

CROSS - INFECTION CONTROL IN DENTISTRY: A REVIEW

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ABSTRACT

The dental environment is associated with significant amount of risk for exposure to various micro-organisms. Infection control is one of the prime elements of a successful dental practice. There are many infectious diseases that can be transmitted in a dental environment. New diseases with serious consequences and a high rate of transmission have evolved in the recent past. Infection control is directed at prevention to exposure of such infections and also to prevent it being transferred from person to person. The universal infection control policy considers that 'Every patient should be considered Infectious'. This review article presents various aspects of cross-infection control in dental environment.

Key words: *Infection control, dental environment, precautions, prevention*

INTRODUCTION

Infection is a process of tissue invasion by microorganisms, characterized by multiplication of these microorganisms in the body of the host to produce disease.¹ Cross infection implies transmission of infection between patients as well as patients and health care professionals.² It has been defined as the transmission of infectious agents among patients and medical staff within clinical environment.³⁻⁴ New infectious diseases have been found at a rate of one disease per year over the past 22 years.⁵ Some of these diseases remain locally contained but others spread over large areas sometimes resulting in world-wide pandemics.⁶ Some of these diseases like Transmissible Spongiform Encephalopathy cannot be controlled with routine sterilization procedures.⁷

Infections can be classified either as:⁸⁻⁹

Community acquired infections; that may be present at the time of admission or visit to a hospital or incubating at that time.

Health-Care-Associated Infections previously known as Nosocomial Infections or Hospital-Acquired Infections; that could be induced from a source outside the patient's body (exogenous) or from within the patient's own body (autogenous) after a visit or admission to a hospital or health care centre.

DISCUSSION

The dental clinic environment has a significant amount of risk for exposure to various micro organisms.¹⁰ Many infectious agents may be present in blood or saliva as a consequence of bacteraemia or viremia associated with systemic infections.¹¹ Failure to comply with universal precautions and breach of protective barriers result in occupational exposure to infectious agents and transmission of infection from one patient to the other.¹²⁻¹⁵

Dentists and their supporting staff are constantly exposed to a variety of micro-organisms found in blood and saliva of their patients. There is a potential risk of these micro-organisms causing infections. During oral surgery, the epithelial barrier which protects the underlying tissues is broken, making tissues of the patient vulnerable to microbes from external environment. If operator's hands and instruments carry infected material, micro-organisms are liable to be deposited into the tissues.¹⁶ However, mere presence of the micro-organisms in the surgical field does not constitute sepsis.¹⁷ The manifestation of specific infections depends on reaction of defense mechanisms of host.¹⁸ Since all these factors vary with time, it is the clinician's duty to keep the source of infection under control.

Some Transmissible Infections in Dentistry

Herpes virus infections; like the herpetic whitlows; the infection of finger with Herpes Simplex Virus before

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the advent of latex gloves. Routine use of universal infection control precautions and avoidance of direct contact with the oral mucosa provides adequate protection against Herpes Simplex Virus.¹⁹

Viral Hepatitis (A, B, C, D and E); is highly transmissible, and among these, hepatitis B (HBV) and C (HCV) are more significant due to their higher morbidity and mortality.¹⁰⁻¹² The HBV and HCV are identified as occupational hazards for dental personnel.²⁰⁻²¹ The HBV is transmitted both per-cutaneously and non-percutaneously.¹³⁻¹⁴ Factors such as heat resistance, the capacity of producing asymptomatic carriers and a high concentration in blood and saliva make HBV a significant transmissible infection in dental office.¹⁴ Dental treatment includes usage of small and sharp instruments. Contaminated instruments pose a risk to the patients as well as the dental staff. Multiple opportunities exist for inadvertent per-cutaneous wounds to the operator or the staff or other patients.²² Allos & Schaffner¹⁰ and Redd et al¹⁴ and have reported cases where there has been a patient to patient transfer of HBV associated with oral surgical procedures. Non per-cutaneous transmission in the dental environment includes transfer of infectious bodily secretions such as saliva, blood and crevicular fluid. The mode of infection is primarily horizontal among staff and patients, predominantly from patient to care provider and is less likely form care provider to the patient.¹³ The dental practitioners are a group with one of the highest risk of exposures to HBV. Effective treatment is still not available for HBV, although interferon alfa-2b is effective in inducing a sustained loss of viral replication.¹⁴ The serious nature of this disease and the limited treatment options available necessitate that methods are devised for prevention of transmission of such an infection in dental offices.¹⁴⁻¹⁶

Acquired Immuno-deficiency syndrome (AIDS) is one of the most significant disease that has emerged in recent past. AIDS is caused by Human Immuno Virus (HIV) and has resulted in a considerable amount of morbidity and mortality worldwide. In dental offices, HIV can be transmitted by transfusions, needle stick injury or contact of mucous membrane with the blood or body fluids of a carrier.²³ Present evidence suggests that transmission of AIDS during routine dental procedures is probably very difficult.²⁴ The amount of HIV infected blood needed to transmit infection is far more than for HBV.²⁵ HIV is also considerably less stable in drying and other environmental inactivation processes, thus further reducing the risk for transmission except via direct inoculation of contaminated blood.²⁶ Although HIV may not be as transmissible as HBV, the serious nature of the disease demands that steps are taken

to prevent the spread of such an infection in dental office.²⁵⁻²⁷

Other viral diseases include Rubella, Rubeola, Mumps, Influenza, Variola and Enteric viral diseases. Most of these infections can occur by droplet infection of discharges from nose, throat and mouth. Recently there has been a scare about H5N1 (Avian) and H1N1 (Swine) Influenza. Transmission is thought to occur through, droplet exposure of mucosal surfaces by indirect contact usually via the hands, with respiratory secretions from an infectious patient or contaminated surface; and through inhalation of small particle aerosols in the vicinity of the infectious individual.²⁸ Some of these diseases have been prevented by vaccination but it is important to observe measures that reduce the chances of transmission in a dental office setting.²⁹ The Centre for Disease Control and Prevention (CDC) has recently published some new guidelines for prevention of these diseases in the dental settings.³⁰

Tuberculosis (TB) is a communicable disease caused by *Mycobacterium tuberculi* and transmitted from person to person almost exclusively by inhalation of droplets containing the organisms which have been expelled from the airway of an individual with active TB. These droplet nuclei can remain suspended in air for hours. In a dental care facility, the TB patient can spread infection to the other people while sneezing or coughing in waiting room although the risk is low.³¹

Candidosis; although transmission of *Candida albicans* fungus has not been documented yet during dental procedures, it must be considered a potential threat for health debilitated and susceptible individuals. Any septic procedure may lead to a supra-infection in an already immuno-compromised person.³²

Risk of Infection Categories

Risks of infection transmission in dental personnel depend upon their tasks and work areas. The risk categories are as follows;

Category I: Tasks that involve exposure to blood, body fluids or tissues as in procedures performed by dentists, dental nurses and assistants.

Category II: Tasks that do not involve routine exposure to blood, body fluids or tissues as in support staff who are involved in cleaning of clinic or laboratory personnel who are involved in the handling of instruments and impressions.

Category III: Tasks that will not involve exposure to blood, body fluids or tissues at all. For example, receptionist or clerical staff in dental office.

The American Dental Association (ADA) and Occupational Safety and Health Act (OSHA) guidelines advise that all dental office staff in category I and category II be trained in infection control to protect themselves and their patients.

Groups of Items Involved in Infection

Transmission

Critical: This category includes all items which may transmit the infected material into the blood stream and sterile areas of the tissues, for example injections, implants, surgical needles, surgical instruments and materials.

Semi-critical: This category may include items which come in contact with the epithelial surface but do not penetrate the epithelial barrier; such as, mouth mirrors, mouth props and suction tips.

Non-critical: This category includes items that do not come directly in contact with the surgical field but can play an important role in cross infection indirectly. For example; dental equipments, suction housings and lights. The operating environment can lead to accumulation of micro-organism on them and then may contribute as a source for transmitting the infected material. Contaminated waste can also be a source of cross infection.³³

Protection by Personal Barriers

Occupational Safety and Health Administration and Centres for Disease Control (CDC) supported by ADA and Office Sterilization and Asepsis Procedures Research Foundation (OSPA) have identified six basic areas for personal barrier protection:²⁹⁻³⁰

- Hand-washing and care
- Gloves
- Face masks
- Body gowns
- Protective eye wear
- Rubber dam

Most carriers of latent infections may be unaware of their condition; the sub-clinical nature of many diseases, the prodromal period and the carrier state can all be asymptomatic. Therefore, same cross infection control routine should be adopted for all the patients. The universal infection control policy states that "**Every patient should be considered infectious**".³⁴⁻³⁵

The universal infection control rules encompass six elements

Routine patient evaluation

Personal protection with barrier techniques

Instrument sterilization

Surface and equipment disinfection

Asepsis in the laboratory

Appropriate disposal of contaminated waste including sharps

The OSHA (Occupational Safety and Health Administration) in USA has summarized the following regulations for infection control in a dental practice.

Immunization to the employees within 10 days of employment especially Hepatitis B vaccination.

Universal precautions must be observed to prevent contact with blood and other potentially infectious materials. Saliva is considered to be a blood contaminated body fluid in relation to dental treatment.

Implementation of engineering controls to reduce production of contaminated spatter, mists and aerosols.

Work practice control precautions to minimize splashing, spatter or contact of bare hands with contaminated surfaces.

Provision of facilities and instructions for washing hands after removing gloves and for washing skin immediately or as soon as feasible after contact with blood or potentially infectious materials.

Safe handling of needles and other sharp instruments.

Encouragement of use of disposable or single use needles, wires, carpules and sharps as close to the place of use as possible. These must be disposed as soon as feasible in hard walled leak proof containers that are closable. The containers must bear a biohazard label. Teeth must be discarded into sharps containers.

Contaminated reusable sharp instruments must not be stored or processed in a manner that requires the employees to use their hands.

Prohibit eating, drinking, storage of food and handling contact lenses etc. in contaminated environments.

Provision of personal protective items (like gloves, gowns etc) for staff including instructions for its usage. The staff should correctly use and discard or reuse the personal protective items.

Soon after treatment, the house keeping requirements should be attended to, like the cleaning of floors and sinks that may be subjected to contamination.

Provision of written schedule for cleaning must be made.

Provision of laundering of protective garments used for universal precautions by the staff

Pragmatic Preventive Measures in Daily Dental Practice

Design of the Clinic

The very basic concept of prevention of infection starts with cleanliness and the design of a clinic. The clinic should be designed to aid cross ventilation. Well organized surgery layout can reduce contamination and facilitate easier cleaning methods. The waiting room and the operatory should have smooth floors and without too many corners to aid easy cleaning. The work tops, spittoons and wash basins should have smooth surfaces. A freer space will aid in more hygienic clinic. The clinic should be equipped with facilities like wash basins. It may be a good practice to use a zoning system for working areas. The need and time spent on disinfection is cut down by reducing the number of contaminated areas. The operator should avoid coming in contact with various things in the dental office like radiographs, patient's notes, telephones and light switches during an operative procedure. An impervious paper or film (Cling film) can be used which avoids excessive cleaning and saves time.

Concept of Asepsis and Infection Control

Asepsis deals with the elimination of the micro-organisms to keep the possibility of infection under control. This concept contains three elements; disinfection, decontamination and sterilization. The disinfection refers to relative accomplishment of destruction of micro-organisms whereby their growth is prevented. It may be achieved by the application of an agent on inanimate objects used during surgical procedures. Disinfection of the operatory, for example, can be carried out by wiping the floor with disinfectant solutions or spraying of disinfectant sprays like ethylene oxide. Decontamination is achieved by mechanical cleaning of equipments and the office environment. The air syringes, water syringes, lamps and buttons attached to the dental chair, spittoon and the sinks must all be decontaminated before disinfection. However, it is important that the disinfectant and decontamination procedures ensure asepsis without altering or interfering with the working efficiency of instruments and equipment. Routine and standard proce-

dures for sterilization need to be followed that include autoclaving reusable instruments in sterilization packs that indicate the completion of sterilization process. Different manufacturers provide different autoclaves; manufacturer's instructions need to be followed and a regular audit should be performed to ensure proper sterilization process is followed in accordance to the standards set by CDC.³⁶

Education and Training

Personnel are more likely to comply with an infection-control program and exposure-control plan if they understand its rationale. Clearly written policies, procedures and guidelines can help ensure consistency, efficiency, and effective coordination of activities. Personnel subject to occupational exposure should receive infection-control training on initial assignment, when new tasks or procedures affect their occupational exposure. Education and training should be appropriate to the specific duties of Dental Health Care Personnel (DHCP), like techniques to prevent cross-contamination or instrument sterilization. For DHCP who perform tasks or procedures likely to result in occupational exposure to infectious agents, training should include; 1) a description of their exposure risks; 2) review of prevention strategies and infection-control policies and procedures; 3) discussion regarding how to manage work-related illness and injuries, including Post Exposure Prophylaxis; and 4) review of work restrictions for the exposure or infection. Inclusion of DHCP with minimal exposure risks (e.g., administrative employees) in education and training programs might enhance facility-wide understanding of infection-control principles and the importance of the program. Educational materials should be appropriate in content and vocabulary for each person's educational level, literacy, and language, as well as be consistent with existing federal, state, and local regulations.

Immunization and Personal Protection

Immunization of the personnel can aid in protection against certain diseases, however, it is more important to prevent the contact to these diseases at first place. Most dentists and the dental staff get immunization against hepatitis B which is a very contagious disease. The dental staff or the dentist may be one of the most 'at risk person' to such an infection. Some other conditions like HIV have no immunization protection and hence it becomes more imperative to exercise personal protection by barrier techniques like using gowns, gloves, face masks, eye wear and rubber dam.

Use of Disposables

For safe practice, the importance of increasing orientation to disposable materials must be considered. More and more materials are now being supplied as single use disposables which reduce the chance of infection from patient to patient. These materials include syringes, suturing material, needles, anesthetic carpules, rinsing cups, paper napkins, restorative materials like amalgam and Glass Ionomer capsules and items used as personal barrier protection. Disposable items provide the simplest means of infection control though it has a disadvantage of not being economical and may cause problems of disposal or environmental pollution. The use of such material becomes more prudent in wake of the less understood diseases like the Creutzfeldt-Jakob Disease (CJD) or Mad Cow Disease.³⁷ Even though the risk of transmission of CJD via dental treatment is low yet it poses a significant risk with severe consequences.³⁸

Decontamination of Reusable Instruments

Proper decontamination of used instruments is an insurance against cross infection. Particularly, the critical instruments which are used in surgical fields need to be decontaminated from saliva and blood. Blood and saliva form the main contaminants. All the instruments must be thoroughly washed before sterilization and all blood stains and debris removed. Some suppliers provide anti-rust sprays for instruments prior to sterilization. Mechanical dislodgment by effective cleaning continues to be the primary means of eliminating the viable micro-organisms and other organic contaminants accumulated on the surface of the instruments and the operatory environment. Instruments with smooth, non porous, cleansable surfaces are more readily decontaminated as compared to instruments where the surfaces are rough and porous. Saliva, blood and other organic material may prevent the penetration of the cleansing agents. Such instruments may need rigorous cleansing or soaking for a longer time. It is thus important that proper disinfection be done prior to sterilization and after thorough decontamination, especially with instruments like forceps, elevators and currettes.

Sterilization

The most effective procedure in infection control is sterilization of instruments. It is an absolute term that denotes total destruction of all the living organisms including spores and viruses. It renders the surgical instruments inert by destroying all the pathogens. If any item is sterilizable then sterilization should always be preferred over disinfection which is an intermediate method used to reduce the number of pathogens through chemical germicides. Any instruments that penetrate

tissue, critical instruments, must be completely sterilized or should be new, unused and packed.

There are various methods of sterilization available. Broadly, sterilization may be by dry heat or moist heat. Moist heat is more effective against organism especially spores. Dry heat may be used for instruments which are semi-critical or some instruments that may get rusted or become blunt with moist heat like scissors etc. Usually moist heat is the best effective among various procedures used for sterilization. Autoclave or steam under pressure is a widely accepted method for sterilization. It is an efficient, reliable and rapid method of sterilization where instruments are heated to 121°C temperature under 15 lbs pressure for 15 minutes. Different variations of this procedure, like use of packaging to prevent wetting of instrument, chemicals such as formaldehyde and different time and temperature cycles like flush sterilization at 134 °C for 3 minutes, can also be used. There is a marking on the sterilization packs indicating completion of the cycle. For monitoring and evaluation certain spore strips can be employed along with the instruments to be autoclaved and then sent for bacterial and viral incubation, an absence of growth validates the process. The sterilization process should be monitored and evaluated once a week using the resources at disposal. Manufacturers now provide specialized autoclaves for oil functioning instruments like hand pieces and pliers. These autoclaves clean and oil the instruments prior to a 134°C temperature followed by the drying of the instruments. Other variations of sterilization include immersion of instruments in Cidex (2% Gluteraldehyde solution). After proper sterilization the instruments must be appropriately stored so that the sterilization is maintained prior to usage.

Waste Disposal

Proper disposal of hazardous and non hazardous biological and non biological waste is an important step in prevention of cross infection. Infected blood and other liquid clinical waste can generally be poured down a sanitary sewer or drain. At the end of each session the suction unit should be flushed out using a recommended solution. Heavy duty protective gloves should be used to avoid contact. The drain should be regularly flushed and cleaned so that there is no clogging or retraction of any infected material. The water retraction valves within dental units may aspirate infective material back into the tubing, so water from hand pieces and syringes should be discarded for about 20 seconds into the sink at the end of each patient for operative procedures.¹⁷ Overnight accumulation is reduced by discharging water from the hand pieces for about 3 minutes.

The used materials include disposables items, dental materials, radiographic and organic waste. These are categorized as biological waste and non-biological waste and each of these can be hazardous or non-hazardous. There is a provision of special containers which have markings on them. All the waste should be discarded in the appropriate containers according to their categorization. The sharps' container is used for the disposal of sharp instruments like syringe needles, suturing needles, scalpel blades, injection ampoules and discarded root canal instruments. This sharps box has a small lid through which the sharp items should be dropped in. Recapping of needles and other items should be avoided to prevent needle stick injuries. The used caps of such items should be separately discarded in a non-biological non-hazardous container. The extracted teeth may also be discarded in the sharps' container. When the containers are three fourths full they should be labeled, closed and disposed according to the local waste disposal method. Organic waste such as tissue remnants, blood soaked cotton & gauze and other pathological waste must be discarded into the biological hazardous waste container.^{27, 33} For other items like used gloves, masks, filling materials and certain chemicals a separate container may be used. Mercury and certain other chemicals should be discarded separately.³⁹

Aseptic Surgical Techniques and Post-operative Care

Regular update with recent advancements and techniques helps in reducing chances of infection. Aseptic surgical techniques and proper post-operative care ensures fewer chances of infection and thereby controlling cross infection. For example sterile gauze can be provided for patients after extractions.

Challenges in Implementation of Cross Infection Policies

Cost: The entire ideal requisites for complete control of cross infection policy may not always be available due to the high cost implications. The use of disposable items will be more expensive than the reusable ones. Specialized equipments, for example autoclave for hand pieces, may be more expensive than the conventional ones.

Time: It is an important factor and may act as a constraint for implementation of proper methods. The dentist may fall short of time to monitor whether appropriate practices are being followed by the dental staff.

Workload: This may hinder implementation of an ideal policy. The overload of patients may not permit the

infection control measures to be taken perfectly. This will also increase the chances of infection and cross infection.

Manpower and Resources: The control of cross infection needs appropriate personnel and resources for its implementation. Appropriate manpower is needed for maintenance of infection control. For example there should be people available for cleaning, maintenance, sterilization and disposal of waste. Incinerators are needed at least once a week for incineration.

Compliance: In spite of all the facilities available and a local policy or infection control schedule present, the dentist or the associated dental staff may not show full compliance. Many factors can affect the compliance of the dentist and the dental staff.⁴⁰⁻⁴³ The dentist or the dental staff may be complacent about the nature of the situation. They may not perceive the potential danger especially from patients who are carriers with no active disease or symptoms. The sub-clinical nature of some diseases or conditions may deceive the dental staff. In some cases the dental staff unknowingly may become the carriers of disease and a source of infection. Some policies may be complex and be practically impossible to implement. For an effective policy, routines should be carefully taught to the whole dental team and subsequently audited. New staff should receive training as soon as possible. Regular monitoring and evaluation of the policy will ensure better implementation. New machines should be accompanied with training and education.

Summary

Most steps in infection control routine are directed at prevention of contact with infectious agent. Personal protection barriers are of great significance in this process. Various methods like sterilization, decontamination and disinfection are indispensable. The WHO and CDC have issued certain guidelines regarding prevention and dealing with certain infective conditions. Dentists need to update themselves about these guidelines, to be able to administer these policies effectively.

Use of disposable items may be expensive but is an effective and simple means of infection control. More and more disposable items are being inducted into dental practices especially critical items like needles, syringe etc. With careful evaluation and analysis, infection control routine can be employed in daily practice with the resources available. Constant monitoring and evaluation of infection control routines is required for good effectiveness.

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