

## Infection control practice in private dental laboratories in Riyadh

Abdulaziz A. Al-Kheraif, BSc, MPhil, PhD  
Fahmy A. Mobarak, BDS, MS, PhD

نظرا لخطورة انتقال العدوى للعاملين في مجال صحة الأسنان بالإضافة للمرضى فإن مكافحة العدوى أمر مطلوب. هدفت هذه الدراسة لتقييم مدى مكافحة العدوى لدى معامل الأسنان الخاصة، الرياض- المملكة العربية السعودية، أجريت هذه الدراسة على ٣٢ معمل أسنان خاص بواسطة توزيع استبيان يحتوي على عشرة أسئلة على مشرفي تلك المعامل. أوضحت هذه الدراسة أن ٨٧.٥% من المعامل ليس لديه أي آلية لمكافحة العدوى أثناء ممارسة العمل، كما أن ٩٠.٦% من المعامل ليس لديها أي طريقة اتصال بالعيادات فيما يتعلق بإجراءات التعقيم، كما أفاد ٦٢.٥% من المعامل بأنهم قلقين من احتمال إصابتهم بالعدوى من المواد الغير معقمة، كما تبين أن ٧٥% من المعامل تستخدم المعطف الواقي أثناء العمل و كذلك ٥٩.٣% تستخدم القفازات و ٥٦.٢% تستخدم النظارات الواقية، بينما ٢١.٨ تستخدم كمادات على الوجه. أوصت الدراسة بوجوب إيجاد دليل إرشادي يحتوي على الخطوط العريضة لمكافحة العدوى داخل معامل الأسنان وأيضا وجوب إيجاد آلية اتصال بين أطباء الأسنان وفني الأسنان فيما يتعلق بتعقيم المواد المعملية.

**BACKGROUND:** In view of the risk of infection of dental health care workers and patients, interruption of possible chains of infection is to be demanded. **OBJECTIVE:** The objective of this study was to assess infection control practice in private dental laboratories in Riyadh City, Kingdom of Saudi Arabia. **METHODS:** The study was conducted on thirty-two private dental laboratories in Riyadh City regarding infection control practiced by these laboratories. The instrument of the study consisted of ten open-ended questions that were asked from the laboratories directors. **RESULTS:** A large percentage of the surveyed laboratories (87.5 %) did not implement any infection control protocol during their practice. The mean number of impressions received per week was 16. Most of the surveyed laboratories (90.6 %) had no way of communication with the clinics regarding the disinfection procedures. The results indicated that 62.5 % of the laboratories reported that they were aware that they may get infection from non-disinfected items. Only a small percentage (6.2%) of the laboratories added disinfecting agent to pumice slurry. Wearing laboratory coats was reported by 75% of the laboratory workers. The use of gloves during work was reported by 59.3% of the laboratories while 56.2% reported the use protective eyewear. Only 21.8% of the laboratories use face masks during work. **CONCLUSIONS:** Construction of infection control manuals that contain updated and recommended guidelines to ensure aseptic practice in private dental laboratories is highly recommended. Also, a way of communication between dentists and dental technicians regarding disinfection of laboratory items should be strongly encouraged.

### INTRODUCTION

The past two decades have produced more professional interest in the spread of infectious diseases in dental practice than perhaps any other period.<sup>1,2</sup> However, the emergence of acquired immunodeficiency syndrome (AIDS) caused by human immunodeficiency virus (HIV), the re-emergence of resistant strains of tuberculosis and the world wide spread of hepatitis B and C viral infections have revived wide spread public fear and consensus about incurable and fatal infectious diseases.<sup>3-6</sup>

Public pressure has led inevitably to governmental intervention to require

protective measures against disease transmission by health-care providing facilities, including dental settings.<sup>7</sup>

The reemphasis of infection control policy in dentistry that occurred during the last two decades has now resulted in impressive approaches to prevention of disease spread in the dental office.<sup>8</sup> These approaches are directed toward patient protection and protection of the dental staff. However, in contrast to the dental treatment rooms and surgical operatories where infection control measures are rigidly recommended and regulated, the dental laboratories are often overlooked when planning effective infection control and exposure control measures.<sup>9</sup> This constitutes threats to the safety of dental technicians, who may acquire pathogenic microorganisms from impressions and

Department of Dental Hygiene  
Faculty of Applied Medical Sciences  
King Saud University

other items contaminated with patient blood or saliva.<sup>10,11</sup> Cross infection may occur among dental staff and patients from contaminated items sent from the dental laboratories to dental clinics.<sup>12</sup>

The dental health care personnel (DHCP) refers to all personnel in the dental health care settings who might be occupationally exposed to infectious materials including body substances and contaminated supplies.<sup>13</sup> The DHCP include dentists, dental hygienists, dental assistants and dental laboratory technicians.<sup>13</sup> Dental patients and DHCP can be exposed to multiple pathogenic microorganisms including cytomegalovirus (CMV), hepatitis B virus (HBV), hepatitis C virus, herpes simplex virus, (HIV), *Mycobacterium tuberculosis*, *staphylococci*, *streptococci* and other viruses and bacteria that colonize or infect the oral cavity and respiratory tract.<sup>13</sup> These organisms can be transmitted in dental settings through (1) direct contact with blood, oral fluids or other patient materials and (2) indirect contact with contaminated objects.<sup>14</sup>

Dental prostheses and appliances, as well as items used in their fabrication (impressions, occlusal rims and bite registrations), are potential sources for cross-contamination and should be handled in a manner that prevents exposure of DHCP, patients, or the office environment to infectious agents.<sup>15, 16</sup> Effective communication and coordination between the dental laboratory and dental clinic will ensure that appropriate cleaning and disinfection procedures are performed either in the dental office or laboratory so that disinfection is guaranteed but duplication of procedures is avoided.<sup>17</sup> Infection control practice must therefore cover all aspects of dental activities.

In Saudi Arabia, no data is available regarding infection control practice in dental laboratories in Riyadh. However, such data would be needed in evaluation

of infection control procedures in the dental settings. Therefore, the objectives of the present study were: (1) To survey infection control practice performed by private dental laboratories in Riyadh City and (2) To evaluate communication between dentists and dental technicians regarding disinfection of laboratory items.

## MATERIALS AND METHODS

A list of 50 privately owned dental laboratories in Riyadh City, Saudi Arabia was obtained from the Ministry of Health. Only 32 (64%) laboratories were located, while the rest, because of improper information regarding addresses could not be located and therefore were not included in the survey. The instrument of the study consisted of ten open-ended questions that were asked of laboratories directors through direct personal interviews. All directors stated that they were quite familiar with infection control regimen performed in their laboratories.

The survey questions were pilot-tested via ten-minute interviews with ten consecutive students in their final year from the Dental Technology Department, College of Applied Medical Sciences, King Saud University. Responses from the pilot tests were analyzed to assess the clarity and relevance of the questions. Consequently, necessary modifications were carried out based on the feed-back from pilot-test participants. The study was carried out between January and May 2007.

The survey requested respondents to provide data regarding the number and types of impressions received by the laboratory each week, the manner in which the impressions were received from the clinic, the infection control protocol (ICP) implemented by the laboratory, awareness of the possibility of getting infection from contaminated

impressions, communication between the laboratory and the clinic about disinfection procedure, addition of disinfectant to pumice slurry and types of personal protective equipments used in the laboratory.

## RESULTS

The mean number of impressions received per laboratory was 16 (range 10-30). The results showed that 47 % of the received impressions were of the rubber type, while 40 % were alginate and 13 % were made of other materials. The results indicated that 31 % of the impressions were received from the clinics in plastic box, 28% in sealed plastic bag and 41% were received wrapped in tissue papers or unwrapped.

In most of the surveyed laboratories, 87.5% were not implementing any ICP while 12.5% stated that they did have ICP. In most of the laboratories, 90.6% did not have a separate receiving area for incoming cases while only 9.4% had isolated areas for incoming cases. The laboratories which have ICP disinfected only the incoming impressions but not other items as bite registration records. None of the laboratories reported relevant information about their methods of impression disinfection. Also none of them reported any disinfection procedures for outgoing cases (dentures, crowns, etc.). Only 9.4 % of the laboratories reported that they receive disinfected impressions and were informed through notification labels, while 90.6 % of the laboratories did not have any communication with the clinics regarding the disinfection procedures. The results indicated that 62.5 % of the laboratories reported that they were aware of the possibility of getting infection from non-disinfected items, while 37.5% were not. Only a small percentage (6.2%) of the laboratories added disinfecting agent to pumice slurry. During work, 75% of the

laboratories reported the use of laboratory coats, while 59.3% reported the use of gloves. The use of protective eyewear and face masks were reported by 56.2 % and 21.8% of the laboratories, respectively.

## DISCUSSION

Infection control forms an important part of practice for all health care professions and remains one of the most cost-beneficial interventions available.<sup>18</sup> The British Dental Association (BDA) stated that "infection control is a core element of dental practice" and the BDA fully supports its members in achieving excellence in this area.<sup>19</sup> We studied infection control practice in private dental laboratories because they often lack rigid supervision regarding occupational safety rules that are commonly practiced in universities and hospitals. Today, the formally trained and certified dental technician is recognized as a broadly educated and highly skilled artisan who can demonstrate the ability, understanding and credentials as a key member of the modern restorative dental health care team. Nevertheless, optimization of this health care team is sometimes hampered by a lack of understanding and communication about infection control.

The aim of this investigation was to highlight the area of infection control procedures in private laboratories in Riyadh to assure proper safety for DHCP and patients as well. This study showed that 87.5% of the surveyed laboratories did not implement any ICP and this percentage is relatively high compared to developed countries such as United Kingdom.<sup>20</sup> The other important finding in the study was that only 9.4% of the laboratories received known disinfected impressions. This finding is similar to that obtained by other reported studies.<sup>20-24</sup> This study supports previous studies which showed that few dentists working in private dental sector in Riyadh

were conversant with proper infection control measures in dental practice.<sup>25</sup> Disinfection of impressions is now considered a routine procedure in dental settings in countries like USA and UK.<sup>26-32</sup>

The results of the present study showed that the lack of communication between the dental offices and commercial dental laboratories regarding handling and decontamination of dental items was high at 90.6%. The results are in agreement with the study by Kugel *et al.*<sup>21</sup> about communication practice between dental laboratories and dental clinics regarding disinfection procedures. Anil *et al.*<sup>33</sup> recommended that communication between the dental laboratory and the dental staff regarding disinfection procedures performed for both items sent to or received from the laboratories should be in a written form.

Previous microbiological reports found that non-disinfected impressions are capable of transmitting microorganisms to dental laboratory technicians and alginate material transmits more bacteria than silicon impressions.<sup>34-37</sup> Results of the present study indicated that 62.5% of the laboratories were aware of the possibility of getting infection from non-disinfected items while 37.5% were not aware of that. Although, the awareness about cross infection was high, this study showed a lack of general attitude in using the personal protective equipments (coat, glove, eye wear, masks) during work. These findings are in agreement with previous studies which documented that 44% of dental technicians in England wore protective gloves when working on materials delivered from offices, 15% wore gloves for about 50% of their working time and 26% of them did not use protective gloves at all.<sup>20</sup> The lack of use of these personal protective equipments explained the high prevalence of ocular injury and foreign bodies in the eyes of dental technicians during practice.<sup>38-43</sup>

Only 6.2 % of the surveyed laboratories added disinfecting solution to the pumice slurry. The results are in agreement with the study by Jagger *et al.*<sup>20</sup> who reported that about 61% of dental laboratories used no disinfectant in the pumice and 93% did not disinfect the polishing instruments, e.g., wheels and mops.

Verran *et al.*<sup>44</sup> in their 1997 study documented that both clinical and non-clinical (teaching) laboratories are not immune from the presence of potentially pathogenic microorganisms in pumice slurry and stated that disinfection reduced contamination by oral microorganisms. Williams *et al.*<sup>45</sup> documented the presence of fungi in used dental laboratory pumice which presented an unhygienic condition in the dental laboratory and which could place dental laboratory technicians and denture patients at increased risk of fungal sensitization and disease. On the other hand, Witt and Hart<sup>46</sup> proved that pumice slurry freshly made up using disinfectant was reported to be free from contamination.

Literature indicated that pathogen of tuberculosis (*Mycobacterium tuberculosis*) remains dangerous for several weeks.<sup>13,39</sup> Other studies showed that HBV could survive in dried blood at room temperature on environmental surfaces up to one week.<sup>47</sup> So infection can take place through skin abrasions or scratches of bare hands. Moreover, HBV is known to be present in saliva of patients with viral hepatitis infection and could be transmitted to health care workers.<sup>48</sup> Several serological studies have shown that DHCP have a significantly higher prevalence of HBV infection than the general population.<sup>49-58</sup> Moreover, occupational infection of dental laboratory technicians with HBV infection has been reported.<sup>59</sup> In addition, in a survey reported by McCarthy and Britton,<sup>60</sup> dental students showed the highest rate of occupational injuries among dental, medical and nursing students. Previous reports confirmed that all members of

the dental profession are at a risk at least three times greater than the general population of contracting HBV infection and developing the carrier state.<sup>61</sup> The risk is even greater than the risk of acquiring HIV infection from practice.<sup>62</sup> This study's finding and other studies suggest that all health care workers who work in dental laboratories or handle laboratory cases on regular basis should be vaccinated against hepatitis B.<sup>63-66</sup> In addition, post-vaccination serological test is mandatory to assess the effectiveness of immunization.<sup>67</sup>

### CONCLUSIONS

The present study showed that there was a lack of commitment to the standards of infection control practice in private dental laboratories in Riyadh. Also, communication between dental clinics and dental laboratories regarding disinfection of laboratory items was found deficient. Formal supervision of private dental laboratories through official channels to assure proper adherence to infection control measures is demanded. Continuing education through infection control courses and infection control manuals that contain updated and recommended guidelines to ensure aseptic practice in private dental laboratories is highly needed.

### REFERENCES

1. Miller CH, Palenik CJ. Sterilization, disinfection and asepsis in dentistry. In: Block SS, ed. *Disinfection, sterilization and preservation*, 4<sup>th</sup> ed. Philadelphia: Lea and Febiger, 1991; 676-695.
2. Billingsley M. Outpatient surgery asepsis. *Oral Maxillofac Surg Clin North Am* 1993; 5:1-9.
3. Centers for Disease Control. Recommendations for prevention of HIV in health care settings. *MMWR* 1987; 36:1-66.
4. Sewell DL. Laboratory-associated infections and biosafety. *Clin Microbiol Rev* 1995; 8:389-405.
5. Ahtone J, Goodman R. Hepatitis B and dental personnel: Transmission to patients and prevention issues. *J Am Dent Assoc* 1983; 106:219-222.
6. Cleveland JL, Gooch BF, Shearer BG, Lyerla RL. Risk and prevention of hepatitis C virus infection: Implications for dentistry. *J Am Dent Assoc* 1999; 130:641-647.
7. Council on Dental Therapeutics and Council on Prosthetic Services and Dental Laboratory Relations. American Dental Association. Guidelines for infection control in the dental office and the commercial laboratory. *J Am Dent Assoc* 1985; 110:969-972.
8. Miller C. Infection control. *Dent Clin North Am* 1996; 40: 437-456.
9. Dental Laboratory Relationship Working Group of the Organization for Safety and Asepsis Procedures (OSAP). OSAP Position Paper: Laboratory Asepsis: November, 1998. Available at [www.osap.org](http://www.osap.org).
10. Verran J, Kossar S, McCord J F. Microbiological study of selected risk areas in dental technology laboratories. *J Dent* 1996; 24:77-80.
11. Owen CP, Goolam R. Disinfection of impression materials to prevent viral cross contamination: A review and a protocol. *Int J Prosthodont*. 1993; 6: 480-494.
12. Council on Dental Materials, Instruments and Equipment; Dental Practice; and Dental Therapeutics. American Dental Association. Infection control recommendations for the dental office and the dental laboratory. *J Am Dent Assoc* 1988; 112:241-248.
13. Centers for Disease Control. Guidelines for infection control in dental health care settings - 2003. *MMWR* 2003; 52 (RR-17):1-66. Available at [www.cdc.gov/oralhealth/infectioncontrol](http://www.cdc.gov/oralhealth/infectioncontrol).
14. Toroglu M, Bayramoglu O, Yarkin F, Abdullah Tuli A. Possibility of blood and hepatitis B contamination through aerosols generated during debonding procedures. *Angle Orthod* 2002; 73: 571-578.
15. Bentley E M, Sarll DW. Improvements in cross-infection control in general dental practice. *Br Dent J* 1995; 179:19-21.
16. McCarthy GM, Ssali CS, Bednarsh H, Jorge J, Wangrangsimaku KL, Page-Shafer K. Transmission of HIV in the dental clinic and elsewhere. *Oral Dis* 2002; 8: 126-135.

17. Lepe X, Johnson GH, Berg JC. Surface characteristics of polyether and addition silicone impression materials after long-term disinfection. *J Prosthet Dent* 1995; 74:181-186.
18. Wenzel RP. The Lowbury lecture. The economics of nosocomial infections. *Hosp Infect* 1995; 31: 79-87.
19. BDA Advisory Service. The control of cross infection in dentistry. Advice Sheet A12, 1991.
20. Jagger DC, Huggett R, Harrison A. Cross-infection control in dental laboratories. *Br Dent J* 1995; 179: 93-96.
21. Kugel G, Perry R, Ferrari M, Lalicata P. Disinfection and communication practices: A survey of U.S. dental laboratories. *J Am Dent Assoc* 2000; 131: 786-792.
22. Watkinson AC. Disinfection of impressions in UK dental schools. *Br Dent J* 1988; 164:22-23.
23. Al-Omari M, Al-Dwairi Z. Compliance with infection control programs in private dental clinics in Jordan. *J Dent Educ* 2005; 69: 693-698.
24. Yengopal V, Naidoo S, Chikte UM. Infection control among dentists in private practice in Durban. *SADJ* 2001; 56:580-584.
25. Al-Rabeah A, Mohamed AGI. Infection control in the private dental sector in Riyadh. *Ann Saudi Med* 2002; 22: 13-17.
26. American Dental Association. Infection control recommendations for the dental office and the dental laboratory. ADA Council on Scientific Affairs and ADA Council on Dental Practice. *J Am Dent Assoc* 1996; 127:672-680.
27. World Health Organization. Technical report series 512, viral hepatitis. New York: WHO 1973.
28. Bahannan SA, Abdel-Salam MM. An in vitro study of the effects of various disinfectants on prosthetic and surface materials. *Saudi Med J* 2002; 23:396-399.
29. BDA-BDTA-DLA. Disinfection of impressions. *Br Dent Assoc News (Supplement)* 1995.
30. Blair FM, Wassell RW. A survey of the methods of disinfection of dental impressions used in dental hospitals in the United Kingdom. *Br Dent J* 1996; 180: 369-375.
31. Wassell RW. Disinfection of impression materials and casts. *Br Dent J* 2007; 202: 36-37.
32. Herrera SP, Merchant VA. Dimensional stability of dental impressions after immersion disinfection. *J Am Dent Assoc* 1986; 113: 419-422.
33. Anil S, Samaranyake LP, Krygier G. Infection control practice. AITBS Publishers & Distributors: India. 1<sup>st</sup> ed. Chapter 9, 1999.
34. Jennings KJ, Samaranyake LP. The presence of microorganisms on impression materials following disinfection. *Int J Prosthodont* 1991; 4:382-387.
35. Sofou A, Larsen T, Fiehn NE, Owall B. Contamination level of alginate impressions arriving at a dental laboratory. *Clin Oral Invest* 2002; 6:161-165.
36. Mitchell DL, Hariri NM, Duncanson MG Jr, Jacobsen NL, McCallum RE. Quantitative study of bacterial colonization of dental casts. *J Prosthet Dent* 1997; 78:518-521.
37. Junevicius J, Pavilonis A, Surana A. Transmission of microorganisms from dentists to dental laboratory technicians through contaminated dental impressions. *Stomatol Baltic Dent Maxillofac J* 2004; 6:20-23.
38. Al-Wazzan KA, Almas K, Al Qahtani MQ, Al Shethri SE, Khan N. Prevalence of ocular injuries, conjunctivitis and use of eye protection among dental personnel in Riyadh, Saudi Arabia. *Int Dent J* 2001; 51: 89-94.
39. USAF Guidelines for Infection Control in Dentistry, September 2004. Available at [www.brooks.af.mil/dis/infcontrol.htm](http://www.brooks.af.mil/dis/infcontrol.htm).
40. Powell GL, Runnells RD, Saxon BA, Whisenant BK. The presence and identification of organisms transmitted to dental laboratories. *J Prosthet Dent* 1990; 64:235-237.
41. Lewis DL, Arens M, Harlee R, Michaels GE. Risks of infection with blood- and saliva-borne pathogens from contaminated impressions and models. In: National Association of Dental Laboratories: Trends and techniques. Alexandria, VA: National Association of Dental Laboratories 1995; 12:30-34.
42. Leung RL, Schonfeld SE. Gypsum casts as a potential source of microbial contamination. *J Prosthet Dent* 1983; 49:210-211.
43. Ivanovski S, Savage NW, Brockhurst PJ, Bird PS. Disinfection of dental stone casts: Antimicrobial effects and physical property alterations. *Dent Mater* 1995; 11:19-23.
44. Verran J, Winder C, McCord J F, Maryan CJ. Pumice slurry as a cross infection hazard in nonclinical (teaching) dental technology laboratories. *Int J Prosthodont* 1997; 10: 283-286.

45. Williams HN, Falkler WA, Smith AG, Hasler JF. The isolation of fungi from laboratory dental pumice. *J Prosthet Dent* 1986; 56:737-740.
46. Witt S, Hart P. Cross-infection hazards associated with the use of pumice in dental laboratories. *J Dent* 1990; 18:281-283.
47. Bond WW, Favero MS, Petersen NJ, Gravelle CR, Ebert JW, Maynard JE. Survival of hepatitis B virus after drying and storage for one week. *Lancet* 1981; 1:550-551.
48. Bond WW, Petersen NJ, Favero MS. Viral hepatitis B: Aspects of environmental control. *Health Lab Sci* 1977; 14:235-252.
49. Schiff ER, de Medina MD, Kline SN, Johnson GR, Chan YK, Shorey J, Calhoun N, Irish EF. Veterans Administration cooperative study on hepatitis and dentistry. *J Am Dent Assoc* 1986; 113:390-396.
50. Mori M. Status of viral hepatitis in the world community: Its incidence among dentists and other dental personnel. *Int Dent J* 1984; 34:115-121.
51. Goldsmith RS, Zakaria S, Zakaria MS, Mabrouk MA, Hanafy AM, El Kalioubi AH, El-Rifae M. Occupational exposure to hepatitis B virus in hospital personnel in Cairo, Egypt. *Acta Trop* 1989; 46:283-290.
52. Thomas DL, Gruninger SE, Siew C, Joy ED, Quinn TC. Occupational risk of hepatitis C infections among general dentists and oral surgeons in North America. *Am J Med* 1996; 100: 41-45.
53. Chobe LP, Chichi MS, Arankalle VA, Gogate SS, Banerjee K. Hepatitis B infection among dental personnel in Pun and Bombay (India). *Indian J Med Res* 1991; 93:143-146.
54. Panis B, Roumeliotou-Karayannis A, Papaevangelou G, Richardson SC, Mitsis F. Hepatitis B virus infection in dentists and dental students in Greece. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 1986; 61:343-345.
55. Faoagali JL, Berry ME. Hepatitis B markers in Canterbury dental workers: A seroepidemiological survey. *N Z Med J* 1986; 99:12-14.
56. Lim DJ, Linage A, Macasaet A, Morimoto M, Mochizuki H. Zero-epidemiological study on hepatitis A and B virus infection among dentists in the Philippines. *Int Dent J* 1986; 36:215-218.
57. Noble MA, Mathias RG, Gibson GB, Epstein JB. Hepatitis B and HIV infections in dental professionals: Effectiveness of infection control procedures. *J Can Dent Assoc* 1991; 57:55-58.
58. Wilcox CW, Mayhew RB, Lagree JD, Tiffany RL. Incidence of hepatitis B exposure among USAF dental laboratory technicians. *Am J Dent* 1990; 3:236-238.
59. Georgescu CE, Skaug N, Patrascu I. Cross infection in dentistry. *Roum Biotechnol Lett* 2002; 7:861-868.
60. McCarthy G, Britton J. A survey of final-year dental, medical and nursing students: Occupational injuries and infection control. *J Can Dent Assoc* 2000; 66:561-569.
61. Cottone JA. Hepatitis B virus infection in the dental profession. *J Am Dent Assoc* 1985; 110:617-621.
62. Capilouto EI, Weinstein MC, Hemenway D, Cotton D. What is the dentist's occupational risk of becoming infected with hepatitis B or the human immunodeficiency virus? *Am J Public Health* 1992; 82:587-589.
63. Centers for Disease Control. Hepatitis B virus: A comprehensive strategy for eliminating transmission in the United States through universal childhood vaccination: Recommendations of the Immunization Practices Advisory Committee (ACIP). *MMWR* 1991; 40 (RR-13): 1-19.
64. Infection Control Manual CWRU School of Dentistry 1993-94. Revised 5/01/95. Revised 5/31/96. Revised 5/21/98. [dental.case.edu/insidecase/manual](http://dental.case.edu/insidecase/manual).
65. Centers for Disease Control. Immunization of health-care workers: Recommendations of the Advisory Committee on Immunization Practices (ACIP) and the Hospital Infection Control Practices Advisory Committee (HICPAC). *MMWR* 1997; 46 (RR-18):1-42.
66. Centers for Disease Control. Updated U.S. Public Health Service guidelines for the management of occupational exposures to HBV, HCV and HIV, and recommendations for post prophylaxis. *MMWR* 2001;50 (RR-11):1-52.
67. Paul T, Maktabi A, Almas K, Saeed S. Hepatitis B awareness and attitudes amongst dental health care workers in Riyadh, Saudi Arabia. *Odontostomatol Trop* 1999; 22: 9-12.