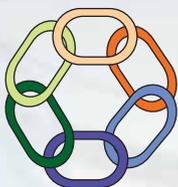




"Safety Above All"

Infection Control And Occupational Safety Recommendations For Oral Health Professionals



Anil Kohli
Raghunath Puttaiah



**Infection Control & Occupational Safety
Recommendations for Oral Health Professionals
in India
2007**

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Foreword

As we move forward in the twenty first century, new specializations are coming to the forefront in the field of medicine. Medicine today, is no longer limited to its traditional contours of study and application. Globalization has given birth to new concepts which have integrated nations and professionals together. Time and again medicine has proved to be the catalyst in breaking geographical barriers across the globe.

One of the positive outcomes of this dynamic configuration has been the birth of health professionals across different specialities in the medical arena. India has seen a tremendous growth in the potential and ability of its medical professionals. Our doctors today rub shoulders with the best professionals across the world and they are brand managers for their ability and application. Dentistry has been one of the key areas of growth as far as technology, treatment and medical professionalism is concerned. There are now over 250 registered dental schools in our country with the enrolment from across the globe. We have over one lakh dental professionals in the country and this is second to the United States of America.

In the last few years there has been a clear focus on specialization within the field of dentistry. This has been facilitated by lifestyle habits and practices and the emergence of new form of diseases. Dental safety is a key area of concern and needs to be addressed on top priority. Many countries in the world have strong guidelines and recommendations for dental safety which includes labour regulations for employee safety. In a country like India, the concept is new and needs to be advocated on the highest priority.

This publication is just the beginning of a new era in Dental Safety and has been crafted by Dr. Raghunath Puttaiah, a tenured faculty at Baylor College of Dentistry, Texas A&M University Health Science Center, Dallas and Dr. Anil Kohli, President, Dental Council of India. This

document is based on standards and regulations applicable to and being implemented in other medically advanced countries for the benefit of the patients and care providers. This document would be a good starting point for infection control and safety curriculum development in all Indian dental schools. I am sure practitioners would take the document earnestly in mainstreaming infection control and occupational safety in their profession in India.

My very best wishes to the authors in their endeavour

A handwritten signature in black ink, appearing to read 'Dr. Anbumani Ramadoss', written in a cursive style.

(Dr. Anbumani Ramadoss)



Dr. Raghunath (Raghu) Puttaiah

Dr. Raghu Puttaiah received his Degree in Dentistry from Bapuji Dental College, Davangere, University of Mysore, India in 1983. He completed his MPH in Epidemiology and International Health, and a Residency in Dental Public Health at the University of Alabama at Birmingham, USA in 1992 and was awarded the first Johnson & Johnson Medical Inc. Post-Doctoral Fellowship in Infectious Disease Control in Dentistry at UTHSC-SA Dental School under the guidance of Dr. James A. Cottone. Currently, he is a tenured Associate Professor in Diagnostic Science and the Director of Infection Control at Baylor College of Dentistry, Texas

A&M University System Health Science Center in Dallas, Texas, USA. Prior to his entry into the field of Infection Control, Raghu was extensively involved in Oral Cancer Epidemiological Research. He has been an adjunct faculty at the Eastman Dental Institute, University College London. He has conducted numerous research projects in the field of Dental Infection Control and Occupational Safety, dental materials/devices development and testing. He has presented over 90 original research abstracts at international level meetings in dental research. He has published book chapters, research papers, review papers, and columns on Dental Infection Control. His papers are cited by institutions such as the Centers for Disease Control and Prevention, and the National Cancer Institute in their documents. He is a reviewer for the Journal of the American Dental Association, BioMed Central and Quintessence. He has been a consultant for over 25 dental industries and has received multiple product development grants from the National Institute for Dental & Craniofacial Research-NIH in the field of dental infection control, specifically on biofouling in dental water systems. He serves on national committees and the ISO Committee on Dental Units. He is also a grant reviewer for the United States Health Resources and Service Administration. Raghu has been an invited speaker on dental infection control and safety in United States, India, Mexico, United Kingdom, Taiwan, Philippines, Malaysia, Thailand, India and Italy. He has developed a complete program/course on Dental Infection Control and Occupational Safety and has developed a compact disc/DVD/Online Program on this subject. His interest is to develop a complete training program/curriculum for India, China and other developing countries on Dental Infection Control, to provide safe dental care for patients and occupational safety for dental health care providers. He has been a member of the Organization for Safety and Asepsis Procedures since 1993. His ambition in life is to help develop public health educational and model systems for emerging economies and developing countries and introduce new infection control devices and methodologies into India and China. Dr. Puttaiah is the President of “Innovative Devices & Educational Solutions (D-IDEAS), LLC, Plano, Texas, USA. This document has been adapted from the In-Office Dental Infection Control Manual of D-IDEAS.



Dr. Anil Kohli

Dr. Anil Kohli is the President of the Dental Council of India. He was the Founder Member and President of the Indian Endodontic Society, President of the Federation of Operative Dentistry, President of the International College of Dentists (India Section) and the Advisor to the Ministry of Health & Family Welfare. Presently, he is the Chairman of Pierre Fauchard Academy, Member of the King George's Dental University, Lucknow, India. At the international level, he serves as the Chairman of the Commission for Education, Asia Pacific Dental Federation. He received the Merit Award for Professional Excellence by the Pierre

Fauchard Academy, USA. He has been conferred the Padma Awards twice; The Padmashree in 1992 and the Padmabhushan in 2005. He received the much coveted B.C. Roy Award in 2005 for his contributions to the profession. Recently, he has been conferred the Presidential Gold Medal at the 94th Indian Science Conference by the Honourable Prime Minister of India, Dr. Manmohan Singh. He is presently functioning in the capacity of Consultant in the President Estate Clinic at the Rashtrapati Bhawan and also the Personal Dental Surgeon to the Prime Minister of India. Dr. Kohli has the rare distinction of being the first ever dental surgeon to be conferred the Honorary Rank of "Brigadier" by the President of India in 2007. Dr. Kohli recently published a handbook for dental practitioners on "HIV and AIDS in Dental Practice. He attends international meetings regularly and keeps in touch with scientists and educators around the world in developing alliances; He also keeps up with scientific, research, policy and educational updates in dentistry from around the world so that the same advances be initiated and implemented in India in about 250 dental colleges and educational institutions. He has to his credit more than 30 publications in national and international dental journals.

Acknowledgements

I am extremely grateful to my family and friends who have constantly been a source of inspiration and encouragement. My sincere gratitude to Raghu for having his collaborative efforts to bring this manuscript into the present form. I take this opportunity to express my reverence to the “**Almighty**” with whose blessing I have been able to realize my dreams. My sincere thanks to all who provided the encouragement and support, and the same from my colleagues at the Dental Council of India and the entire dental fraternity in the country. I would like to express the tremendous pride I have about **Malika**, my cherished daughter, who has been instrumental in my journey towards accomplishment. My friends Vimal Arora and Vishal Gupta have put in a lot of effort and time in bringing out this document. My special thanks to Dr. Usha Mohan Das for conceptualizing and designing the cover, and contributing to the scientific contents of the manuscript in molding it into completion.

Finally I acknowledge every person who in some way or the other has motivated me towards accomplishing my objectives and dreams...

.....Anil Kohli

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I thank my wife Dr. Radha Holavanahalli, my daughter Aditi and my son Vishnu for being loving and patient while I was away from my family. I am grateful to the patients that have made me understand the gravity of infectious diseases. I thank Dr. James A. Cottone, Mr. Walter Bond, Dr. Chris Miller, Dr. Jim Crawford and Johnson & Johnson Medical Inc., for providing me the Socratic learning experiences in Dental Infection Control & Safety. I thank OSAP for giving me the opportunity to be a part of the infection control group, and Dr. Shannon E. Mills for being a good friend and facilitating use of the state-of-the-art facilities at the USAF DIS, Brooks AFB, San Antonio during my Fellowship. I thank Dr. Robert Langlais and Dr. William H. Binnie who helped me find my first and current position as a faculty. I also thank all my colleagues at the Baylor College of Dentistry for all the support in my research & clinical work, affording me the time to concentrate on this project. I appreciate the help of Dr. Anil Kumar Reddy and Dr. Bobby Jivnani allowing me to use their clinic for developing the visual aids. I am lucky to have good childhood friends whose company I cherished, whose intellect and science I admired, and who steered me towards academics and research rather than purely clinical practice. I am fortunate and grateful to have research support from the dental industry in the US, Canada and Italy. I sincerely thank Dr. Kohli and the Dental Council of India for providing an opportunity in utilizing my expertise to develop and implement Infection Control & Safety by Indian students and practitioners. Lastly, I thank all who have helped me in their own ways even without me realizing the worth of their efforts. My sincere thanks, love and respect to all of you...

..... Raghu Puttaiah

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INTRODUCTION

Kohli & Puttaiah

Scope of these recommendations

This “**first**” document addresses the Dental Infection Control & Occupational Safety for practices in India. These recommendations are applicable to all levels and fields of dental practice and all persons involved in providing dental care directly or indirectly including dentists, dental assistants, dental nurses, dental technicians, students, trainees and volunteers.

This document is applicable to dental care provided within dental clinics, hospitals, dental colleges, dental auxiliary institutions, mobile dental units, dental laboratories, clinical laboratories and dental camps or outreach services providing dental care. This document will be updated regularly based on new risks and possible control measures for the risks.

Objectives of these recommendations

The objectives of this document when implemented, is to control patient-to-patient infectious disease transmission, and occupational exposure of dental health care personnel (DHCP) to infectious, chemical and other hazards present/encountered during the practice of dentistry.

This document provides a framework for developing a concise yet practical curriculum in dental safety to be implemented in the didactic and clinical curriculum of undergraduate dentistry, post-graduate dentistry, and dental auxiliary programs as an integral part of educational requirements.

This document provides the framework in initial and regular periodic continuing dental education requirements and documentation of training for all active dental practitioners, including dental auxiliaries involved in patient care, as well as supervisory and educational duties as in clinical faculty.

Sources of information

The sources of information for crafting this document is from published papers, reports, white-paper documents and governmental publications of recommendations and standards that are being followed in countries that have achieved success. While evidence-based information is used in developing this document, a pragmatic and common sense approach is used in the absence of evidence-based information.

A majority of this document has been adapted from “Dental Infection Control & Safety Manual, © of Dental Innovative Devices & Educational Solution LLC, Dallas, TX, USA” and is being used as an in-office safety manual in conjunction with an Audio-Visual CD/DVD by dental practitioners in the United States.

Chapter 1

The Rationale for Dental Infection Control and Occupational Safety

Puttaiah, Bedi, Youngblood, Shulman & Kohli

Introduction

Many countries currently follow acceptable standards in Dental Infection Control & Safety dictated by a higher level of practice standards. These standards are formulated by regulatory agencies in their respective countries or regions to improve the level of patient safety and personnel safety. Many patients were infected with Hepatitis-B virus by dentists and dental surgeons in the United States in the nineteen sixties and seventies, still, infection control did not gain importance, possibly due to the advent of vaccines to combat the Hepatitis-B virus. Although concepts in dental infection control were developed in the 1960s (due to Hepatitis-B viral infections), this field only gained priority and was implemented after Human Immunodeficiency Viral (HIV) infections reached epidemic proportions. Infection control gained further momentum in the United States of America after patients treated by a Human Immunodeficiency Virus dentist later tested positive for the HIV virus, and also after health care workers became infected while involved in patient care activities. While this disease has been ravaging the African subcontinent since the late eighties, and today Asia and South-Asia in particular, it is now being controlled in the United States of America and Western Europe, where dentists have improved their practice of infection control either voluntarily or involuntarily. The number of individuals infected with HIV and developing severe disease (i.e. AIDS) continues to rise worldwide. There is an annual increase world-wide, each with high morbidity levels within the populations, but with dramatic regional variations. While the caseload in the Americas and Europe is increasing, it is not as much as in Asia, with India having about 5.7 million cases, and China about 650,000 cases of HIV infections. Apart from HIV and AIDS there is a plethora of bloodborne and other common diseases encountered in the dental clinic that may pose a risk. Based on the evidence, information, and rules, local to either the country or region, high standards of Dental Infection Control & Occupational Safety must be followed by the dental team for the safety of the patients and Dental Healthcare Workers. Disease transfer to the dentist and dental staff during dental care is considered an “occupational exposure” to a given pathogen, while disease transfer from one patient to another in the dental clinics is considered “cross-infection”. Therefore, the dental health care provider must be knowledgeable about the diseases commonly encountered during dental care and must responsibly provide care to patients without getting infected, or without infecting patients.

Rationale:

The rationale for infection control is to “control” iatrogenic, nosocomial infections among patients, and potential occupational exposure of care providers to disease causing microbes during provision of care.

The term “disease control or infection control” does not mean total prevention of iatrogenic, nosocomial infections or occupational exposures to blood and other potentially infectious material (BOPIM), it only means reducing the risks of disease transmission. Although the goals are oriented towards disease prevention, reduction in potential risks of disease spread is only practical.

Routes of Disease Transmission

Routes of disease transmission can be specific to various fields of healthcare. In dentistry, diseases can be transmitted from patient-to-patient, dentist to patient, and patient to dentist, when adequate precautions are not followed. Dental Healthcare Workers and patients can further transmit the diseases to their respective families and friends. Common modes of disease transmission in the order of severity are—

Percutaneous (high risk)

- Inoculation of microbes from blood and saliva transmitted through needles and sharps

Contact (high risk)

- Touching or exposing non-intact skin to infective oral lesions, infected tissue surfaces or infected fluids, splash and spatter of infected fluids

Inhalation of Aerosols or droplets containing pathogens (moderate risk)

- Breathing bioaerosols suspended in the clinics ambient air laden with infective material while using handpieces and scalers or droplet nuclei from coughing

Indirect contact through fomites (low risk)

- Touching contaminated inanimate surfaces in the dental treatment room or operatory

Routes of Disease Transmission



Percutaneous



Contact/Splash



Inhalation



Indirect contact

The risks of disease transmission may vary depending upon host susceptibility, virulence and infectivity of the organism, the dose of or number of organisms, period of exposure (time-span) and finally the mode of transmission. Controlling virulence of all pathogenic organisms or trying to reduce inherent patient susceptibility is next to impossible. A practical approach would be to understand the disease processes, routes of transmission, methods for controlling transmission, and implementing adequate infection control and safety measures during practice to break the chain of infection. Immunization against diseases, use of practical barrier techniques, use of personal protective equipment, engineering and work practice controls, disinfection of contaminated surfaces/equipment, sterilization of critical and semi-critical instruments, and use of aseptic protocols during treatment, broadly encompass the realm of Dental Infection Control & Safety.

Decontamination & Spaulding’s Classification:

- The first level of decontamination is called sanitization, a process of thorough physical cleaning to reduce the quantity of microbes and bioburden (normally a solution containing a detergent is used). "Sanitization or thorough cleaning is carried out prior to disinfection or sterilization". This can be achieved by thoroughly cleaning the surfaces with soap and water or initially with disinfectants that have a detergent.
- The next level is disinfection, a process that kills all vegetative microorganisms, fungi and some viruses but not necessarily bacterial endospores using chemical germicides, radiation, ultraviolet rays or heat.
- The third level is **sterilization**, a process that kills all bacteria, fungi, viruses, and bacterial endospores using chemical methods such as liquids and gases, chemical methods in combination with heat and pressure, physical methods such as dry heat, steam under pressure, or radiation.

Before one uses any infection control measure, it is necessary to understand the criticality of surfaces. Earle H. Spaulding in 1968 categorized medical devices based on risk of disease transmission and their reprocessing methods prior to their use in patient care. The same principles were modified by Favero & Bond to include 4 categories (expansion to include Environmental Surfaces as a category). Instrument and operatory surfaces can be classified as critical, semicritical, non-critical, & environmental surfaces based on potential for disease transmission. All materials being used in dentistry should be approved for patient care in the respective countries. Items which are considered single-use-disposable must be discarded after one use and not be reprocessed.

Decontamination

Sanitization



Sanitization or cleaning by wiping with a disinfectant/detergent



Sonication of instruments with a cleaner

Disinfection of Surfaces



Spray with disinfectant and wipe to clean

Spray disinfectant and wait for the TB kill time

Disinfection of Impressions



Make impression

Rinse

Spray & Wait

Rinse

Sterilization



Autoclave



Chemoclave



Dry heat

Universal Precautions/Standard Precautions for Dentistry:

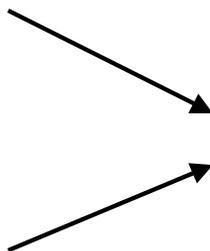
Some infectious diseases have symptoms and signs which are readily recognizable in a clinical situation, while, others conditions are clinically unidentifiable without further laboratory tests. Therefore, it is recommended by the Centers for Disease Control & Prevention that all patients be treated as potentially infectious. One should not discriminate the patient based on their appearance, medical history only or based on other possible tell-tale signs of disease. Appropriate level of infection control measures such as use of personal protective equipment or other levels of control should be the same for all patients. For example the clinician should not double glove for only known HBV infected patients as only 20 -30% of the HBV patients know that they are infected. If one needs to double glove it should be done for all patients and not only for known infectious disease patients. The level of infection control should be based upon the anticipated clinical procedures to be carried out and not on the knowledge of the patient’s infectious disease status. The level of PPE use should be based upon reasonably anticipated risks and based during the procedure to be conducted. If there is no use of aerosol/splash/spatter during a procedure, only exam gloves would suffice as PPE. If a handpiece, air/water syringe or ultrasonic scaler is to be used, then Protective Eyewear, Mask, Gown and Gloves must be used. In dentistry, both universal and standard precautions means the same. Additional precautions may need to be used in other adverse events or when there is a public health crisis or disaster situations where the risks may be different.

Examples of Standard Precautions



Anticipated use of aerosol, splash or spatter generating devices such as high-speed handpiece, air/water syringe or ultrasonic scalers

Eyewear, Mask, Gown, & Gloves (full PPE) are needed if splash and spatter anticipated. If no splash or spatter anticipated, then only gloves are sufficient



Nitrile utility gloves on a glove hanger while not being used. Outer surface of the gloves should be disinfected after each use.

While anticipating exposure to wastes, sharps and other non-normal high risk duties as above, a higher level of control is needed. Exam gloves cannot be used during changing out evacuation system filter or while handling instruments/sharps during instrument reprocessing. Nitrile utility gloves must be used (these are cut and puncture resistant and therefore controls injuries). Also, full PPE (Mask, Eyewear and Gown) should be used in conjunction with Nitrile utility gloves while handling most disinfectants and corrosive chemicals.

Table 3. Infectious Diseases commonly encountered in dentistry

Condition	Habitat	Routes of Transmission
Sexually transmitted diseases		
1. Herpetic Infections	Oral, pharynx, ano-genital, skin, viscera, eye	Contact-lesion exudate, saliva, sexual contact, blood
2. Acute herpetic gingivostomatitis	Oral, gingiva, pharynx	Contact-lesion exudate, saliva, blood
3. Herpetic Whitlow	Fingers, hands	Contact-lesion exudate, saliva, blood
4. Gonococcal Infections	Oral, pharynx, genitals	Contact-lesion exudate, saliva, blood, nasopharyngeal secretions
5. Chlamydial Infections	Genitals, eyes, oropharynx	Contact-lesion exudate, genital secretions, secretions from eye
6. Trichomonal Infections	Genitals, oropharynx, oral, gastrointestinal	Contact-lesion exudate, mucosa, saliva, blood, body fluids
7. Condyloma Acuminatum	Ano-genital skin, oral, mucosal areas	Contact-lesion, mucosa, blood
8. Syphilis	Genitals, skin, oral mucosa, oropharynx	Contact-lesion, mucosa, saliva, blood, body fluids
9. Infectious Mononucleosis	Skin, oral mucosa, genitals, parotids, saliva	Contact-mucosa, saliva, lesion exudate
10. Hepatitis B Virus Infection	Liver, blood, body fluids	Contact-blood, saliva, body fluids
11. Hepatitis D Virus Infection	Liver, blood	Contact-blood, saliva, body fluids
12. Hepatitis C Virus Infection	Liver, blood	Contact-blood, saliva, body fluids
13. Human Immunodeficiency Virus Infection	Blood, oral mucosa, skin	Contact-blood, semen, non-intact skin
Respiratory Diseases		
1. Common Cold	Upper Respiratory Tract	Aerosol, contact
2. Sinusitis	Upper Respiratory Tract	Aerosol, droplet
3. Pharyngitis	Upper Respiratory Tract	Aerosol, droplet
4. Pneumonia	Respiratory Tract	Aerosol, droplet
5. Tuberculosis	Respiratory Tract	Aerosol, droplet
6. SARS	Respiratory Tract	Aerosol, droplet, intimate contact
7. Avian Influenza (H5N1 Flu)	Respiratory Tract, Gastrointestinal Tract	Aerosol, droplet, intimate contact
Childhood Diseases		
1. Chickenpox	Oral, skin	Droplet, contact
2. Herpangina	Oral, oropharynx	Droplet, contact
3. Hand, foot and mouth disease	Oral, hands, feet	Droplet, contact, ingestion
4. Rubella & Rubeola	Respiratory tract, oral skin	Droplet, contact, saliva, blood, exudate
5. Mumps	Parotids, pancreas, testis, CNS	Droplet, contact, saliva
6. Cytomegalovirus infection	Salivary glands	Droplet, contact, saliva, blood
Other Common Conditions		
1. Hepatitis A Virus Infection	Liver, gastrointestinal tract	Ingestion, rarely blood
2. Hepatitis E Virus Infection	Liver, gastrointestinal tract	Ingestion, rarely blood

Note: Conditions addressed in the table are frequently seen in dental patients and therefore need to be considered in protecting patients and the dental health care workers. The modes of transmission in dentistry are commonly direct contact with lesions, saliva, blood, oral mucosa, and droplets or aerosols containing infectious agents.

Table 4. Adaptation of Spaulding’s Classification:

Level	Risks	Control Methods	Materials/Devices
Critical	High	<p>Sterilization by:</p> <ul style="list-style-type: none"> -Autoclave -Chemical -Dry Heat -Immersion in full strength Glutaraldehyde (8 hours for sterilization and rinsed with sterile water) <p>or</p> <ul style="list-style-type: none"> -Sterile single-use-disposables 	<p>Items that are used in surgery which pierce soft and hard tissue—</p> <p>Scalpel blades, burs, extraction forceps, elevators, needles, files, bone-rongers, periodontal instruments used in prophylaxis, surgical drains for abscesses, and any other instrument used in surgery, dental explorers, periodontal probes, biopsy punch, surgical drains, endodontic files and reamers, and implants</p>
Semicritical	High	<p>Sterilization by:</p> <ul style="list-style-type: none"> -Autoclave -Chemical -Dry Heat -Immersion in full strength Glutaraldehyde (8 hours for sterilization and rinsed using sterile water) <p>or</p> <ul style="list-style-type: none"> -Sterile single-use-disposables -Clean but non-sterile single-use-disposables supplies 	<p>Items that do not necessarily penetrate soft and hard tissues but which cross the vermillion border (lip) into the oral cavity—</p> <p>Mouth mirrors, handpiece, anesthetic syringes, chip syringes, amalgam condensers, impression trays, air/water syringe tips, high-volume evacuator tips</p>
Noncritical	Moderate to low	<p>Surface Disinfection with intermediate level hospital disinfectants:</p> <ul style="list-style-type: none"> -Hydrogen peroxide based -Phenols -Iodophors -Quaternary Ammonia Compounds <p>or</p> <ul style="list-style-type: none"> -Disposable Barriers 	<p>Items used in dentistry which do not cross the vermillion border or penetrate the soft tissues—chair light handles, instrument trays, high touch work surfaces, bracket tables, chair controls, Air/water syringes, hoses and dental chairs</p>
Environmental	Low	<p>Disinfection with Intermediate to low level disinfectants:</p> <ul style="list-style-type: none"> -Phenols -Iodophors -Quaternary Ammonia Compounds <p>Sanitization:</p> <ul style="list-style-type: none"> -Scrub wash with soap and water 	<p>Floors, walls and door handles that are not considered high touch surfaces. General housekeeping rule applies to these surfaces</p>

Examples for Spaulding's Classification



Critical Items:

Items that pierce the skin or mucosa must be sterilized or sterile single-use-disposables



Semi-Critical Items:

Non-sharp items that enter the oral cavity must be sterilized, sterile single-use-disposables or single-single-use disposable supplies



Semi-Critical Items:

Non-sharp items that enter the oral cavity must be sterilized, sterile single-use-disposables or single-single-use disposable supplies



Environmental Surfaces:

Walls, floors and non-high touch or non-intimate surfaces should be maintained through house-keeping methods

Chapter 2

Common infectious diseases encountered in Dentistry

Puttaiah & Roychowdhury

Many diseases are encountered in dental practice. Sometimes it is the patient that is infected who comes in to seek care, and sometimes it could be the clinician or clinical staff affected by the disease condition.

Hepatitis

Hepatitis A

Hepatitis A Virus (HAV) belongs to the picornoviridae family and is an RNA virus. HAV infection causes jaundice and rarely causes death. Among otherwise healthy adults the death rate is about 1 in 1000, in people >50 years of age the rate is 27 in 1000. Incubation period is about 4 to 6 weeks. Once the person recovers from Hepatitis A infection, the person is protected for life. A vaccine against Hepatitis A viral infection is now available. If one has not been exposed to HAV, a one time vaccination may provide life long immunity.

Hepatitis E

Hepatitis E Viral (HEV) infection is similar in nature to the HAV infection epidemiologically but for the higher rate of infection among pregnant women in the third trimester (20% infection rate). Outbreaks are commonly seen in the South Asia, Southeast Asia, Africa, Central and South American regions among other geographic regions in the world. As of today, there is no vaccine available against Hepatitis E Virus.

Hepatitis B

Hepatitis B Viral (HBV) infection is caused by a DNA virus which is a hepadnavirus. Most patients with HBV infections cannot be clinically identified as being infected. About 2-7% of the population in the South Asian, Middle-Eastern, Mediterranean region, East European, Russian, Parts of Central and South American region are infected with this virus. Certain Alaskan and Canadian regions (Tundra), South American Region, Africa, Southeast Asian region including China are considered high in prevalence (>8% of the population). Most of the North American, parts of the South American, Australian, and West European regions are considered low in prevalence (<2% of the population). The incubation period lasts from 45-160 days therefore it is also called chronic hepatitis infection. Transmission can be both percutaneous and non-percutaneous, but, primarily bloodborne. This variety of hepatitis is very contagious and has been occupationally acquired by dentists in the past. Outcomes of HBV infection are — about 90% of the infected become healthy again; about 9-10% become asymptomatic carriers or suffers from chronic persistent hepatitis or develop active hepatitis leading to hepatocellular carcinoma and death; about 1% develops fulminant disease right after infection and die. Vaccines against HBV infections are available. The rate of infection among dentists (general practitioners and specialists included) ranged from 13.6% to 38.5%. Therefore it is not an uncommon disease affecting dentists. There have been cases

of dentists infecting patients with HBV. According to the Centers for Disease Control & Prevention (CDC) booster doses of the vaccine may not be necessary due to the anamnestic response and lack of evidence of previously immunized persons being re-infected (although the titers may be low after immunization, in the event of an exposure to HBV, the body will show a protective immune response and therefore booster vaccines are not necessary).

Hepatitis C

Hepatitis C virus or the parenterally transmitted non-A non-B virus is an RNA virus, usually seen in association with blood transfusions and contact with blood and other body fluids. This disease is also seen commonly among persons sharing needles during illegal drug-use, and in patient with other sexually transmitted diseases. This disease can be very debilitating and can be fatal. Over 60% of the infected may develop chronic liver disease. Of those who develop liver disease, 30-60% develops active liver disease and 5-20% cirrhosis of the liver. HCV infection and hepatocellular carcinoma are found to be epidemiologically associated. Although a vaccine is not available, various treatments including chemotherapy against this infection have shown to help control the disease and reduce viral load. This virus is highly infective; therefore, healthcare providers must take adequate precautions while treating patients.

Hepatitis D

Hepatitis D viruses a virus-like particle always dependent on presence of Hepatitis B viral infection in the patient (piggy-back virus). It may occur as a co-infection with HBV or after being infected by HBV. Mode of transmission is similar to blood and other body fluid contact.

Hepatitis G

Hepatitis G viral infection is the most recently identified virus that is a bloodborne condition.

Hepatitis viral infections are the most insidious infections which occur among susceptible patients. Dentists must avoid contact with blood and other body fluids of patients by using adequate barrier techniques and adopt proper disposal of the waste to avoid cross-infection among other patients.

Human Immunodeficiency Virus

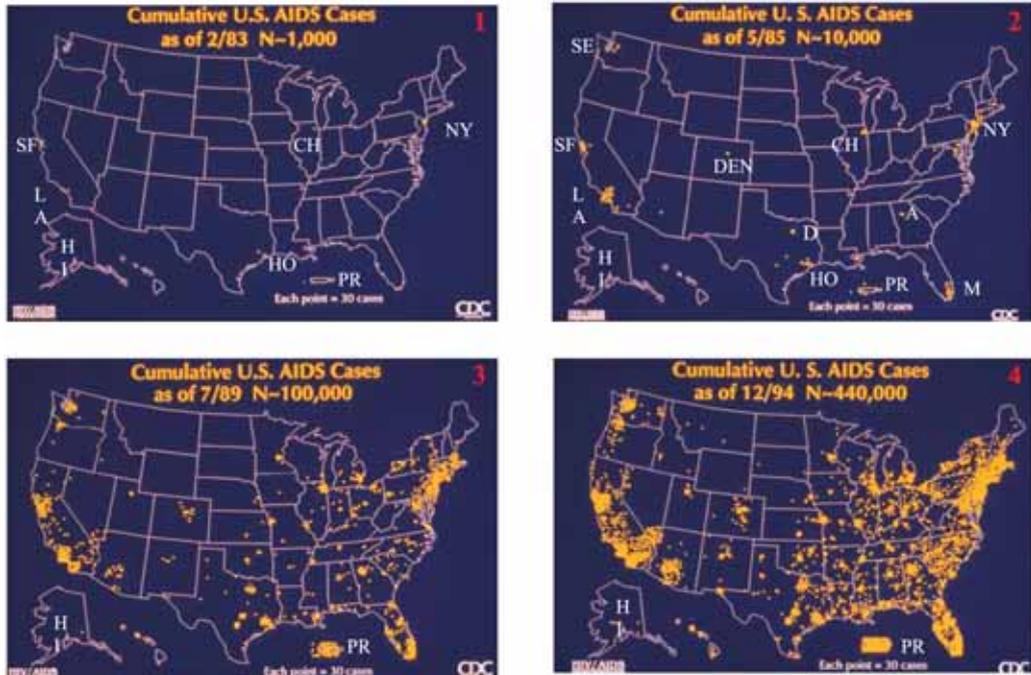
HIV or Human immunodeficiency virus is a condition where transmission occurs through contact with blood and other body fluids. This disease was identified in June 1981 and has been the plague of the 20th century. Initially it was seen among homosexual persons and later found its way into all parts of the society including heterosexuals, females and children. This infection is on the rise in South Asia and Southeast Asia while the infection rates are on the decline or has been stable in the US. The initial HIV infection progresses into a more severe and debilitating condition where it is associated with a variety of other infections and is called **AIDS** or **Acquired Immunodeficiency Syndrome**. There are many classifications for AIDS such as the Center for Disease Control's Surveillance Definition, the Walter-Reed's Classification or the WHO's Classification. In the early stages the HIV infection may not be noticeable and may be accompanied by symptoms such as weakness, arthralgias, or even totally asymptomatic. On progression, HIV infection may be associated with a variety of conditions. Some of the oral lesions associated with HIV infection and AIDS are Hairy Leukoplakia, Kaposi's Sarcoma and Candidiasis. It is imperative that the dentist have knowledge of the clinical appearance of these oral lesions. Other than the oral conditions there may be systemic condition such as protozoal infections, fungal infections, other viral infections and mycobacterial infections. Almost all organ systems may be involved in this infectious process. Although there has been a series of patients being infected by a dentist in Florida, USA, no other cases of transmission from a dentist has been reported in the US. There have been no occupational exposures leading to HIV infection of the dentist or dental auxiliaries during dental treatment. It is absolutely essential to understand that post exposure protocols must be followed to reduce

the probability of sero-conversion, by taking antiviral drugs immediately after exposure to a patient infected with HIV.

Tuberculosis

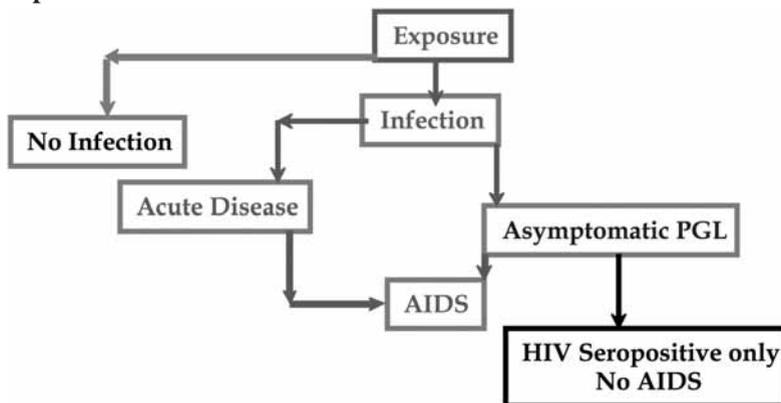
Tuberculosis is one of the oldest infectious diseases known to humans. In the past most countries had this disease under control. But now this disease has reemerged in both prevalence and with a new type of a multi-drug-resistant-strains. *Mycobacterium tuberculosis* is the organism which commonly affects the lungs but may involve most organs in the body. Each year about 8 million people develop TB and 3 million die. TB mimics many respiratory conditions, therefore when the practitioner observes a cough of more than 3 weeks of duration, sputum possibly tinged with blood, unexplained weight loss, and night sweats, the patient should be referred for a TB skin test and treatment. If diagnosed with active infection the patient must be treated till pronounced non-infectious and then may access dental care. It is pragmatic to defer care for patients with active TB till such time the disease is controlled. In the United States, dentists can defer elective dental care till such time the patient is pronounced non-infectious, and all emergency dental treatments may be provided in institutions that are equipped to deal with the control of cross contamination or occupational exposure. Such facilities should include negative air pressure treatment rooms with the air vented to the outside of the building. The air conditioning and ventilation system must also be equipped with HEPA filters and the personnel must use masks that have a HEPA filter during the contact with infected patients. Dentists and staff must undergo testing for the disease on a periodic basis, especially if living in endemic areas where the prevalence is high. Many healthcare institutions in the United States have made annual TB testing mandatory for their personnel and have effective TB control plans. In endemic areas, the testing may be done every six months. Similar control plans may be adopted by individual clinics for the benefit of the personnel and patients.

Spread of infection Diseases–HIV in the USA



This series of images shows clusters of HIV cases (each yellow dot = 30 cases) being spread in the USA over a period of 11 years. In 1983 there were about 1000 registered cases, in 1985 about 10,000 cases, in 1989 about 100,000 cases, and in 1994 about 440,000 HIV cases (The Centers for Disease Control & Prevention, Atlanta, Georgia, USA).

Outcomes of Exposure to HIV



In initial exposure, there are two possibilities, infection or no infection. If there is no infection the person is lucky. If infected after exposure the outcomes could be immediate or acute HIV infection leading to AIDS, or asymptomatic persistent generalized lymphadenopathy that may be in a chronic state for many years and then go into the AIDS state. On the other hand asymptomatic PGL or asymptomatic patients can remain so for many years (over 20 years) without advancing into the AIDS stage.

In a dental setting, the dentist and the dental staff may be infected by a variety of conditions. Following are the conditions and possible return to work approach—

Table 5: When can an infected clinician return to work?

Condition	When should one return to work OR what is to be done
Conjunctivitis	After discharge ceases
Staph. Aureus (active)	After lesions have healed
Strep. Group A	24 hours after starting effective antimicrobial treatment
Viral Respiratory Infection	After resolution of Acute symptoms
Active Tuberculosis	After treatment with antimicrobials and deemed non-infectious
Positive Skin Test for TB	After evaluation for infectious status, chest x-ray, and treatment if needed till deemed non-infectious
Influenza	After symptoms resolve
Pediculosis (hair lice)	After treatment provided and no lice
Herpetic Whitlow	After lesions heal
Orofacial Herpes	After lesions heal, need to be regularly on anti-herpes medicines for the rest of the life
Chicken Pox (Varicella)	After lesions dry and crust out
Shingles (Herpes Zoster)	After lesions dry and crust out
Hepatitis B (HBe antigen +ve)	After deemed HBe antigen –ve, UP/SP and expert panel /Infectious Diseases MD to monitor clinician
Hepatitis C Seropositive	Need to use UP/SP, Proper Aseptic Techniques to protect patients, Anti-viral Medication, Monitoring
HIV/AIDS	After anti-retroviral therapy started, UP/SP and expert panel /Infectious Diseases MD to monitor clinician
Measles	After 7 days from the appearance of rash
Mumps	After 9 day from start of parotitis
Rubella	After 5 days from the appearance of rash
Pertussis	After 5 days from start of effective antimicrobial therapy
Diarrhea	After symptoms resolve
Amoebiasis	After starting effective antimicrobial therapy and symptoms resolve
Enteroviral Infections	After symptoms resolve
Hepatitis A	After 7 day from the onset of Jaundice

Although it is difficult to implement in most clinical situation, we should try to implement these guidelines to the best of efforts. These conditions range from low risks of disease transmission to very high risks of transmission within the clinics. These conditions may be passed on to the patient or be spread in the clinical area between clinicians.

Chapter 3

Infectious Disease in India – Epidemiology, Impact and Perceptions

Kohli, Mohan Das, Arora & Puttaiah

HIV & AIDS

Almost 5 million people were infected by HIV globally in 2005 – the highest jump since the first reported case in 1981 – taking the number living with the virus to a record 40.3 million, the United Nations announced in November 2005. They further announced 4.9 million new infections was fueled by the epidemic's continuing rampage in Sub Saharan Africa and a spike in the former Soviet Union and Eastern Europe, Central Asia and East Asia. More than 3.1 million people died this year from AIDS, including 570,000 children – far more than the toll from all natural disasters since last December's tsunami or natural disasters in Asia, particularly Indian and Pakistan. Southern Africa, including South Africa, which has the world's most cases at more than 5.1 million, continues to be worst hit. Sub-Saharan Africa is home to 25.8 million HIV-positive people, or 64% of the world's total. In Asia, a total of 1.2 million new cases since 2003 pushed total cases to 8.3 million, with conditions in countries such as Vietnam and Pakistan ripe for a rapid spread.

UNAIDS said the number of HIV-positive women reached 17.5 million this year, one million more than in 2003. “UNAIDS and governments should “wake up and smell the coffee”, said “Anjali Gopalan, director of the Naaz Foundation, India, (a well established organization working on the control of HIV in India). The outgoing chief of India's official National Aids Control Organization, S.Y. Quraishi, said 70 percent of Indian sex workers either did not know what a condom was or how to use one. “If the situation remains unchanged, India could have an estimated 50 million HIV cases by 2025.” For nearly two decades India is one of the leading countries as far as AIDS infections are concerned. Since 1994 almost every country in Southeast Asia and Africa has seen its HIV prevalence rates double and India is no exception. India with a population of more than 1 billion is a melting pot in the global marketplace. About half the population is in the sexually active age. The first HIV case was detected in 1986 by Dr. S. Solomon (YRG Care, Chennai, India) and as of today, HIV has been reported in all the individual States and Union Territories. As of today, it is in almost all segments of the society, gender, age and social class and sexual orientation. The spread of HIV in India has been diverse, with much of India having a low rate of infection and the epidemic being most extreme in the southern half of the country and in the far north-east. The highest HIV prevalence rates are found in Maharashtra in the west; Andhra Pradesh and Karnataka in the south; and Manipur and Nagaland in the north-east. As of August 2006, 90% of all nationally reported AIDS cases have been found in 10 of the 38 States Union Territories. The greatest numbers were in Maharashtra and Gujarat in the west; Tamil Nadu, Andhra Pradesh and Karnataka in the south; and Manipur and West Bengal in the north-east.

In the southern States, the infections are mostly due to heterosexual contact, while infections are mainly found amongst injecting drug users in Manipur and Nagaland. The Indian National AIDS Control Organization (NACO) estimates that 5.21 million people were living with HIV in 2005, giving an adult prevalence of 0.91%. This represents a slight increase from the 2004 estimate, and a substantial increase from 4.58 million in 2002. These rates are still being reviewed and updated with some reports stating a much lower prevalence. However, even low prevalence rates in such a large population still means a huge caseload, impacting both the public health, primary and tertiary care systems with respect to prevention, control, stabilization, education and intervention modalities. Even if there is a very low increase of about 0.1% in the HIV prevalence rate in within this huge population, the caseload increases tremendously further burdening the already stretched healthcare system.

The national HIV prevalence has risen dramatically since the start of the epidemic, but a study released at the beginning of 2006 suggests that the HIV infection rate has fallen in southern India, the region that has been hit hardest by AIDS. In addition, NACO has released figures suggesting that the overall rate of new HIV infections in the country is slowing. Researchers claim that this decline is the result of successful prevention campaigns, which have led to an increase in condom use. "Could this also have been to attrition within the HIV population?" is a question we may want to address.

Today it is globally known and evidence-based that HIV viral particle have been isolated from saliva, and the latter is one of the primary screening methods for HIV infection. Saliva is normally contaminated with blood from gingival inflammatory tissue and therefore it is possible that HIV and HBV could spread from one individual to another even through saliva. Therefore, saliva must be treated as potentially infectious as blood or other body fluids with respect to HIV and other bloodborne diseases.

The need for an effective infection control program has always been an essential and integral part of the dental practice. Over the years dentistry, with rare documented exceptions, dental infection control has been successful in limiting the transmission of infectious diseases during patient care. Exceptions have involved the transmission of hepatitis B virus (HBV) and herpes simplex virus (HSV) between practitioners and patients during dental treatment and are being investigated. Unfortunately, early reports of occurrences of disease transmission between dentists and patients were not taken seriously and were treated by the profession as isolated incidences. However, when acquired immunodeficiency syndrome (AIDS) a disease with a social stigma of initially being more prevalent among homosexuals was identified as an infectious disease, health care providers involved with close patient contact began to review and re-evaluate the already existing control measures developed for HBV. The HIV/AIDS epidemic precipitated rethinking the implementation of infection control measures. In 1983, the Centers for Disease Control (CDC) made the first recommendations for the prevention of exposure to blood and body fluids through the use of universal precautions. In 1986, recommended Infection-Control Practices for Dentistry was published and later updated in 1993. The CDC published recommendation for prevention of HIV transmission in health-care settings in 1987, which recommended that blood and body fluid precautions be consistently used for all patients regardless of their bloodborne infection status. Under universal precautions, blood and certain body fluids of all patients are considered to be potentially infectious for human immunodeficiency virus (HIV), hepatitis B virus (HBV), hepatitis c virus (HCV) and other bloodborne pathogens. The rationale for treating all patients as potentially infectious is due to the fact that most patients are unaware of their infectious disease status. This concept was intended to use protective measures to prevent parenteral, mucous membrane and non-intact skin exposures of healthcare workers to bloodborne pathogens based on the clinical procedure rather than the known infectious disease status of the patient or the appearance of the patient. In addition, the recommendation for health care workers to be immunized against hepatitis B was an additional measure.

Infection Control & Occupational Safety is all measures taken to control infections during clinical care, be it patient-to-patient transmission or between the patient and care provider. In dentistry due to multiple procedures and specialized fields, the techniques that are used today have to be specifically adapted multiple idiosyncrasies yet simplified to accommodate diversity in the risks. Although basic principles about the spread of infections in dental clinics and hospital set-ups have not changed, new issues have emerged with underlying diseases being more compromising, invasive procedures being more common, newly identified varieties of microorganisms responsible for a broader spectrum of infection, bacterial isolates becoming more resistant to common and conventional antibiotic therapies, and patients being treated by greater variety of health care providers. Taken cumulatively these factors have presented an impressive array of new challenges for the most sophisticated clinician and the infection control practitioner.

About 20 years after exposure to infection control concepts in this country as well as in other advanced countries of the world, control and prevention of infectious diseases in dental patients and health care providers remains a conundrum. There has been a lot of effort placed on the practice of infection control without acceptance (positive attitude) towards the acquired knowledge. A survey on Infection Control Needs Assessment of Practitioners in Eight Countries by Puttaiah et al, AADR, 2005 showed that even in advanced countries, dentists practice adequate infection control but still did not understand the real concept of Universal or Standard Precautions. About 17% to 64% of practitioners felt that all patients were not to be treated as potentially infectious, 50% to 86% felt that medical history and appearance of the patient dictated the level of infection control to be practiced, 53% to 75% felt it was appropriate to double-glove while treating infectious patients, 12% to 64% felt that the infectious disease status of the patient was always known, and lastly 18% to 65% felt that it was alright to refuse care to infectious patients. Could this be due to Stigma? These numbers are very discouraging as even practitioners in advanced countries have not understood the concepts but still practice by rote. It is our duty as teachers in Infection Control and Safety to make the practitioners have the knowledge, make them

develop a positive attitude and then practice in a safe manner. The “why, when and what”, need to be explained about any new concept for safer practice. While anticipating risks, clinical application of personal safety techniques as prescribed by U.S. Occupational Safety and Health Administration addresses procedure specific aseptic techniques, barrier use such as gloves, masks, protective eyewear, clinical attire and use of disposable inanimate surface barriers in the absence of decontamination. Further use of automated instrument decontamination devices, time efficient and effective heat sterilization methods, chemical disinfectants, waste management procedures and single use disposable items have created a safer environment for dental personnel and patients alike.

Tuberculosis

Tuberculosis has been and continues to be taking a terrible toll on the Indian population. According to the WHO Global TB Report 2006, India has more new TB cases annually than any other country, ranking first among the 22 high-burden countries worldwide. TB remains one of the leading infectious causes of mortality in India, resulting in 364,000 deaths annually. There were more than 1.8 million new TB cases in India in 2004, representing over one-fifth of all TB cases worldwide. The estimated incidence rate in 2004 was 168 per 100,000 people. (Global Tuberculosis control WHO report 2006). However, the Indian Scientific Community has developed many of the basic principles necessary to fight this epidemic. These methods are now being practiced in many countries around the world. [GUEST Editorial 2004 Journal of the Indian Medical Assoc., New Delhi, India].

TB is able, to produce acute to latent-chronic disease that mostly affects lungs but can virtually affect every organ system in the body. The main concern for dental professionals and health care workers is transmission of the disease by inhalation of infective droplets expelled through cough by an infectious patient with active pulmonary disease. Authors around the world have emphasized strict adherence to infection control guidelines and for prompt initiation of treatment for patients with confirmed or suspected tuberculosis among this patient population. Obviously these patients present a serious risk for us as dentists and health care workers. We need to emphasize the critical importance of deferring routine care, isolation of active cases (infectious) till treated and deemed non-infectious. As in other parts of the world, multi-drug resistant TB is seen in patients with HIV. Therefore, one should not only understand that additional precautions beyond universal/standard precautions may be needed. As India is a high risk country for TB, dental health care professional must undergo annual tests/chest x-rays to rule out active TB. TB skin test - PPD or purified protein derivatives skin test will show positive reaction to TB because most Indians have been immunized with the BCG vaccine. Therefore, chest x-rays as well as other microbiological/immunological methods need to be used for testing the care provider. If found with active lesions and deemed infectious, they should be isolated including from patient care and treatment started immediately. After successful initiation and when deemed non-infectious, the care provider can be allowed to return to active clinical practice. However, periodic monitoring needs to be conducted on the sustained efficacy of treatment.

HIV and TB

HIV and TB form a lethal combination, each speeding the other’s progress. HIV weakens the system. An HIV-positive patient has a greater likelihood of acquiring TB, more so multi-drug resistant TB. A leading cause of death in HIV patients is TB. It accounts for about 13% of AIDS deaths worldwide. In Africa. WHO and its international partners have formed the TB/HIV Working group, which develops policy on the control of HIV-related TB and advises on how to tackle this lethal combination.

HEPATITIS – B Virus

HBV is found in blood and blood products, saliva, sputum, breast milk, tears, wound fluid, sperm, sweat, vaginal discharges. Minute quantities of fluid may be sufficient for parenteral transmission of disease. Only half of those infected with HBV have a clinically diagnosed illness, therefore about 50% does not report disease status, of these patients 15% could become carriers. Hepatitis B is a major cause worldwide of acute and chronic hepatitis, cirrhosis and primary hepatocellular carcinoma. Hepatitis B virus (HBV) is probably the most important chronic viral infection affecting humans and HBV is a leading killer among all infectious agents. Approximately 400 million people are chronic HBV carriers worldwide. HBV infection and its complications are global health problems. The spectrum of chronic HBV infection ranges from asymptomatic Hepatitis B surface Antigen (HBsAg) carrier state to chronic hepatitis with progression to cirrhosis and end-stage liver disease. Despite the development of an effective vaccine against HBV, this infection remains a serious threat to public health in India. Several studies from India have reported a HBV prevalence rate of 3% to 6%. However, these data are known to underestimate the prevalence of chronic HBV Infection. India with a population of approximately one billion and assuming a lower prevalence rate of 3%, India still harbors approximately 30 million HBV carriers. A modest estimate would put the number of deaths occurring due to HBV infection per year in India to around 100,000. HBV is responsible for about 68% of cirrhosis of the liver,

and 80% of hepatocellular carcinoma in India. In spite of the fact that HBV is a major killer in India, and this is easily preventable, the new infections are on the rise. A decision-analytical model estimated that in India, vaccination should save 25 lives per 100,000 people/year; hepatitis B immunization is not yet available freely to infants and children as part of the state sponsored immunization program as in the United States. Incorporation of HBV vaccination into the Expanded Program of Immunization for infants could bring down the rates over time. One of the successes in the control of bloodborne diseases among dental professionals is the reducing rates of HBV due to mandatory immunization.

On the global perspective, one third of the world's total population (2 billion) has been infected with hepatitis B virus. There are approximately 400 million people with chronic HBV infection (lifelong infection). Near to home (India) about 67% (275 million) reside in Asia and the Pacific Islands. By comparison, there are 170 million people with chronic hepatitis C and 47 million people with HIV/AIDS in the world. In many Asian countries, 10% (5-20%) of the population are HBV carriers. China has the greatest burden of chronic hepatitis B and liver cancer. An estimated 130 million (10% of the population) has chronic hepatitis B. About 0.5 million die each year from liver cancer or end stage liver disease caused associated with hepatitis B. About 1 million people die each year (equivalent to 2800 deaths/day, 115 deaths/hour, or 1-2 deaths/minute) from liver cancer or liver failure caused by HBV.

HBV Facts - How Does It Spread?

HBV is fifty to hundred times more infectious than HIV. The highest concentrations of the virus are found in blood (as high as ten billion viruses per mL); ten to a hundred times lower concentrations are found in semen and vaginal fluid. Hepatitis B virus is not spread by air, food, water, breastfeeding, casual contact in an office setting, kissing, hugging, coughing, sneezing, and sharing eating utensils or drinking glasses. Spread of HBV from mother to baby usually happens at the time of birth (still horizontal transmission). Child to-child spread most likely happens as a result of contact with skin sores, small breaks in the skin, or mucous membranes with blood. Spread within the household from sharing toothbrushes or razors may also occur because HBV can survive for at least seven days outside the body. 90% of infants infected at birth with HBV will become chronically infected. About 30-60% of children aged 1-5 years infected with HBV will become chronically infected. Up to 10% of older children and adults infected with HBV will become chronically infected. Most people from Asia including the Pacific Region and Africa become infected with HBV during childhood: from infected mother to child at birth, from child to child contact in household settings, and from reuse of non-sterilized needles and syringes healthcare facilities.

The Relationship between HBV and Liver Cancer - A Silent Killer

One out of four people with chronic hepatitis B virus infection who become chronically infected during childhood (in other words, approximately 100 million of the 400 million chronic HBV infected people in the world) will die of HBV-related liver cancer or cirrhosis. Liver cancer is often fatal because of its insidious nature of being practically asymptomatic in the initial stages. Thus, the diagnosis is incidentally made quite late while the patient is being treated at a tertiary center for other health problems. Liver cancer can occur in those with chronic HBV infection without cirrhosis; the risk is higher with cirrhosis, in men (3:1 male to female ratio), and with a family history of liver cancer. Liver cancer usually develops between thirty five to sixty five years of age. An estimated 600,000 people each year die of liver cancer; 380,000 deaths each year are from countries in Eastern Asia alone (China, Hong Kong, Japan, and Korea). China alone accounts for 54% of the liver cancer deaths worldwide. Liver cancer is one of the top three causes of death by cancer in most of Asia, the Pacific Region, and sub-Saharan Africa. At least 80% of liver cancer is caused by HBV. Worldwide, liver cancer is the fourth leading cause of cancer death in men, although uncommon in North America and Europe.

HBV infection, especially during infancy and early childhood, is easy to prevent with the hepatitis B vaccine. Since 80% of liver cancer is HBV-related, the vaccine is considered the first 'anti-cancer vaccine.' Hepatitis B vaccine is safe and has been given to over 500 million people in the world. When given to infants immediately after birth and at 1 month and at six months, completion of the three-dose vaccine series induces a protective antibody response in 95% to 99% of vaccinated infants, even when the mother is a hepatitis B carrier. In addition, a direct reduction in liver cancer in cohorts of immunized children has already been demonstrated in Taiwan. Post-vaccination testing for immunity is not necessary after routine vaccination of infants, children, adolescents, or adults. Testing for immunity (anti-HBs) at nine to fifteen months of age after completing the series at six months of age is advised for infants born to mothers who are infected with HBV. Testing one to two months after completing the series is advised for healthcare workers, and persons with HIV infection. No booster shot is necessary after completion of the three-dose series due to the anamnestic response in successfully immunized patients.

Chapter 4

The Status of Dental Infection Control & Safety in India – A Study

Puttaiah, Bedi & Shetty

Introduction: This Dental Infection Control needs assessment study was conducted by investigators from India (Dr. Sadashiva Shetty, Davangere), the United States (Dr. Raghu Puttaiah, Dallas) and United Kingdom (Dr. Raman Bedi) using a self-administered needs assessment survey in India. The data collected were from a convenience sample in South India and could be used by educational institutions, governments and industries interested in improving the quality of infection control in South Asia. This study could help understand the needs and help develop a basic need-based educational curriculum in dental infection control and safety for India. Similar studies have been conducted in Pakistan, South Korea, China, Philippines, Thailand, Taiwan and the United States of America.

Background: Dentistry is predominantly a field of surgery, involving exposure to blood and other potentially infectious materials,¹ and therefore, requires a high standard of Infection Control and Safety practice in controlling cross contamination and occupational exposures to bloodborne diseases. Apart from bloodborne diseases such as Hepatitis B infection and HIV infections, the dental health care workers are potentially at risk of acquiring respiratory diseases, childhood diseases, sexually transmitted diseases commonly encountered in dentistry.^{2, 3} Although most principles of dental infection control and safety were formulated in the 1960s, this field only gained importance over the past two decades due to the AIDS Epidemic in the Americas and Europe.² Currently, adequate control of communicable diseases have been achieved in the developed countries through education, public health measures, regulations as well as practice of dental infection control & safety.^{4, 5, 6, 7, 8, 9, 10, 11} As the incidence of AIDS and other associated bloodborne diseases is on the rise in South Asia (with the case load in India about 5.7 million) and is predicted to reach epidemic proportions similar to that in Africa and the United States,^{10, 11} it is essential to improve the knowledge, attitude and practice of Dental Infection Control and Safety in the South Asian region. The population at risk of being infected through dental care would be all ages, gender, social class and occupation if strict infection control and safety procedures are not followed by the practitioners. Anyone who seeks dental care at a place that does not utilize strict aseptic and protective measures could possibly be a victim of infectious disease.

Materials & Methods: A preliminary data collection instrument with about 100 variables on the Knowledge, Attitude and Practice regarding Dental IC & Safety was developed by the investigators. About 500 of this self-administered instrument was distributed in South India (Karnataka and Tamil Nadu States) among faculty members of dental schools, dentists in private clinical practice, and dentists working for the Governments. The completed instruments were edited for content and context and data were entered and analyzed using SPSS for Windows

Results: Of the 500 instruments distributed 456 (91.2%) returned completed instruments. About 63.5% were male and 36.5 female. The mean age of the respondents was 30.92 years. The mean amount of time involved in practice among these respondents was 6 days per week, 11.7 months per year, 6 years in practice treating about 12 patients per day. About 57.9% were graduates without post-graduate training, 42.1% with at least a post-graduation or advanced training. About 21% were in General Practice, 10.4% had specialized in Oral Surgery, 7% in Orthodontics, 5.8% in Restorative Dentistry, and 55.4% in other specialty fields. The respondents represented about 20 schools from the South and South Central regions of India but were practicing in the states of Karnataka and Tamil Nadu in South India. About 82% were involved in private clinical practice and about 16% were faculty in various dental schools (Tables 1 and 2 provide details on the Knowledge, Attitude, Practice and Needs of the respondents).

Table 1. Knowledge, Attitude, Practice and Needs Regarding Infection Control

Variable	Percent
1 Epidemiological trend of “HIV on the rise in India” versus Perceived Level of Training	
HIV on the rise in India	98.2
Have adequate training in Dental Infection Control & Safety	70.0
2 Knowledge versus Attitude regarding HBV and HIV among respondents	
Perception of knowledge on HBV as a disease	76.0
Tested knowledge HBV as a disease	96.0
Perception of knowledge on HIV as a disease	83.0
Tested knowledge on HIV as a disease	99.0
3 Knowledge versus Attitude regarding HBV and HIV disease transmission	
HIV & HBV transmission possible in the dental office	94.8
Potential for disease transmission through splash or spatter	73.0
Infectious diseases transmitted through sharp injuries only	56.3
4 Universal Precautions – Knowledge, Attitudes and Practice	
HIV & HBV status of patients is always known	15.2
All patients should be treated as potentially infectious irrespective of appearance	69.3
Medical History patient dictates the level of infection control practice	54.1
Double-gloving practiced while treating a patient with known infectious disease status	77.7
Right to refuse care for patients with infectious diseases	20.8
5 HBV infections in dentistry:	
Risk of transmission in dentistry	98.2
Need for immunization for Dental Practitioners	99.6
6 Immunization against infectious diseases	
HBV	80.7
Influenza	58.1
Polio	96.4
Diphtheria	94.7
Tetanus	96.1
Rubella	79.3
Measles	87.0
Mumps	83.0
Chicken pox	82.6
7 HIV & AIDS in Dentistry:	
Risk of transmission in dentistry	94.9
Need for improved infection control measures	99.1
Practicing adequate infection control	61.5
Having access to the needed infection control materials and equipment	38.3
8 Perceptions of Needs regarding Dental Infection Control & Safety	
Need more training	97.3
Local agencies, organizations, associations and bodies to be more involved	98.2
Can afford the costs for implementing infection control measures (equipment and supplies)	80.3
Need for local financial institutions to provide loans for upgrading the equipment	98.6
Need for local manufacture of infection control equipment and materials	95.9
Mandatory infection control & safety curriculum in dental schools	99.3

Table 2. Practice measures being implemented

	Variable	Percent
1	Antimicrobial Handsoaps	
	Carbolic acid-based	71.4
	Chlorhexidine gluconate-based	70.0
	Triclosan-based	36.0
	Parachlorometaxenol-based	22.6
2	Use of Personal Protective Equipment – PPE	
	-Single-use-disposable exam gloves	87.3
	-Sterile single-use-disposable for surgical procedures	84.2
	-Face masks	92.6
	-Protective Eyewear	46.6
	-Protective Gowns	48.7
3	Safety on Sharps	
	Use of single-use-disposable syringe/needles	95.0
	Use of Sharps Containers for disposal of needles and other sharps	35.0
4	Use of Chemical Germicides	
	Preprocedural antimicrobial mouthrinse	71.0
	<u>Immersion disinfectant-</u>	
	-Glutaraldehyde	90.7
	<u>Surface disinfectant-</u>	
	-Bleach (sodium hypochlorite)	79.1
	-Phenolic disinfectant	43.0
	-Quaternary Ammonia compounds/disinfectants	45.5
	-Iodophor disinfectant	27.8
5	Use of surface barriers	74.8
6	Control of Aerosols	
	Rubber-dam	40.0
	High-volume-evacuator	54.0
7	Use of Instrument Reprocessing Devices	
	-Ultrasonic cleaners	46.9
	-Autoclaves	81.9
	-Chemiclaves	55.5
	-Dry heat	62.5
	-Glass bead (unapproved method)	67.6
	-Immersion sterilant (Glutaraldehyde as a sterilant)	84.0
8	Use of Heat Sterilizable Instruments	
	Highspeed handpiece	67.5
	Burs	67.1
	Endodontic instruments	72.2
	Orthodontic instruments	58.3
	Hand instruments	91.8
	Mouth mirrors	93.5
9	Infection Control Equipment and Materials	
	Local availability	76.2
	Willingness to use if made available	93.6

Discussions: Preliminary analysis of data from this convenience sample showed a good response rate in completion of instruments. Most respondents were general dentists while a significant number were specialists. Each dentist treated about 2500 patients per year which is 25% more than in the USA. Therefore, the rate of exposure to infectious diseases could be higher in this sample due to practice profile and not disease prevalence in the patient population alone.

Only about 80% of respondents were immunized against HBV, while the prevalence of HBV in South Asia is 2-7 %. A significant number were not immunized against other immunizable diseases. Most respondents (>98.8%) recognized the risk of HIV infection and the need for formal training in IC, while

only 61.5% used adequate measures, and 38.3% materials required in the practice of infection control and safety during patient care.

Variables demonstrating inadequate use and infection control principals were:

Germicide use, Preprocedural Mouthrinse, Antibacterial Handwash, Disinfectants and Liquid Sterilants, Personal Protective Equipment, Safety devices, High Volume Evacuators & Rubber Dams, Ultrasonic Instrument Cleaners and Sterilizers. Although, the respondents mentioned use of autoclaves, most were modified pressure cookers (locally manufactured) at the best. Some clinics still used boiler tanks and most clinics never packaged instruments. Other than some in institutional practice (Dental Schools attached to Medical Centers), none of the respondents interview individually practices sterilization monitoring (validation of sterilizer function with biological indicators).

Although most respondents were willing to change and use IC materials and equipment, the latter were not locally available. Most respondents had the knowledge of HBV, HIV and other infectious diseases, but few were adequately educated/trained in Universal Precautions and use of PPE. Data collected showed a need for formal training and sustenance of an IC Program.

Data also demonstrated a multifactoral need such as “Involvement” by—

-Local and National Dental Associations

-Banking and Financial Institutions

-Local Manufacturing firms to produce materials and equipment needed for infection control

-Marketing Firms to obtain licensing to market equipment and materials for infection control

-Dental Schools to provide education and become a local resource and make a education in IC mandatory for dental students.

As the prevalence of HIV infection & AIDS and other related conditions is on the rise, the loss of productive hours among the employed population will not only affect the internal economy of the South Asian countries, but will indirectly affect investment of the other countries in South Asia. Public health measures and improvement in the field of medicine are being addressed in South Asia, but the field of dentistry still lacks the needed knowledge, training and equipment. It would therefore be in the economic and social interest to facilitate and sustain the proposed program of Infection Control and Safety Program in India for protection of the former's economic investments in the region. Further, the advanced countries and India should note that “travel dentistry” is becoming an affordable and a hot topic in India. The latter only shows that Infection Control & Safety Practice by all Dental Health Professionals in India is a high priority and must meet not only the international standards but the best available standards being practiced in the United States and Europe.

Conclusions: The level of Infection Control in India is still in its infancy and many years behind that of the United States and some European countries. Formal programs in Infection Control and Safety must be developed not only for the Indian sub-continent but for the South and Southeast Asian Region and implemented within the next couple of years. Lack of Infection Control is life-threatening for the both the Patient and the Dental Professional and requires more efforts than dental caries or periodontal disease, let alone cosmetic dentistry. In this context, Infection control in dentistry is to prevent life-threatening diseases and communicable conditions and not dental caries or periodontal diseases which some researchers and policy makers have classified the latter as infectious diseases. A pragmatic policy on Infection Control & Occupational Safety through grass-roots education should address mandatory—

- Training for dental students (didactic curriculum including aseptic techniques)
- Training for practitioners (requirement in basic training and maintaining continuing education credits in IC&S)
- Training for institution based practitioners
- Introduction of Materials and Equipment needed for IC&S

- Recommendations for Dental Infection Control & Safety for India (detailing standards-of-care and Public Health Law)
- Surveillance of safe practices
- Dissemination of information Dental Safety for patients so that they may informed of the measures being taken
- Setting-up HIV and other Bloodborne Disease Dental Care Centers at Dental Schools
- Expanding duties of the Public Health Dentistry/Community Dentistry Departments of Dental Schools to provide out-reach dental care to rural HIV and other BBP infected patients
- Eventually make all clinics provide dental care to all patients including HIV and other BBP infected patients

An initial measure would be to craft the Infection Control Recommendations for Dental Professionals. The next step is to set-up a Nationwide Train-The-Trainer Program in Infection Control & Safety for India where future local experts would be trained. We need to set-up collaborative efforts with Recognized Universities in India and the US using Training Grants such as Fogarty International Training Programs. These programs should provide exposure to qualified individuals to obtain short-term fellowships in the US (4-6 months) and develop applicable programs for India. International Health Promotion Agencies (Fogarty Intl., USAID, Bill & Melinda Gates Foundation, DFID and WHO) must get involved in supporting formal IC programs in South Asia and other developing countries. Local Dental Associations, Governments, Dental Schools, Banks, Industry and Marketing firms must also be involved for a multifactoral role to make transition smooth. Industries from developed countries must help in this transition in any way possible as they would be able to increase the market for materials and equipment with the available of educated and trained dentist.

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Chapter 5

Medical History and Dental Safety

Puttaiah & Roychowdhury

While taking medical history the clinician should not discriminate an infectious disease patient with reference to the potential of spreading the disease in the clinic. The reason one should look out for patients with infectious diseases is to protect them from other acquiring other infectious disease conditions, as they usually are medically compromised. For some patients with active infectious disease it may be advisable to defer routine dental care (as in Tuberculosis) till such time the patient is deemed non-infectious. Some times it may be necessary to differentiate between patients at risk for infections such as patients with a history of rheumatic heart disease, recent intraosseous implants or recent extensive cardiac or other surgeries, where antibiotic prophylaxis may be indicated. All in all, one must know as to where the patient stands in the panorama of health and disease, before offering treatment or even advice. Knowledge of various infectious diseases, their potential for transmission, clinical features, progression and outcomes is essential for a clinician. While speaking to patients with infectious diseases one must maintain a high level of professionalism and confidentiality in acquiring the patient's trust and confidence. If the patient is not comfortable, there is bound to be a barrier in doctor-patient-communication such as information giving and seeking, the end result being an incomplete history, reporting bias by the patient, and possible misdiagnosis, leading to inappropriate treatment. A legal issue that may be associated with the patient's medical history is the completeness of the medical/dental record in the event of malpractice and litigation. In the event the dentist does not pay due importance to medical history, this inaction may be construed as negligence during litigation, and may affect the right to practice dentistry. Therefore, not only must the dentist possess skills in providing dental care, but also have the acumen to address general health of the patient, focusing on the required options for general patient management.

Some Components of the Patient Assessment Record in Relation to Infectious Disease

Identification Characteristics

Dates of visit, Name, Age, Gender, Ethnic Origin, Marital Status, Address, Occupation are some of the variables that are needed. Each variable may have a bearing on the infectious disease status of the patient. For example, military personnel may be exposed to a different variety of infectious diseases based on the geographic region of residence. Certain ethnic population may have a predilection to infectious diseases that may not be common locally (sickle-cell anemia). The date of history taking may have a bearing on the time of occurrence and progression of disease.

History of Illness (Past & Present)

History of trauma or other medical conditions which involved hospitalization and invasive surgery requiring blood transfusion, blood dyscrasias, immunosuppressive therapy, chemotherapy and radiation therapy that may alter the immune response of the patient must be recorded and dental treatment provided

accordingly. Patients with chronic diseases such as diabetes mellitus, cancer These patients may be more likely to fall sick due to microbial and viral exposures and with a greater probability of recurrence than healthy persons.

Family History

Hereditary diseases and disorders such as hemophilia, diabetes and certain conditions affecting the nervous system may be elicited here (vertical transmission of disease i.e. parents to offspring). Certain acquired diseases through proximity such as tuberculosis are also of importance (horizontal transmission i.e. between spouses, patients, patient to healthcare provider and vice-versa).

Social History

Information on travel, sexual promiscuity, use of drugs and alcohol, personality and emotional state may also determine the level of risk of acquiring infectious diseases and possible immunosuppression as a sequela.

Review of Systems:

Skin

Generalized itching could be commonly seen as a sign of cirrhosis prior to occurrence of jaundice. Macules, papules, vesicles and scar could be various stages of chicken pox. A variety of pigmentation conditions associated with varying levels of immunosuppression such as Addison's disease, von Recklinghausen's disease, Puetz-Jeghers syndrome and Cushing's disease and some nutritional/micronutrient deficiencies. Body hair (Lack or Loss thereof) may be associated chronic illnesses, dermatomyositis, systemic lupus erythematosus, lymphoma, cachexia, herpes zoster and micronutrient deficiencies.

Limbs

Infectious, immunologic and neoplastic processes may be associated with joint disorders. One must consider modification of routine dental treatment so as to reduce the risk of infections in persons with prosthetic implants and total joint replacement with antibiotic prophylaxis, with a possible consult from the patient's physician.

Eyes

Blurred vision may be associated with diabetes mellitus and Stevens-Johnson syndrome. Some signs of hemolytic/obstructive jaundice, chronic hepatitis, cirrhosis may be associated with icteric sclera. Herpes keratitis, common cold, viral infections, Gonococcal infections and Chlamydial infection could be associated with signs of conjunctivitis.

ENT

Hearing loss may be associated with rubella or syphilis. Sinusitis with purulence may be associated with an acute episode of viral infection and a bacterial super-infection. Acute viral and bacterial infections of the upper respiratory tract may be associated with pharyngitis.

Respiratory infections

Chronic bronchitis, pulmonary tuberculosis, pneumonias and viral infections in the upper respiratory tract could be associated with productive or non-productive cough. Hemoptysis may be associated commonly with pulmonary tuberculosis. A cough of three weeks or more could be a sign of pulmonary tuberculosis necessitating a referral for a TB skin test and a pulmonology consult to rule out active TB.

Cardiovascular system

Most patients with cardiovascular disease must be handled with care. They are more likely to suffer from stress and are more likely to be immunocompromised. Infective endocarditis prophylaxis must be applied to rheumatic heart disease which includes organic heart disease, and non-rheumatic heart conditions such

as mitral valve prolapse with regurgitation. Other conditions that warrant such action is prosthetic heart valves and persons undergoing dialysis. If adequate antibiotic coverage is not provided, patients may end up with infective endocarditis. Apart from the above mentioned conditions, a complete list may be obtained from the ADA or the AHA that need prophylaxis. But when in doubt, one should obtain a consult from the patient's primary care physician.

Gastrointestinal tract

Signs of jaundice could be related to hepatitis, cirrhosis, hepatocellular carcinoma as sequelae to viral infections of the liver. Other than Hepatitis A, E, B, C, D and G, Epstein - Barr virus, Cytomegalovirus, Rubella, Rubeola, Coxsackie B virus, Herpes viruses and Adenoviruses may also be associated with inflammation of the liver. Inflammation and infections of the liver will predispose the patient to other infections due to immunosuppression.

Genitourinary tract

Among non-infectious conditions that can affect the kidneys is hypertension leading to secondary renal damage and affecting the patient's immune system. Patients with prolonged use of medications that affect renal function are also at risk of suffering from immunosuppression. STD also affects the function of the genitourinary system.

Endocrine system

Diabetes mellitus, thyroid abnormalities and adrenal insufficiencies also alter the patient's immune function.

Hematopoietic Abnormalities

Persons on long-term treatment with various medications may suffer from abnormalities that may affect the immune system. Anemias, HIV infection, Leukemias and patients without a spleen (asplenic) are also important conditions that alter the immune function thereby routine treatment of such patients.

Neurologic System

Paresthesias and numbness not associated with trauma may be due to micronutrient deficiencies and metabolic abnormalities.

Medical history helps understand possible medical complications that may arise out of routine dental care and helps us understand the special needs, plan adequate and safe delivery of routine dental care, reduces the possibility of litigation due to oversight, and builds patient's confidence in the dentist.

Chapter 6

Immunization of Personnel Involved in Dental Care

Puttaiah & Kohli



In the developed countries and in India routine childhood immunization is a part of life and is taken for granted. Immunization is the first line of defense against infectious diseases. Even employees with minimal patient contact should accept vaccination.

Table 6. Common Childhood Vaccines

Vaccine	Disease
Hepatitis A	Hepatitis A viral infection
Hepatitis B	Hepatitis B viral infection
Varicella	Chicken Pox
MMR	Measles, Mumps and Rubella
DPT	Diphtheria, Pertussis and Tetanus
Rubeola	German Measles
Meningitis	Meningitis
Polio	Poliomyelitis

Other than the above, additional vaccines and Immunoglobulins are provided based on the geographic location and risks of certain endemic conditions. Bloodborne diseases such as Hepatitis C and Human Immunodeficiency viral infection do not have vaccines.

Immunizations for Healthcare Workers

Apart from the routine prescribed immunizations as seen listed in the vaccines and Immunoglobulins for children, influenza vaccines must be used as needed (i.e. prior to the onset of the “Flu Season”). We as health care workers are at a high risk of preventable infectious diseases and therefore must adopt this first line of defense. We should be vaccinated against all immunizable infectious diseases. It may be the law in some situations, or a prescribed preventive measure within certain professions that have a potential for exposure and in institutions that immunizations as a policy are a must for employees. Irrespective of the law or regulations that dictate, it is the ethical and moral duty of the health care provider to stay healthy

and protect oneself against diseases through immunization. It is less expensive and less time consuming to be immunized than to be treated otherwise. If one is the head of the clinic or an institution, one must provide access and if possible pay for the immunization as the law or affordability may dictate.

Other than the common vaccinations (childhood vaccines), the clinicians should also be regularly vaccinated against other conditions such as Influenza on an annual basis. If the clinicians live in endemic areas of Cholera, or travel frequently to endemic areas of Cholera, the clinicians should be vaccinated against Cholera.

Proposed protocol recommendation for HBV vaccine for Dental Health Care Workers in India

A record of immunization should be obtained while hiring a clinician. Employees should be provided immunization against HBV as soon as possible if the employee has not been immunized. If the employee declines immunization, it must be documented and kept on record. The recipient of the vaccines should be explained about the adverse effects if any (hypersensitivities to protein components of the vaccine, preservatives and stabilizers), prior to making a decision of administering the vaccine. Pretesting whether a non-immunized recipient is protected is not required. Post-testing (anti-HBs) to determine protection is normally done 6 months after vaccination series. Negative can mean two outcomes— 1) Responder with low or non-detectable levels but still protected; or 2) Recipient is a primary non-responder. If adequate protection is not determined by post-testing, they may require additional doses of the vaccine. For those who have been determined to be responders (immunized), no booster doses are necessary due to anamnestic response or immunological memory.

Vaccines that are recommended are Rubella, Rubeola (Measles), Mumps, Poliomyelitis, Hepatitis B, Influenza, Tetanus and Diphtheria. For those not protected against Hepatitis A viral infection, immunization is advised but not recommended. Rubella and Rubeola must not be given to immunocompromised persons. Booster doses are not required for mumps. If a health care worker who is immunized against polio is exposed to the oral secretions of a patient with active polio, Oral polio vaccine (live attenuated virus) or Inactivated Polio virus vaccine boosters are needed. Hepatitis B vaccine (three 1 mL doses at 0, end of 1 month and 6 months intramuscularly (deltoid muscle) is recommended. If a person is not immunized against HBV and is exposed to an infected patient's body fluids, a combination of Hepatitis B vaccine and an immunoglobulin (HBIG) must be administered immediately. If the exposed person does not want to take the vaccine, two doses of the HBIG immunoglobulin must be given (in most cases, dose 1 within 24 hours and dose 2 given 25 to 30 days after exposure). Periodic preventive programs for the clinic would be to get every one in the clinic immunized against the seasonal influenza virus to avoid loss of productive work time.

Proposed protocol for HBV vaccine for Dental Undergraduate & Postgraduate students and Dental Teaching Faculty in India

It is mandatory for every dental student undergraduate and postgraduate and dental teaching faculty to be vaccinated against Hepatitis B with a three dose regimen and a booster. The institute head will confirm that the undergraduate and the postgraduate students have had a course of HBV vaccination before the admission procedures are completed. Other than the teaching faculty all non teaching faculty which include dental assistants, dental hygienists, dental mechanics and all those who come directly in contact with patient care, cleaning and sterilization of instruments and all those who are in the clinical area or the pre clinical area of the dental teaching institution must to be vaccinated against Hepatitis B. It is also mandatory for the institution managements including government owned institutions to provide free Hepatitis B vaccine to all its students both undergraduate and postgraduate, teaching and non teaching faculty.

Chapter 7

Handwashing and Handcare

Puttaiah & Youngblood



Patients notice most things in the clinic...from cleanliness to personal hygiene and the clinician's professionalism. Sometimes they even take into notice whether the clinician and staff have clean finger nails, whether they have washed the hands with soap before donning gloves, whether the hair is unkempt and also whether the clothes are clean and presentable as a clinic staff or dentist. Dental treatment occurs in close proximity of bodies and therefore, body odors are an issue to the patient. Therefore, personal hygiene, cleanliness, cleanliness of the clinical area, as well as professional appearance among others, are important issues that can affect the patient's perception of the level of care being received.

Examination of hands

Before wearing personal protective equipment, the dentist and staff need to remove chunky jewelry and wrist watch, and examine their hands for cuts and bruises and hangnails. After handwashing, the cuts and bruises should be medicated and covered using a band aid/dressing to avoid coming in contact with patient material.

What should one use?

Hands should be washed with water and an antimicrobial soap. Some of the antimicrobial soaps that have been cleared by the US FDA have Chlorhexidine Gluconate (CHG) at 0.75% to 4% concentration that may be dispensed as liquid soap or foam, Parachlorometaxyleneol (PCMX) liquid, Iodine liquid or Triclosan liquid, gel or foam. CHG at 4% is marketed for surgical scrub as opposed to routine handwashing and the latter may show residual effect or substantivity (remains on the skin as a protectant) on the skin after 4-5 repeated washes. PCMX is also an effective germicide but may lack the level of substantivity as seen in CHG. Triclosan based soaps are not as powerful as CHG, PCMX or Iodine based soaps. Soaps dispensed as foam use lesser soap than liquids (when liquid soap is mixed with air using a specialized dispenser/nozzle, foam is produced) and may be less expensive on the long term. The rationale for handwashing is to reduce the number of microbes on the hand by the process of cleaning mainly, apart from the antimicrobial effect of the germicidal soaps.

When should one wash hands?

Handwashing should be done at the beginning of the clinic session and soon after removal of gloves. One of the reasons to wash hands after removal of gloves is to reduce bacterial counts that build up on the skin during glove use. Handwashing also helps remove glove related materials on the skin including corn starch; other powders that are used in the gloves for easy donning hat have the potential to cause sensitization or skin irritation.

Sequence followed in routine handwash procedures

- 1) Remove jewelry and wrist watch and examine hands
- 2) Wet hands with warm water
- 3) Dispense an adequate amount of soap
- 4) Thoroughly rub both surfaces of the hands including around the thumb and fingers for about 30 - 60 seconds
- 5) Wash hands with warm water to remove the soap
- 6) Dry hands with paper towels
- 7) Examine hands for injuries such as nicks, cuts and bruises and treat as needed
- 8) Wear single-use-disposable gloves.

The same procedure should be followed after removal of contaminated gloves. Hands should be dried using disposable paper towels before donning a new pair of gloves because gloving wet hands is difficult.

Handwashing and Handcare



Use of Hand Sanitizers



In the recent past, hand sanitizers that are alcohol based with or without other germicides have entered the market. These items are primarily for use when handwashing is impractical or cannot be done (non-availability of water and antimicrobial handsoap). Hand sanitizers with alcohol have been showed to be effective in germicidal control on hands. Some hand sanitizers have been produced without alcohol, with emulsions of natural oils and have also reported anti-microbial efficacy. Although there is germicidal control, these hand sanitizers do not clean hands adequately, and therefore, should be used in conjunction with a disposable wipe to remove the dirt and grime build-up on the hands. Recently, hand sanitizers incorporated in wet-wipes have entered the market and show promise in both cleaning the dirt on the hands as well as reporting antimicrobial efficacy.

Surgical Handwashing

While planning to conduct a surgical procedure where exposing bone is involved, surgical handwashing



procedures must be followed. All the basic precautions such as having short trimmed nails, no jewelry, cuts and bruises on hands should be taken as during regular handwashing and hygiene procedures. In addition, these procedures dictate a more involved process needing additional steps. Bacteria on the skin (both patient as well as the dental professional) can lead to wound infections if they enter the operative field (tissue). Therefore, thorough cleaning/scrubbing of the hands immediately prior to surgery with a surgical scrub level soap (Chlorhexidine Gluconate 4%, or other Iodine based surgical soaps) are beneficial in many ways. Scrubbing hands all the way up to the elbow for about 2 to 6 minutes using a single-use disposable sponge or a soft scrub brush removes the dead cells along with the bacteria resident on the skin of the hands. Bacteria under the gloves rapidly multiply due to the humid and warm environment as opposed to a dry and cool area. If the soap has residual properties (staying on the skin on repeated washing with the antimicrobial soap) it tends to slow the multiplication of microbes. Reducing multiplication of resident skin microbes on the hands of the clinician/surgeon for the duration of a procedure reduces the risk of letting bacteria being released into the surgical field if gloves become compromised (torn/punctured). Surgical scrub soaps should have properties such as substantivity or residual action, must have broad spectrum antimicrobial activity, have a good kill rate (fast or rapid action and reduce the bacterial load effectively), be a good detergent, non-irritating to skin, and be fast-acting.

Steps involved in handwashing are as follows—

1. Dispense out the needed PPE to be worn immediately after the scrub
2. Remove jewelry and examine hands for cuts, bruises and hang nails (take care of them)
3. Clean under the nails using a nail cleaner under running clean water
4. Wet hand and apply the antimicrobial soap
5. Scrub hands for 2-6 minutes (based on the length of antimicrobial exposure time per manufacturer's recommendation) using a sterile single-use-disposable sponge or a scrub brush
6. Dry hands with sterile towelettes or paper towels
7. Wear sterile surgical gloves without touching the outer surface of the gloves
8. After surgery, remove gloves aseptically without letting the blood or body fluids coming in contact with hands
9. Examine hands for cuts, punctures or bruises and wash hands with an antimicrobial soap and water
10. At the end of the session apply an emollient (hand lotion) that is suitable and that helps moisturize the skin

Some institutions and recommendations advocate the use of alcohol sanitizers in addition to the scrub, but it is not widely practiced. If used, wait till the hands dry before donning surgical gloves.



Washing hands multiple times per day with soaps tends to make the skin dry. At the end of each session (during lunch break, or at the end of the clinic day) a good quality emollient/skin cream should be used for hand care.

Chapter 8

Personal Protective Equipment

Puttaiah

Personal Protective Equipment (PPE) commonly used in general dental care are single-use-disposable gloves (sterile or non-sterile), protective eyewear, face-shields, masks, gowns and utility gloves used to protect personnel from blood and body fluids and chemical hazards. The main use of barriers is to control gross contamination and not prevent spread of every single microbe. As an example, some of the viruses are smaller than the microscopic pores in latex exam gloves and therefore have a probability of passing through the glove material. In this instance, one may safely infer that gloves are meant for reducing the amount of exposure to the viral particles of the body fluids and not to totally prevent contact with the virus. Therefore, handwashing with an antimicrobial soap after removing gloves is necessary and pragmatic. With respect to dentistry, there has not been a single reported and accepted case of disease transmission linked to passage of viral particle through the pores in the gloves.



No anticipation of splash
Or spatter needs only
exam gloves



When splash and spatter is anticipated, protective
eyewear/face-shield, mask, gown and gloves are
needed. Bonnets may also be used to harness hair

Rationale for determining the level of PPE

PPE use is determined by the anticipated exposure to blood or other potentially infectious material (BOPIM) and chemical hazards. We need use “full PPE” (protective eyewear, mask, gown and gloves) when there is a potential for splash or spatter (use of air/water syringe, highspeed handpiece and/or scalers), or a potential for exposure to chemicals that could splash/spatter on the face or mucosa. Full PPE would include protective eyewear, mask, gown and gloves. When we anticipate no potential exposure to splash/spatter to BOPIM or chemical hazards, we could still achieve compliance by using exam gloves only (as in suture removal or cursory examination of the oral cavity).

Personal Protective Equipment Gloves

Gloves may be single-use-disposable non-sterile exam gloves or single-use-disposable sterile surgical gloves that can be used in a patient's mouth. Over gloves or food handlers gloves are used over contaminated gloves to obtain supplies or touch non-contaminated surface once the dentist has begun treatment and has body fluids on the exam gloves. Utility gloves (reusable) should be used while decontaminating the operator, handling contaminated instruments and sharps, while handling disinfectants/chemical sterilants or as when indicated by the chemical manufacturer.



Powder-free single-use-disposable latex gloves



Powder-free single-use-disposable nitrile gloves



Powder-free single-use-disposable polyurethane gloves

Exam gloves can be made from latex, vinyl, nitrile, and polyurethane. They may be powder-free or powdered, fitted left and right hand or ambidextrous. Sterile surgical gloves may be powdered or powder-free and as of today they need not be latex. In dentistry, we handle many different materials and films, which may get contaminated or affected by the powder from the gloves. Powder in the gloves may help carry the allergens from the latex glove material on to the skin leading to a possible allergic or hypersensitivity. As of today, powder-free gloves are not very expensive; therefore, their use must be encouraged. Non-latex gloves available are made from nitrile, polyurethane, vinyl and other newer materials and their use should be considered due to latex allergies.

While donning the gloves, one must look for visible breaches in integrity of the gloves such as holes and wicking before putting the hands in the patient's mouth. Breach in the integrity of the gloves is not a rare occurrence and can be seen at least once a day in a busy practice. Hands must be washed before wearing the gloves with a medical grade anti-microbial soap to reduce the quantum of the resident bacteria on the skin surface. While handling chemicals, germicides and during instrument it is safer to use nitrile utility gloves to avoid exposure to the skin.

Allergic Reactions to Latex



Hands show peeling or skin along with inflammation and report of irritation while using latex gloves. On discontinuation of latex glove usage, skin showed healing in a week

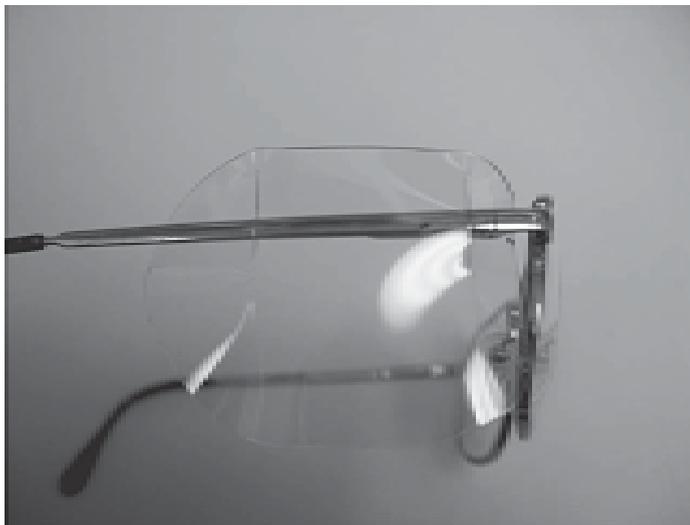
There are two types of allergic reactions to gloves or the materials comprising the latex gloves—

- The first type of reaction is the Type IV or delayed hypersensitivity. This reaction may occur in about 2 to 3 days after exposure. Clinical characteristics of this reaction may be itching, broken skin and dryness of skin
- The second variety of allergic reaction is Type I or immediate reaction characterized by itching and erythema of the area of the hand covered by the glove leading to a generalized systemic reaction that may range from a rash, rhinitis, conjunctivitis, bronchospasm, hypotension, anaphylaxis and in some instances death

There are many chemicals that are used in the manufacture of latex gloves. These chemicals including latex particles can irritate the skin of the clinicians leading to Type IV reaction. In extreme cases it may lead to a Type I reaction or systemic anaphylaxis. Even powders that are used in the gloves for easy donning may irritate the skin. Therefore, non-latex and more so, powder-free gloves are better options. Most items/materials used in dentistry that have natural latex rubber must have an indication in the literature stating that the item contains natural rubber latex. While taking a patient's history of allergies, latex allergy must be used. Every clinic must be equipped with non-latex glove alternatives such as nitrile and vinyl gloves for patients with latex allergies. All clinicians who are allergic to latex gloves must use non-latex gloves and must avoid the use of any latex materials. All employees allergic to latex gloves must be provided with safe alternatives at the clinics expense. Nitrile and polyurethane gloves are more cut and puncture resistant than latex gloves.

Masks

Face masks use in dentistry are primarily to control the exposure of the clinician's oral and nasal mucosa to BOPI and the patient's blood and oral fluids. They should not be considered respirators as they do not have an air tight fit around the face irrespective of the material's filtration efficiency. Absence of an airtight fit around the periphery of the mask increases the chances of air to get inside the mask through the periphery and this phenomenon is called "blow-by". If there is a blow-by, then masks cannot be deemed respirators, nor the filtration efficacy of the material applicable.



Mask can be dome shaped or surgical masks with or without a fluid resistant membrane layer. Masks must be disposed after one use (per patient or earlier if visibly soiled). Eyewear should protect eyes adequately. For prescription glasses sideshields are available that can be inserted to protect the sides.

Dental aerosols that are generated during patient care are usually smaller than 5 microns in diameter (these are usually considered to be aerosols (<50 microns in diameter). Aerosols can be suspended in the air for many hours. Larger particulate liquid matter (50-100 microns) tends to settle down due to gravitational forces. The passing of the liquids from the outer layer of the mask on to the inner surface is called “strike-through” and this should be avoided by using masks that are impervious for liquid passage. The surgical mask may have three layers— the outer (esthetic layer), the middle (fluid shield layer), and the inner layer (that is soft and compatible with the skin of the face). The mask may be shaped for a good fit such as being pleated or being duckbill shaped.

Masks may have attached eye-shields that may be disposed along with the single-use-mask. Whenever one uses a mask, a work practice must be to dispose the mask after treating one patient. If the procedure extends beyond 25-30 minutes, one may need to replace the mask with a new one. When visible contamination or episodes of splash or spatter occur, a new mask must be used after washing the face and eyes (as needed).

Protective eyewear

In dentistry can be goggles, polycarbonate glasses with side-shields, face-shields and prescription glasses with disposable side-shields. Protective eyewear must be worn in conjunction with facemasks. Even when a face-shield is worn, a mask must be worn along with it to control exposure to splash/spatter from the sides. Most eyewear should at least be cleaned with soap and water at the end of each session or when visibly contaminated. While trimming models, dentures, cutting wires and doing lab work or during reprocessing of instruments, use of protective eyewear is a must to reduce the probability of exposure to hazardous materials and hard particulate matter that may damage the eyes.

Protective clothing

Scrubs are street clothes and not considered personal protective equipment. A fluid resistant gown that is full sleeved is adequate for use as protective equipment. Gowns are to be changed between patients to control cross contamination between patients. If scrubs are used as protective equipment, then reprocessing (laundering) should be done on premises, done at a laundromat (with contaminated clothes carried in a biohazard labeled bag) or given to a professional laundry and the costs borne by the employer. The employer should provide and pay for all clothing and PPE that are used as PPE. The employer need not pay for scrubs as well as laundering of the scrubs as they are considered street clothes.

Note—

PPE including Masks, head covers, gowns and gloves should not be removed in the clinical area if there is a risk of splash and spatter. PPE should be removed and disposed off if disposable immediately after the procedure or stored safely for reprocessing/laundrying if reusable. It is recommended that all dental students undergraduate and postgraduate wear hospital clinical attire while treating patients in the clinical areas based on the level of anticipated exposure. It is also recommend that dentists and faculty members who guide dental students in clinical area should routinely wear clinical attire while working on patients or in laboratories based on the levels of anticipated exposure hazards and while working chairside with students. Personnel handling contaminated instruments such as during instrument reprocessing should wear full PPE including puncture/cut resistant nitrile utility gloves to reduce risks of occupational exposure to blood and body fluids.

*Some institutions require everybody in the clinical areas to wear full PPE irrespective of anticipated exposure to splash/spatter, this is considered wasteful. PPE use is expensive as money is spent in its purchase as well as its disposal. Further, unnessesary use of PPE when not indicated will pollute the environment and landfills. Cookie cutter approaches towards infection control must be avoided as it is wasteful.

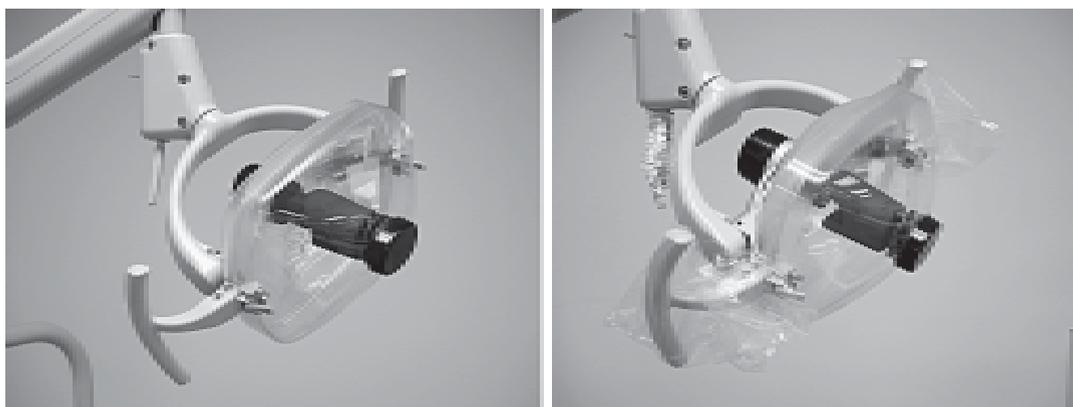
Chapter 9

Surface Barriers Versus Disinfection

Puttaiah & Kohli

Surface barriers are a practical and an easy way to contain cross-contamination. Barriers can be sterile or non-sterile depending on whether they are used for a surgical or a non-surgical routine dental care. Most dentists use disinfectants to clean the equipment and work surfaces between each patient. If disinfection of work surfaces is done between each patient instead of only changing barriers, the time taken is considerably more due to the initial sanitization step with the disinfection (that may take between 2-5 minutes) and then the disinfection step (based on the TB kill time of 5-10 minutes based on the claims of the disinfectant). The turn around time for an operatory if a disinfectant is used (8-15 minutes) is longer than the time taken for removal of barriers, placing new surface barriers, disposal of the waste, return of the used instrument to the instrument reprocessing area (3-5 minutes). Therefore barriers make it quicker to turn around an operatory between patients. When barriers are routinely changed between patients, disinfection of the surfaces proximal to patient care may be done at the beginning of the clinic session, or at the end of the clinic session and when visibly soiled.

Work surface barriers



Light handles and light switches need to be barriered during patient use and discarded after each patient. Thin plastic bags, wraps or aluminum foil may be used



Air/water syringes, HVE and Saliva Ejector Syringe/couplings may be barriered to at least 6 inches below the coupling. Other options are to disinfect between patients. Computer Keyboard and Mouse that are water resistant may either be disinfected or barriered between patients

Flat works surfaces such as the counters that are in immediate proximity to the clinician (within hands reach) and at a higher risk of contamination and touch with soiled gloves may be covered with plastic barriers or other fluid impervious barriers such as patient bibs (one side absorbent and one side impervious to fluids). Instead of using a patient bib, one may opt for alternatives such as a cling wrap (plastic food wrap), a plastic bag (such as those used in the dry-cleaning industry to cover garments). Many dental barrier manufacturers have other preformed plastic barriers that can be used for this purpose. The bracket table is another example for barrier use. While placing contaminated items on work surfaces, it is essential to place them on impervious barriers to control the spread of cross-contamination to the primary work surface. The same example may be extended to work in dental laboratories or while handling contaminated prostheses and impressions either chair side or in the laboratory. In the absence of preformed barriers those that are designed for the food industry such as cling wrap (roll of plastic sheet that has static electricity and tends to cling to surfaces) may be an inexpensive alternative. Clinicians have used aluminum foil and sterilized them between patients (today it is not acceptable and not practiced, while single-use-disposable are allowed).

Surfaces to be barriered

Single-use-disposable barriers that are preformed or generic should be used over some of the commonly touched surfaces—

1. Dental Unit Light handles
2. Dental Unit electrical or mechanical controls
3. Dental Chair Head Rest
4. Dental Chair Arm Rests
5. Dental Unit controls including the Bracket Table
6. Highspeed Handpiece couplings and hose (extended 6 inches below the coupling covering the hoses)
7. Slow speed motor, coupling and hose (extended 6 inches below the coupling covering the hoses)
8. Air/water syringe and hose (extended 6 inches below coupling covering the hose)
9. Saliva ejector handpiece and hose (extended 6 inches below coupling covering the hose)

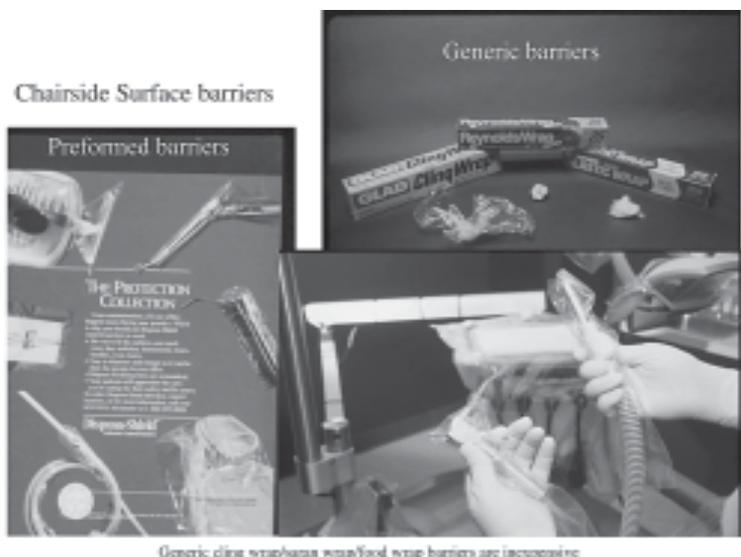
10. HVE handpiece and hose (extended 6 inches below coupling covering the hose)
11. X-ray unit handles and cone
12. X-ray Unit controls
13. Bite Block of the Panoramic X-ray Unit
14. Intra Oral Digital Sensors
15. RVG equipments
16. Apex locators
17. Endosonic Ultrasonic Units
18. NITI Torque control hand pieces

Items that can be sterilized such as handpieces should not be barriered due to slippage of barriers causing the handpieces to fall or hurt the patient.

Many preformed barriers are available that are relatively inexpensive and specific to certain equipment surfaces. Other less expensive alternatives are generic plastic cling-wrap or food wrap. These barriers are single-use disposable and must be changed between patients. The surfaces must be disinfected when soiled, at the beginning of the session or at the end of the day. Between patients one may change only the barriers to help reduce the chair turn around time between patients.

For surgical suites and surgical procedures one may want to use aluminum foils that are autoclaved. If one has to use barriers effectively between patients and avoid over use of disinfectants, as a work practice control only barriered surfaces should be touched with contaminated gloves and non-barriered/unprotected surfaces must not be touched. This work practice comes out of experience and diligence.

Single-use-disposable barriers extending over six inches onto the tubing, beyond the coupling should be used on Air/Water Syringes, Saliva Ejector and High-Volume Evacuator attachments that are not detachable from the waterlines. When soiled or at least twice daily they must be cleaned and disinfected. Evacuation systems that include the saliva ejector tubing and the high-volume evacuator system should be cleaned with an approved low-level disinfectant at the end of the day followed by a flush with water. Suction traps must be either single-use-disposable changed regularly or if re-usable, cleaned regularly to maintain effective suction.



Chapter 10

Single-Use-Disposables

Puttaiah, Youngblood & Cederberg

In the absence of a decontamination process one can use single-use-disposable devices such as barriers for surfaces. Today, single-use-disposable devices comprising personal protective equipment, surface barriers and consumables are to be used regularly in the dental practice. This section deals with the common disposables, proper use and the rationale for such use. Prior to addressing the issue of single-use-disposables, certain general items on infection control need to be addressed. “Sterilization”, the accepted reprocessing method in dentistry, requires precleaning as an essential step in instrument reprocessing. If precleaning is not achieved, sterilization can be confounded by the presence of bioburden or inorganic material on critical and semi-critical devices. Ideally, the goal of instrument reprocessing for critical and semi-critical items is to remove or reduce bioburden and dry instruments prior to sterilization. Reduction of bioburden on instruments and devices to be sterilized is essential to the success of any sterilization process. To overcome this problem, use of inexpensive single-use-disposables (SUDs) for each patient is pragmatic.

Common single-use-disposable devices used in dentistry

As of today, single-use-disposable devices have become relatively inexpensive. Most single-use-devices available have been cleared by governmental regulatory bodies in most developed countries. Reprocessing and reuse of SUDs is not reliable and therefore prohibited. Furthermore, these devices must strictly be used per manufacturers’ instructions and for the given purpose. The oral cavity is not a clean site, and therefore, use of non-sterile disposable gloves are permitted as long as they have been stored hygienically and have not been overtly exposed to contaminants. A non-sterile glove is to protect the clinician against possible contaminants from the patient’s mouth.

When we anticipate exposure of deeper structures such as bone, it is pragmatic to use sterile single-use-disposable gloves as an additional measure of safety for the patient, although one may question the presence of a very high amount of microorganisms in the oral cavity that may potentially contaminate the surgical site. The common microorganisms found associated with surgical site infections are *S. aureus*, coagulase-negative Staphylococci, Enterococci, *E. coli*, *P. aeruginosa* and Enterobacteria spp., and they are normally found on skin and fingers. The thrust of infection control in general dental procedures is to control cross-infections and occupational exposure, not to eliminate or prevent.

1. Personal protective equipment

- a. Exam Gloves, Surgical Gloves, Overgloves and Finger-cots
- b. Side shields for prescription glasses
- c. Surgical masks with or without eye protection and Dome shaped Masks
- d. Gowns, bonnets and shoe-covers, patient bibs

2. Surface barriers

- a. Headrest covers, chair covers, bracket table cover, X-ray tube, X-ray switch control, and barrier for work surface

- b. Plastic barrier for light handles, light switch, chair controls, Saliva ejector and high speed evacuation syringe/hose sleeve, Air/Water syringe/hose sleeve, high and slow-speed handpiece sleeves
- c. Barrier sleeves for Composite Curing Lights, IO Videocam wands, IO Radiology Film Barriers
- d. Sterilization Pouches and Instrument Tray Covers

3. **Items used intraorally**

- a. Single-use-disposable Needles and Burs, Anesthetic Cartridges, Air/Water Syringe Tips, Saliva Ejector and High Volume Evacuator Tips
- b. Matrix Bands, Mylar Strips, Wooden Wedge, Packing Cord, Articulating Paper, Thompson's Marker and Sandpaper
- c. Dispensing tips for flowable and condensable composites, enchants dispensing tips, Irrigation syringes, Monojet Syringe, Plastic Impression trays, Fluoride Trays, plastic composite mixing trays, plastic mixing spatula, composite brush, unit dose composite carpules and bonding agents
- d. Rubber dam, Tongue Blade, Cotton Swab, Cotton Roll, Floss, Prophy Paste Cups, Floss Threader, Disposable Prophy Angle, biteblocks for bitewing radiographs

The Concept of "Unit Dose"

Unit dose means to have ready consumables, instruments and dental materials dispensed for a given standard procedure. The total amount of the consumables and dental materials needed for the procedure must be dispensed irrespective of being used up during the procedure. The sterile single-use-disposables remaining must not be recycled or reprocessed but discarded. Therefore, the amount of materials and consumables should be carefully calculated to avoid waste on one hand or abuse during the procedure. The reusable instruments must be reprocessed and maintained sterile till the next use on a patient.

An example of unit dosing PPE for a procedure anticipating splash or spatter such as doing an amalgam restoration would be to have a set that includes—

- a) Reusable protective eyewear or disposable side shields
- b) Disposable mask
- c) A pair of disposable exam gloves
- d) Disposable plastic overglove
- e) Disposable gown
- f) A bib and protective eyewear for the patient.

The dental unit should have the following single-use-disposables—

- a) Head rest/back cover
- b) Barriers for
 - light handles
 - chair controls
 - HVE and Saliva Ejector syringe sleeves
 - sleeves for the highspeed handpiece
- c) Barrier for the bracket table
- d) Single-use-disposable air/water syringe tips, HVE and SE tips
- e) Barrier for the work surface/bench.

For the same procedure materials to be unit dosed would be—

- a) Sterile exam kit
- b) Sterile assorted burs in a bur block
- c) Sterile highspeed handpiece
- d) Restorative instrument kit including matrix band, retainer and an interproximal wooden wedge
- e) Articulating paper
- f) Cotton rolls and 2X2 gauze
- g) Topical anesthetic and cotton tip applicator, sterile needle, syringe and a carpule of a local anesthetic
- h) Cavity liner, calcium hydroxide cement including the mixing tip and tray and adequate amalgam capsules.

After completion of the procedure, all used and unused single-use-disposable devices and materials that had been unit dosed for the procedure should be discarded chair-side starting with the sharps into the sharps container, the regulated soft waste into biohazard labeled bags, the non-regulated soft waste into the regular trash and the reusable devices taken in a secure manner for reprocessing including sterilization. The single-use PPE should be discarded and reusable PPE such as protective eyewear decontaminated with at least soap and water. A common error by clinicians is to continue using the same eye-protective devices, mask and gown over multiple patients. As observed by the investigator, adjusting eyewear and the mask is quite common during the clinical procedure with the contaminated gloves. Gowns normally come in contact with contaminated gloves and other aerosols being generated chair-side. Therefore, it is essential for the clinicians to completely get rid of the disposable PPE after treating each patient and decontaminate devices designed for reprocessing. The concept of unit dose in reality develops over time and is very operator or user defined to suit the idiosyncrasies of individual dentists.

Utilization and Unit Dosing of Single-Use- Disposable Devices and Supplies



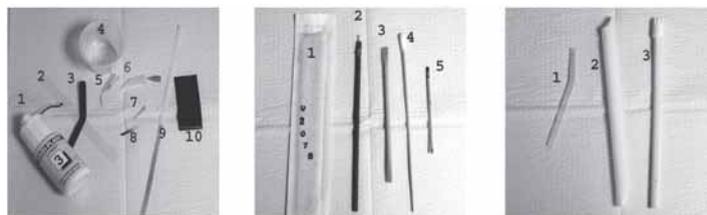
Non-sterile and sterile PPE should be dispensed prior to the procedure. Items that are open from the packaging must not be re-used due to possible contamination.



Surface barriers should be dispensed/made into sets for use prior to procedures. These can be assembled into sets to reduce between patient turn around time. Supplies should be stored in dust free shelves with multiple compartments or facets.



All disposables should be unit dosed for a procedure and what remains left over must be discarded after the procedure.



If in small bottles, the chemicals/cements should be unit dosed before procedure to control cross-contamination. If additional devices or consumables are needed, then the dirty gloves discarded first and then the supplies should be accessed as needed.

Chapter 11

Chemical Germicide Use

Puttaiah

Some of the germicides commonly used in dentistry can be classified into three main categories such as liquid sterilants/high level disinfectants, intermediate & low level disinfectants surface, and antiseptics.

1. Sterilants

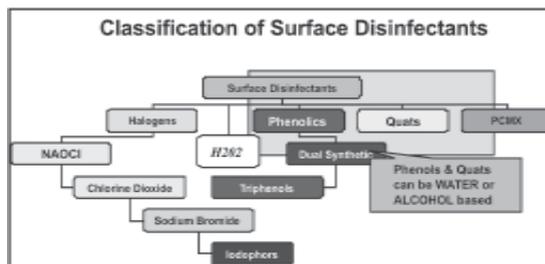
Glutaraldehyde
Chlorine dioxide
Hydrogen Peroxide

2. Disinfectants (Intermediate and Low Level)

Hydrogen peroxide
Sodium Hypochlorite
Chlorine Dioxide
Iodophors
Synthetic Phenols

3. Antiseptics (for oral and non-oral use)

Quaternary Ammonia Compounds
Active Chlorine Dioxide Germicides
Essential oil compounds
Iodinated Compounds
Chlorhexidine Compounds
Cetylpyridium compounds
Sanguinarine based compounds
Parachlorometaxylene compounds
Other bacteriostatic/bactericidal compounds



Disinfectants are available as concentrated liquids or those that are ready to use in spray bottles, wipes or as immersion solutions. Read the label for use directions and for safety in the event of a chemical exposure.



Based on duration of exposure, a sterilant may be used as disinfectant (example—glutaraldehyde exposure for 10 - 12 hours is a sterilant, while the same concentration if exposed for 30 minutes is considered a disinfectant). Sterilants should kill all bacterial endospores, vegetative microorganisms and viruses. A sterilant that is used for a short duration of contact is also called a High Level Disinfectant where all vegetative bacteria, fungi and viruses are killed including *M. tuberculosis* (Tuberculocidal).

Intermediate- level disinfectants should kill all vegetative microorganisms, fungi, viruses and *M.tuberculosis* (Tuberculocidal).

Low-level disinfectants are those that kill vegetative microorganisms, some viruses and no kill claim for *M.tuberculosis*.

There are two types of viruses that the disinfectant should have kill claims on. Hydrophilic viruses are harder to kill than the lipophilic viruses.

A hospital disinfectant is one that has to kill the following three marker organisms that are commonly associated with nosocomial infections—

- Staphylococcus aureus
- Salmonella typhimurium
- Pseudomonas aeruginosa.

In dentistry, a disinfectant must be EPA registered and have the following claims –

1. Intermediate-Level Disinfectant

- a. M. tuberculosis kill claim
- b. At least one hydrophilic virus kill claim (difficult organism to kill)
 - Rotavirus WA
 - Rotavirus SA 11
 - Poliovirus Type 2
- c. At least one lipophilic virus kill claim (easier organisms to kill than Hydrophilic viruses)
 - Herpes simplex 1
 - Herpes simplex 2
 - Influenza A₂
 - Human immunodeficiency virus HIV

2. Hospital Disinfectant

- a. Kill claims on the following organisms that are normally implicated in hospital infections (Marker Organisms)
 - Staphylococcus aureus
 - Salmonella typhimurium
 - Pseudomonas aeruginosa

Ideal Disinfectant for Dental Use

Therefore while choosing a disinfectant, utilize the above requirements and find out whether it is an intermediate level disinfectant with a hospital claim, and a tuberculocidal claim with kill claims on one hydrophilic and one lipophilic virus. In addition, it should have a fungal kill claim.

Use and Misuse of Disinfectants

One must not use an immersion disinfectant/sterilant such as glutaraldehyde as a spray due to toxicity and sensitization reasons. Similarly, a disinfectant cannot be used as an antiseptic or an antiseptic as a disinfectant. Always follow the manufacturer's instructions while using a product. All chemical germicides must have an Material Safety Data Sheet (MSDS) and the latter must be read and filed as per the Hazard Communication Rule pertaining to the country of practice. Misuse of germicides is dangerous and must be avoided. All germicides that are considered disinfectants must be cleared for market in India. Efficacy against bacteria, fungi and viruses and methods of use must be present on the container label. If the disinfectant claims are not clear or if there is a controversy, one may request the manufacture to provide the regulatory or marketing approval of the product/claims. (these normally are not provided with the product unless and until requested by the user). Generic household bleach or other non-medical level domestic use germicides not cleared for use for dental office use are not medical/dental grade products and should not be used in the dental office. These products may be used for household and janitorial needs in the dental office.

Immersion disinfectants

These could be glutaraldehyde, chlorine dioxide, bleach (Sodium Hypochlorite), iodophors, synthetic dual and triphenolic compounds and quaternary ammonia compounds. The immersion time for these products as a disinfectant may vary as little as 3 minutes to 30 minutes to be used as a disinfectant. Disinfection claim time is based on how early it can kill *M. tuberculosis* (which is used as a marker organism, as it is difficult to kill). Only items that cannot be sterilized by heat or by other chemical methods should be disinfected (examples — impression materials, casts, and some mirrors used in intraoral photography). Method for immersion disinfection is as follows –

1. Rinse out the bioburden (Sanitization)
2. Immerse for the disinfection time (Disinfection)
3. Rinse out the disinfectant (removal of disinfectant)



If one needs to re-use the item in a patient's mouth, sterile water must be used for the final rinse to remove disinfectant from the item/instrument. For impressions and casts, one may use tap water as these items do not go into the patient's mouth. Therefore, rinse-immersed-rinse is the method for immersion disinfection.

Surface disinfectants

Hydrogen peroxide, chlorine dioxide, bleach (Sodium Hypochlorite), iodophors, synthetic dual and triphenolic compounds and quaternary ammonia compounds are also considered as surface disinfectants (they have to be specifically formulated for disinfection use). These germicides also have a disinfection time based on *M. tuberculosis* kill time ranging from 3 minutes to 30 minutes. Surfaces that cannot be immersed such as bracket table, light handles, hoses, counter surfaces, chair controls, x-ray unit head/handles/controls and other surfaces that have a tendency to get contaminated during patient care must be disinfected. The method of surface disinfection is as follows–



1. Spray to wet surface, and wipe to remove bioburden (sanitization)
2. Spray to wet complete surface and wait for the prescribed disinfection time (disinfection) and wipe to remove excess of disinfectant.

Certain surfaces such as electrical controls, the chair surfaces including the headrest, arm rest and seat may be sanitized and disinfected by initially spraying the disinfectant on a disposable paper towel and wiping the surfaces thoroughly once to remove the bioburden and then repeating the same process over and finally wiping dry the surface with a new paper towel. Spraying a paper towel may be replaced with the use of disinfectant laden towels/wipes and then wiped dry with a new paper towel. Reusable sponges or cloth towels must not be used, as they tend to harbor bioburden and bacterial debris and hinder the efficacy of the disinfectant.

Dispensing

Disinfectants can be dispensed as foams, alcohol based aerosol sprays, alcohol based pump sprays, water-based pump sprays or towelettes that are saturated with a disinfectant (may be water based or alcohol

based). Some manufacturers dispense the disinfectant as concentrates either in a bottle or in unit-dosed sachets to be further diluted as per instructions. Most manufacturers also provide secondary containers in which the concentrate can be added and mixed with water to obtain a given concentration.

Alcohol based disinfectants

Although alcohol based germicides are considered potent germicides, these high concentration alcohol containing foams, aerosol sprays and pump sprays may have a fixing action of the bioburden/organic materials on to the surface to be disinfected and may hinder sanitization before the disinfection process (example — alcohol used to fix specimen on glass slides during microscopy). In warmer environments, alcohol may evaporate well before the claimed disinfection time. There is a greater amount of the alcohol based aerosol spray that does not come into contact with the surface as the particles are light and may get carried upwards into the air. Therefore, alcohol content may be a negative factor in the choice of disinfectants.



Water based disinfectants

Water based pump sprays are more reliable than the alcohol based aerosol sprays as they do not tend to fix bioburden on to the surface and are heavier particles that do not evaporate or aerosolize easily within the claimed disinfectant time. Water based sprays are more accurate and the droplets tend to settle on the desired surface without immediate evaporation. As of today there are disinfectant presoaked wipes that are easy and quicker than spray bottles.



Antiseptic germicides

These are germicides that are used on the skin and mucosa of the patient. Alcohol swabs are used to clean skin surface prior to injection of medicines/anesthetics. Introrally, tinctures and paints are used to clean and decontaminate surgical sites. Mouthwashes having antimicrobial claims (Chlorhexidine, Listerine, Scope) are also beneficial in reducing the microbial load in the mouth when used as a pre-procedural mouthrinse prior to treating the patient. Antiseptics must not be used to decontaminate work surfaces, equipment or reprocessing instruments as they are not potent enough to kill microbes as disinfectants are.



Alcohol by itself —is not recommended as a disinfectant for use in dentistry.

A few facts about disinfectants

Bioburden can change the efficacy of most disinfectant; therefore, removal of bioburden is very necessary before the disinfection phase. Certain disinfectants can affect the surface detail reproduction or dimensional stability of elastomeric and non elastomeric impression materials and therefore, ask the manufacturer for compatibility data with impression materials. All disinfectants must be handled with care. If the disinfectant can harm or kill bacteria, they are most likely to be toxic to humans. Some disinfectants can cause sensitization to the employees and therefore must never again be used in the clinic as long as the sensitized person is working in the clinic. Dilutions of disinfectants must be made as per manufacturers' instructions. While handling any disinfectant, protective eyewear, mask, utility gloves and a gown are a must. Always read the safety instructions and adverse effects of the disinfectant. Always know what to do in the event of an adverse exposure such as a splash or spatter of the disinfectant on to skin and mucosa. Keep the disinfectants out of the reach of children (especially in pediatric offices). Lastly, a disinfectant must be economical to purchase.

Table 7. Disinfectant Advantages and Disadvantages of Germicides

Advantages	Disadvantages
Iodophors Broad spectrum Short biocidal activity Few reactions Residual biocidal action	Unstable at high temperatures Dilution and contact time critical Solution to be prepared daily Rust inhibitor needed Inactivated by hard water May discolor some surfaces
Hypochlorite (Bleach) Rapid antimicrobial action Broad-spectrum kill Effective in dilute solution Economical	Very corrosive to metals Damages plastic and rubber, clothes To be prepared daily Unpleasant odor Toxic disinfection by-products
Chlorine Dioxide 3 minutes for disinfection 6 hours for sterilization No Trihalomethanes	Highly corrosive to metals and certain plastics on prolonged exposure To be mixed daily Adequate ventilation needed
Hydrogen Peroxide (0.05%) Rapid antimicrobial action Broad-spectrum kill Effective in dilute solution Economical Compatible with metals, plastics and impression materials	Not many reported disadvantages as it is still new in the market
Synthetic Phenols Triphenols are better than Dual Phenols Broad Spectrum Kill Compatible with most materials Residual biocidal action Fast acting Very long shelf life (some 60 days) Good cleaners	May affect some polymers Some have film accumulation May not be used in neonatal and pediatric practices due to possible adverse reaction
Quaternary Ammonia Compounds Good cleaners Some have M.tuberculosis kill claim Good vacuum line cleaner	Inactivated by hard water Some have variable bactericidal activity Most do not have M. tuberculosis kill claim Alcohol based quats may affect low viscosity impression dimensional stability
Hydrogen Peroxide (7%) Very potent germicide Sporocidal at prolonged short exposure Active in the presence of bioburden Prolonged shelf and active life Reusable Compatible with plastics & impressions Good for use in dental laboratories	Can be corrosive on metals Can be dangerous to skin (burns) Not tested widely (very little data available)
Glutaraldehyde & OPA Very potent germicide Sporocidal at prolonged contact Active in the presence of bioburden Prolonged shelf and active life Reusable Compatible with most materials Good for use in dental laboratories	Items must be rinsed with sterile water Only for immersion and not for surface use Severe tissue / respiratory irritant Must use closed containers Must have good ventilation and evacuation Can sensitize users

Cleaning of Evacuation Systems



Suction traps must be cleaned regularly or replace regularly. The suction hoses must be cleaned with either an enzymatic cleaner or a low level disinfectant that has a good detergent and is compatible with the components of the evacuation system and the pump.



At the end of the day, the suction lines (High-volume-evacuator, and Saliva Ejector) should be cleaned with either a quaternary ammonia compound cleaner or an enzymatic detergent mixed in water. The cleaner should be sucked through the lines either aerosolized or as a liquid and let sit for about 10 minutes. After the 10 minute soak, water should be sucked through the lines to wash out the cleaner along with patient debris and other materials. The suction traps must be examined and replaced at least weekly.

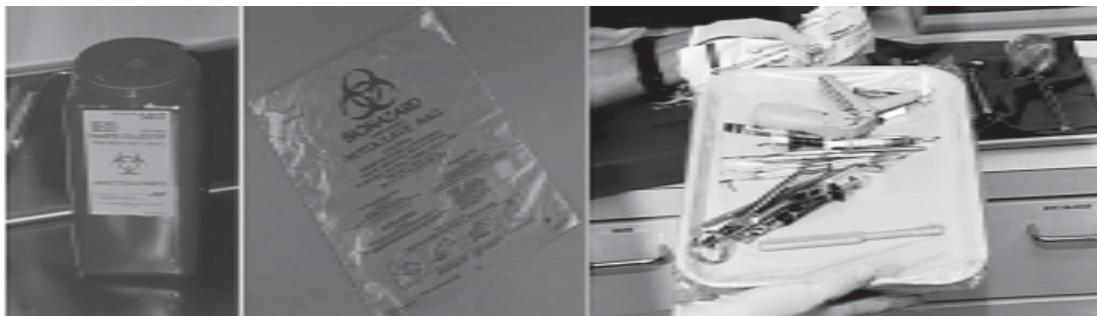
Chapter 12

Instrument Reprocessing and Sterilization Monitoring

Puttaiah

Instrument reprocessing is the most important aspect of Dental Infection Control as it deals with items that have the greatest potential for disease transmission during dental care. Any dental instrument that enters the oral cavity is classified as **critical or semi critical** surfaces per Spaulding's Classification and must be sterilized. Common methods of in-office sterilization in dentistry are Autoclaving, Chemiclaving and Dry Heat. For items that are heat labile chemical immersion methods using an approved chemical sterilant although rare, must be used. Today, all items that are used in dentistry as critical and semi-critical items are heat sterilizable or sterile-single-use disposable.

Separation of Waste and Instruments



Sharps Container for the disposal of sharps

Biohazard-labeled bag for disposal of saturated soft waste

After separation of waste chairside (disposal of sharps and saturated waste), instruments are taken for reprocessing

While handling any contaminated instrument after patient care, the handler must use eye protection, a mask, and a gown and wear utility gloves (heavy duty latex or nitrile) as there is a potential for exposure to patient material and sharps injuries. Immediately after patient care, the saturated waste (items that are soaked with blood or body fluids) must be disposed off in a red/orange biohazard labeled plastic bag. Disposable sharps must be discarded into sharps containers. Other disposable items can be discarded into regular waste. Instruments should now be taken securely to the reprocessing area and handpieces (high speed and slow speed) removed from the tray to be processed per manufacturers' instructions. Most handpiece manufacturers have specific methods of cleaning and therefore handpieces should not be soaked or sonicated. All other items that need to be reprocessed must be soaked in a holding solution or in the ultrasonic machine.

Soaking or keeping bioburden moist

Instruments that have been used on patients need to be placed in a holding container with a detergent (soap



solution) or an ultrasonic solution to keep bioburden (patient material such as blood or tissue tags) moist. In the absence of a holding container, one may use the ultrasonic machine with ultrasonic solution to keep instruments moist. Soaking solutions or ultrasonic solutions need not be disinfectants as the latter have no proven effect and tend to be more expensive than detergents. Instruments should be soaked for at least 10 minutes before sonication. Do not soak instruments overnight as even the best detergents can be corrosive and cause pitting.

Cleaning instruments



Ultrasonic Bath and Solution



Hydrim SciCan Instrument Washer



Miele Washer/Thermal Disinfectant

Prior to sterilization, instruments must be cleaned to reduce bioburden. Ultrasonic cleaning (sonication) is very efficient and works by a process called cavitation where there is implosive activity or cavitation that helps tear away dirt and debris from instrument surfaces. Sonication is a few hundred times better than manual cleaning with a long handle brush. Sometimes, even after an ultrasonic process patient material may still be on the surface of instruments that may need to be physically removed by using a long handle brush to reduce the risk of sharps injury. Sonication of loose instruments should be carried out for 8-10 minutes and the period doubled (15-20 minutes) for instruments in cassettes. Ultrasonic solutions that are non-ionic and some enzymatic ultrasonic solutions are less corrosive on instruments than others. One should not use disinfectant solutions instead of ultrasonic solutions as there is no proven antimicrobial efficacy but leads to a false sense of security.

Inspection of cleaned instruments

After the instruments are cleaned, the whole ultrasonic machines basket containing instruments must be removed and rinsed under running water to remove the residual solution and the dirt. The basket should then be tipped gently allowing the instruments to roll on to a layer of paper towels. The instruments should be pat dried using a small stack of paper towels and inspected for residual bioburden or debris. If residual debris is found, that particular instrument should be manually cleaned using a long handled brush, rinsed, dried and re-inspected. The inspected instruments can now be made into sets and bagged. If cassettes are used, the cassettes need to be opened on the stack of towels and instruments inspected for residual debris, pat dried and rearranged into the cassette to be bagged in sterilization pouches or wraps.

Packaging of instruments



Layer Instrument

Instrument Tray

Instrument Tray with Plastic Wrap

Instrument Tray

If instruments are to be used loose or in a cassette, they should be packaged in the prescribed type of packaging material for sterilization (one type of material for Autoclaves and Chemiclaves and a different one for Dry Heat). The packaging should have a chemical indicator on the packaging or a process indicator tape to show that the process has been completed (due to the color change on the indicator after sterilization process). Packaged sterile instruments can be stored for as long as the integrity of the pouch/package is not broken, damaged or affected by moisture after being sterilized and dried. There is no time limit on storage if the package integrity is maintained (event related). If the clinic uses non-bagged sterilization of instruments, the instruments have to be used immediately and cannot be bagged after sterilization, preserved or considered sterile for later use.

If instruments are to be “cold sterilized” in glutaraldehyde or any approved immersion sterilant, the instruments should not be packaged but should be rinsed with sterile water to remove residual chemical sterilant from the surfaces of the instrument and used immediately. If immersion sterilants such as glutaraldehyde are used, the tubs should be covered and placed under an evacuation hood to reduce ambient chemical vapor in the sterilization area that may affect the staff.

Common methods of heat sterilization

Common methods of sterilization in dentistry are a) Autoclave or steam under pressure; b) Chemiclave or combination of synergistic chemicals, heat and pressure; and c) Dry Heat.

Autoclave



Autoclaving or sterilization using steam and pressure is by far the most common method of sterilization. This is the most reliable process but could be more corrosive than the other methods for instruments that have a high content of carbon steel (especially if packages are not adequately dried). Many autoclaves have process/parametric information that is printed out at the end of the given cycle. Items such as water (liquids) can be sterilized other than regular instrument. Following are the most common parameters at which the autoclave is used—

Table 8. Parameters of Sterilization for Autoclaves

Parameters	Standard Cycle	Fast Cycle
Sterilization Time	15 - 20 minutes ¹	3-5 minutes
Temperature	121° Celsius (250° F)	134° C (273°F)
Pressure	15 pounds per square inch (psi)	30 pounds per square inch

¹ Sterilization time is the time required for killing 10¹² B. stearothermophilus spores and does not include the complete sterilization cycle i.e. ramp-up time for the temperature to reach 250°F and chamber pressure of 15 pounds per square inch. Normally the complete cycle would take about 60-90 minutes (heat-up, sterilization and cool down)

Even among the autoclaves there are different types. The quick turnaround sterilizers such as Statim take one cassette with loose or packaged instruments. Loose instruments can be sterilized quickly using the Flash cycle (although not recommended for regular use), while packaged instruments take a longer time. Other efficient type is one that has a pre-vacuum and post vacuum feature. This feature allows sucking all the air out of the chamber and is beneficial in sterilizing hollow bore instruments such as metal air/water syringe tips and highspeed handpieces. After the vacuum is created, the steam is released into the chamber filling the hollow bore instruments thereby increasing the efficacy of sterilization access into the most difficult areas of the instrument. After the sterilization process, the steam is sucked out of the chamber including the space in the hollow bore instruments and heat maintained to dry the instruments and the packaging. Therefore, the pre-vacuum and post-vacuum cycle is very efficient in both sterilization and drying of the pack. All high-speed handpieces must be sterilized between patients.

Chemiclaving

Chemiclaves use a combination of liquid chemicals (with <15% water) that are introduced into the chamber, heat and pressure for a sterilization cycle. The parameters for sterilization are temperature of 131°C (270°F), 20 psi and sterilization time of 30 minutes. Chemical Scavengers that are a part of the Chemiclave must be replaced regularly to reduce risks of chemical exposure to employees.

Dry Heat

Dry heat is another common method of sterilization in dentistry. Following are the parameters for dry heat—

Table 9. Parameters of Sterilization for Dry-Heat Sterilizers

Parameter	Slow Cycle	Fast Cycle	Rapid Heat ²
Temperature	160° C (320° F)	170° C (340° F)	190° C (375° F)
Sterilization Time	120 minutes	60 minutes	6-12 minutes

Chemiclave and dry heat are less corrosive to carbon steel metals than autoclave methods. Packaging materials are different for dry heat vs. Chemiclave or autoclave methods. All instrument packs must be removed from sterilizers and stored dry.

Monitoring Efficacy of Sterilizers



“**Weekly**” monitoring of the sterilizer’s efficacy using Biological Equivalent monitoring devices or Sterilization Integrator (it measures whether the parameters of temperature and pressure over time) is necessary as this can be done in-house. The information should be recorded and maintained for a period of 3 years. The biological equivalents show color change when the sterilization parameters have been met (the chemical strip changes from green to greyish black)

“**Monthly**” sterilization monitoring for all sterilizers is necessary by either using a biological indicator such as a spore-strip containing *B. stearothermophilus* and *B. subtilis*. These spore-strips are used for testing the efficacy of the sterilizers and both spores are available on the same spore strip called dual strips



² Some high-speed handpiece manufacturers recommend “**not using**” a rapid heat transfer method of dry heat as the high temperatures could breakdown the bearings of the turbine.

and need to be mailed out to a monitoring service. In-office 24 hour sterilization monitoring kits are available that are very convenient and with little lag time for obtaining the results. When a positive growth occurs from a spore test or a biological equivalent test (failure of the sterilizer) the sterilizer must be taken out of service, tested again. The sterilizer should be reinstated only after repair and testing for efficacy. Each set of instruments being sterilized should have a chemical indicator (to show that the pack has been through a sterilization cycle).

Recommended maintenance of the reprocessing equipment is essential for proper function. Autoclaves should use distilled water to avoid slaking and breakdown, and **must** be serviced per manufacturer's recommendations for proper functioning (check the sterilizer's manual). The chamber should be cleaned periodically using recommended methods. Leaks in the gasket will not allow temperature and pressure parameters to be met during the sterilization cycle, thereby causing failures.

Ultrasonic Solutions



Ultrasonic solutions should be prepared daily per manufacturer's dilutions and the machine run for a minimum of 15 minutes at the beginning of the day without instruments to remove bubbles, this process is called degassing. Degassing is done to remove bubbles that hinder the process of sonication. Once a month, an aluminum foil (to the width of the bath) must be submerged into

the depth of the bath with water/solution and the machine run for 30 seconds. The submerged area of the foil should show uniform pitting or pin-holes when placed against a dark background. If the pitting or pinholes are not uniform, the ultrasonic machine must be serviced and the transducers that generate the ultrasonic action calibrated. At the end of the day, the ultrasonic machine should be drained, the bath rinsed and wiped dry to increase the longevity of the bath.

Storage of Sterile Instruments

Sterile bagged instruments must be stored in clean dust-free shelves or cabinets. These sterile packs can be dated. The packages are considered sterile till the packaging is compromised (damaged, torn or wet) irrespective of the date of sterilization. If the packages are compromised, all the instruments in the pack must be reprocessed again and stored sterile prior to use. If the instruments are not in a sterile pack (loose instruments not in packs/sterile pouches) they must be used immediately after sterilization. Instruments that have not been sterilized in pouches cannot be stored as sterile and must be sterilized immediately prior to use.

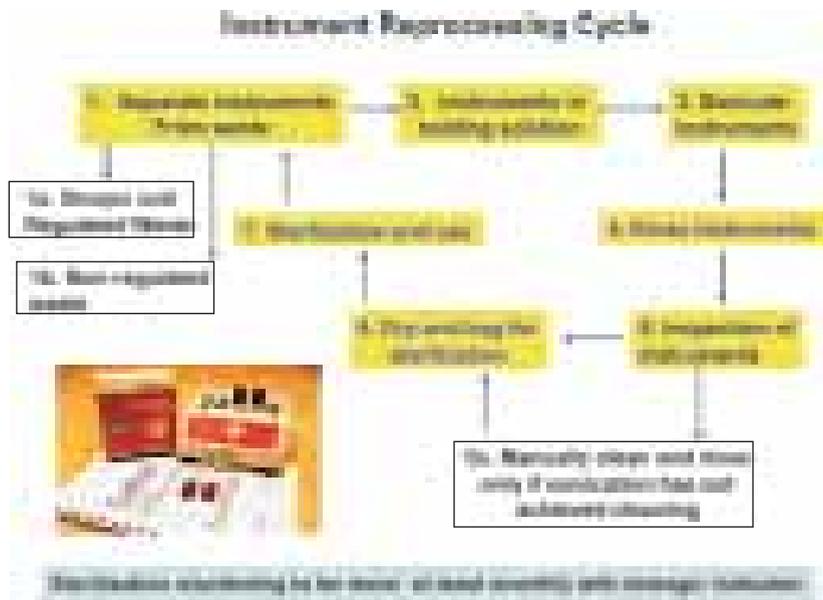


W&H Assistina is designed to clean and lubricate the W&H Handpieces prior to sterilization.

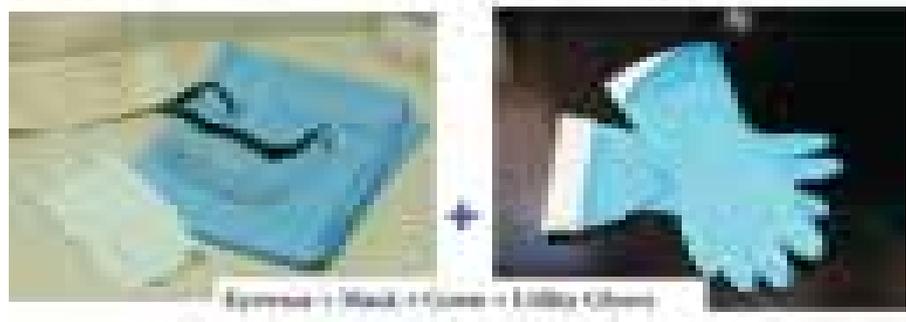
Reprocessing of High-Speed, Slow-Speed Handpieces and Scaler handpieces

All handpieces that are used in the oral cavity must be sterilized or single-use disposable (such as in disposable contra-angle handpieces). Both, high-speed and slow-speed handpieces retract patient material and are difficult to clean and decontaminate using chemical germicides. All re-usable handpieces must be reprocessed separately immediately after use between patient care. High-speed handpieces should be cleaned and lubricated per manufacturer's recommendation and sterilized using either a Chemiclave, autoclave or dry-heat. Slow-speed handpieces should be single-use-disposable such as the contra-angle handpieces that are used for polishing during oral prophylaxis. Other slow-speed handpieces

must be cleaned, lubricated and sterilized. Some manufacturers have restrictions on immersion of handpieces in a holding solution or in a liquid sterilant. Wiping down the handpieces does not adequately control cross contamination between patients. Similarly, handpieces and inserts for scaling teeth (ultrasonic or Piezo electric) must be cleaned and sterilized between patients. Handpiece and equipment manufacturers must provide reprocessing instructions to the users to meet these recommendations.



PTC required for surface decontamination and reprocessing of endoscopes



Chapter 13

Dental Unit Water System Contamination Control

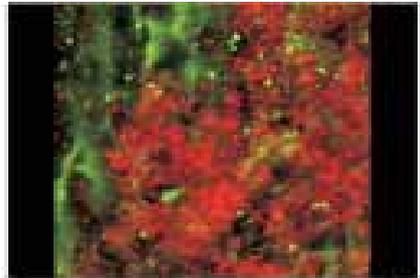
Puttaiah & Lin



The dental water system is like a maze with about 60 feet of small bore plastic through which stagnant water sits over 200 hours per day in a hot dental clinic.

Prior to the introduction of high-speed handpieces, dentists did not use water as a coolant or as an irrigant. Along with the high-speed handpieces came the dental unit water system that provided water for irrigation as well as a coolant during the cutting of teeth. Modernization of cutting instruments introduced a new problem of 'dental unit water system contamination' and 'release of bio-aerosols' in the dental clinic. Most modern dental unit water systems are made up of a complex maze of waterlines, control blocks, valves, barbs and connectors that are of various sizes and composed of different metals, plastics and rubbers.

Traditionally, these water systems are directly rigged to the municipal water system and very few as of recent years are equipped with a bottle (self-contained water system) into which the treatment water or irrigants are added. The design of all dental unit water systems allows settling of contaminants from water and air. These contaminants can be inorganic materials such as salts from the hardness of the source water that coat the lines and cause corrosion of metals and allow settling of microbes. The other types of contaminants are organic in nature including extremely high counts of bacteria, fungi, viruses and even nematodes. These problems of contamination have been known by dentists and researchers for over 50 years. Only recently have agencies such as the American Dental Association (ADA), the Centers for Disease Control and Prevention (CDC) the dental industry seriously broached this topic in providing some methodologies and measures to modify the equipment, treat the contamination and monitor the level of contamination.



Scanning laser confocal microscopy showing biofilms (microbes, green/yellow) inside the waterlines (individual microbes, red/yellow).

Factors associated with treatment water contamination

Some factors associated with water system contamination are—
1) Nutrient content of source water; 2) Extended period of stagnation per day; 3) High surface to volume ration; 4) Low flow-rate; 5) Laminar flow; 6) Microbial quality of source water; and lastly 7) Equipment design.



Dental treatment water biofilms - cleaned system in this image shows 100,000 colony forming units per ml.

Potential Risks

This biofilm is found to be teeming with microbes and chunks of which detach contaminating the dental treatment water. While municipal water normally may have less than 500 “**planktonic**” or free-floating microbes per milliliter, the water coming out of the dental handpiece and air/water syringe may have more than a million microbes per milliliter. The units of measurement for the microbial contamination in water is “colony forming units per milliliter” or cfu/mL. An example of usage is – 100 microbes in one milliliter of water is referred to as 100 cfu/mL. These environmental microbes survive even under very low nutrient conditions and may shrink to a tenth of their size, but still have the capacity to live on salts and other contaminants.

All environmental microbes are not pathogenic, but the sheer numbers that are found in the dental treatment water is of concern. Most of the microbes found in the dental water system biofilms are gram negative rods. When these gram negative rods die, they release a toxin called “**bacterial endotoxins**”. These endotoxins in large amounts (as seen in un-cleaned water systems) have a potential in causing health problems in patients. In the first study on dental unit water system and endotoxins, investigators at Baylor College of Dentistry found potential of release of endotoxins to an extent of 500 endotoxin units per milliliter (EU/mL), and this amount is deemed to be quite toxic.

Among the potentially pathogenic microbes isolated in the dental unit water systems are— Pseudomonas (potential for super infections), Mycobacterium (potential for causing lung infections), Legionella (potential for causing Legionnaire’s Disease), and Moraxella (potential for causing bacterial endocarditis). Therefore, one has to consider the potential for being exposed to life-threatening infectious diseases from the dental treatment water of un-cleaned water systems. Investigators have also isolated amoebae, fungi and nematodes in the dental water systems.

Although there have not been studies linking association between the dental unit waterline contamination and mortality/morbidity among the dental patient population, it is pragmatic to keep the water system decontaminated and reduce the potential risks. It is difficult to conduct either retrospective or prospective epidemiological studies to find association between diseases and water source due to legal issue and logistical issues. Some studies have demonstrated significantly high titers of antibodies to Legionella among dental health care providers as opposed to a normal population and another study has shown that a large percentage of the dental water samples contaminated by at least one variety of Legionella.

During oral prophylaxis, use of a highspeed handpiece or even the air/water syringe we generate aerosols that may be laden with microbes and endotoxins. These organic matter laden aerosols are referred to as “**bio-aerosols**”. These aerosols may reach up to 12 – 16 feet from the source during patient care and may stay suspended in the air for over 24 hours if there is “inadequate ventilation or air exchanges” and therefore, having a potential for exposing the employees to contaminants over time. Many studies have also demonstrated the contamination of the water system by common oral microorganisms that could have been sucked back into the waterlines during patient care due to faulty antiretraction valves. Antiretraction valves are designed to prevent suck back or retraction of oral fluids during patient care, and researchers have shown that even new valves fail within few days of use leading to the risk of cross-contamination.

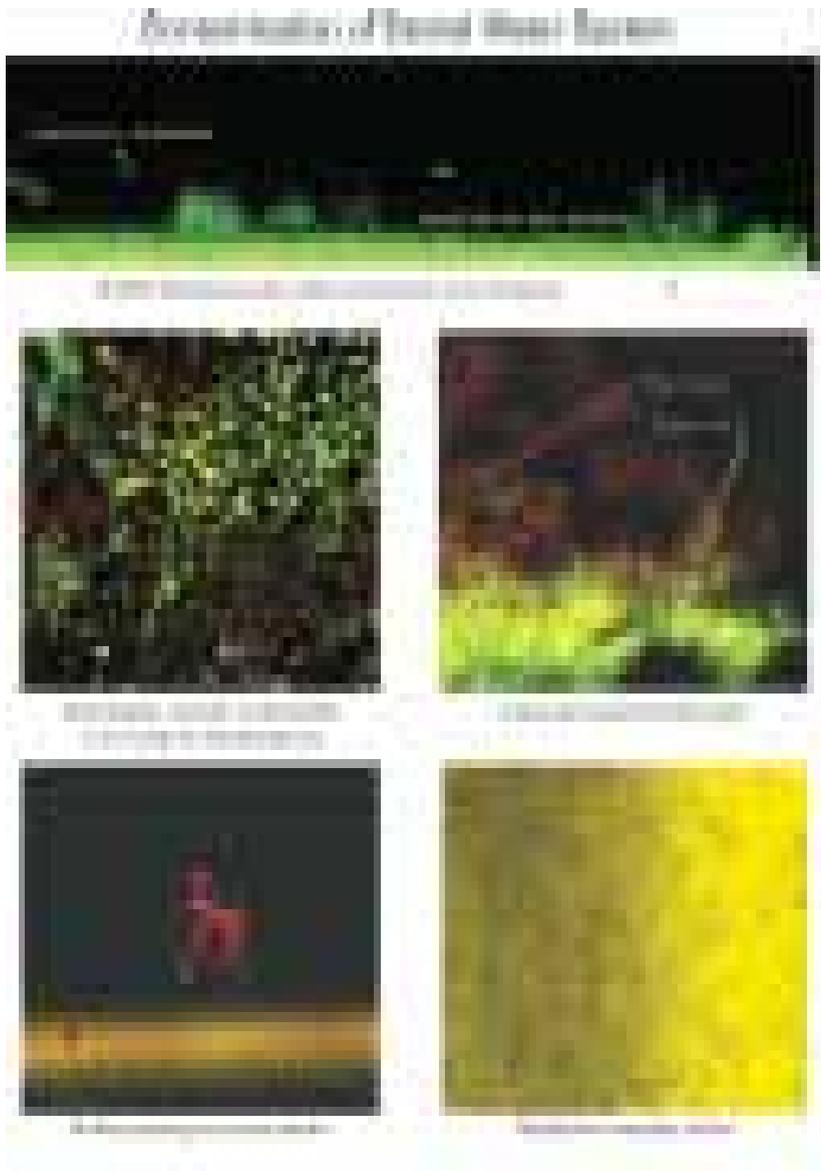
Disinfection-by-products

When certain chemicals come in contact with biofilms, they react adversely and can lead to production of an array of toxic substances called disinfection-by-products (**DBPs**). When bleach comes in contact with biofilms a group of DBPs call trihalomethanes are produced that are considered to be carcinogens. In a study done at Baylor College of Dentistry, over 8,000 parts per billion (ppb) of DBPs were expressed in dental treatment water when bleach was used to clean the lines. The permissible limit on DBPs set by the

US-EPA is 80 ppb. Therefore, use of certain agents such as bleach to constantly or periodically decontaminate the water system may prove to be more deleterious than beneficial. Further, we have to consider corrosive effects of the chemical on the components of the water system as well as its safety on human health.

Some methods of control

Microbial control of dental treatment water/irrigant contamination is a two pronged issue. Firstly, the dental unit water system has to be cleaned and kept free of biofilms and other inorganic contaminants by initially and frequent periodic cleaning/disinfecting the system with a decontaminating agent. Secondly, the water/irrigant used for patient care must be microbe-free, and therefore, the water needs to be filtered, sterile, and distilled/boiled or an EPA registered and FDA approved low-grade antimicrobial added prior to use.



Periodic cleaning methods of the water system with a cleaning/decontamination agent alone may remove some amount of biofilm or inorganic materials but will not prevent re-growth of biofilms. The water system can get re-colonized with biofilms very soon and therefore may show high cfus/mL within days after periodic cleaning. Periodic cleaning products should not only disrupt and remove well established biofilms but also be effective on dissolving the inorganic salts coating the water system that may act as neutralizing agents against the low-grade disinfectants/irrigants.

Selection of decontaminating agents and irrigants should entail asking manufacturers' information on—

1. Registration of the chemicals with agencies such as the United States Environmental Protection Agency (US-EPA) and clearance of the United States Food and Drug Administrations (US-FDA) or agencies in the European Union (EU) for safety issues
2. Biofilms and other deposit removal efficacy
3. Compatibility with metals, plastics and rubbers in the water system
4. Evidence of easy removal of periodic cleaning agent from the water system
5. Biocompatibility of periodic cleaning agent and irrigant with humans
6. Should not produce dangerous disinfection-by-products such as trihalomethanes
7. Compatibility of irrigant with composites bonding to enamel and dentin



Examples of available control measures

There are many different options for controlling dental treatment water system contamination. The first step is to have a self contained reservoir (bottle system) to be retrofitted to the dental unit. Some manufacturers of periodic cleaning agents feel that periodic cleaning is good enough in controlling the treatment water contamination, but experimentation and science has shown otherwise. If municipal water is used as an irrigant, the quality of such water varies from <10 cfu/mL to greater than a few thousand cfu/mL at the same location, and therefore is not reliable treatment water let alone for swimming. Therefore, water that has been treated with a physical or a chemical method or a low-grade antimicrobial must be used. Dental units with low grade antimicrobial irrigants should be used frequently to replenish the lines with new fluid; otherwise, the active ingredient to control the microbes in the lines gets depleted. An example is that the same antimicrobial irrigant may show better microbial control in dental units that treat at least 5 patients per day (as in private dental clinics), in comparison with units treating about 2 patients per day (as in a dental school setting).

Table 10. List of some periodic cleaners and irrigants being used by practitioners

Some Periodic Cleaners	Method of Use
Alkaline Peroxide – Sterilex Ultra	Full strength, overnight contact followed by flushing with hot water
Chlorine Dioxide Tablets – Vista Tabs	30 – 50 ppm in water, 5-10 minutes followed by flushing with water
Chlorine Dioxide 2 part Liquid – BioClenz	30 – 50 ppm in water, 5-10 minutes followed by flushing with water
Electro-chemical Oxidants – Sterilox	Full Strength 30 minutes – overnight contact, followed by flush with dilute oxidant
Silver Citrate Powder – specific to Pure Tube	Dissolved in water with low total dissolved solids (TDS) and left over night, followed by a water flush
Peracetic Acid - TAED+Perborate (Italy/EU)	5-10 minute between patients used in the Castellini Autosteril System, followed by sterile water flush
Some Irrigants	Method of Use
Boiled water/Distilled/Sterile water	Directly in the bottle as irrigant
Silver Nitrate Tablets – ICX	Dissolve in 700 ml of municipal water
Silver Citrate Tablets – BluTabs	Dissolve in 700 ml of municipal water
Silver – PureTube (Sterisil)	Silver ions in water with Low TDS
Iodine – Dentapure (DP 40, 90 and 360)	Used inside the bottle replacing the intake tube, or placed in line with water flow (3-4 ppm)
Chlorine Dioxide 2 part Liquid – BioClenz	2 – 4 ppm in municipal water
Electro-chemical Oxidants – Sterilox	Concentrate diluted for irrigant purposes
Grapefruit Extract Botanical – Vistaclean	5 drops per 700 ml of municipal water (emulsifying agent)



Monitoring the quality of treatment water

Dental treatment water or irrigants should have less than 500 cfu/mL of heterotrophic mesophilic microorganisms. Apart from the microbial quality, the water should not have a high endotoxin content and should at least be as clean as drinking water. Traditionally, the microbes found in dental treatment water are slow-growing and need low nutrient agars for growth.

The ideal agar (for providing the diagnostic or contamination) for heterotrophic counts (total counts) is R2A agar, which can grow these environmental microbes at room temperature over 1-4 weeks. Normally, after plating, the microbial colonies can be counted after one week (7 days). Prior to plating the water/irrigant samples, the latter has to be neutralized using an appropriate chemical that will neutralize the antimicrobial agent to provide a natural environment for microbial growth. Using R2A agar is not feasible in a dental office, therefore the water collected from the water system should be sent refrigerated/on ice over night to a water quality monitoring laboratory to plate the samples.

For in-office use, there are very few microbial quality monitoring kits. One such kit is the Aquasafe™ by Pall Sciences. Aquasafe™ provides heterotrophic counts of microbes in the water in about 3 days. The other kit is made by Millipore Corporation. Millipore HPC water samplers can also be used to determine the counts in about 7 days of incubation. Both the kits need no incubator for the growth of the microbial colonies as the incubation temperature is room temperature. Millipore also provides neutralizers containing sodium thiosulphate that can neutralize bleach, chlorine dioxide or a few other oxidants.



Although both in office samplers are easy to use, they are not very accurate in predicting the level of contamination, however, they are very easy to use and not expensive, and do not need incubation.

As of today, there are many devices available in the market for cleaning and maintaining the microbiological quality of dental unit water systems. In conclusion, dental unit water systems that have not been cleaned regularly are highly contaminated and release high amounts of microbes and endotoxins into patients' oral cavities. The water system should be cleaned periodically to dislodge the biofilm and should use an irrigant free of microbial contamination. Low-grade antimicrobials may also be used as irrigants. Materials selected for cleaning/decontaminating the water system must be biocompatible and not harm the patient, employee or the equipment and should not affect composite bonding to enamel or dentin. Water quality should be periodically monitored and contamination levels kept below 500 cfu/mL (similar to CDC's Guidelines). Water samples may be screened for contamination using in-office kits or be sent to water quality testing laboratories.

Chapter 14

Infection Control in Dental Radiology

Puttaiah & Liang

Most of oral and maxillofacial radiology normally consists of non-invasive procedures. Although exposure to blood is not common, contact with saliva does occur. Blood and saliva are the most common routes of transmission of infectious diseases in dentistry through direct contact or through cross-contamination. Therefore unit dosing of materials and specific step-by-step infection control protocols are required. Although oral and maxillofacial radiology (OMR) procedures fall mainly in the semicritical and non-critical categories of Spaulding's Classification of inanimate objects, many contagious diseases such as infectious mononucleosis and hepatitis-B can possibly be spread by simple contact with saliva. Therefore, whenever a potential for contamination by saliva exists during any OMR procedure, universal precautions must be observed including the use of adequate personal protective equipment (PPE) such as gloves, the proper handling of contaminated materials, and the decontamination of surfaces exposed to saliva or contaminated materials. It is not usually necessary to wear PPE such as impervious gowns, long sleeves, masks and protective eyewear during routine OMR procedures when no aerosols, droplets or spatter are generated. It is advisable to use gowns, masks and protective eyewear while treating patients with a history of gag-reflex.

Following are the steps—

Table 11. Unit Dosing of Materials

Materials during Film Exposure	Materials during Transportation
<ol style="list-style-type: none">1. One dose of pre-procedural anti-bacterial mouthrinse2. Paper towels3. Disinfectant4. Barriers (pre-formed or a roll of plastic wrap)5. Powder-free gloves (latex or vinyl)6. Radiographic films7. Sterile film holders8. Two paper cups9. Over-gloves (food handlers gloves) with wrist area of gloves everted10. Leaded thyroid collar and apron <p>Masks, eyewear and protective gowns are needed when a patient has a known gag-reflex</p>	<p>Without barrier envelopes:</p> <ol style="list-style-type: none">1. Empty paper cup2. Cup with exposed films3. Paper napkin/barrier4. Overgloved hands <p>With barrier envelopes:</p> <ol style="list-style-type: none">1. Non-contaminated exposed film packets



Unit dosing of materials before the start of radiological procedures is essential for both infection control & radiology

Table 12. Steps in Exposure and Processing

Activities During The Exposure Phase
<ul style="list-style-type: none"> °Pre-procedural mouth rinse with a mouthwash ° Disinfect surfaces at the beginning and end of each day (between patients if visibly contaminated) °Avoid spraying electrical switches, wipe with disinfectant moistened paper towel °Apply surface covers to the yoke, tube head, cone, control unit, head rest, arm rest, and any hand held switches °Place a paper towel/surface cover on a work area to hold film packets, sterilized film holding devices, bite blocks, paper cups, and overgloves °Wear powder-free examination gloves °Place the sanitized lead apron and collar on the patient after seating the patient °Set the required mA, kVp and exposure time on the control unit and reset as required °Open the sterile pack containing the film holding devices; affix the film and position in the patients' mouth. °Position the tube head and cone by touching areas with barrier °Preferably use a foot switch or a barriered hand-held switch to trigger the unit °Drop exposed films into a paper cup without touching the outer surface of the cup °If films are pouched (ClinAsept Barriers), disinfect the envelope and/or remove the non-contaminated film packets. These can now be processed without further infection control considerations as outlined below.
Activities During The Transportation Phase
<ul style="list-style-type: none"> °Don over-gloves over the exam gloves now before transportation °Pick up the cup with exposed films and the extra empty cup °Carry the two paper cups to the processing area
Activities During The Film Processing Phase If Using a Daylight Loader
<ul style="list-style-type: none"> °Open top lid of the processor with over-gloved hands °Place a paper napkin/plastic wrap on the floor of the loader's open chamber °Place the empty cup and the one with the films in chamber, keep the clean/empty paper cup on one side °Close the lid of the chamber °Insert over-gloved hands through the sleeves °Take off the over-gloves and place them on the dirty side of the paper napkin °Open the film packet by pulling gently on the outer tab to open the packet °Carefully hold the black paper tab and tease it out of the packaging, shake it gently till the film drops into the clean paper cup °Discard the paper, lead foil and plastic wrap on the dirty side °Once all wrappings have been removed and the films dropped into the cup, discard the powder free latex gloves on the dirty side °With the clean bare hands pick up the films by the edges and feed them into the processor °Remove hands through the sleeves

°Wear new gloves to remove the waste from the loader chamber, remove the surface covers from the radiographic equipment, chair and control unit and discard them in to a regular waste bin

°Wash hands with soap and water and dry them

°With bare hands, remove the films from the processor and mount them

If Using a Darkroom Processing

°Place two paper napkins/plastic wraps on a work surface near the processing area

°Place the cup with exposed films on one paper napkin

°Discard the overgloves

°Open each film packet by pulling gently on the outer tab

°Now the inner black paper tab is seen

°Hold the paper tab and tease it out of the packaging and shake it gently till the film drops onto the clean paper napkin

°Discard the paper and/or plastic wrap and empty film packets onto the other paper napkin

°Once all wrappers have been removed and the films dropped onto the paper napkin, discard the powder free latex gloves

°With the clean bare hands pick up the films by the edges and feed films into the processor

°After films are processed, with bare hands pick up the films mount them under regular lighted conditions





Infection Control in Digital Radiography

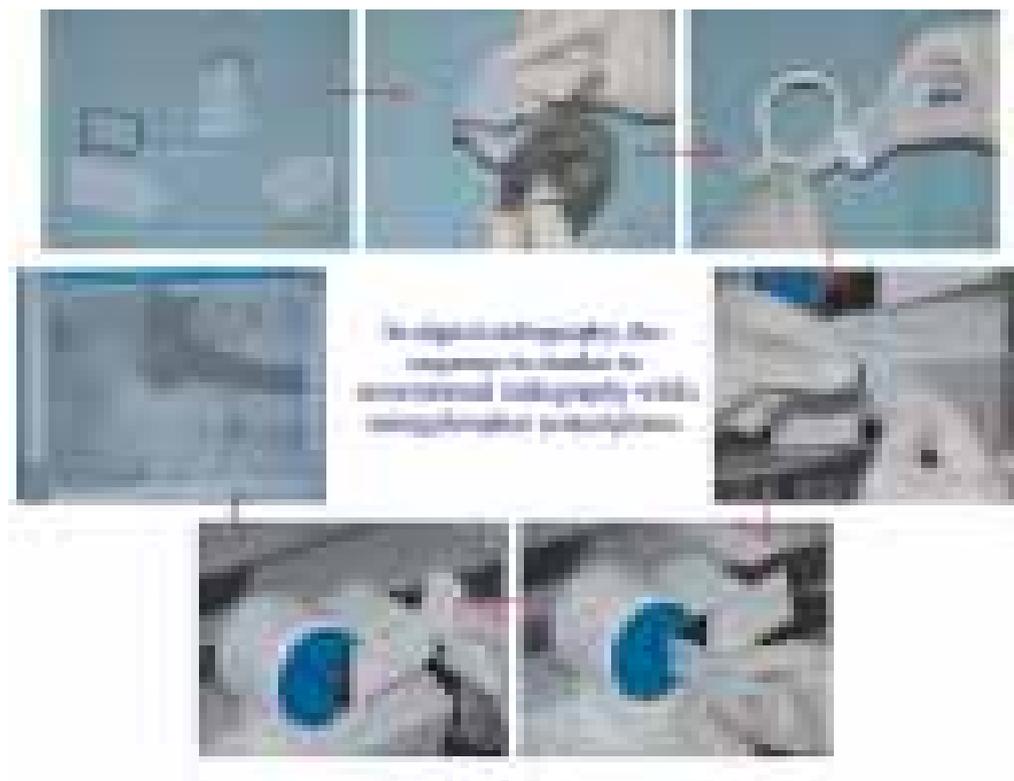
Hardware used in dental informatics (clinical information systems in dentistry) include digital radiographic equipment, digital intra-oral camera systems, periodontal probing devices, printers and personal computers used for management of patient information and office records. Physically this hardware could be within the patient care area or in the outer offices. Equipment used in patient care should be handled following infection control protocols to control cross-contamination.

The digital receptor is used in the patient's oral cavity needs to be sheathed with a plastic sheath extending at least 5 inches outside the patient's mouth. The sheath needs to be changed between patients and the digital receptor and only needs to be wiped with a disinfectant wipe if contaminated. If in the patient care area, the CPU has to be plastic wrapped with air vents exposed (to prevent heating of the unit. The keyboard cannot be disinfected or sterilized due to the existing design. It is essential to obtain preformed membrane/silicon covers to completely cover the keyboard which can be sanitized and disinfected between patients. These cover needs to be changed/wiped down with a disinfectant between patients. The mouse should not be of a trackball design as it is difficult to cover it with a membrane cover. It should be covered with a membrane cover which should not interfere with the movement of the mouse or create a static electricity interference. A joystick design for a mouse is convenient for easy application of barriers, or an electronic pointing device (Wacom Pen and Tablet). The front monitor should also be covered with screen shade/cover which will prevent aerosol particles settling on the screen. These screens need to be sanitized when visibly soiled. Do not cover the monitor's air-vents. The printer if located within the patient care area needs to be covered with a plastic wrap to prevent aerosol particles settling on it, and the switches need to be covered too. The printer need not be barriered if it is located outside of the patient care area. Apart from using barriers and disinfection techniques, the personnel should use gloves while handling this equipment if they are also touching the patients

Table 13. Digital Radiographic Equipment

Parts	Level	Barriers
1. Cart	Non-critical	Covers
2. a. Digital Receptor	Semi-critical	Plastic Sheath/sleeve
b. Digital Sensor	Semi-critical	Plastic Sleeve
3. CPU	Non-critical	Covers
4. Key board	Non-critical	Covers
5. Mouse	Non-critical	Cover
6. Monitor	Non-critical	Screen Shade
7. Printer	Non-critical	cover controls

If any of the equipment is contaminated, disinfect using a disinfectant wipe (do not immerse or spray). Do not immerse Digital Receptors (ones with electronic leads) in disinfectant as the leaching of liquids may short the circuits in the receptor. Digital Sensors (that do not have leads) may be immersed in a disinfectant per manufacturer's recommendation.



Chapter 15

Considerations for Dental Laboratories

Puttaiah

Risks in the dental laboratory are slightly different from in the clinic. Due to safety reasons, gloves are not used while handling lathes (risk of glove snagging in the lathe) and during most laboratory procedures. Therefore, whatever comes into the dental laboratory must be decontaminated or shipped decontaminated to the dental laboratory. On the other hand, the dental laboratory should also decontaminate impressions, casts or appliances that have been exposed to the patient prior to handling with bare hands. There should be adequate communications between the dental laboratory and the dentist about decontamination of items that have been shipped (must have a label stating whether it was disinfected and with which disinfectant). Items such as impressions, casts, bite-registration/blocks, partial and complete dentures that have been exposed to patients must be disinfected before being handled by the dentist or the laboratory technicians. Items that are sent back to the clinic for patient care from the laboratory must also be cleaned and disinfected. There should be no residual germicides on the items that go into the patient's mouth. Items that can withstand sterilization (veneers, porcelain/porcelain fused to metal crowns and bridges) must be sterilized. Items that cannot be sterilized must be cleaned, disinfected and rinsed in clean water before being used in the patient's mouth. Acrylic trimmers/handpieces being used chair-side for repairing or adjusting prostheses must be cleaned and disinfected between patients and the burs re-processed between patients.

Table 14. Some Methods of decontamination in the dental laboratory

Items for Decontamination	Decontamination Methods
Impressions & Stone Casts Removable Prosthesis, Bite-Registration/Blocks Metal, Porcelain & Porcelain Fused to Metal crowns and Bridges Burs/Finishing/Polishing Burs/Discs, Garnet, Cuttle etc. Compound/Green-Stick Compound for border-molding Hot-Water Bath/Tub for softening Flame torch/Bunsen Burners etc. Reusable metal impression trays Plastic impression trays Face-Bow Bite-Plane/Intra-oral Insert for Face Bow Articulators Rag-Wheels and Rotary Polishing Brushes Lathes, Trimmers, Work Surfaces All other devices including mixing bowls, wax knives, buffalo knife spatulas etc. Counter/Work Surfaces/Bench	Surface Disinfection or Immersion Disinfection followed by rinsing in water Surface Disinfection or Immersion Disinfection followed by rinsing in water Ultrasonic Cleaning and Sterilization Ultrasonic Cleaning and Sterilization Unit-Dose per patient and discard the unused items Clean and disinfect after each patient (wait till it cools down) Clean and disinfect after cool down Cleaned, sonicated and sterilized Discarded after one use Sanitized and Disinfected Sanitized and Sterilized Cleaned/Sanitized and Disinfected Ultrasonic cleaning and Sterilization at least once daily Sanitization and disinfection at least once daily Use of surface barriers as needed Sanitization, Disinfection and sterilization as needed Use of a Disposable Brown Paper (Heavy Gauge) as lab bench/ table/work-surface cover, disposed after use. Work Surface sanitized and disinfected at the end of each day

Pumice if used in the clinic while working on individual patients during try-in must be unit dosed (only a needed amount dispensed), the pumice discarded after single use, and the container/trough/tub sanitized and disinfected after each use.

Surface covers must be used regularly so that there is minimal contamination or dirtying of the bench tops. Laboratory work surfaces must be cleaned and disinfected at the end of each day. Before disinfection, all stone/plaster, wax, metal or other filings must be cleaned or scraped off of the surface. All sharps such as burs, knives and scalpels must be cleaned and decontaminated and stored safely to avoid any sharps injuries.

At the end of the day, the ultrasonic instrument cleaning units including the trough must be drained, wiped dry and disinfected. This will prolong the life of the ultrasonic unit by avoiding corrosion of the through.

Dust/metal filings/chemical vapors are generated in the dental laboratory on a regular basis. During trimming of acrylic, metals, dry stone etc., the trimming should be done close to a vacuum/suction spout to remove the inhalation risks for the staff. While handling acrylic monomer, there should be adequate ventilation or evacuation of the air to reduce inhalation of the monomer. Similar safety measures should be in place for other inhalation risks as needed.

PPE used in the laboratory as follows—

- Mask to reduce splash/spatter from trimmers, rag-wheels etc.
- Goggles/Protective Eye-Wear to protect eyes from particulate matter and flying debris
- Fluid resistant Gown as needed
- Heavy-duty heat resistant gloves while handling hot devices/investment flasks, hot water baths for removal of invested wax or for curing acrylic dentures.

All Bunsen burners, torches, flame torches used in the laboratory should be cleaned, inspected and stored safely. Any source of oxygen/gases used in the laboratory must be shut off at the end of the day. During period of extended non-use such as vacation periods (extending beyond one week) the hoses should be disconnected and the lids screwed back on the cylinders. All gas cylinders must be harnessed securely (fixed to a wall with brackets and chains, or to a broad base) to avoid tipping over or falling.

As torches/burners/open flame is regularly used in the laboratory, fire-extinguishers should be installed and the technicians/staff trained in proper use of the extinguisher.

Dental Laboratories



Gloves cannot be used while operating the lathe due to snagging of gloves. Prior disinfection of impression, casts, dentures or other contaminated materials is needed



Chapter 16

Special Topics

Puttaiah & Kohli

Considerations for extracted teeth, biopsy specimens and tissues

Extracted teeth are infectious and must be treated as medical waste if being discarded. Medical waste that includes teeth and tissues is potentially infectious and can be a risk for personnel handling waste. Extracted teeth that are to be used in the dental laboratory for shade-matching, in research and in materials testing laboratories, or in the preclinical laboratory for practicing cutting/restorative procedures or for preclinical examination must be decontaminated. Methods to decontaminate teeth could be heat sterilization, immersion in a sterilant such as 5000 ppm bleach, 7% hydrogen peroxide or in Glutaraldehyde for the sterilization time. If the teeth are to be used in preclinical laboratories or for research purposes (bonding of composite to teeth for shear bond strength tests), they must be immersed in 0.05% thymol solution in water for at least a couple of weeks with solution changed daily. Bleach should not be used in this instance as it can dissolve the organic matter in the teeth and alter outcomes. Teeth can be autoclaved and then discarded in regular waste. Teeth with amalgam fillings should also be disposed as medical waste that is not incinerated (however there is very little significant evidence/scientific studies regarding mercury release beyond permissible limits due to incineration). Given the available information, teeth with amalgam fillings could be autoclaved with other saturated medical waste prior to disposal with regular waste. If patients request extracted teeth, the teeth must be washed, soft tissue tags trimmed, placed in 5000-6000 ppm (1:10 dilution in commercial liquid bleach) bleach for at least 10 minutes, rinsed again and dried using a paper towel and then provided to the patient in a plastic bag/zip-lock bag. The patient should also be informed that it is potentially infectious and not to allow others to handle the tooth/teeth. It is always better not to give it back to the patient, but dispose of the extracted teeth as medical waste.

If extracted teeth are to be stored, the teeth should be washed, soft tissue trimmed, teeth soaked in a disinfectant for a minimum of 2 weeks (10% formalin) with the disinfectant being changed every 24 hours. The jars/containers with extracted teeth must be handled with gloves and other required PPE as it is still considered potentially infectious. The teeth must be placed in leak-proof rigid container with biological hazard labeling as well as chemical hazard labeling specifying the name and concentration chemical. Even after disinfection, the teeth should be handled as potentially infectious (use of gloves and other PPE depending on the further use)

Biopsy specimen should be handled as potentially infectious material and should be immediately stored in 10% buffered formalin if being transported for histopathological investigation. The specimen should be placed in leak-proof rigid container with biological hazard labeling as well as chemical hazard labeling

specifying the name and concentration chemical. During histopathology, the specimen must be handled with gloves and other required PPE as it is still considered potentially infectious.

Considerations for Oral and Maxillofacial Surgery and LASER/Electrosurgery plumes

As of today, electro-surgery and the use of LASER in dentistry is becoming commonplace. Electrosurgical procedures tend to burn the tissue creating smoke and other possible byproducts contaminating ambient air with smoke plumes in the dental clinic. Similarly, LASERs also generate plumes or smoke in the clinic that could be laden with patient material. These gases/smoke/plumes could contain hydrogen cyanide, benzene and formaldehyde, affecting both the dental care providers and the patients. With respect to disease risks, these gases/smoke and plumes may also contain tissue debris, microbes and viruses. Some of the organisms detected in the plumes are Staphylococcus, Corynebacterium, Neisseria, Human papilloma virus and HIV. The methods of controlling risks from electrosurgical and LASER plumes is to wear Full PPE that includes well fitting (tight face-fit) high filtration masks, face shields/goggles/protective eyewear, gloves, and fluid resistant gowns. To control release of the gases/smoke/plumes into the ambient air, a high volume evacuation system (high-speed suction) as close as possible to the site generating the gases/smoke/plumes must be used. Further, other methods of improving air circulation in the clinic should also be used. This is an emerging field and is still under study with respect to risks to the dental and medical personnel, and therefore, needs to be constantly researched and updated.

Considerations for new and emerging diseases including Creutzfeldt-Jakob Disease (CJD)

CJD & Prion Related Diseases

Creutzfeldt - Jakob disease (CJD) or commonly fall under a degenerative neurological diseases/disorders/conditions such as Transmissible Spongiform Encephalopathies (TSE). These conditions affect both humans and other mammals and are associated with a form of protein called a Prion that lacks nucleic acid but are capable of self-propagation within a host. Other than CJD and variant CJD, there are other conditions such as kuru, Bovine Spongiform Encephalopathy (BSE) or mad cow disease, and Gerstmann-Straussler-Scheinker syndrome associated with human illness and death. The incubation period of these prions prior to clinical signs and symptoms could be years. Death could occur within a year of the occurrence of clinical signs and symptoms. Apart from being isolated in the brain and neurological tissue, prions have been identified in the tonsils, eye tissue, and pituitary glandular tissue. Prions are resistant to conventional physical and chemical decontamination processes and therefore additional measures need to be taken. As of today, the potential infectivity of oral tissues with respect to prion related conditions is not definite. If it is a patient with known status of a prion related condition, defer routine care and treat only urgent/emergent needs with additional precautions such as—

- single-use-disposable critical and semi-critical devices, or if possible patient-specific devices not to be used on others
- burs, endodontic files must be single-use disposable
- hand instruments must be cleaned thoroughly and rinsed well before undergoing the longest sterilization cycle
- reusable instruments soaked, cleaned with ultrasonic means and rinsed thoroughly
- **no-flash sterilization** of instruments but a complete cycle at 134°C and 15 psi for a minimum sterilization time of 18 minutes, but the use of the longest cycle (up to 1 hour of sterilization time and with prior rigorous cleaning of the instruments)

Chapter 17

Classification & Management of Dental Wastes and Sharps

Puttaiah & Kohli

While it is essential to protect the patient and the care provider, we do generate a lot of medical waste. With respect to dentistry, waste can be classified as follows—

1. **Regulated waste**
 - a. **Biological waste**
 - i. Saturated waste soft waste (materials that are saturated blood and saliva and can express blood/saliva/body fluid when squeezed)
Examples: —2X2 gauze and cotton rolls saturated/soaked in saliva/blood
 - ii. Soft tissues (oral soft tissues including biopsy specimen) and hard tissues (bone and teeth)
 - b. **Disposable Sharps**
 - i. *Examples:* —Scalpel blades, needles, used carpules, orthodontic wires, disposable matrix bands, single-use-disposable burs, contaminated broken glass, wire sutures used for splinting and reducing fractures, and failed implants
 - c. **Environmentally hazardous chemicals and metals**
 - i. *Examples:*—Mercury, amalgam, Beryllium, chemicals used in processing radiographs (Silver Nitrate), formaldehydes, glutaraldehyde, OPA, and Phenols
2. **Non-regulated waste**
 - a. *Examples:*—Unsaturated cotton rolls, paper towels, gauze, non-sharp single-use-disposable devices (plastic AWS tips, Saliva Ejector Tip, HVE tip), disposable syringe, plastics, disposable PPE and other inanimate surface barriers

During patient care, all sharps that can be immediately discarded into a sharps container must be placed in a sharps container unless and until needed further during the procedure. Each operator must have a rigid approved and a labeled sharps container. Immediately after patient care, all sharps must be discarded into the sharps container safely (never use a two handed technique to re-sheath needles, just discard them into the sharps container by unscrewing the needle with a needle holder. Similarly, the scalpel blade must be removed from the BP handle or if using a disposable scalpel and blade, discard the whole device into the sharps container. After getting rid of the sharps, the regulated soft waste that is saturated with blood/saliva must be placed in a biohazard labeled orange/red bag that needs to be disposed into a rigid larger red container as regulated waste (cumulative waste removed periodically) by a contracting agency. Waste Tissues including soft tissues and extracted teeth and bone must also be placed in the red bag and taken to the rigid large container for professional disposal. The clinics should have a contract with a professional waste management company that regularly removes the hazardous waste from the clinic and terminally incinerates the waste at a remote facility. The professional waste management company must also be able to remove the filled sharps containers for proper professional disposal. In the absence of such services, the clinic may opt (as in the US) to place all the soft regulated waste in an autoclavable bag (with bio-hazard markings) and autoclaved/sterilized for one complete cycle before disposing into regular non-regulated waste receptacles.

Chemical wastes should not be poured down the drain as they pose a grave environmental hazard. They should be discarded based on the local rules for hazardous chemicals. Regulated waste management companies may also be able to dispose off the waste chemical as needed. Non regulated waste such as non-saturated soft waste poses no threat to the final waste handlers and can be disposed off similar to household waste. Waste should also be separated based on the type of material. Plastic wastes when incinerated may generate environmentally hazardous chemicals such as dioxins that are carcinogens and therefore, it may be good to involve the input of professional waste management companies as to possible separation of certain hazardous wastes that can be safely disposed off without burdening the environment. While treating patients, we must also find ways to reduce waste that may harm the environment.

Chapter 18

Management of Exposure to Blood and Body Fluids

Puttaiah & Kohli

Exposure of the Dentists, Auxiliaries, Laboratory Technicians, Students and Volunteers to blood and body fluids of patients through splash/spatter to the mucosa (eye, nose and mouth), sharps injury (percutaneous as in a needle-stick or other sharps puncturing intact skin) is possible during dental care. It is essential to know the HIV status of the patient and the DHCP during such inadvertent events. It is also good to know other chronic infectious disease status (HBV, HCV status) of both so that appropriate and effective post exposure treatment and follow-up be initiated. One has to understand that with respect to dentistry, saliva must be considered as potentially infectious as blood (most dental procedures will bring about bleeding and saliva is normally mixed or contaminated with blood from the gingiva even if blood is not visible). These exposure incidents can happen chairside while treating a patient, where the source patient can be identified; or it can happen during instrument reprocessing where the instruments are mixed after treating multiple patients where the specific source patient is unknown. When the source patient is known it becomes easier to implement specific post-exposure testing and therapeutic protocols. When the source is unknown, the protocols become more difficult.

Steps to be taken in the event of an exposure

In the event of an exposure, stop treatment of the patient and stabilize the patient temporarily—

- a. If it was a splash or spatter exposure to the mucosa—
 - i. Wash the area with flowing water/eyewash station for at least 10 minutes
 - ii. Contact a medical practitioner/infectious diseases specialist who can evaluate the situation, initiate testing to find out the infectious disease status of the source patient as well as the exposed personnel
 - iii. initiate treatment of the exposed personnel as needed with antibiotics and antiretroviral medications and future follow-up of the source and the exposed
- b. If it was a sharps injury (needle-stick, puncture wound from a contaminated instrument—
 - i. Wash the injured area with an antimicrobial soap for about 2-3 minutes
 - ii. Apply first aid (medications / band-aid / suture) as needed
 - iii. Contact a medical practitioner/infectious diseases specialist who can evaluate the situation, initiate testing to find out the infectious disease status of the source patient as well as the exposed personnel
 - iv. Initiate treatment of the exposed personnel as needed with antibiotics and antiretroviral medications and future follow-up of the source and the exposed

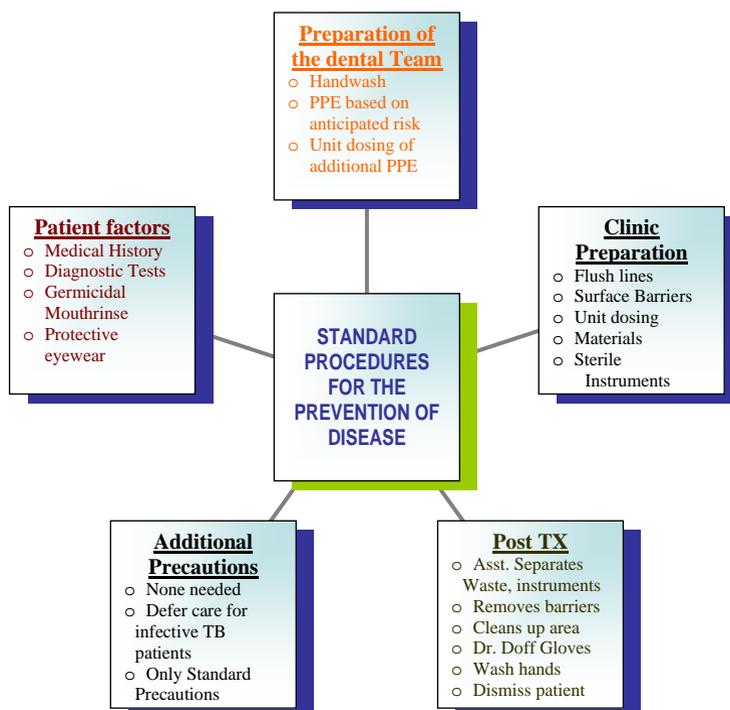
All incidents should be documented in detail as follows—

- i. When did it happen?
- ii. How did it happen?
- iii. What was the type of exposure (splash/spatter or percutaneous)?
- iv. For percutaneous injuries describe whether it was a needle stick, puncture or laceration of the skin with a sharp instrument
- v. Whether any fluid was injected into the healthcare provider

Although there is no quantitative risk assessment of the type of exposures in causing infectious diseases in DHCPs, the type and amount of blood and other body fluids, the type of exposure (mucous membrane exposure, non-intact skin exposure, bites or percutaneous exposures), source individuals disease status (severity of the disease) could qualitatively help in post exposure protocol with respect to HIV, HBV and HCV. Personnel exposed to HIV patients would need to undergo testing and start effective, state-of-the-art antiretroviral therapy within 24 hours of exposure. If the personnel is sero-negative for HIV and has completed anti-retroviral therapy, testing at 3 months and 6 months would need to be done. If the source patient was sero-negative at the time of exposure, it may not be necessary to start anti-retroviral therapy. If the personnel is an employee of an organization, institution or a corporation and chooses to decline testing and post exposure prophylaxis with anti-retroviral medications, the refusal for care should be documented with the personnel's signature.

If the patient or the source has a history of other infectious diseases such as HBV, HCV or other blood-borne conditions, appropriate treatment and follow-up measures should be carried out to reduce the disease risk to the exposed personnel.

Sample Diagram of Aseptic and Clinical Requirements during patient care



Chapter 19

Occupational Safety Directives for Dentistry (Sample based on US OSHA Standards)

Puttaiah & Kohli

1. Bloodborne Pathogens

Scope and application

This directive applies to all occupational exposure to blood and other potentially infectious material (BOPIM). Examples would be blood, saliva, extracted teeth, biopsy specimen, urine and materials that come in contact with these potentially infectious materials. These materials may contain pathogens that transmit disease to employees. Whenever these risks are anticipated, there must be a plan to control exposures, and a post exposure protocol in the event of exposure to BOPIM.

Exposure control

- Every clinic must have a manual of Dental Infection Control & Occupational Safety
- In this manual there must be an Exposure Control Plan for the specific clinic
- An exposure control plan will include—
 - List of categories of employees and their names
 - Exposure Determination - Job responsibilities of employees and risk levels based on duties with respect to exposure to bloodborne pathogens at work
 - The types of risks to BOPIM by the clinic's employees
 - After determining the risks of exposure in the duties of the employees, they need to be trained in controlling the risks and the training documented. The training should also include evaluation of the exposure incident, further methods of controlling such incidents, and annual reviews/updates or when new risks are introduced into the clinical arena
 - Use of engineering and work practice controls to reduce the risk of exposure
 - Protocols to follow in the event of an exposure
 - Documentation of Initial and Periodic training in exposure control and post exposure protocols with respect to bloodborne pathogens

Tasks involved in Exposure Determination

- List all job categories in the clinic
- Determine the categories that may have regular (High) contact with BOPIM (Dentist, hygienist, assistant, lab-tech); Determine the categories that may have only occasional (Moderate) contacts (front office staff who may assist occasionally in patient care, clean-up etc); Determine categories that have potentially no (low) contact with BOPIM (Front office staff who do not assist in clinical work at all).
- Each category should have a prescribed method of exposure control such as use of PPE, level of PPE (gloves, gowns, masks, eyewear, bonnets, shoe covers) for each type of task based on anticipated

exposure, engineering controls (sharps holders; HVE and rubber dam use to control bioaerosols; use of sharps dispenser in each operatory), work-practice controls (proper or no re-sheathing of needles, safe handling of sharps during care, and instrument reprocessing). These controls may be referred to as standard operating procedures for the clinic.

Methods of Compliance

There must be a designated safety person for a clinic whose role is to manage and implement the safety program. Compliance is the “Heart of the Exposure Control Plan”. The safety person keeps a tab on the training, compliance during practice and documentation and should coordinate all safety efforts in the clinic to control exposures to BOPIM. Some of the common issues the safety person should look into and document are–

- Whether there are safety protocols and acceptable methods to reduce risks in the office
- Use of appropriate PPE by employees
- Universal Precautions being followed in the clinic
- Engineering and Work-Practice Controls being followed, including periodic testing and documentation of the function of engineering controls
- Initial and periodic immunizations against immunizable diseases
- Checking to see if sharps are being handled properly during provision of care, transportation of contaminated sharps to the reprocessing area, and during reprocessing
- Safe and appropriate disposal of waste (both regulated and non-regulated waste)
- Recording of Exposure incidents and logging them in prescribed OSHA format
- Keeping a post-exposure protocol in place
- Housekeeping issues

Common Engineering Controls in the Exposure Control Plan

- High Volume Evacuator & Rubber Dam in conjunction to control bioaerosols
- Aerosol/Dust Evacuation Hood in the dental laboratory
- HVAC with laminar flow of air to reduce aerosols
- Sharps Containers in every operatory and in the laboratory
- Splash guards/safety guards for lathes and table-top rotary devices
- Crush resistance devices incorporated into dental chairs (to avoid crushing of toes and knees during the use of chairs)

These engineering controls should be examined and tested periodically, and there should be documentation of the test.

Common Work practice controls

- Handwashing & use of PPE
- Safe handling sharps or other potentially dangerous items
- Single handed recapping of needles, or use of a needle holder to grasp the cap in a two-handed technique
- Pointing the bur on the handpiece away from employees and patients while being placed in the socket
- Disposing sharps and contaminated waste chair side into appropriate containers
- Never overfilling a sharps containers
- Prohibition of eating, drinking, smoking, application of cosmetics, handling contact lenses in potentially hazardous areas of the clinic (during patient care, instrument reprocessing, laboratory work where there is a risk of exposure to BOPIM)
- Minimizing splash & spatter
- Safe handling of blood & saliva specimen including extracted teeth
- Biohazard labeling of containers including secondary containers
- Use of labeled leak free secondary containers for shipping
- Labeling contaminated equipment with a biohazard label
- Decontaminating contaminated equipment before use or shipping

Use of Personal Protective Equipment (PPE)

All required PPE must be provided at no cost to the employees. Level and use of PPE use should be determined based on anticipated exposure to BOPIM and the change of PPE spelled out clearly (example would be changing gloves every 30 minutes for long procedures). The PPE being used should be effective and not overtly permeable to blood and other body fluids. They should be accessible to all employees of all sizes and the employees should be trained in their use effectively. All the single-use-disposables must be discarded after one use and the reusable PPE decontaminated in an acceptable manner before being reused. Common PPE used in the dental clinic are Face Mask, Face Shield/Goggles/Prescription Glasses with Side-shields, Gown and Gloves used in combination while anticipating splash or spatter. While not anticipating splash or spatter, and while working intra-orally, only exam gloves may be sufficient. PPE should not be worn outside the clinic (i.e. in the patient waiting area). Scrubs are not considered to be PPE, but are considered to be common clothes.

Housekeeping-General Rules:

- Work site should be clean and sanitary
- Written Schedule and instructions as what to clean and with what to clean and as to who should clean it

Decontamination

- Work surfaces
- Equipment surfaces
- Change of protective coverings
- Clean bins, pails and cans periodically
- Safe handling of broken glass (use PPE & mechanical devices)
- Recirculation of reusable sharps (instruments)

Regulated Waste

Items that qualify as regulated (needs special handling including chair side as well as during disposal)

- Liquid or semi liquid BOPIM
- Items that would express BOPIM if compressed
- Items caked with blood or saliva
- Contaminated Sharps
- Pathologic and microbiologic wastes containing BOPIM or derived from BOPIM

Sharps Containers:

- Located as close as possible to dental operatory, upright and with a Biohazard label
- Not to be over filled and replaced As Soon As Possible when full
- Lid Closed while being moved/transported
- Placed in secondary container if leaky while being transported/shipped

Laundry

- Contaminated laundry is that which is soiled by blood or other potentially infectious materials
- Handled as little as possible
- Bagged on site
- Not sorted or rinsed on site
- Bags labeled with Biohazard label or red bags
- Handled with gloves and other PPE as needed

Choices for handling laundry

1. Single-Use-Disposable items better than Reusable Barriers
2. Outside Professional Laundry Services
3. Washer & dryer on site dedicated for contaminated laundry
4. Employee(s) designated to handle (train & document)

Hepatitis-B Vaccination

- All employees with the risk of exposure to bloodborne pathogens

- Vaccination offered within 15 working days, evaluated and provided by a Medical Doctor knowledgeable in infectious diseases and occupational medicine
- Vaccination Refusal Form must be signed if refused
- Booster every 5 years not required (as in the US)
- Records: documentation of HBV status required and maintained confidential
- No prescreening required
- Provide standard copy to Healthcare Professional who will administer the vaccine
- Post vaccination test not a must but is desirable
- Post-Exposure Evaluation and Follow-Up

Definition of an Exposure Incident

Eye, mouth or mucous membrane contact with BOPIM, non-intact skin contact with BOPIM, or parenteral contact with BOPIM.

Procedures After Exposure Incident

- Confidential medical examination
- Post-Exposure Evaluation and Follow-Up

General information

- Complete an exposure report
- Identify Source Person
- Container Labeling with the chemical name and color coded labeling for specific risks (use NFPA or other international standard labeling format)
- Understanding the MSDS with respect to chemical hazards
- Employee Training in HAZCOM
- Inventory of hazardous chemicals in the Clinic
- Hazards involved during routine and non-routine task
- Define possible chemical hazards in the clinic
- Exposure of other personnel and outside contactors
- Outside contactors must be informed of—
 - o Hazardous chemicals in the office
 - o Measures to reduce possibility/risks of exposure
 - o Location of MSDSs for all hazardous chemicals
 - o Procedures to follow if exposed
 (If the contractor is interested, let them visit and evaluate the situation, the risks)
- Hazardous Chemical Inventory
 - o Maintain a list of hazardous chemicals in the office
 - o List of all dental materials used in the office
- Identity or infeasibility of identifying source person
- Source tested for HBV and HIV after consent with refusal if any documented in writing and Employee provided with source's test results
- Confidentiality of the sources results/status explained to the exposed employee to avoid publicity or any other infringement of law

Evaluating Health Care Professional (HCP)

- Employee's job responsibilities during the exposure incident
- Documentation of route of exposure and circumstances in which the exposure occurred
- Results of source persons blood test/status
- Employee's medical record that is maintained by the employer
- The evaluating healthcare professional will do the following:
 - Collect and test employee's blood after consent
 - If blood collected but testing for HIV is refused by employee then preserve blood for 90 days
 - Employee notified of all results

- Post-exposure prophylaxis provided per USPHS
- Counseling regardless of testing
- Illnesses evaluated that are reported by employee in the first 12 weeks irrespective of tests performed
- Healthcare professionals written opinion
- Made available to the employer within 15 days after completing evaluation
- Diagnosis and findings unrelated to exposure incident not reported but held confidential

Report Must contain:

- Whether HBV vaccine was indicated/received
- Employee informed of evaluation results
- Employee informed of any medical condition resulting from exposure, that require additional evaluation and treatment
- All costs should be borne by the employer or should be according to local and national labor laws

Labeling for Bloodborne Risks

Biohazard warning labels affixed to:

- Containers of regulated waste
- Refrigerators or freezers containing BOPIM
- Containers used to store or transport or ship BOPIM

Label design (use international standards/US standards as needed)

- Fluorescent Orange with Biohazard Symbol and word Biohazard in a contrasting color
- Affixed as close to the container by string, wire or adhesive
- Red bags or containers may be substituted for labels

Medical Records

- Confidential medical record established
- For each employee
- If the employee has not had an exposure
- Name and other identification characteristics of employee
- Copy of employee's HBV vaccination status including known dates of vaccination, record related to vaccination or ability to receive vaccination or refusal of vaccination

When Incident Occurs

- Exposure incident report
- Copy of all results, exam, testing follow-up
- Written opinion of health care provider
- Copy of information provided to employer

Record Keeping

- Medical record maintained for the duration of employment and during the lifetime of the clinic
- Available to employee upon request
- If dental practice is sold
- Record transferred to new owner

Training and Training Records

- Employees with occupational exposure must be provided training at no cost and during working hours
- Training at initial assignment, changes in tasks/procedures and annually
- Level of material must be appropriate in content and vocabulary of the employee

Contents of Training

- OSHA Bloodborne Pathogen Standards
- Bloodborne diseases
- Exposure control plan and Emergency Procedures
- Signs and labels

Question and answer period (necessary)

2. Chemical hazard control

Clinic Manual should have a “Written HAZCOM Program”

Issues Covered by the program should include—

List Must Have—

- Name of Hazardous Chemical
- Reference # for each chemical, with the same placed on each MSDS to assist employees for easy reference in case of emergency
Location & use of list should be known to all employees and the employees must be trained in the use of the list.

Material Safety Data Sheets

- Kept in a notebook/file with index/quick ref.
- Book Clearly Labeled MSDS
- Each MSDS should have the following:
- Chemical Common Name
- Physical & Chemical Characteristics
- Fire, Explosion, & reactivity
- Health Hazards, Carcinogenicity (listed NTP/IARC)
- Permissible exposure limits
- Control Measures, PPE, Fire and general precautions
- Emergency & first aid
- Date prepared & changed
- Name, address & telephone of manufacturer

Employees must be trained in using MSDS

- How to read it
- Review Health Hazard Data

MSDS should not be discarded even if chemical use is discontinued

If material is not hazardous then .OBTAIN LETTER FROM MANUFACTURER STATING THAT
“MATERIAL IS NOT HAZARDOUS AND CONTAINS NO HAZARDOUS CHEMICALS”

Container Labeling

- Each Container of Hazardous Chemical labeled or tagged with specific information
- Responsibility of Both Manufacturer & Employer
- Information should be:
- Identity of hazardous chemical
- Appropriate hazard warning including target organs
- Name & address of manufacturer

Secondary containers

- Identity of hazardous chemical
- Hazard warning including target organs

Containers to be labeled

- Disinfection tubs
- X-ray fixer & developer tanks/trays
- Oxygen & nitrous oxide outlets for piped-in systems

Although containers for immediate use need not be labeled, it is still prudent to do so in case of an exposure. Therefore, label all containers; it only takes a few seconds. Train employees in labeling or get

safety manager to label

Employee Training & Information

1. Train BEFORE starting work
2. When NEW HAZARDS introduced and once yearly.

Contents of Training In Reducing Risks to Chemical Hazards

- Copy of the directive & explanation of contents
- Location and availability of HAZCOM Program/Manual
- Chemicals present in workplace
- Explanation, location of MSDS and Hazardous Inventory
- Effects of Hazardous chemicals
- Employee Training & Information
- Methods and observation techniques to determine release or presence of hazardous chemicals or factors. example—dosimeters for formaldehyde
- Instructions on reducing the risks of exposure
- Use of PPE, work-practice and engineering controls
- Steps taken by the office to reduce the risks
- Emergency procedures to follow if Exposed
- Explanation of the labeling system

Training & Documentation

- Training Certificate proves training provided
- Protocol in case of Exposure to Hazard. Chem.
- This is an emergency situation
- Determination of Hazard from the label
- Application of First Aid indicated on MSDS
- Obtain physicians help if it is life-threatening
- Continuous Medical Re-evaluation if needed

Protocol for Chemical Spill

- Determining the hazard from the label of container
- Wear Appropriate PPE
- Containment and removal of chemical with Spill Kit
- Place contaminated materials in appropriate containers
- Labeling containers
- Notify the waste collector as to what is in the container
- If spill is very hazardous, call manufacturer
- Document the chemical spill
- When, Where
- What happened
- Who Was Exposed, and remedial action taken
- What program was implemented to reduce future exposure

Personnel Monitoring

- Use of dosimeters
- Personal Monitoring Badges
- Potential Hazards :
- Radiation
- Nitrous Oxide
- Formaldehyde (Chemiclave- Vaposteril->Formaldehyde)

3. Facility and equipment safety

Contains Some Important Aspects of:

- Fire Safety
- Building Safety
- Equipment Safety

Fire Safety

- Automatic Sprinkler System for the building based on the local safety codes and that are functional (Maintained in reliable operating condition at all times)
- Written Fire Safety Policy
- Use appropriate fire extinguisher (to cover all types of fires that may be encountered in the dental office)
- Portable Fire Extinguishers (with regular maintenance, training of employees in fire extinguisher use, training of employees in maintenance of extinguisher)
- Check and record function Annually & Monthly
- Training in Evacuation Plan

Fire Safety Plan

In An Event of Fire

Notify all employees to leave premises to regroup at a safe place (please consider safety of the patients as an additional measure). Close doors on the way out. The receptionist should turn off computer and take the appointment record. Never Use Elevators but use the stairs to evacuate. Go outside the premises and Call emergency Number (fire department and ambulance). All employees must regroup at a predetermined safe place for a head count and treatment of injuries before dispersion for the end of the day. Document the training and Post evacuation plan

Doors

- Sufficient exits for easy/ smooth evacuation and prompt escape during disaster
- Boldly MARKED as EXITS & must be VISIBLE
- Lighted Arrow towards exit if not over door
- Doors that are NOT an EXIT marked ...“NOT AN EXIT” or marked otherwise
- Main Doors Should have a LIGHTED exit sign
- Should not be locked during working hours or if any employee is in the building
- No items should barr or block doors or evacuation in the event of an emergency

Gas Cylinders

- Nitrous Oxide
- Oxygen
- Compressed gases

Must be maintained in safe condition and safety determined by visual inspection. Cylinders must be secured safely with chain links to a wall or an immovable surface. Lids must be secured during transportation or during periods the cylinders are not in use or when they are not attached to the lines. Employees must be trained in its use and training documented.

Eyewash Stations

Quick Flush and Eyewash Facilities are required when employees are at risk of the eye exposure to

BOPIIM, hazardous and corrosive materials. These fixed equipment must be located within 10 seconds or 25 feet of reach from anyplace within the treatment facility. More than one station may be required for a facility. Eyewash Bottles are NOT acceptable. The eyewash equipment must not be connected to hot water source and must be operable by a single movement (paddle or lever). This equipment must be tested weekly. The temperature of the water must be 60 to 95 degrees Fahrenheit. Eyes must be flushed for at least 15 minutes in case of an emergency requiring the use of the eyewash station. Water supply should be free of bacterial and other contaminant build-up. Drinking water or municipal water source should be used. This equipment can be ordered through safety catalogues and must be installed as per safety and buildings code. Employees must be trained and the same documented.

Trash Bins

Waste receptacles should be maintained clean & hygienic. Solid tight-fitting covers are needed for such items. Covered receptacles are safer than bins that do not have a cover. Surface should be smooth and the equipment corrosion resistant. The material should facilitate easy cleaning and disposal of contents. The containers must NEVER be OVERFILLED. Never try to compress waste with hands or feet. DO NOT PUT REGULATED WASTE IN TRASH BINS

First Aid Kit

First Aid Kits must be present in each facility. OSHA requires presence of Physician Certified First Aid Kit especially in rural areas or areas that are reasonably far from emergency facilities. If a First Aid Kit is needed, a person trained in its use must be present. Obtain a First Aid Kit, as dictated by a Physician and Document it with a letter from the Physician. If First Aid is available within the same business complex, have written instructions on how to obtain help

Electrical

Items such as electrical cords must be in Good Condition and well maintained. No repair of cords is permitted per safety standards (only replacements are allowed). As a temporary measure one extension cord per appliance may be allowed that is to be detached after use. Extension cords are not a permanent substitute for fixed wiring. Circuit breakers and switches must be used for appliances. Only one appliance permitted per each wall socket. No multiple appliances resembling an OCTOPUS for one socket. Circuit breakers, switches, main switches marked boldly for ON & OFF positions, and what they control must be displayed clearly.

GFCI circuits within 6 feet of water sources must be used as this applies to all inside and outside outlets.

Grounding Electrical Devices is quintessential. All devices must be grounded to avoid sparking and arcing endangering the employee when he or she touches them. Three wire direct and 2 wire direct systems operating between 50 to 300 volts require grounding. Alternating current systems require grounding.

Hazardous area that house flammable gases, flammable liquids, vapors, dust and their storage should not discharge static electricity, arcs or sparks must be explosion proof for gases, vapors and liquids; and ignition proof for combustible dusts. Electrical devices proximal to these storage areas must meet National ISI Codes. Repair and replacements must only be carried out by a certified electrician.

Building Safety

Dentist as a tenant

Employee complains of safety issue to the dentist and the latter who is the Renter/Leaser needs to inform

owner of safety breaches that need to be rectified. It is the owner's responsibility to alleviate the Safety Problems within the premises. The employer in this case must document the problems complaints. If the owner does not respond, the employer who is the renter/leaser should inform the clinic's attorney or make alternate settlement and charge the owner of neglect. The bottom-line is "safety of employees."

Dentist as the owner

If the dentist is the Owner and the EMPLOYEE COMPLAINS OF SAFETY ISSUES to the Dentist/ Employer and Owner, the latter must take immediate action to correct problem, and correction documented. To correct any physical facility problems, Certified Agencies/Workers must be contracted to Repair or Address Issue.

Stepladders

Stepladders that are Make-Shift Appliances OR Step-Stools that do not meet the ISI and international standards are not to be used in the business/clinic premises. Only Stools & Ladders that meet Standards may be used.

Radiation safety

Radiation safety requires personal monitoring

Historically there is very little or no Hazards from routine use of Dental Radiology Employee training in Radiological Hazards and Safety and documentation of the same completed on an annual basis. The radiological equipment used in the clinic should be monitored /checked for breaches in safety periodically. Any repairs to the equipment should be done immediately by a qualified technician.

Cardiopulmonary Resuscitation Devices

CPR devices are needed in every clinic and the clinical staff may be trained in their use. All dentists must have a certification in CPR. Pocket Mask with a One-Way-Valve should be used. Ambu-bag devices are an alternative. All training that is provided must be documented. For the purpose of infection control and safety, single-use-disposable CPR devices may be purchased. Reusable CPR devices with disposable barriers or mouthpieces are an alternative. If reusable devices are used, adequate reprocessing and decontamination of the device must be attained after use.

Air Compressors

Air compressors should be equipped with pressure release valves & gauges. Safety devices must be checked periodically. Air intake should take only clean uncontaminated air, especially if HVE is in the room. Employees should be prohibited from using highly compressed air for cleaning purposes. Bleed pressure before repairing the equipment is necessary.

Selected Definitions

Alcohol-based hand rub: An alcohol-containing preparation designed for reducing the number of viable microorganisms on the hands.

Antimicrobial soap: A detergent/soap containing an antiseptic agent.

Antiseptic: A germicide used on skin or living tissue designed to reduce microorganisms on the tissue surface (e.g.— alcohol, chlorhexidine, hexachlorophene, povidone iodine, Parachlorometaxylenol [PCMX], some quaternary ammonium compounds, and Triclosan).

Glass Bead sterilizer: A device using glass beads 1.2—1.5 mm diameter and temperatures 2170C—2320C for brief exposures (e.g. 45 seconds) to inactivate microorganisms. (This device is not considered to be effective as a terminal reprocessing device or Sterilizer by the US FDA)

Bioburden: The microbiological load (i.e., number of viable organisms in or on the object or surface including other organic matter prior to decontamination, or sterilization; also known as “bioload” or “microbial load”).

CDC: The Centers for Disease Control & Prevention, Atlanta, GA, USA.

Colony-forming unit (CFU): The minimum number of separable cells a bacterial growth medium (Agar) that gives rise to a visible colony of progeny. CFUs can consist of pairs, chains, and clusters, or as single cells and are often expressed as colony-forming units per milliliter (CFUs/mL). In simple terms it is the number of microbes per milliliter of a liquid (such as water, blood, serum etc.).

Decontamination: Use of physical or chemical means to remove, inactivate, or destroy microbes or pathogens on a surface or item so that they are no longer capable of transmitting infection and device surface rendered safe for handling, clinical use, or disposal.

Dental treatment water: Water of good microbial quality (<200 CFU/mL) used during dental treatment, including irrigation of non-surgical operative sites and cooling of high-speed rotary and ultrasonic instruments. This water must not be used during oral and maxillofacial surgery, surgical extraction, periodontal flap surgery where bone is exposed, or during surgical placement of implant.

Disinfectant: A chemical agent used on inanimate objects (e.g.— work surfaces in proximity to the patient, non-critical dental equipment and surfaces, environmental surfaces such as floors, walls, or sinks) to kill vegetative microorganisms, viruses and fungi, but not necessarily bacterial endospores. U.S. Environmental Protection Agency (EPA) groups disinfectants on the basis of whether the product label claims limited, general, or hospital disinfectant capabilities.

Disinfection: Destruction of vegetative microbes, viruses and fungi by physical or chemical means. Disinfection is less lethal than sterilization, because it kills a majority of recognized pathogenic microorganisms, but not necessarily all microbial forms (e.g., bacterial spores). Disinfection does not ensure the degree of safety associated with sterilization processes.

Droplet nuclei: Particle =5 µm in diameter formed by dehydration of airborne droplets containing microorganisms that can remain suspended in the air for long periods of time.

DOTS: Directly Observed Treatment Strategy for tuberculosis patients. Technique pioneered by Indian Health Authorities being observed in over 150 countries globally.

Droplets: Small particles of moisture (e.g., spatter) generated when a person coughs or sneezes, or when water is converted to a fine mist by an aerator, handpiece or shower head. These particles, intermediate in size between drops and droplet nuclei, can contain infectious microorganisms and tend to quickly settle from the air so that any risk of disease transmission is usually limited to persons in close proximity to the droplet source.

Endotoxin: The lipopolysaccharide of gram-negative bacteria, the toxic character of which resides in the lipid protein. Endotoxins can produce pyrogenic reactions in persons exposed to their bacterial component.

EPA: Environmental Protection Agency of the United States of America.

FDA: Food and Drug Administration Agency of the United States of America.

Germicide: An agent that kills microorganisms. Terms with the suffix (e.g., virucide, fungicide, bactericide, tuberculocide, and sporicide) indicate agents that destroy the specific microorganism identified by the prefix. Germicides can be used to inactivate microorganism on or on living tissue (i.e., antiseptics) or on environmental surfaces (i.e., disinfectants) or to sterilize instruments when exposed to extended periods of time (i.e. Immersion sterilant when exposed for 3-8 hours or high-level-disinfectant when exposed for 30 minutes).

Hand hygiene: General term that applies to handwashing, antiseptic handwash, antiseptic hand rub, and surgical hand antisepsis.

Health-care-associated infection: Any infection associated during providing medical or surgical care. The term Health-care-associated replaces nosocomial, which is limited to adverse infectious outcomes occurring in hospitals.

Hepatitis B immune globulin (HBIG): Product used for prophylaxis against HBV infection. HBIG is prepared from plasma containing high titers of hepatitis B surface antibody (anti-HBs) and provides short term protection.

Hepatitis B surface antigen (HBsAg): Serologic marker on the surface of HBV detected in high levels in the serum during acute or chronic hepatitis. The body normally produces antibodies to surface antigen as a part of the normal immune response to infection.

Hepatitis B e antigen (HBeAg): Secreted product of the nucleocapsid gene of HBV found in the serum during acute and chronic HBV infection. Its presence indicates that the virus is replicating and serves as a marker of increased infectivity.

Hepatitis B surface antibody (anti-HBs): Protective antibody against HBsAg. Presence in the blood can indicate past infection with, and immunity to, HBV, or immune response from hepatitis B vaccine.

Heterotrophic bacteria: Those bacteria requiring an organic carbon source for growth (i.e., derive energy and carbon from organic compounds).

High-level disinfection: Disinfection process that inactivates vegetative bacteria, mycobacteria, fungi and viruses but not necessarily high numbers of bacterial spores. FDA further defines a high-level

disinfectant as a sterilant used for a shorter contact time (about 30 minutes).

Hospital disinfectant: Germicide registered by EPA for use on inanimate objects in hospitals, clinics, dental offices, and other medical-related facilities. Efficacy is demonstrated against *Salmonella*, *Staphylococcus*, and *Pseudomonas* species.

Iatrogenic: Induced inadvertently by HCP, medical (including dental) treatment, or diagnostic procedures. Used particularly in reference to an infectious disease or other complication of medical treatment.

Immunization: Process by which a person becomes immune, or protected against a disease. Vaccination defined as the process of administering a killed or weakened (attenuated) infectious organism or a toxoid; however vaccination does not always result in immunity.

Implantable device: Device placed into a surgically or naturally formed cavity of the human body if it is intended to remain there for = 30 days.

Independent water reservoir: Container used to hold water or other solutions and supply it to handpieces and air and water syringes attached to a dental unit or ultrasonic scalers. The independent reservoir, which isolates the unit from the public/municipal water system, can be provided as original equipment or as a retrofitted device.

Intermediate-level disinfection: Disinfection process that inactivates vegetative bacteria, fungi, *Mycobacteria*, and viruses. Intermediate level disinfectants should kill both hydrophilic and lipophilic viruses, but not necessarily bacterial endospores.

Intermediate-level disinfectant: Liquid chemical germicide registered with US EPA as a hospital disinfectant with a label claim of potency as tuberculocidal agent (Appendix A).

Low-level disinfection: Process that inactivates the majority of vegetative bacteria, certain fungi, and some viruses, but cannot be relied on to inactivate resistant microorganisms (e.g., *Mycobacteria* or bacterial spores). This process is only used for housekeeping and environmental surfaces but not for clinical surfaces such as non-critical surfaces in proximity to patient care.

Low-level disinfectant: Liquid chemical germicide registered with US EPA. OSHA requires low-level hospital disinfectants also to have a label claim for potency against HIV and HBV if used for disinfecting clinical contact surfaces (Appendix A).

Microfilter: Membrane filter used to trap microorganisms suspended in water. Filters are usually installed on dental unit waterlines as a retrofit device. Micro-filtration commonly occurs at a filter pore size of 0.02 to 10 microns. Sediment filters commonly found in dental unit water regulators have pore sizes of 20—90 μm and do not function as microbiological filters.

Nosocomial: Infection acquired in a hospital during provision of medical care.

Occupational exposure: Reasonably anticipated skin, eye, mucous membrane, or parenteral contact with blood or other potentially infectious materials (BOPIM) that can result from the performance of an employee's duties.

OPIM: Other potentially infectious materials. OPIM is an OSHA term that refers to items other than blood within the Bloodborne Pathogen Standards – 1) body fluids; semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, pericardial fluid, peritoneal fluid, amniotic fluid, saliva in dental

procedures; any body fluid visibly contaminated with blood; and all body fluids in situations where differentiating between body fluids is difficult or impossible ; 2) any unfixed tissue or organ (other than intact skin) from a human (living or dead); and 3) HIV-containing cell or tissue cultures, organ cultures; HIV-or HBV – containing culture medium or other solutions; and blood, organs, or other tissue from experimental animals infected with HIV or HBV.

OSHA: Occupational Safety and Health Administration of United States of America.

Parenteral: (Other than enteric or oral): Means of piercing mucous membranes or skin barrier through such events as needle-sticks, human bites, cuts, and abrasions.

Persistent activity: Prolonged or extended activity that prevents or inhibits proliferation or survival of microorganisms after application of a product. This activity can be demonstrated by sampling a site several minutes or hours after application and demonstrating bacterial antimicrobial effectiveness when compared with a baseline level. This term is also referred to as residual activity or substantivity of germicides.

Prion: Protein particle lacking nucleic acid that has been implicated/associated with certain neurodegenerative diseases (e.g., scrapie, CJD, and bovine spongiform encephalopathy [BSE]).

Retraction: Entry of oral fluids and oral microorganisms into waterlines through negative water pressure or failure of antiretraction valves in dental unit water system.

Seroconversion: The change of a serological test from negative to positive indicating the development of antibodies in response to infection or immunization.

Sterile: Free from all living microorganisms; usually described as a probability (e.g., the probability of a surviving microorganism being 1 in 1 million).

Sterilization: Use of a physical or chemical process to destroy all microorganisms including bacterial endospores.

Surfactants: Surface-active agents that reduce surface tension and help cleaning by loosening, emulsifying, and holding soil in suspension, to be more readily rinsed away.

Ultrasonic cleaner: Device that removes debris by a process called cavitation or highly frequent implosive activity, in which waves of acoustic energy are propagated in aqueous solutions to disrupt the bonds that hold particulate matter to surface.

Vaccination: See immunization.

Vaccine: Product that induces immunity, therefore protecting the body from the disease. Vaccines are administered through needle injections, by mouth, and by aerosols/mists.

Washer-thermal-disinfector: Automatic unit that cleans and thermally disinfects instruments, by using a terminal high temperature cycle rather than a chemical bath.

Wicking: Absorption of a liquid by capillary action through the material (e.g., penetration of liquids through microscopic pores in a glove).

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