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Original Research Article

Observed infection control compliance in a dental school:
A natural experimentPatrick L. Anders DDS, MPH*, Nora E. Townsend DDS, Elaine L. Davis PhD,
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Key Words:
Ebola virus disease**Objective:** The objective of this study was to determine student adherence to infection control policies at 1 dental school. A secondary objective was to determine the influence of Ebola virus disease (EVD)-related training on student infection control behaviors.**Methods:** An instrument to assess and record infection control behaviors was developed to reflect Centers for Disease Control and Prevention guidelines as well as current teaching. Third- and fourth-year dental students were observed during patient-care appointments and behaviors were recorded and analyzed. Behaviors observed before the EVD outbreak and subsequent mandatory in-service training were compared with behaviors observed after completion of the training.**Results:** Use of personal protective equipment was nearly universal. Overall compliance with infection control parameters was 88%. However, only a minority of students demonstrated no breaches of protocol. Most violations involved improper mask use and improper glove use during the intraoperative phase of an appointment and failure to wash hands after removing gloves. There were no significant overall differences in observed behavior pre- and post-EVD training.**Conclusion:** Overall compliance with recommendations was high but some areas showed room for improvement. Future training in infection control should focus on these areas. Training related to EVD had no influence on student behavior.© 2016 Association for Professionals in Infection Control and Epidemiology, Inc. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Infection control recommendations for dentistry were first published by the Centers for Disease Control and Prevention (CDC) in 1986,¹ last updated in 2003,² and have been widely disseminated to practicing dentists, dental educators, and state Boards of Dental Examiners.³

Compliance with infection control protocols in dental practice has been variable at best, both in the United States^{3,4} and in developing countries.⁵ Compliance in a school environment has also been less than ideal,⁶ and 1 study suggested a decrease over time for some parameters.⁷ In response to concerns expressed by clinical faculty at our institution, our original objective for this study was to determine student adherence to infection control policies at our dental school.

Most studies examining infection control behaviors in dental settings have relied on self-report.⁷⁻¹³ However, this method is open to bias and provides no objective assessment of actual

compliance. Self-reporting can lead to overestimation of a socially desirable behavior, and intention to comply has been shown to be more positive than compliance itself.⁶ Gordon et al¹⁴ went so far as to say that additional self-report studies “can offer little more to this field of research.” Therefore, we used direct observation to determine the level of dental student compliance with infection control protocols.

After several weeks of gathering data, the national news reported the Ebola virus disease (EVD) crisis in Africa, and the first case in the United States was reported on September 30, 2014.¹⁵ The emergence of EVD led to renewed attention to infection control protocols as well as to recommendations specific to management of patients who may be at risk of transmitting the virus.¹⁶ A new screening protocol for EVD was mandated by the acting commissioner of health for New York State on October 16, 2014.¹⁷ This mandate applied to our dental school. Online training in the use of personal protective equipment (PPE) related to EVD was also mandated for all faculty and students. Therefore, our study became a pretest-posttest quasiexperiment to determine if increased publicity as well as mandatory EVD screening and online training would affect student behaviors related to infection control.

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MATERIALS AND METHODS

Subjects

Subjects observed were third-year (D3) and fourth-year (D4) dental students assigned to the comprehensive care clinic. The data were gathered anonymously. This study was deemed exempt by the State University of New York at Buffalo Social and Behavioral Sciences Institutional Review (No. IRB00003128).

Instrument

An instrument to assess and record infection control behaviors was developed using items designed to reflect CDC guidelines as well as current teaching. Items were reviewed for face validity by 3 clinical faculty members in the Department of Oral Diagnostic Sciences. The faculty reached consensus that the items reflected behaviors that were observable and represented best practices in infection control. The final instrument consisted of 13 items related to infection control behaviors.

Data collection

D3 and D4 dental students were assigned to operatories by senior dental assistants who were unaware of this research. The investigator collecting the data used an available operatory to observe behavior of students in neighboring operatories. Thus, students were selected for observation based on chair assignment and proximity to an operatory that permitted such observation.

Data were collected 2 days per week over a period of 24 weeks. D4 students were in clinic both of these days, and D3 students were in clinic 1 of the 2 days. Of the 214 observed encounters, 155 were with D4 students and 55 with D3 students. Ninety-four encounters occurred before the implementation of the mandated EVD protocol on September 27, 2014, 27 encounters occurred while the screening and training initiatives were being implemented, and 93 encounters occurred after the screening protocol was in place and mandatory training had been completed on January 1, 2015. Other than year of graduation, no record was kept of which students were observed during a particular clinic session and it is likely that some students were observed on multiple occasions. To avoid the issue of interrater reliability, all observations were made by 1 author (NT). Due to faculty time constraints, students were not observed for the entire 3-hour appointment but intermittently throughout the appointment.

Data analysis

The variables "Wash hands before mask" and "Wash hands before gloving" were combined into 1 variable ("Handwashing pre") to more closely align with CDC guidelines that call for hand hygiene before gloving but not before donning a mask.

Data were examined at both the encounter (defined as 1 student, 1 clinic period, multiple behaviors) and item (defined as multiple students, multiple clinic periods, 1 behavior) levels. For encounters, we examined the total number of observed infractions, calculated as the sum of infractions across observed behaviors. Percent compliance was also calculated: for each encounter, the number of behaviors recorded as "yes" ("no" for improper mask use and improper glove use) was divided by the total number of behaviors observed.

At the item level, we determined percent compliance based on recorded observations. That is, for all compliant behaviors, the number of times the behavior was recorded as "yes" divided by the total number of recorded observations ("yes" + "no"). For improper

mask use and improper glove use, percent compliance was the number of times the behavior was recorded as "no" divided by the total number of recorded observations.

The items were also categorized by operative stage: preoperative, intraoperative, and postoperative. Preoperative behaviors occur before any contact with the patient and include proper placement of protective barriers in the operatory; handwashing before donning of PPE; and donning of gown, gloves, mask, and protective eyewear with side shields.

Intraoperative behaviors were breaches related to mask and glove use. These include having a mask on one's chin, reusing a mask, touching items with contaminated gloves, and placing contaminated gloves or mask on a counter. Intraoperative behaviors are reported in the negative because they involved protocol violations.

Postoperative behaviors include proper glove removal, proper mask removal, and handwashing after glove removal, which were observed either at the end of an appointment or when a student broke scrub during the appointment.

To compare operative stages, percent compliance was determined for each operative stage by aggregating items within the stage and then applying the calculation described for item-level compliance.

All analyses were performed using SPSS Statistics version 23 (IBM-SPSS Inc, Armonk, NY) and R (R Foundation for Statistical Computing, Vienna, Austria).

RESULTS

Encounter level

The distribution of violations per encounter is shown in [Figure 1](#). Before the EVD mandate, 23% of encounters exhibited no infractions of infection control policy. The number ranged from zero to six with a mean \pm standard deviation of 1.31 ± 1.17 . After the mandate, 30% of encounters showed no infractions with a range of 0–4, and a mean \pm standard deviation of 1.29 ± 1.09 . No statistically significant difference was seen premandate versus postmandate.

Item level

Percent compliance and total number of observed behaviors are given in [Table 1](#). Preoperative compliance was significantly higher ($\chi^2 = 4.13$; $df = 1$; $P = .042$) postmandate compared with premandate. Intraoperative compliance (proper glove use and proper mask use) was significantly lower ($\chi^2 = 24.2$; $df = 1$; $P < .001$) postmandate compared with premandate. There was no significant difference in postoperative compliance premandate and postmandate ($\chi^2 = 1.57$; $df = 1$; $P = .21$).

When aggregated across all operative stages, overall compliance was 87% both premandate and postmandate ($\chi^2 = .002$; $df = 1$; $P = .996$).

DISCUSSION

The mean percent compliance with observed infection control parameters was very high (87%) overall. Use of barriers and PPE are clearly part of the culture of the dental school: compliance was 100% for wearing a protective gown and gloves, 98% for mask use, and 94% for protective eyewear. This compares favorably with a study⁸ that found that 70% of dentists reported always using PPE, including gloves, masks, and eye protection. Another study reported very high rates of glove use but much lower use of masks and protective eyewear.¹⁸ Other studies reported lower rates of compliance with PPE.^{5,12}

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