

SHORT COMMUNICATION

The Rationale for Dental Safety

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ABSTRACT

Dental infection control and occupational safety are very important aspects of dentistry. It is quintessential to provide safe care to patients and at the same time not to be affected personally by occupational hazards. While patient safety addresses control of disease transmission to patients during care, occupational safety addresses control of occupational hazards to the care provider. Collectively, we can refer to both patient safety and occupational safety as “dental safety”.

“Primum non nocere” or “first, do no harm” is the key to providing safe dental care. Dentistry has evolved in science, technology and esthetics over the years, and around making various types and options of treatments available, but dental safety has not kept pace with changes and advancements. This is not due to lack of availability of information, materials and equipment, but due to lack of importance given to safety in comparison with other fields of dental sciences. While dental care is important in improving oral health, dental safety is important in controlling morbidity and mortality that is more important than improving oral health.

In this manuscript, we address the rationale for understanding the need for dental safety. We address recent status in epidemiology of infectious diseases, including HIV, infectious diseases commonly encountered during provision of dental care, routes of disease transmission, Spaulding's classification of surfaces, universal and standard precautions, additional precautions while anticipating certain diseases or during certain endemics and epidemics, and finally infectious disease related stigma impacting universal precautions.

Keywords: HIV epidemiology, Routes of disease transmission, Spaulding's classification, Universal precautions, Standard precautions, Additional precautions, Stigma and infectious diseases.

INTRODUCTION

Due to the pandemic of Human Immunodeficiency Viral (HIV) infections in the mid 1980 through the turn of the century, many medically advanced countries have set standards and implemented regulations with respect to both patient and employee safety. These standards have been formulated by regulatory agencies within their respective countries or regions to improve the level of patient care and personnel safety.^{1,2,3}

Although, many patients and dentists were infected with Hepatitis-B virus (HBV) in the United States in the 60s and 70s, the field of infection control did not gain momentum. The possible reasons were due to the advent of vaccines to combat HBV and possibly because it was not a disease with social stigma. Although concepts in dental infection control were developed in 1960s (due to HBV infections),^{4,5} this field only gained priority after the HIV infections reached epidemic proportions. Infection control gained further momentum in the United States of America after patients treated by a Human Immunodeficiency Virus infected dentist later tested positive for the HIV virus,⁶ and also after health care workers became infected while involved in patient care activities.⁷ While this disease has been ravaging Africa, Asia and the Eastern Europe and the Russian Federation, it is now under control in the United States of America and Western Europe. This control of the spread of HIV has been achieved to a large extent due to public

health and awareness programs and also because dentists and other healthcare professionals have improved their practice of infection controls either voluntarily or involuntarily. The rates of new infection among certain groups have decreased or stabilized in the recent past due to various public health measures.⁸ In the United States, the number HIV patients being classified into the AIDS category has also reduced due to improved therapeutic measures.⁸ However, worldwide estimates of incidence of individuals infected with HIV and developing severe disease (i.e. AIDS) continues to rise due to lack of therapeutic and public health measures.⁹ There is an annual increase worldwide, each high morbidity levels within the populations, but with dramatic regional variations.¹⁰ While the caseload in the Americas and Europe was increasing in the late 1990, it was not as much as in Asia,¹¹ with India having about 1.8 to 3.2 million cases and China about 450,000 to 1 million cases of HIV infections.¹²

Recently, the Russian Federation has reported caseload of about 1.5 million HIV cases and is taking action in implementing education and policies towards controlling possible spread during dental care.^{13,14} 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 (Table 1, a list of conditions/pathogens, habitat and routes of transmission that has been developed using information from various sources).¹⁵⁻¹⁸

Table 1: Infectious diseases commonly encountered in dentistry

Condition	Habitat	Routes of transmission
Sexually transmitted diseases		
1. Herpetic Infections	Oral, pharynx, anogenital, 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. Trichomonas infections	Genitals, oropharynx, oral, gastrointestinal	Contact-lesion exudate, mucosa, saliva, blood, body fluids
7. Condyloma acuminatum	Anogenital 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 (HIV)	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
8. A H1N1 influenza (swine flu)	Respiratory 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 and rubeola	Respiratory tract, oral skin	Droplet, contact, saliva, blood, exudate
5. Mumps	Parotids, pancreas, testis, CNS	Droplet, contact, saliva
6. Cytomegalo virus 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 are frequently seen in the clinics and 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

Based on the evidence, information and rules local to either the country or region, higher standards of Dental Infection Control and 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 infecting patients.

As of today, India has implemented requirements for dental safety. The Dental Council of India has published a book on Dental Safety and has implemented mandatory continuing education requirements of 2-4 hours of training in dental safety annually for all practicing dentists in order to keep their privilege

to practice and maintain licensure. The electronic version of this book can be downloaded at no charge at www.dental-safety.in.

Rationale

The rationale is to control iatrogenic, nosocomial infections and potential occupational exposure of care providers to disease causing microbes. The terms “disease control *or* infection control” do not mean total prevention of iatrogenic, nosocomial infections or occupational exposures to “blood and other potentially infectious material” (BOPIM). 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.¹⁹ Dental Healthcare

Table 2: Adaptation of Spaulding's classification

Category/level	Disease risks	Control methods	Materials/Devices
Critical	High	Sterilization by: <ul style="list-style-type: none"> – Autoclave – Chemiclave – Dry Heat – Immersion in full strength glutaraldehyde (8 hours for sterilization and rinsed with sterile water) or – Sterile single-use-disposables 	Items that are used in surgery, which pierce soft and hard tissue—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 (Fig. 1).
Semicritical	High	Sterilization by: <ul style="list-style-type: none"> – Autoclave – Chemiclave – Dry heat – Immersion in full strength glutaraldehyde (8 hours for sterilization and rinsed using sterile water) or – Sterile single-use-disposables – Clean but non-sterile single-use-disposables supplies 	Items that do not necessarily penetrate soft and hard tissues but which cross the vermilion border (lip) into the oral cavity—mouth mirrors, handpiece, anesthetic syringes, chip syringes, amalgam condensers, impression trays, air/water syringe tips, high-volume evacuator tips (Figs 2A and B).
Noncritical	Moderate to low	Surface disinfection with intermediate level hospital disinfectants: <ul style="list-style-type: none"> – Phenols – Iodophors – Quaternary ammonia compounds or – Disposable Barriers 	Items used in dentistry, which do not cross the vermilion 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 (Figs 3A and B).
Environmental	Low	Disinfection with intermediate to low level disinfectants: <ul style="list-style-type: none"> – Phenols – Iodophors – Quaternary ammonia compounds sanitization: <ul style="list-style-type: none"> – Scrub wash with soap and water 	Floors, walls and door handles that are not considered high-touch surfaces. General housekeeping rule applies to these surfaces (Fig. 4).

Workers and patients can further transmit the diseases to their respective families and friends. The common modes of disease transmission^{20,21} in the order of severity are:

1. Percutaneous (*high risk*)
Inoculation of microbes from blood and saliva transmitted through needles and sharps.
2. 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.
3. 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.
4. Indirect contact through fomites (*low risk*)
Touching contaminated inanimate surfaces in the dental treatment room or operatory.

The risks of disease transmission may vary depending upon host susceptibility, virulence and infectivity of the organism, the dose 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 these 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 semicritical instruments, and use of aseptic protocols during treatment broadly encompass the realm of Dental Infection Control.

Standard Precaution and Additional Precautions

Standard precautions are recommended by the centers for Disease control and prevention (CDC) for reducing the risk of transmission of blood-borne and other pathogens during provision of care. In dentistry, standard precautions and universal precautions mean the same. These precautions must be taken for all patients regardless of their diagnosis, reported medical history, presumed infection status or appearance. These precautions apply

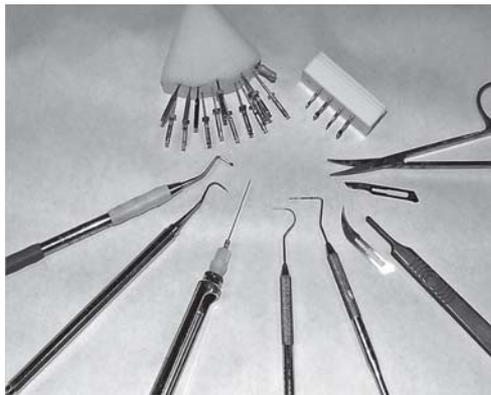


Fig. 1: Examples of critical category of devices that must be sterilized between patients or be sterile single-use-disposable items



Fig. 4: Examples of environmental surfaces category are floors, walls and other surfaces that are not normally touched during patient care, and may be cleaned or disinfected with a low-level disinfectant during routine housekeeping



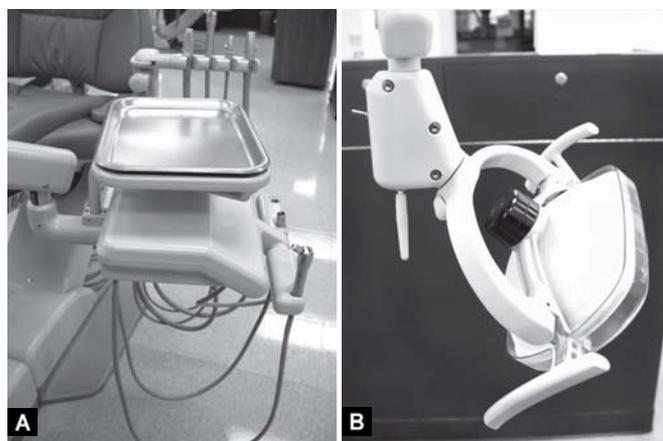
Figs 2A and B: Examples of semicritical category of devices that must be sterilized between patients, or be sterile single-use-disposable items including clean supplies

to mucous membranes, non-intact skin, blood, body fluids, including salivary secretions, other excretions and biopsy/tissue specimens (including extracted teeth). When anticipating exposure to these potential contaminants, the care provider must use adequate precautions, such as wearing personal protective equipment. For example, if we anticipate splash or spatter during oral prophylaxis or preparation of a cavity during caries excavation using a high-speed handpiece with a coolant (water spray), we must wear protective eyewear, facemask, gown and gloves. If we are only doing a suture removal, where there is no generation of splash and spatter, only the use of gloves may be appropriate. We must also clean surfaces (sanitize) and decontaminate (disinfect or sterilize) surfaces/equipment/instruments based on the potential for disease transmission. We must not base the level of precautions given the appearance or medical history of a patient but base the level of precautions on the procedure to be carried out during patient care.

Additional precautions are specific safeguards for documented or suspected cases infected with highly transmissible or epidemiologically important pathogens (such as TB, SARS, AH1N1 Influenza), where additional precautions above and beyond standard precautions are prescribed to control the epidemic or disease during dental care. Three types of transmission-based precautions are airborne precautions, droplet precautions, and contact precautions or combinations based on routes of transmission that need specific measures of control. For example, during the outbreaks of AH1N1 Influenza (Swine Flu), it may be appropriate to wear full PPE while treating most patients, washing hands more frequently and reducing physical contact with common surfaces and patients. Further, we need to call scheduled patients prior to their appointment and tell them not to come for elective dental care, if they have signs or symptoms of AH1N1 Influenza so as to avoid spreading it to other patients or employees in the clinics. We must also post information for patients on measures to be taken in controlling spread, such as seek medical care immediately, cover the cough with the sleeve of the shirt and reduce contact with others (isolation) till signs and symptoms of the condition have abated.

Spaulding's Classification

- The first level of decontamination is called *sanitization*, a process of thorough physical cleaning to reduce the quantity of microbes and bio burden (normally a solution containing a detergent is used). "Sanitization or thorough cleaning is



Figs 3A and B: Examples of noncritical category of device high-touch areas (constantly contaminated) not entering the patient's mouth that need to be decontaminated or barriered between patient. Barriers to be used can be disposable plastic covers, plastic cling-wrap or aluminum foil

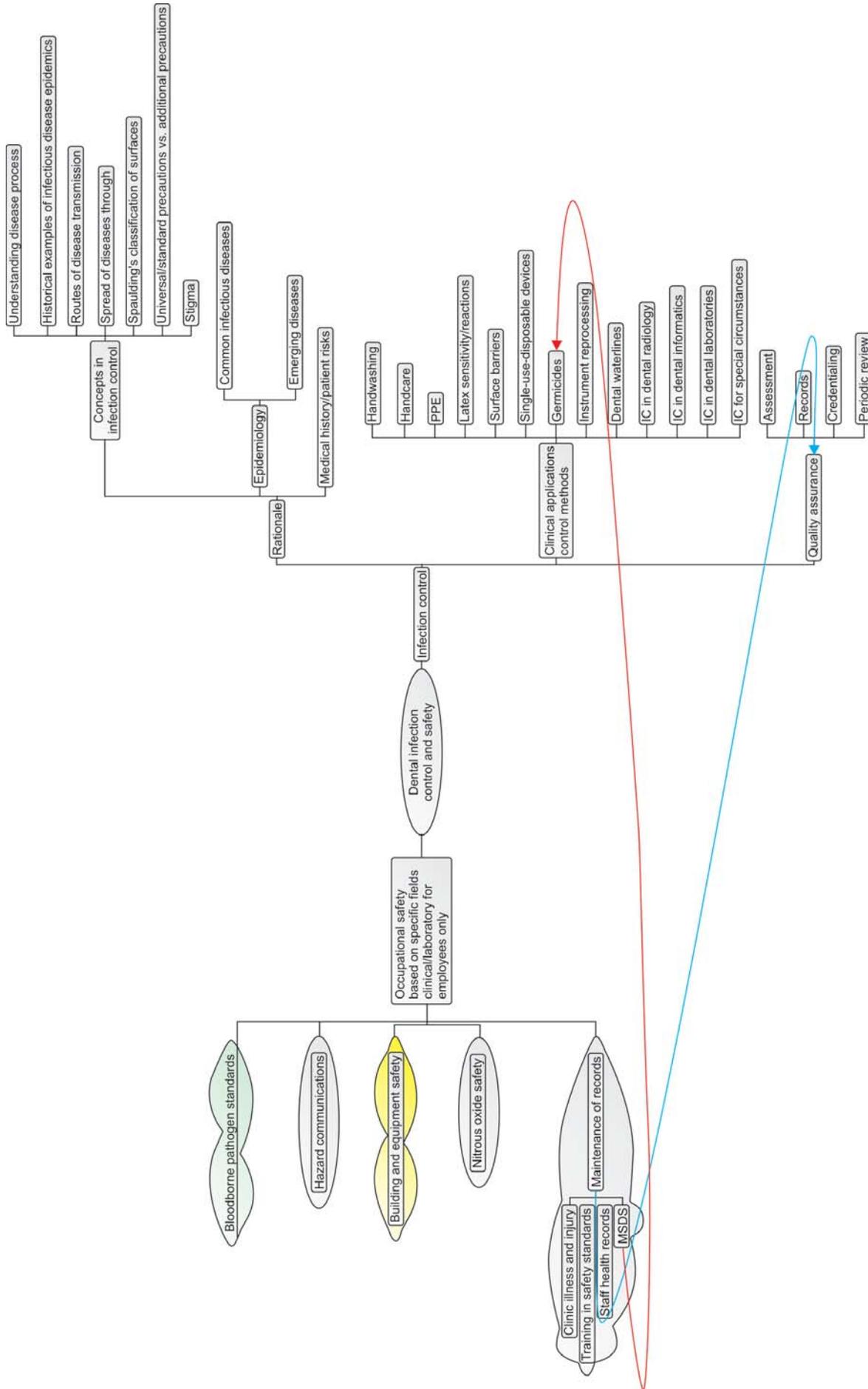


Fig. 5: Components of a dental safety program outlining the occupational safety components applicable to employee safety on the left and patient safety on the right

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 and Bond²² to include 4 categories (expansion to include environmental surfaces as a category). Table 2 is an explanation of this modified classification as applicable to dentistry. Instrument and operator surfaces can be classified as *critical*, *semicritical*, *non-critical*, and *environmental surfaces* based on potential for disease transmission. All materials being used 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.

Stigma, Discrimination and Precautions

Some infectious diseases have symptoms and signs, which are readily recognizable in a clinical situation, while other conditions are clinically unidentifiable without further laboratory tests. Therefore, it is recommended by the Centers for disease control and prevention that all patients be treated as potentially infectious. One should not discriminate the patient based on the 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 to 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.

Dental safety is made up of various components that address patient safety as well as employee safety (Fig. 5). Occupational safety applies to employees, where Bloodborne Pathogen Standards, Hazard Communication Standards, Building and Equipment Safety Standards and Nitrous Oxide Safety play an important role in protecting employees including the dentist against occupational hazards during provision of care. Infection control on the other hand addresses patient safety where the rationale for safety procedures, clinical application of safety measures and finally quality assurance of the patient safety program are integral components.

Note: This manuscript is an introductory article on Dental Safety. In the next few manuscripts within this journal, we intend to systematically address all components and explain, how each component contributes to Dental Safety.

REFERENCES

1. Centers for disease control and prevention. Guidelines for infection control in dental health-care settings 2003. MMWR 2003;52(No.RR-17):1-76.
2. Centers for disease control and prevention. Recommended infection-control practices for dentistry 1993. MMWR 1993;42(No. RR-8):1-20.
3. Kravitz AS, Treasure ET. The Dental Liaison Committee in the European Union, Manual of Dental Practice, May 2004;1-318.
4. Cottone JA, Puttaiah R. Viral hepatitis and hepatitis vaccines. In: Practical infection control in dentistry, 2nd Ed., edited by Cottone JA, Terezhalmay GT, Molinari JA Philadelphia: Williams and Wilkins 1995;15-47.
5. Cottone JA, Puttaiah R. Hepatitis B virus infection-current status in dentistry. Dental clinics of north America. Volume 40. Number 2 April 1996.
6. Ciesielski C, Marianos D, Ou D-Y, et al: Transmission of HIV in a dental practice. Ann Intern Med 1992; 116:798-805.
7. Centers for disease control: 101 healthcare workers may have HIV from on-the-job accidents. AIDS Weekly 1992; 09(November):12.
8. Trends in HIV/AIDS diagnoses—33 States, 2001 to 2004. MMWR November 18, 2005/54(45);1149-53.
9. Worldwide HIV and AIDS Statistics—Global Trends 2008. AVERT [AVERTing HIV and AIDS]. Web link: <http://www.avert.org/worldstats.htm>
10. Centers for disease control and prevention 1995. HIV/AIDS surveillance reports 7: 1-39.
11. Nelson KE, Suriyanon V, Taylor E, et al. 1994. The incidence of HIV-1 in village populations in Northern-Thailand. AIDS 1951-1955.
12. Country Statistics. UNAIDS Interactive Map: Towards Universal Access. http://www.unaids.org/en/KnowledgeCentre/HIVData/mapping_progress.asp.
13. Strategic health partnership initiative—Russian-American cooperation in HIV/AIDS capacity building. American International Health Alliance. Web Link: http://www.aiha.com/en/WhatWeDo/HIV-AIDS_RussiaSHPI.asp.
14. HIVDent Russia. Joint Project of Moscow State University and American International Health Alliance (Funded by USAID). Web link: <http://www.hivdent.ru/>.
15. ADA research institute department of toxicology: Infection hazards for both dental personnel and patients in the operatory. J Am Dent Assoc 1988; 117:374.
16. Runnells R. Infectious diseases important in dentistry. In: Cottone J, Terezhalmay G, Molinari J (eds). Practical infection control in dentistry. Philadelphia: Lea and Febiger 1991;1-17.
17. Puttaiah R and Cooley R. Infection control and personnel safety in periodontics. In: Wilson T, Kornman K (eds). Fundamentals of periodontics. Chicago: Quintessence Publishing C, Inc 1996;179-194.
18. Puttaiah R and Cooley R. Infection control and safety in orthodontics. In: Sachdeva R, Bartleon H-R, White L, Johnson J (eds). Orthodontics for the Next Millenium. Glendora: ORMCO 1997;519-40.
19. Miller C, Palenik C: Sterilization, disinfection, and asepsis in dentistry. In: Block S (ed). Disinfection, sterilization, and Preservation. Philadelphia: Lea and Febiger 1991;676-95.
20. Cottone J, Terezhalmay G, Molinari J. Rationale for practical infection control in dentistry. In: Cottone J, Terezhalmay G, Molinari J (eds). Practical infection control in dentistry. Philadelphia: Lea and Febiger 1991;71-79.
21. Miller C, Palenik C. Development of infectious diseases. In: Miller C, Palenik C (eds). Infection control and management of hazardous materials for the dental team. St. Louis: Mosby 1994:30-45.
22. Favero M, Bond W. Chemical disinfection of medical and surgical materials. In Block S (eds). Disinfection, Sterilization and preservation. Philadelphia: Lea and Febiger 1991;617-41.