INNOVATION AND IMPROVEMENT

Blood and Body Fluid Exposures Among US Medical Students in Botswana

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INTRODUCTION: Medical students from resource-rich countries who rotate in resource-limited settings have little pre-departure experience performing procedures, and lack familiarity with local equipment. The risk of blood and body fluid exposures during such rotations is significant.

AIM: 1) Determine whether a simulation-based intervention reduced exposures among US medical students on a rotation in Botswana; 2) determine whether exposures were underreported; 3) describe exposures and provision of human immunodeficiency virus (HIV) post-exposure prophylaxis (PEP).

SETTING: University of Pennsylvania medical students who traveled to Botswana for a clinical rotation from July 2007 to February 2010 were eligible to participate.

PROGRAM DESCRIPTION: Twenty-two students participated in the simulation-based intervention.

PROGRAM EVALUATION: To evaluate the intervention, we used a pre/post quasi-experimental design and administered a retrospective survey. The response rate was 81.7% (67/82). Needlesticks were eliminated [8/48 (16.7%) to 0/19 (0.0%), p= 0.07]. Splashes were unchanged (6/48 [12.5%) to 3/19 (15.8%), p=>0.99]. Three students did not report their exposure. Fifteen exposures were reported to an attending, who counseled the student regarding HIV PEP. Three students did not take PEP because the exposure was low-risk.

DISCUSSION: Our intervention was associated with a decrease in needlestick exposures. Medical schools should consider training to reduce exposures abroad.

KEY WORDS: medical education-simulation; infectious diseases; international health; occupational health.
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INTRODUCTION

Students from resource-rich countries often travel to resource-limited settings. In 2008, 27.5% of graduating US medical students participated in a global health experience[1]; 60–70% of British students travel abroad.[2] Medical students from resource-rich settings may have minimal experience with common bedside procedures such as phlebotomy because of the availability of procedure teams and ancillary staff in the US. Equipment abroad may be unfamiliar, and needlestick safety devices are often unavailable. As a result, medical students from resource-rich settings are particularly susceptible to blood and body fluid exposures if performing procedures while abroad.

Little information exists about students' occupational risk when traveling to resource-limited countries. In one study of 148 British medical students who traveled abroad for electives, four students reported needlesticks or splashes, but only one reported the incident to their school and received HIV post-exposure prophylaxis (PEP).[3,4] This important topic has not been revisited recently, and interventions to address this problem have not been applied.

The study objectives were to 1) determine whether a simulation-based intervention reduced student exposures while on a rotation in a resource-limited setting; 2) determine whether any exposures were not reported when they occurred; 3) describe the exposures and provision of HIV PEP.

SETTING AND PARTICIPANTS

In 2006, the Government of Botswana and the University of Pennsylvania established the Botswana–UPenn Partnership. Along with physicians and other trainees, University of Pennsylvania medical students travel to Princess Marina Hospital, a tertiary care hospital in the capitol city of Gaborone, and nearby district hospitals, for six- to seven-week inpatient rotations. Students are active members of teams that care for mostly HIV-infected patients. Students perform procedures such as phlebotomy, intravenous catheter (IV) placement, lumbar puncture, thoracentesis, and paracentesis. Students receive instructions about what to do if they have an exposure: stop working, and call an in-country attending for counseling on HIV PEP. A supply of PEP is kept in the hospital.

Medical students from the University of Pennsylvania who traveled to Botswana for a clinical elective from July 2007 to February 2010 were eligible to participate. Students who rotate in Botswana are 3rd or 4th year medical students, and

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have completed all core clerkships and a sub-internship in medicine, emergency medicine, or pediatrics.

PROGRAM DESCRIPTION

Prior to this study, procedural training was available to University of Pennsylvania medical students, but was not specific to resource-limited settings. Students rotating in Botswana received a lecture on blood and body fluid exposures prior to departure, and many received a lecture and an orientation to supplies upon arrival.

Despite these measures, based on preliminary study data, exposures were occurring at a high rate. During the course of the study, we developed a comprehensive risk reduction curriculum. This curriculum was developed from a series of meetings with content experts, including several physicians who have experience supervising University of Pennsylvania Medical Students in Botswana, and physician leadership of the Penn Medicine Simulation Center.

Prior to departure, students participate in a four hour session at the simulation center. The session begins with a lecture on blood and body fluid exposure risk reduction, including strategies for handling contaminated needles without safety devices, such as bringing the sharps bin to the bedside and recapping using only one hand. Students watch the *New England Journal of Medicine* procedure videos,[5–8] and perform phlebotomy, IV placement, lumbar puncture, thoracentesis, and paracentesis on task trainers designed for these procedures, under instruction from physicians with experience in resource-limited settings. Students practice using equipment similar to what they will use in Botswana, such as IVs without retractable needles. Students also perform 10 phlebotomies on inpatients at the Hospital of the University of Pennsylvania supervised by a phlebotomist before departure. In Botswana, the first five phlebotomies and five IV placements are supervised by a physician prior to independent performance. Lumbar punctures, thoracenteses, and paracenteses always require supervision. This program was piloted in February 2009 and became mandatory in April 2009.

PROGRAM EVALUATION

We used a pre/post quasi-experimental design to evaluate the educational intervention. Students were surveyed in two groups based on their departure date: July 2007 to March 2009 (pre-intervention group, surveyed in May 2009) and April 2009 to February 2010 (intervention group, surveyed in April 2010). As needlesticks and splashes have greatly differing risks,[9] and may require different interventions, we analyzed them separately.

We administered a retrospective survey to students after they returned from Botswana. The survey was designed from literature reviews of other occupational exposure studies,[1,5,10–14] informal discussions with faculty, staff, and content experts in occupational medicine and infection control, and semi-structured focus groups of students who have traveled to Botswana. Surveys were conducted anonymously and confidentially online using LimeSurvey® version 1.85+, and were collected over one month. The survey was not pilot tested.

Blood and body fluid exposures were defined as either a needlestick (injury with a sharp object that was previously in contact with a patient's blood or body fluid and broke the student's skin) or a splash (patient's blood or body fluid in contact with the student's mucous membranes, such as the eye). Students were asked to describe each individual exposure, and were asked about whether the exposure was reported when it occurred, the circumstances surrounding the exposure, and whether PEP was taken. One student had a second splash exposure that is not reflected in these numbers.

The circumstances of reported and unreported exposures were described. We compared the proportion of subjects in the pre-intervention and intervention periods who had exposures overall, as well as the subgroups of exposures due to sharps and due to splashes. P values were calculated using the Fisher's exact test (OpenEpi, version 2.3).

This study was approved by the Institutional Review Board of the University of Pennsylvania Health System, and acknowledged by the Human Research and Development Committee of the Botswana Ministry of Health.

Of the 82 students who received the survey, 67 responded (response rate 81.7%; 48/60, 80% in the pre-intervention group, 19/22, 86% in the intervention group). Seventeen of 67 (25.4%) reported having a blood or body fluid exposure; eight were needlesticks, and nine were splashes. All splashes were eye splashes. Overall exposures decreased in the intervention group, but this did not reach statistical significance (14/48, 29.2% vs. 3/19, 15.8%, p=0.26). There were no needlesticks in the intervention group (8/48, 16.7% vs. 0/19, 0.0%, p=0.07), but splashes remained an issue (6/48, 12.5% vs. 3/19, 15.8%, p=>0.99).

Three exposures were not reported to an attending when they occurred, including the second splash exposure. Fifteen students reported the exposure to an attending. Twelve students took PEP. All received their first dose within an hour. The three students who reported their exposure but did not take PEP reported a low risk splash exposure, not lack of availability of medications or fear of side effects.

The eight students who had needlesticks were asked about potentially preventable circumstances that may have surrounded their exposure: two reported needle recapping, one reported needle disassembly, and one reported transferring blood or body fluid between containers. All students who had a needlestick reported wearing gloves during the procedure.

The 17 students who were stuck or splashed were asked about additional circumstances that may have applied to their injury: unexpected movement of the patient during the procedure (4), doing an urgent or emergent procedure (2), and doing a procedure without direct resident or attending supervision (5). Most sticks and splashes occurred during phlebotomy and IV placement (Table 1).

To understand how exposures affect students' experiences during the rotation, we asked students to check all of the following that applied: I felt embarrassed (9); I felt scared (9); I didn't want to tell anyone but I knew I had to (6); the exposure negatively impacted the rest of my trip (5); I felt less confident in my ability to do procedures (2); I didn't want to tell anyone so I kept it to myself (1); after the injury I was less likely to volunteer to do procedures (1). One student reflected, "Everyone found out … I felt socially isolated after my incident…I still feel humiliated."

Table 1. Type of Exposure by Procedure*

	Overall	Needlestick	Splash†
Phlebotomy	6	4	2
IV placement	6	3	3
Lumbar puncture	1	0	1
Thoracentesis	1	0	1
Paracentesis	0	0	0
Injection, IM or SQ	0	0	0
Suturing	0	0	0
Abscess drainage	1	1	0
Other (IV flush, skin biopsy, unspecified)	3	0	3

*Table includes student who had a second exposure while placing an IV.
†All splashes were eye splashes

DISCUSSION

Since the implementation of our intervention, no needlesticks have occurred among medical students traveling to Botswana. While these results did not reach statistical significance, they are clinically significant. To our knowledge, this is the first study to examine the effect of an intervention on exposures in medical students rotating abroad; the strong trend towards decreased exposures in the intervention group is encouraging. Our study also highlights students' potential reluctance to report exposures, and the negative impact of exposures on their experiences.

Exposures among medical students at home[16,17] and abroad[3,4,15] are well-documented and are not unique to our institution. Given the number of medical students from resource-rich countries who rotate abroad,[1,2] the magnitude of this problem is large, and its implications are far-reaching. Medical schools should implement methods to prospectively identify and characterize these exposures.

A simulation-based intervention is a first step in addressing exposures in medical students on clinical rotations in resource-limited settings. It is important to engage in ongoing quality improvement to address types of exposures that do not improve with the intervention, such as splashes. We are investigating causes of splashes among our students, and are revising our pre-departure curriculum to emphasize wearing goggles during all procedures.

Given students' negative feelings about their exposures, and some students' reluctance to report their exposures, our pre-departure curriculum now explicitly encourages students to report every exposure, and reassures them that they should not feel embarrassed, exposures are not their "fault," and that the administration wants to know about all exposures.

Although the generalizability of our findings has not been established, the environment at Princess Marina is typical of resource-limited settings in which medical students are expected to do procedures. Furthermore, simulation training is widely available at US medical schools. The incremental cost of running our simulation course is $100 per student, including supplies and instructors fees.

This study has several limitations. We did not collect data on the number of procedures done by each student to calculate the risk of an incident per procedure. Also, we did not collect data on goggle use among students who were splashed. The duration of follow-up after the intervention was one year, which resulted in a small sample size. Simulation training has been available to University of Pennsylvania medical students since 2006, and the University of Pennsylvania's Simulation Center opened in July 2008. As a result, some students may have had other simulation-based training prior to the intervention, although not specific to resource-limited settings, biasing our results towards the null.

The generalizability of the intervention was not established; this is an important target for future research. The application of the intervention was not uniform. Students traveling from April 2009 onwards were required to take the course. Students traveling in March 2009 were analyzed in the pre-intervention group. This group was offered a pilot course, and one student took it. The pre-departure phlebotomy and in-country supervision requirements were not fully implemented until August 2009. All of these factors make the groups appear more similar and bias towards the null.

Our pre/post study design limits our ability to control for improvements and other training experiences that may have occurred during the study period, despite our efforts to comprehensively identify all potentially confounding exposures. To our knowledge, there were no changes to phlebotomy equipment or procedures in Botswana, or phlebotomy training among medical students (excluding the intervention) during the entire study period.

The study intervention became mandatory when the University of Pennsylvania School of Medicine and the Botswana–UPenn Partnership reviewed this study's preliminary data. Therefore, a randomized controlled trial, which would have been the ideal methodology for evaluating the intervention, was not possible.

Our results highlight the neglected problem of medical student blood and body fluid exposures while on rotation in resource-limited countries. Our intervention is a simple and relatively inexpensive way to address this problem. Medical schools should consider implementing pre-departure simulation-based interventions and a monitoring system to assess the incidence of needlestick and splash exposures.

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Conflict of Interest: *None disclosed.*

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