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A Survey of Infection Control Teaching in U.S. Dental Schools

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Objective: This survey was conducted in 2011 to determine the extent of infection control (IC) curriculum, IC monitoring and compliance, and the number of percutaneous injuries/year in U.S. dental schools.

Methods: A self-administered questionnaire was sent electronically to subjects with responsibility for IC in predoctoral programs. The questionnaire contained one open-ended, and 23 multiple-choice questions.

Results: The response rate was sixty percent. Most schools did not have an independent IC course. The most frequently-used number of IC classroom teaching hours was 6-10. Ninety-one percent indicated that IC evaluation was part of overall students' assessment; non-compliance penalties ranged from verbal warning to remediation. Ninety-one percent of schools had an IC coordinator; those schools were more likely to issue grade reductions for IC violations than schools with no IC coordinator ($p<0.05$). Seventy-nine percent of schools had an IC committee; those schools were more likely to: use online learning to teach IC ($p<0.05$); utilize four or more different methods of teaching ($p<0.05$); issue written warnings for IC violations ($p<0.0001$), and use multiple disciplinary actions for IC violations ($p<0.005$) than schools without an IC committee. High level of faculty and staff IC promotion correlated significantly with respondents' ($p<0.005$), and graduating students' satisfaction with IC curriculum ($p<0.005$). Thirty-eight percent of schools reported $\geq$16 percutaneous annually; eighteen percent reported $\leq$5. There was a significant correlation between high number of percutaneous injuries and larger class size ($p<.005$); and fewer online IC hours in first year ($p<.0005$).

Conclusion: The majority of respondents were satisfied with IC curriculum in their schools. They also perceived that their dental students had a high level of IC compliance, along with staff IC promotion and compliance. Fewer respondents had the same perception about faculty IC compliance and promotion. Percutaneous injury surveillance is indicated in some schools to facilitate targeted intervention.

Funded by Health Resources and Services Administration (HRSA), U.S. Department of Health and Human Services

Blood Contamination of Used Dental Anesthetic Cartridges

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Objective: OSHA does not consider used dental anesthetic cartridges to be a type of regulated medical waste. This is based on a small study where only 2% of cartridges examined contained visible blood. Objectives of this study were to determine levels of blood contamination in/on used dental anesthetic cartridges and to measure antibacterial effects of exposure to anesthetic solutions.

Methods: Involved were 1000 used cartridges of three types coming from an oral surgery clinic at Indiana University Hospital. Blood testing involved both visual observations using a dissecting microscope and chemical analyses. Removed from each cartridge was either 0.5 mL of residual anesthetic solution or a combination of anesthetic solution plus added saline. All solutions underwent analyses for minute amounts of blood using *Hemastix* dipsticks. Scoring of visual examinations was on a "positive" or "negative" basis. Blood scoring included development of a blue color with values varying from "zero" through "six." Lidocaine or physiological buffered saline (PBS) was mixed with four types of bacteria (*Lactobacillus casei* ATCC 334, *Staphylococcus aureus* ATCC 6538, *Streptococcus mutans* ATCC 25175 and *Mycobacterium bovis*, BCG) for exposure periods up to 30 days. Measurement of decreasing viable cell counts over time then occurred.

Results: Most cartridges (78.67%) contained lidocaine. Anesthetic solutions did not interfere with *Hemastix* testing. Only seven cartridges examined contained visible blood. Over 76% contained measurable amounts of blood as detected by *Hemastix* analyses. Exposure to lidocaine over time resulted in bacterial death rates similar to those produced by PBS.

Conclusion: Levels of blood contamination in the absence of pronounced antibacterial activity support the position that used anesthetic cartridges could be considered as a type of regulated medical waste.

Partial support came from the Departments of Oral Biology and Oral & Maxillofacial Surgery and Hospital Dentistry at Indiana University School of Dentistry.

Higher MRSA contamination among dental students and their mobile phones

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Objective: To compare MRSA carriage status between dental and non-dental students.

Methods: This study adhered to relevant guidelines for appropriate ethical research design, and the relevant standards to ensure the protection of human subjects of research. All participants provided their informed consent. No incentives were offered. During an unannounced visit to the teaching clinics MRSA screening was offered to each consecutive student who was working with a patient. In campus, non-dental students were sampled too.
From all participants (100 dental and 100 non-dental) paired swabs were obtained from the anterior nares and the posterior wall of the pharynx. Their respective mobile phones (n=200) were sampled too. After 24 hr. aerobic growth at 37ºC, mannitol-fermenting isolates were subject to catalase and coagulase tests, Gram stain, antibiotic susceptibility tests, MIC determination, and PCR amplification of *mec*A gene.

Results: A significantly (p=0.01) higher prevalence of MRSA carriage (18%) was observed among dental students, than among non-dental students (5%). Of the dental students' mobile phones 6% were contaminated with MRSA, and 2% of the non-dental students' mobile phones carried MRSA.

Conclusions: These findings indicate that the dental student population has a greater risk of MRSA infection. Therefore infection control protocols must be mandatory for dental students to reduce their occupational exposure.

Microbial Contamination of Computer Keyboards and Mice

E.A. Hughes and C.J. Palenik*
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Objective: This study evaluated microbial contamination of computer keyboards and mice used present within various dental school clinics.

Methods: Included were chairside desktop computers in twenty-six dental hygiene units. Policy required that plastics sheets cover keyboards and mice when in use and their disposal after each patient. The other seven computers evaluated were general use and were adjacent to clinics throughout the School. These were never covered. None of the studied keyboards/mice underwent disinfection. Sterile cotton swabs moistened with saline sampled the entire keyboard/mouse surface. Then, the swabs went into 2.0 mL of saline and vortexed. Spread plating of specimens followed. Used were general purpose and selective growth media. After incubation, isolate identification occurred. Then, keyboards/mice underwent three weekly surface disinfections followed by a repeated microbial sampling.

Results: Bacteria were present on every keyboard and mouse surface sampled. Over 90% were gram-positive cocci with 60% being staphylococci. Uncovered keyboards/mice had ten times the numbers of bacteria than those covered. Oxacillin-resistant *Staphylococcus aureus* comprised 1.5% of all microbial colonies isolated and were present on 4.5% of the surfaces sampled. Only one such isolate came from a covered keyboard/mouse. Further testing indicated that all were MRSA. Disinfection reduced microbial counts by more than 90% on covered keyboards/mice. Reductions of only 50% occurred on the uncovered surfaces.

Conclusions: Data suggest microbial contamination of computer keyboards/mice is prevalent, especially in the absence of covers. Disinfection of keyboards and mice was most effective when used with covers. Disinfection more than on a frequent basis, such as daily, could possibly result in greater microbial reductions.

Microbial Contamination of Dental Student Scrubs

C.J. Palenik*, A. Merryman and L.M. Romito
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Objective: Microorganisms can remain viable on clinical attire for extended periods. Our dental students purchase their own scrubs and are responsible for laundering them. They routinely wear the scrubs to and from school. Students wear disposable isolation gowns clinically with their scrubs underneath. The aim of this study was to measured microbial contamination present on scrubs exposed leg sections.

Methods: Rodac plates containing mannitol salt and enhanced trypticase soy agar sampled eight sites from knee to cuff on 20 cotton scrub pants worn clinically for at least four hours. Colonies underwent subculturing onto media selective for yeast, enteric rods, oral streptococci, and MRSA. After laundering by the students, sampling again occurred. Also, 20 professionally laundered scrub pants (ironed and returned in shrink-wrap plastic) underwent the same sampling method.

Results: Every Rodac plate had microbial contamination with the highest levels being near/around the cuffs. Yeasts, enteric rods, oral streptococci were commonly present as were staphylococcal species. MRSA was present on six scrubs. Student laundering usually employed cold-water temperatures, no bleach and mechanical hot air drying. There was an average reduction of 81.5% in colony counts with elimination of yeasts, oral streptococci, and MRSA. Commercially laundered scrubs had minimal microbial contamination with staphylococci and gram-positive rods present.

Conclusions: Contamination by a variety of microorganisms occured on all exposed scrubs leg areas. Student laundering did reduce levels of contamination even without the use of warm or hot water or bleach. Professionally laundered scrubs had less than 5% the level of contamination, as did the student laundered scrubs.

Positive MRSA carrier status among dental students and their mobile phones

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Objective: To assess the prevalence of MRSA carriage among dental students.

Methods: This study adhered to relevant guidelines for appropriate ethical research design, and the relevant standards to ensure the protection of human subjects of research. All participants provided their informed consent. No incentives were offered. During an unannounced visit to the teaching clinics, MRSA screening was offered to each consecutive student who was working with a patient.

Paired swabs from the anterior nares and the posterior wall of the pharynx were collected from each student. Their respective mobile phones were sampled too. After 24 hrs. aerobic growth at 37ºC, mannitol-fermenting isolates were subject to catalase and coagulase tests, Gram stain, antibiotic susceptibility tests, MIC determination, and PCR amplification of *mec*A gene.

Results: Of 100 students, 18 (18%) were MRSA positive, of them 9 were nasal and 8 pharyngeal carriers. Only 1 was positive in both samples. Of 100 mobile phones 6 were contaminated with MRSA. Of these, two belonged to MRSA negative individuals.

Conclusions: MRSA carriage is common among our dental students. Mobile phones in use chairside may be contaminated with MRSA even if the owner is MRSA negative. This indicates that infection control measures must be in place to prevent transmission to patients.

Development of Biomaterials with Potential Application in Health Sciences

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Objective: This study evaluated antibiofilm activity of biomaterials with potential application in health sciences (catheters, prosthesis, dental unit waterlines).

Methods: The natural biomaterials were made of the castor oil-based polyurethane (COBP). Besides, COBP impregnated with melaleuca essencial oil (COBP-M), propolis lyophilized (COBP-P) and silver nitrate (COBP-Ag). The antibiofilm activity was analyzed against reference microorganisms: *Staphylococcus aureus* (ATCC 25923), MRSA (ATCC 43300), *Staphylococcus epidermidis* (ATCC 14990), *Escherichia coli* (ATCC 25922), *Pseudomonas aeruginosa* (ATCC 27853) and *Candida albicans* (ATCC 10231). Twenty three coupons of each biomaterial were made and biofilms formed in 24-well microtiter plates with microbial inocula (~10^{4-6}CFU/mL) at 37ºC for 24h. After incubation, the coupons were: 1) Removed from each well and immersed in new well containing methanol (15min); 2) Withdrawn the methanol and allowed to dry at room temperature; 3) Added crystal violet 1% to each well and incubated for 5min; 4) Removed the crystal violet; 5) Washed with water; 6) Immersed in acetic acid 33% to dilute the stain; 7) Read the absorbance at 570nm.

Results: The COBP-Ag demonstrated the best results of antibiofilm activities among biomaterials ($p<0.05$), in descending order, against *S. epidermidis* and *P. aeruginosa* ($p>0.05$); *S. aureus*, *E. coli* and *C. albicans* ($p>0.05$) and MRSA. Besides, COBP-M showed only antibiofilm activity against *E. coli*. Moreover, COBP-P allowed more biofilm formation than COBP ($p<0.05$).

Conclusion: The biomaterial impregnated with silver nitrate showed the best antibiofilm results. Furthermore, additional studies are needed to improve the development of new biomaterials with potential application in health sciences.

Supported by FAPESP (Process n° 10/50090-8)

Efficacy and Limitations of an ATP-Based Monitoring System in Dental Settings

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Objective: To identify the possibility of ATP bioluminescence method in monitoring surface sanitation in dental settings.

Methods: 30 groups of nearby patient surfaces were randomly chosen in the periodontal department. Each group includes three samples, operational panel of dental units, lamp chimney and face shield. Both ATP bioluminescence method and plate culture method were used to monitor such surfaces before and after disinfection.

Results: The detection value from both methods is respectively significant different between before and after disinfection. The lg RLU value of bioluminescence method and the lg CFU value of plate-culture method have relationship before disinfection($R=0.504$, $P<0.01$), while two groups of value have no relationship after disinfection($R=-0111$, $P>0.05$).

Conclusion: Compared with traditional plate-culture method, ATP bioluminescence method is efficient and convenient in monitoring surface sanitation, thus easily to be applied in supervision and instruction on-site. The limitation of ATP method is it cannot identify the microorganism strains and it is hard to directly establish the correlation between outcome of ATP and that of culture method. Consequently, ATP bioluminescence method is not a substitute for the plate-culture method but an effective supplemental method for monitoring.

Improving Cleaning of the Dental Operatory

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Objective: To evaluate and improve cleaning practices used by custodial staff in the dental operatory.

Methods: We used a fluorescent targeting method (DAZO) to objectively evaluate the thoroughness of end-of-day (terminal) cleaning of dental operatories. On unannounced days, targets were marked in two randomly chosen operatories on each of five clinical floors (153 operatories total). Performance of school-employed, custodial staff was evaluated before and after structured educational interventions which included demonstrations of the expected cleaning process. A goal was set at 80% of targets cleaned in all sample operatories. Performance feedback was routinely provided, and when the cleaning goal was not met, the structured educational program was repeated. Care was exercised to provide "blame-free" skills improvement training. Facilities Management leaders actively supported and participated in the program.

Results: Phase 1: *preintervention*. Of 240 environmental surfaces (8 standardized high-touch objects in the operatories), only 73 (30.4%) were cleaned. Phase 2: *program analysis, provision of objective performance feedback and structured education for the custodial staff*. This was followed by reassessment of performance using the targeting method. It was determined that 45 (56.3%) of 80 environmental surfaces were cleaned. Phase 3: *performance feedback and training*. During this 7 months period, of 848 environmental surfaces marked, 699 (82%) were cleaned (Yates Chi square; $p<.0001$). No additional custodial staff was hired during this time period.

Conclusion: Significant improvements in terminal cleaning of dental operatories can be achieved without additional fiscal commitment. Success can be accomplished by using a structured approach that incorporates an easy-to-use, highly objective, surface targeting method, routine performance feedback to custodial staff, and "blame-free" skills improvement training. Management support is critical to success.