Healthcare Worker Adherence to Follow-up After Occupational Exposure to Blood and Body Fluids at a Teaching Hospital in Brazil

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ABSTRACT
Healthcare workers (HCWs) are at a high risk for exposure to pathogens in the workplace. The objective of this study was to evaluate HCW adherence to follow-up after occupational exposure to blood and body fluids at a tertiary care university hospital in the city of São Paulo, Brazil. Data were collected from 2102 occupational exposures to blood and body fluids reports, obtained from the Infection Control Division of the Universidade Federal de São Paulo/Escola Paulista de Medicina/Hospital São Paulo, in São Paulo, Brazil, occurring between January of 2005 and December of 2011. To evaluate adherence to post-exposure follow-up among the affected HCWs, we took into consideration follow-up visits for serological testing. For HCWs exposed to materials from source patients infected with human immunodeficiency virus (HIV), hepatitis B virus (HBV), or hepatitis C virus (HCV), as well as from source patients of unknown serological status, follow-up serological testing was scheduled for 3 and 6 months after the accident. For those exposed to materials from source patients co-infected with HIV and HCV, follow-up evaluations were scheduled for 3, 6, and 12 months after the accident. During the study period, there were 2056 accidental exposures for which data regarding the serology of the source patient were available. Follow-up evaluation of the affected HCW was recommended in 612 (29.8%) of those incidents. After the implementation of a post-exposure protocol involving telephone calls and official letters mailed to the affected HCW, adherence to follow-up increased significantly, from 30.5 to 54.0% (P = 0.028). Adherence was correlated positively with being female (P = 0.009), with the source of the exposure being known (P = 0.026), with the source patient being HIV positive (P = 0.029), and with the HCW having no history of such accidents (P = 0.047). Adherence to the recommended serological testing was better at the evaluation scheduled for 3 months after the exposure (the initial evaluation) than at those scheduled for 6 and 12 months after the exposure (P = 0.004). During the study period, there was one confirmed case of HCW seroconversion to HCV positivity. The establishment of a protocol that involves the immediate supervisor of the affected HCWs, in the formal summoning of those HCWs is necessary in order to increase the rate of adherence to post-exposure follow-up.

KEYWORDS: accidental exposure; blood and body fluids; bloodborne pathogens; follow-up; healthcare workers; hepatitis C seroconversion; occupational exposure
INTRODUCTION

Healthcare workers (HCWs) are constantly at risk in the workplace, the principal risk being that of accidental exposure to potentially contaminated blood and body fluids. The pathogens that can be transmitted include the hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV), all of which pose major threats to the health of HCWs (Kuruuzum et al., 2008).

According to the U.S. Centers for Disease Control and Prevention, HCWs in the USA suffer an estimated 385,000 percutaneous injuries (from needles or other sharps) every year, or an average of 1000 such accidents per day (Panlilio et al., 2004). According to the Brazilian Case Registry Database, 96,113 cases of HCW exposure to blood and body fluids were reported in Brazil between 2007 and 2010, the incidence in 2010 being 16.6 accidents/1000 HCWs nationwide (Centro Colaborador em Vigilância dos Accidentes de Trabalho, 2011).

After accidental occupational exposure to blood and body fluids, it is extremely important that HCWs undergo follow-up evaluations for the detection and early treatment of acute infection, especially in cases of seroconversion to HCV positivity. In cases of exposure to blood-borne pathogens, the efficacy of post-exposure treatment has been shown to correlate positively with the completion of follow-up (Behrman et al., 2001).

Accidental exposure to blood and body fluids poses serious risks for the affected HCWs and calls for appropriate post-exposure follow-up. Therefore, the objective of this study was to evaluate HCW adherence to follow-up after such accidents, as well as the factors related to non-adherence.

METHODS

Study design and sampling

This was a cohort study conducted at the Hospital São Paulo, a 780-bed tertiary healthcare facility in the city of São Paulo, Brazil, operated by the Universidade Federal de São Paulo/Escola Paulista de Medicina. At the Hospital São Paulo, HCWs who are exposed to potentially contaminated blood and body fluids by percutaneous injuries, mucous membrane exposures, non-intact skin exposures and bite exposures, follow a pre-established protocol that calls for local treatment of the affected site, immediate reporting of the accident to their immediate supervisor, and notification of the Infection Control Division, which evaluates the case, making recommendations regarding post-exposure prophylaxis (PEP) and follow-up. Immediately after the exposure, blood samples are collected from the source patient and from the affected HCW. The source patient blood is submitted to rapid HIV testing. The source patient and HCW blood samples are both submitted to serological testing for infection with HIV (HIV antibody reactive), HBV (HBsAg positive), and HCV (anti-HCV positive), in order to determine the serological status of both parties at the time of the accident.

For HCWs exposed to materials from source patients infected with HIV, HBV, or HCV, as well as from source patients of unknown serological status, follow-up serological testing is scheduled for 3 and 6 months after the accident. For those exposed to materials from source patients co-infected with HIV and HCV, follow-up evaluations are scheduled for 3, 6, and 12 months after the accident. Follow-up of the HCW is not recommended after an accident involving a source patient who tests negative for all of the above.

We evaluated all 2102 cases of occupational exposure to blood and body fluids reported to the Hospital São Paulo Infection Control Division between January 2005 and December 2011, using data obtained from the corresponding accident reports. From among those 2102 cases, we selected only those in which the source patients tested positive for HIV, HBV, or HCV, as well as those in which the serological status of the source patient was unknown. Therefore, the initial study sample comprised 612 cases of exposure in which follow-up evaluation was warranted.

To evaluate adherence to post-exposure follow-up, we looked at how many of the affected HCWs underwent the scheduled serological testing at 3, 6, and (if warranted) 12 months after the exposure, as well as analyzing the variables related to each accident. The follow-up was considered complete when the affected HCW submitted to all or to at least the last of the post-exposure evaluations scheduled. All other situations were defined as cases of non-adherence. Among the HCWs who were accidentally exposed to potentially contaminated blood and body fluids in 2010 and 2011, those who failed to appear for any of the
scheduled evaluations were formally summoned, by telephone and by mail (official letter).

**Statistical analysis**
The data were analyzed with the Statistical Package for the Social Sciences, version 17.0 (SPSS Inc., Chicago, IL, USA). Correlations related to categorical variables were quantified with the chi-square test or Fisher’s exact test, as indicated. Trends were evaluated with the Cochran-Armitage test in conjunction with the Statistical Analysis System software, version 9.2 (SAS Institute, Cary, NC, USA). Differences between the time points (scheduled evaluations), in terms of the categorical variables, were determined by McNemar’s test. For all statistical tests, values of \( P < 0.05 \) were considered significant.

**Ethical considerations**
This study conducted at the Hospital São Paulo was done after ethical approval from Ethical Committee of Universidade Federal de São Paulo, study number 0597/11.

**RESULTS**
Among the 2102 cases of accidental exposure reported during the study period, information about the source patient was available in 2056. Among those 2056 post-exposure follow-up was recommended in 612 (29.8%). In the 2005–2009 period (prior to the implementation of the policy of contacting affected HCWs via telephone and official correspondence), the mean rate of adherence to post-exposure follow-up was 33.2%, compared with 54% in the post-implementation period (2010–2011), and the difference was significant (\( P = 0.028 \)).

Of the 612 affected HCWs, 478 (78.1%) were female. Of those 478 females, 183 (38.2%) completed the post-exposure follow-up, compared with only 35 (26.1%) of the 134 male HCWs (\( P = 0.009 \)). The serological status of the source patient was known in 286 (46.7%) of the 612 cases (Table 1). The post-exposure follow-up was completed in 115 (40.2%) of those cases, compared with only 103 (31.6%) of the 326 cases in which the serological status of the source patient was unknown (\( P = 0.026 \)). Table 2 shows the rates of HCW adherence to post-exposure follow-up by serological status of the source patient. Of the 124 HCWs exposed to material from an HIV-infected source patient, 62 (50.0%) completed the post-exposure follow-up (\( P = 0.029 \) versus the other serological profiles). Among the 242 cases in which the affected HCW had previously suffered accidental exposure, the post-exposure follow-up was completed in 75 (31.0%), compared with 143 (38.9%) of the 368 cases in which the affected HCW had no such history (\( P = 0.047 \)).

The rate of HCW adherence to post-exposure follow-up diminished with the passage of time after the accident. For the 612 evaluations scheduled for 3 months after the exposure, the rate of adherence was 43.5%, compared with 36.6% for the 612 scheduled for 6 months after the exposure and 24.0% for the 25 scheduled for 12 months after the exposure. In terms of the rate of adherence, there was a trend toward a significant reduction between the 3- and 12-month evaluations (\( P = 0.004 \)), as well as between the 3- and 6-month evaluations (\( P = 0.001 \)) and between the 6-month and 12-month evaluations (\( P = 0.031 \)).

We found that adherence to post-exposure follow-up did not correlate with the following variables: the

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**Table 1. Healthcare worker adherence to follow-up after accidental exposure to potentially contaminated blood and body fluids, from source patients of known and unknown serological status**

<table>
<thead>
<tr>
<th>Post-exposure follow-up</th>
<th>Serological status of the source patient</th>
<th>( \text{Known} )</th>
<th>( \text{Unknown} )</th>
<th>( \text{Total} )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Affected HCWs, ( n ) (%)</td>
<td>Affected HCWs, ( n ) (%)</td>
<td>Affected HCWs, ( n ) (%)</td>
<td></td>
</tr>
<tr>
<td>Complete</td>
<td>115 (40.2)*</td>
<td>103 (31.6)</td>
<td>218 (35.6)</td>
<td></td>
</tr>
<tr>
<td>Incomplete</td>
<td>171 (59.8)</td>
<td>223 (68.4)</td>
<td>394 (64.4)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>286 (100.0)</td>
<td>326 (100.0)</td>
<td>612 (100.0)</td>
<td></td>
</tr>
</tbody>
</table>

\( *P = 0.026 \) versus cases in which the serological status of the source patient was unknown.
professional category of the HCW affected; the type of accident; the time to reporting; the time of day at which the accident occurred; and the type of material (blood and body fluids) to which the HCW was exposed.

During the study period, there was one confirmed case of HCW seroconversion to HCV positivity, which was identified in the serological testing performed at the 6-month evaluation and confirmed by polymerase chain reaction. Given that there were 151 cases of exposure to material from patients infected or co-infected with HCV during the study period, the rate of seroconversion to HCV positivity was 0.66%. That case, in an HCW on the nursing staff, was attributed to a percutaneous stick from a needle that had been used in the collection of arterial blood. The blood had been collected from a patient who was known to be HCV-infected, and the needle had been discarded in an inappropriate location. It was not possible to compare the two HCV strains (that infecting the HCW and that infecting the source patient) by molecular biology techniques because the patient has already been discharged.

**DISCUSSION**

Accidental occupational exposure to potentially contaminated blood and body fluids can have serious consequences for HCWs, because of the risk of seroconversion, mainly to positivity for HIV, HBV, or HCV (Kuruuzum et al., 2008). In addition to the timely reporting of such accidents, which increases the effectiveness of prophylaxis, post-exposure follow-up of cases in which the source patient tests positive for one or more pathogens or in which the serological status of the source patient is unknown is extremely important, so that cases of seroconversion can be detected as early as possible, thereby avoiding the serious consequences of chronic infections.

The standard operating procedure of Hospital São Paulo for cases of such exposure was established in 1992 and has been widely accepted and disseminated. However, the rate of HCW adherence to post-exposure follow-up was lower than was expected. It therefore became necessary to make a more in-depth analysis of the factors responsible for HCW non-adherence to follow-up.

In the present study, we found that many HCWs did not complete the post-exposure follow-up, even after being contacted by telephone and official correspondence, a finding that is in agreement with those of other studies (Schmid et al., 2007). After the implementation of the new protocol (involving telephone calls and official correspondence to the affected HCWs), there was a significant increase in the rate of HCW adherence to post-exposure follow-up, which rose to 54.0%. In other studies involving similar protocols, the reported rates of HCW adherence to post-exposure follow-up range from 47.0 to 89.4% (Miceli et al., 2005; Ferreira et al., 2012). Even in studies that make no mention of any official summons of the affected HCWs, adherence rates of 40.0–76.0% have been reported (Gutierrez et al., 2005; Almeida and Benatti, 2007; Davanzo et al., 2008; Ko et al., 2009).

### Table 2. Healthcare worker adherence to follow-up after accidental exposure to contaminated blood and body fluids, by serological profile of the source patients

<table>
<thead>
<tr>
<th>Serological profile of the source</th>
<th>Complete</th>
<th>Incomplete</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Affected HCWs, n (%)</td>
<td>Affected HCWs, n (%)</td>
<td>Affected HCWs, n (%)</td>
</tr>
<tr>
<td>HIV-infected</td>
<td>62 (50.0)*</td>
<td>62 (50.0)</td>
<td>124 (100.0)</td>
</tr>
<tr>
<td>HBV-infected</td>
<td>3 (37.5)</td>
<td>5 (62.5)</td>
<td>8 (100.0)</td>
</tr>
<tr>
<td>HCV-infected</td>
<td>40 (33.3)</td>
<td>80 (66.7)</td>
<td>120 (100.0)</td>
</tr>
<tr>
<td>Co-infection among HIV, HBV, and HCV</td>
<td>10 (29.4)</td>
<td>24 (70.6)</td>
<td>34 (100.0)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>115 (40.2)</td>
<td>171 (59.8)</td>
<td>286 (100.0)</td>
</tr>
</tbody>
</table>

*P = 0.029 versus all other serological profiles.
In the present study, we found that HCW adherence to post-exposure follow-up correlated with certain variables, such as gender, serological profile of the source patient, the time from exposure to the scheduled evaluation, and HCW history of such exposure.

The HCWs evaluated here were found to be more likely to complete the follow-up if they were female. We found that knowing the serological status of the source patient correlated with an increase in adherence to post-exposure follow-up, as has been shown in other studies (Ko et al., 2009). Knowing the serological status of the source patient conveys to the affected HCW a real and palpable risk of transmission, which can cause HCWs to be more concerned with their health and submit to the follow-up evaluations, whereas exposure to material from a patient of unknown serological status represents only a subjective risk. We found that the rate of HCW adherence to post-exposure follow-up was higher after accidents involving source patients who were known to be HIV-infected. However, there are conflicting findings in the literature regarding this issue. According to Gutierrez et al. (2005), who evaluated 404 cases of HCW exposure to blood and body fluids at a teaching hospital, adherence to post-exposure follow-up increases when the source patient is known to be infected with HIV or HCV. Davanzo et al. (2008) evaluated 497 such cases and found that knowledge of HCV infection in the source patient was a determinant of increased HCW adherence to post-exposure follow-up.

Although affected HCWs are informed that the risk of seroconversion can persist for up to a year after the exposure, depending of the serological profile of the source, HCW adherence to follow-up was best at the initial follow-up evaluation (3 months after the accident). Adherence decreases in parallel with an increase in the number of scheduled post-accident evaluations, as was also demonstrated in a study conducted by Loureiro et al. (2009).

Our finding that HCW adherence to post-exposure follow-up correlated positively with a no history of such exposure is likely attributable to the fact that HCWs who have previously suffered exposure with no ill effects become more complacent about the potential consequences.

As previously mentioned, the rate of seroconversion to HCV positivity during our study period was 0.66%, which is comparable to the 0.5–1.8% reported in other studies (Puro et al., 1995; Centers for Disease Control and Prevention, 2001; Jagger et al., 2002; Henderson, 2003; Medeiros et al., 2012).

CONCLUSION

The rate of HCW adherence to post-exposure follow-up was lower than was expected. The establishment of a protocol that involves the immediate supervisor of the affected HCWs, regardless of the professional category, in the formal summoning of those HCWs is necessary in order to increase the rate of adherence to post-exposure follow-up. There is also a need for studies involving interviews with the affected HCWs, so that the motives for adhering or not adhering to the recommended practices can be elucidated.

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