ORIGINAL REPORT

Emergency Department Evaluations of Non-Percutaneous Blood or Body Fluid Exposures during Cardiopulmonary Resuscitation

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Abbreviations:
CDC = (US) Centers for Disease Control and Prevention
CPR = cardiopulmonary resuscitation
HCW = healthcare worker
HIV = human immunodeficiency virus
ICD-9 = International Classification of Disease, 9th Revision, Clinical Modification
PEP = post-exposure prophylaxis

Abstract

Introduction: The demography of healthcare workers (HCWs) and non-HCWs seeking medical care at emergency departments after a non-percutaneous potential exposure to human immunodeficiency virus (HIV) during cardiopulmonary resuscitation (CPR), the types and body locations of their exposures, the time elapsed from exposure to emergency department presentation, and usage of HIV-post-exposure prophylaxis (PEP) for these exposures are described.

Methods: A retrospective study of emergency department patients who were exposed to blood or body fluids during CPR in Rhode Island from January 1995–June 2001 was performed. The demography, characteristics of the exposure, and HIV-PEP usage for these patients were compared, and the elapsed time from exposure to evaluation in the emergency department was calculated.

Results: Of the 39 patients exposed to non-percutaneous blood or body fluid during CPR, 22 were healthcare workers (HCWs) and 17 were non-HCWs. Thirty-four patients sustained mucous membrane exposures. Most of the patients (69.2%) were exposed to saliva or sputum (p <0.001), experienced a mouth exposure (71.8%; p <0.0001) and presented to the emergency department within one day of their exposure (84.4%; p <0.0001). Three HCWs and no non-HCWs were offered HIV-PEP for their CPR exposure. Of the three HCWs offered PEP, two actually received it.

Conclusions: Nearly half of the patients who presented with non-percutaneous exposures acquired during CPR were not HCWs. Most of the exposures were to saliva or sputum and occurred on their mucous membranes. Continuing education programs on maintaining universal precautions to prevent blood or body fluid exposures and appreciating the benign nature of most non-percutaneous exposures possible during CPR are needed.

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Introduction

Cardiopulmonary resuscitation (CPR) is practiced by healthcare workers (HCWs) and by non-HCW bystanders who come to the aid of people in cardiopulmonary arrest. During CPR, resuscitators can be exposed to blood or body fluids in various ways, including blood splashes to the eyes and mouth from managing open wounds, and saliva or sputum splashes to the eyes and mouth from supporting ventilation. Although not the subject of this paper, resuscitators using percutaneous devices (needles or other sharps) during CPR can be exposed to blood or body fluids during the administration of medications or through other resuscitative efforts. These exposures potentially could subject the resuscitator to infections from a number of organisms, such as *Neisseria meningitidis*, *Mycobacterium tuberculosis*, and *Herpes simplex*.[1] Acquiring human immunodefi-

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ciency virus (HIV) infection through CPR is a considerable concern to HCWs[2–9] and non-HCWs,[10–12] and this concern may lead to a reluctance to perform CPR.

Between 1981 and the end of 2004, out of an estimated 1.2 million HIV/AIDS cases reported to the (US) Centers for Disease Control and Prevention (CDC), 57 HCWs in the United States were infected by HIV from an occupational exposure.[1,13,14] Three exposures occurred when the HCWs were performing CPR: two were from percutaneous injuries, and one involved prolonged contact between damaged skin and blood. Given that the vast majority of HIV infections in the US are not related to health care, the risk of acquiring HIV through CPR is extremely small. Bierens *et al* estimated the risk of HIV seroconversion to resuscitators from performing mouth-to-mouth ventilation during CPR in high (30%) and low (0.2%) HIV prevalence groups. The high seroprevalence group represented a population in which HIV infections might be common, such as injection-drug users. The low seroprevalence group represented patients >60 years of age, which is the age group more likely to require CPR. The risk of HIV seroconversion was one per one million resuscitations in the high seroprevalence group, and one per one billion resuscitations in the low seroprevalence group.[15]

The CDC has endorsed the use of HIV post-exposure prophylaxis (PEP) for HCWs potentially occupationally exposed to HIV since 1996.[16–19] In 2005, the CDC expanded these recommendations to non-HCWs exposed to known-HIV-infected sources.[20] The recommendations do not target mouth-to-mouth exposures specifically, but include other types of exposures that can occur during CPR. Despite these guidelines, it is unclear how often and for which exposures HIV-PEP has been utilized after CPR.

Healthcare workers and non-HCWs seeking medical care at an emergency department after a potential non-percutaneous exposure to HIV during CPR were described. Their demography, types of exposures, and body locations of the exposures were described, and the time elapsed from exposure to emergency department presentation was calculated. The use of HIV-PEP by HCWs and non-HCWs after CPR was reported.

Methods

Study Design

A retrospective study of emergency department visits for blood and body fluid exposures was conducted by directly reviewing patient medical records. All institutional review boards of the hospitals included in this research approved the study for expedited review with waivers of patient consent.

Study Setting

The study involved all 11 civilian emergency departments in Rhode Island that provide medical care to adult patients. These emergency departments comprise five general teaching hospitals (affiliated with a medical school and sponsor undergraduate and graduate medical education programs), five non-teaching (community) general hospitals, and one women's specialty care hospital. Emergency department visits for blood and body fluid exposures during January 1995–June 2001 were included in the study.

Case Selection

Hospital billing databases from each of the 11 hospitals were searched using *International Classification of Disease*, Ninth Revision, Clinical Modification (ICD-9)[21] codes to identify these visits. For blood and body fluid exposures, these codes primarily were V01.7 (exposure to other viral diseases), V01.8 (exposure to other communicable diseases), V07.8 (other specified prophylactic measure), V07.9 (unspecified prophylactic measure), and V15.85 (exposure to potentially hazardous body fluids). Three hospitals had separate emergency department provider and hospital billing databases. These separate billing databases were searched independently to maximize the capture of patient visits. For two of these hospitals, the provider database contained records from October 1997–June 2001 and for the remaining hospital, November 2000–June 2001. For these three emergency departments, the two databases were merged, duplicate records were removed, and a single list was generated. An additional hospital that only had a hospital billing database did not have records for review prior to 1998. Based on the data for 1998–2001, at most, this hospital likely would have evaluated one patient for CPR-related exposure in 1995–1997.

Data Collection and Processing

Medical records were examined to find all patient visits identified by the ICD-9 code-directed database query. Each medical record was reviewed, and visits that were for a CPR-related, non-percutaneous exposure were included in the study. For these visits, the gender of the patient, the occupation of the patient (indicating HCW or non-HCW), the type and location of the exposure, the HIV status of source (if known), the PEP regimen offered (if one was prescribed), the PEP regimen accepted by the patient, and the days elapsed from time of exposure to emergency department presentation, were recorded on a standard form. Healthcare workers were defined as any person employed in a healthcare setting. Each form was entered into an Epi Info 2002 (Centers for Disease Control and Prevention, 2002) database, and then a data comparison analysis was performed to verify that all forms were entered correctly. Incorrect entries were corrected, and subsequent analyses were performed on this verified database.

Data Processing

For statistical analysis, the database was transferred to STATA 8.2 (Stata Corporation, College Station, TX) using StatTransfer (Circle Systems, Seattle, WA). The analysis included calculating summary statistics of the demographic characteristics (age and gender), the types and body locations of exposures, and the time elapsed from exposure to emergency department presentation. Two-sample tests of binomial proportions were used to compare differences between groups. Differences were considered statistically significant at the $\alpha = 0.05$ level using two-tailed tests.

Results

CPR Exposure Cases

Thirty-nine of the 1,884 non-sexual blood or body fluid exposure cases identified through the ICD-9 code search

	HCWs	non-HCWs	Total
Number	n(%)=22	n(%)=17	n(%)=39
Demography			
Median age (in years) (range)	36 (17–60)	40 (17–65)	37 (17–65)
Gender			
Female	2	4	6
Male	20	13	33
Type of exposure			
Blood splash	2	4	6
Saliva or sputum	15	12	27
Other*	5	1	6
Exposure location			
Eye	2	0	2
Mouth	14	14	28
Skin	3	2	5
Mouth/Skin	1	1	
Mouth/Skin/Eye	2	0	2
Time since exposure			
<1 day	15	12	27
1–2 days	2	2	4
>2 days	1	0	1
Not recorded	4	3	7

Table 1—Demography, types of exposure, body location, and elapsed time from exposure for healthcare workers (HCW) and non-healthcare workers (non-HCW)
*Other exposures were to vomit or a combination of blood and saliva or sputum.

were non-percutaneous exposures sustained by people performing CPR. There were three exposures in 1995, eight in 1996, and six exposures per year for 1996 to mid-2001. Of the HCWs, most (19 of 22) were prehospital personnel (emergency medical technicians and firefighters), two were nurses, and one was a physician. For the 17 non-HCWs, five were police or correctional officers.

The demography, types of exposures, body locations of the exposures, and time elapsed from exposure to ED presentation for HCWs and non-HCWs are listed in Table 1. Of all of the patients in the sample, 56.4% were HCWs and 43.6% were non-HCWs.

There were more males than females (84.6% vs. 15.4%; p <0.0001). Compared to other types of exposures, most (69.2%) of the patients were exposed to saliva or sputum (p <0.001) and/or had a mouth exposure (71.8%; p <0.0001). Of those for whom the elapsed time since their exposure could be calculated, most presented to the emergency department within one day of exposure. (84.4%; p <0.0001).

Given the small sample size, HCWs and non-HCWs were similar in regards to their demography and exposure characteristics. There was a greater percentage of non-HCWs than HCWs with saliva or sputum exposures (70.6% vs. 68.2%), of non-HCWs who presented within one day of exposure (85.7% vs. 83.3%), and of non-HCWs with mouth exposures (88.2% vs. 77.3%).

Thirty-four (87.2%) of all patients had mucous membrane exposures. Four of these mucous membrane exposures were to blood. One HCW sustained a blood splash to the mouth, one HCW had a saliva or sputum exposure to the eye, and 12 had a saliva or sputum exposure to the mouth. Three non-HCWs had blood splashes to the mouth and 11 had saliva or sputum exposures to the mouth.

HIV-PEP

For every case, the HIV status of the source was unknown at the time of the emergency department presentation. Two HCWs and no non-HCWs were offered HIV-PEP for their exposure. The HCW who sustained a blood splash to the mouth received zidovudine as a HIV-PEP. It is notable that the zidovudine monotherapy was prescribed in March 1999 after this regimen no longer was recommended by the CDC.[17] Another HCW who was offered but declined HIV-PEP had a saliva or sputum exposure to the mouth.

Discussion

Patients presenting to the emergency department for an evaluation of non-percutaneous blood or body fluid exposures sustained during CPR were described. From this description, several interesting characteristics of the exposures and their subsequent emergency department management that demonstrate a need for further education on the prevention and management of these exposures were observed.

First, despite the long-standing attention given to HCWs who sustain blood or body fluid exposures, a large percentage of these patients were not HCWs. This finding suggests a need for continued instruction for non-HCWs on how to implement universal precautions to prevent exposures during CPR. It also demonstrates a need for emergency departments to be aware that their blood or body fluid exposure evaluation and treatment protocols should include provisions for non-HCWs.

Second, given the nature of CPR, the vast predominance of patients experienced exposures to saliva or sputum. Since it is well-established that saliva or sputum exposures do not result in HIV infection, HIV-PEP would not be required in these circumstances. This finding suggests that CPR providers should be reminded or taught that in the absence of blood, mouth-to-mouth resuscitation cannot result in HIV infection. Although the reasons why the patients in this study presented to the emergency department after their likely benign exposure is unknown; it is possible they were concerned they might acquire HIV from the exposure. Other studies have shown that house officers are reluctant to perform CPR due to this concern.[2–9]

Third, since most of the patients sustained saliva or sputum exposures, few even would be candidates for HIV-PEP. Moreover, none of the patients knew the HIV status of the source of their exposure. According to the CDC's HIV-PEP recommendations, HIV-PEP generally is not recommended when the HIV status of the source is unknown and the exposure is unlikely to result in an HIV infection.[19] In this circumstance, the decision to initiate HIV-PEP should be made on a case-by-case basis using other features known about the exposure and source of the exposure. Only a small number of patients in this study, particularly those who had blood splashes to mucous membranes, would be candidates for HIV-PEP. Contrary to this rationale, one patient was offered HIV-PEP when it was not indicated. In addition, a suboptimal regimen was prescribed for a patient with a potentially significant exposure. These findings suggest a need for emergency department clinicians to be more cognizant of national standards on the usage of HIV-PEP. It also is important to note that although more non-HCWs had blood splashes to mucous membranes than HCWs, none of these patients were offered HIV-PEP. This suggests a discrepancy in how emergency department clinicians make choices about prescribing HIV-PEP for non-HCWs, and demonstrates a need for teaching the importance of the uniform usage of HIV-PEP regardless of patient occupation.

State guidelines and the CDC provide excellent resources on the underlying science, rationale, indications, and suggested regimens for HIV-PEP and are available online.[18–20,22–24] In addition, the National Clinicians' Post-Exposure Prophylaxis Hotline (1-888-448-4911) is available for clinicians 24 hours per day, seven days per week, and provides advice on when and how to prescribe HIV-PEP. Educational modules based on these guidelines should be created. These guidelines also can be based on other resources that address the prevention of exposures during CPR and the existence and indications for the use of HIV-PEP. These modules would emphasize the importance of precautions to avoid blood or body fluid exposures, the small likelihood of risk of HIV or hepatitis transmission during CPR, the features of significant and non-significant blood or body fluid exposures, the need to seek an evaluation for significant exposures, and the option and limitations of using HIV-PEP.

Limitations

There are several limitations to this study. First, the study was a retrospective review of medical records and, as such, some of the records were incomplete. Furthermore, retrospective reviews involve interpreting prior events as collected by the evaluating clinicians, which are prone to error. Second, using billing codes to search for cases does not always capture all of the ED visits, since billing code errors can occur. As a result of the retrospective study design and use of billing codes to capture patients, CPR-related exposure cases likely were missed. Third, the small sample size of the study precluded complex or meaningful statistical comparisons. Fourth, current ED practice may have changed as time has passed since the HIV-PEP guidelines were released. Lastly, since this study was based on ED visits in Rhode Island, the results might not be accurately generalized to the rest of the country.

Conclusions

In this study, of the emergency department patients who reported a non-percutaneous blood or body fluid exposure during CPR, nearly half of the patients were not HCWs. Most were exposed to saliva or sputum, and most had exposures to their mucous membranes. For most of the CPR exposures, HIV-PEP was not indicated. Nonetheless, improved attention toward the management and evaluation of non-HCW exposures is needed. Continued educational programs for resuscitators on maintaining universal precautions to prevent blood or body fluid exposures and appreciating the benign nature of most exposures possible during CPR also are needed.

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