source patient.

### Study Population

The population at risk in this study consisted of all HCWs in Indonesia who were susceptible to HBV, HCV and HIV. They are working in the various health care settings, 1268 hospitals and 7669 health centres throughout the country. The health care facilities are spread over 33 provinces, 349 districts, and 5,263 sub-districts and serve a total population of approximately 220 million people. The proportion of HCWs at risk for HBV was estimated using the HBV immunization rate.

Since the objective of this study is to estimate the risk of infection among healthcare workers due to sharps injuries during year of 2005, all parameters were collected as close as possible to the year 2005.

## RESULTS

In table 1 the input parameters of the model are given. Based on the last available official information there are almost 500,000 HCWs in Indonesia. As the HBV

**Table 1. Input parameters**

Parameters	Sources	Finding
Number of HCW	Indonesia Health Profile Year 2005 <sup>10</sup>	427,393
HBV immunization rate among HCW	Rapiti et al; 2005 (SEAR B) <sup>5</sup>	39%
<b>Disease (Sero) prevalence</b>		<b>Type of population</b>
HBV	Van Hattum et al, 2003 <sup>11</sup>	1.9 (1.6-2.2)
	Sulaiman et al, 1995 <sup>6</sup>	8.8(7.9-9.7)
	Amirudin et al, 1991 <sup>12</sup>	10.4(3.6-17)
HCV	Sulaiman et al, 1995 <sup>6</sup>	2.1(1.7-2.6)
	Darmadi et al, 1996 <sup>7</sup>	2.3(1.7-2.9)
	Chanpong et al, 2002 <sup>13</sup>	39.0(31.2-46.8)
HIV	Rapiti et al, 2005 <sup>5</sup>	0.28
Needle stick injury rate	Antono SK, 2006 <sup>14</sup>	2.48 /HCW injured/year
<b>Transmission rate</b>		
HBV		30%
HCV	Rapiti et al, 2005 <sup>5</sup>	1.8%
HIV		0.3%

immunization rate varies from one place to another, it was considered more realistic to use the WHO regional estimate.<sup>5</sup> The prevalence of HBV and HCV was estimated to be 8.8% and 2.2%, respectively; based on two relatively recent studies in a population similar to hospital patients using a relatively large sample size (n=3839 and 2233, respectively).<sup>6,7</sup> The prevalence of HBV was directly derived from the study by Sulaiman;<sup>6</sup> the seroprevalence of HCV was derived using the midpoint of the prevalence of each study.

The resulting estimated number of infections is shown in table 2, and the fractions of those infections attributable to the occupation of HCWs are shown in table 3. They show that sharps injuries to HCWs resulted in 1,445 (461-5602) HBV infections, 399 (141-2123) HCV infections and 18 (3-92) HIV infections in Indonesia during the year 2005.

The data in table 3 show that approximately half of the HBV and HCV infections among HCWs can be attributed to sharps injuries, while for HIV infection, sharps injuries account for approximately 11%.

## DISCUSSION

The results of the calculation of the burden of disease among HCWs at the national level for Indonesia show that 1,445; 399 and 18 infections of HBV, HCV and HIV respectively among HCWs could be due to sharps injuries during the year 2005. Compared with the

WHO estimates for the South-East Asia subregion B (SEAR B) as given in table 2, the estimate of HBV, HCV and HIV infections is slightly lower. In table 3, the attributable fractions from the study are compared to the regional (SEAR B) and global attributable fraction estimates from WHO. From this comparison, it can be concluded that the attributable fraction for HCV is somewhat lower for Indonesia than for SEAR B, but that they are higher for HBV and HIV for Indonesia than for SEAR B. These differences are caused by the use of different parameters.

In general, the number of sharps injuries among HCWs in Indonesia is slightly higher than from regional estimate (2.48 versus 2.08). Nevertheless, the number of HCWs and the prevalence of infection in patients, (except for HIV) are slightly lower and therefore contribute to lower estimate for all infections.

Based on the attributable fraction estimates, approximately half of HBV and HCV infections among HCWs are attributed to sharps injuries. However, the actual annual number of HBV infections among HCWs due to sharps injuries (1,445) is highest in absolute numbers. This means that the highest burden of bloodborne disease for HCWs is due to HBV infections. This is consistent with the pattern of the regional (SEAR B) and global estimate. The large fraction of HBV infections due to sharps injuries indicates that promotion of an HBV vaccination program would be very promising in reducing the burden of diseases among HCWs. In

**Table 2. Infections attributable to sharps injuries among health-care workers**

Level	HBV (n)	HCV (n)	HIV (n)
Indonesia	1,445 (461-5,602)	399 (141-2,123)	18 (3-92)
Sear B	1,500 (480-6,100)	500 (180-2,700)	20 (3-90)
Global	65,600 (400-240,000)	16,400 (5,900-86,000)	1,000 (200-5,000)

**Table 3. Fractions of HBV, HCV and HIV infections attributable to sharps injuries in health-care workers**

Level	HBV (%)	HCV (%)	HIV (%)
Indonesia	44 (22-71)	47 (24-83)	10.7 (2.2-38)
SEAR B	40 (19-68)	51 (26-85)	9.8 (1.9-35)
Global	37 (18-65)	39 (19-78)	4.4 (0.8-18.5)

contrast, the HCV and HIV infections among HCWs were relatively low due to the low rate of transmission and the still low prevalence in the population.

This study addresses specifically the issue of the burden of diseases in Indonesia, however, the result still has some uncertainties due to a number of factors that will be discussed below. Due to constraints with regard to the availability of the data, not all the input parameters referred to the same period of time or year. The size of HCWs is for the year 2005 and the number of sharps injuries is for the year 2006, but this should be no source of bias as sharps rates tend to be stable over short periods.<sup>8</sup>

The number of HCWs is available but their exact place of work is not known (hospital or other health care facilities such as community health centre). This may influence the estimate; since the WHO guideline applies rather to hospitals than to other health care facilities. Other health care facilities such as community health centres or small hospitals possibly have different working conditions, which influence several parameters such as number of sharps injuries and HBV immunization coverage. Consequently, this will lead to different estimates among different health care facilities. Therefore, it would be interesting to have more specific data on HCWs in Indonesia.

We could not find published studies on vaccination rates, both from general population and HCWs in Indonesia from our literature search. Therefore, the regional estimate for SEAR B of WHO was used to provide the best estimate of the rate.<sup>5</sup> This also contributes to the uncertainty of estimates and it would be interesting to have data from Indonesia on this point.

The number of sharps injuries per HCWs per year is derived from a retrospective study, which may have recall bias. Up to now, no prospective studies or surveillance data have been published. Available studies did not mention sample size calculations or confidence intervals. Underreporting is an important issue. There are no specific data for each job category that may have different number of sharps injuries due to different occupational risk. If the HCWs also work at other health care facilities (not at hospital), the rate of sharps injuries also might be different.

In Indonesia national statistics for HBV and HCV prevalence and incidence are not available; studies that report the prevalence of HBV and HCV generally cover a specific population (children, pregnant women, voluntary blood donors...), as given in table 1. These study populations might not be representative for the general population. The different areas where the studies were conducted also may cause some geographic variation; therefore, generalization of the results may not be possible. The available studies also were not designed primarily as a survey and do not report calculation of sample size and other statistical estimates such as confidence interval and study precision, which are important indicators for the quality of a prevalence study.

The national data or statistics are only available for HIV prevalence in susceptible groups in the community. For HIV government data are based on routine surveillance leading to underreporting and resulting in very low numbers. Therefore the estimate of HIV prevalence from WHO was considered more reliable and was used in this study.

In general, studies of sharps injuries are rarely conducted in South East Asia, and not all the available studies may be of high quality.

In Indonesia, studies are often conducted locally and are published either in local journals or only in abstract format. These sources could not be retrieved due to practical and administrative constraints. This is an important obstacle for a critical appraisal in order to select a best estimate for the burden of diseases due to sharps injuries at national level. Systematic review is not feasible and therefore, the input variables only could be analyzed qualitatively.

In order to estimate disease prevalences, a Delphi technique may be beneficial when there are no published documents. However, due to the time limitation and practicality, it was not feasible to involve an expert panel to estimate input parameters for the burden of diseases from sharps injuries.

## CONCLUSION

In conclusion, using a validated method proposed by WHO, we estimated that there were 1445, 339 and 18 infections of HBV, HCV and HIV, respectively, among HCWs due to sharps injuries during the year 2005 in Indonesia. The attributable fractions of disease from sharps injuries among HCWs in Indonesia are 44%, 47 %, and 10.7% for HBV, HCV, and HIV, respectively. Even when we take into account the limitations of the study, the country is still confronted with an enormous

burden of blood borne infections due to sharps injuries. As most of these infections are preventable, interventions should be set up in order to reduce this burden.

While post-exposure prophylaxis of HCV and HIV infection associated with sharps injuries is expensive, simple measures are available to engage in effective primary prevention of sharps injuries. These measures include the standard precautions for infection control, which should be tailored to the local working conditions.

Taking into account that the largest number of occupation-related bloodborne infections is due to HBV, programmes to immunize HCWs at risk for sharps injuries against HBV should be considered.<sup>9</sup> Successful implementation of these prevention measures will result in a large progress for HCW's health and safety. However, to be able to evaluate such programmes, prospective studies in different health care settings are urgently needed.

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