INFECTION CONTROL TECHNIQUES USED IN SOUTH AFRICAN DENTAL PRACTICES

by

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DECLARATION

I, Jeanné Oosthuysen identity number [redacted] and student number [redacted] do hereby declare that this dissertation, submitted to the Technikon Free State for the degree of MAGISTER TECHNOLOGIAE: BIOMEDICAL TECHNOLOGY, is my own independent work; and complies with the Code of Academic Integrity, as well as other relevant policies, procedures, rules and regulations of the Technikon Free State; and has not previously been submitted to any institution by myself or any other person in fulfilment or partial fulfilment of the requirements for the attainment of any qualification.

JEANNÉ OOSTHUYSEN

2003-03-28

DATE

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SUMMARY

In dentistry, blood borne microorganisms, including hepatitis B virus and human immunodeficiency virus (HIV), pose a risk for occupational exposure among oral health care workers. Impressive technological advances enable dental practitioners to use valid, practical, measurable and sustainable infection control practices. The unique nature of dental procedures and settings, requires specific and unique preventative strategies to minimise disease transmission. Since 1993 it has been recommended that South African dentists adhere to the recommendations for infection control of the Centers for Disease Control and Prevention. The main objective of this study was to examine the adherence to infection control recommendations in dental practices in South Africa, with specific attention paid to practices associated with the use of a steam autoclave steriliser. All dental practitioners registered with the Health Professions Council of South Africa were included in this study. Practitioners with foreign addresses were not included. A postal questionnaire was used for collecting data. 738 respondents returned completed questionnaires. 87% of respondents indicated that they treat each patient as a possible source of infection. Many respondents (53%) admitted that their preferred method of sterilising handpieces is wiping/soaking in liquid chemicals. Only 17% of the respondents indicated that they autoclave handpieces after each patient. These results indicate a serious need for South African infection control guidelines and audit recommendations specific to dental practices in order to promote a safer dental environment for the health care worker and patient.

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OPSOMMING

In tandheelkunde hou bloedoordraagbare mikroorganismes, insluitende hepatitis B virus en menslike immuniteitsgebrekvirus (MIV) 'n gevaar in vir beroepsblootstelling onder mondgesondheidswerkers. Indrukwekkende tegnologiese ontwikkelings stel tandheelkundige praktisyns in staat om geldige, praktiese, meetbare en volhoubare infeksiebeheermaatreëls te kan toepas. Die unieke aard van tandheelkundige prosedures en opset, vereis spesifieke en unieke voorkomende strategieë om oordrag van siekte te beperk. Sedert 1993 word daar aanbeveel dat Suid-Afrikaanse tandartse die aanbevelings vir infeksiebeheer van die "Centers for Disease Control and Prevention" moet aanhang. Die hoofdoel van hierdie studie was om die aanhang van hierdie infeksiebeheermaatreëls in tandheelkundige praktyke in Suid-Afrika te ondersoek, met spesifieke aandag aan praktyke wat 'n stoomoutoklaafsteriliseerder gebruik. Alle tandheelkundige praktisyns geregistreer by die Gesondheidsberoepe Raad van Suid-Afrika was ingesluit by hierdie studie. Praktisyns met buitelandse adresse is nie ingesluit nie. 'n Vraelys per pos is gebruik vir die versameling van data. 738 respondente het voltooide vraelyste teruggestuur. 87% van respondente het aangedui hulle behandel elke pasiënt as 'n moontlike bron van infeksie. Verskeie respondente (53%) erken dat hulle gekose metode van sterilisasie van handstukke afvee/week in vloeibare chemikalieë is. Slegs 17% van die respondente het aangedui dat hulle handstukke na elke pasiënt outoklaaf. Hierdie resultate dui 'n ernstige behoefte aan vir Suid-Afrikaanse infeksiebeheermaatreëls en kontrole-aanbevelings spesifiek vir die tandheelkundige praktyk, ten einde 'n veiliger tandheelkundige omgewing vir die gesondheidswerker en die pasiënt te bevorder.

LIST OF ABBREVIATIONS

ADA:	American Dental Association
AIDS:	Acquired Immune Deficiency Syndrome
ASSA:	Actuarial Society of South Africa
BHF:	Board of Health Care Funders
CDA:	Canadian Dental Association
CDC:	Centers for Disease Control and Prevention
COHSASA:	Council of Health Services Accreditation of South Africa
CPD:	Continuous Professional Development
CSSD:	Central Services and Sterilisation Department
EPA:	Environmental Protection Agency
FDI:	Fédération Dentaire Internationale
HBV:	Hepatitis B Virus
HCV:	Hepatitis C Virus
HIV:	Human Immunodeficiency Virus
HSV	Herpes Simplex Virus
HSV1:	Herpes Simplex Virus Type 1
HSV2:	Herpes Simplex Virus Type 2
NICD:	National Institute of Communicable Disease
ODA:	Ontario Dental Association
OHCW:	Oral health care worker
OMFS:	Oral Maxillofacial Surgeon
OSAP:	Office Sterilization Asepsis Procedures
OSHA:	Occupational Safety and Health Administration
PPE:	Personal Protective Equipment
RCDS:	Royal College of Dental Surgeons
SADA:	South African Dental Association
TB:	Tuberculosis
TBSYS:	National Tuberculosis Register System
WHO:	World Health Organization

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CHAPTER 1

INTRODUCTION

1.1 Title

Infection control techniques used in South African dental practices.

1.2 Background

Most countries have standards, guidelines, regulations or recommendations regarding infection control in dental practices. In South Africa one applicable law is the Occupational Health and Safety Act, Act 85 (Republic of South Africa, 1993), which relatively few dental professionals are aware of; they are also unaware of the implications it holds for them. According to the Act both the employer and employee have a shared responsibility "to provide for the health and safety of persons at work and for the health and safety of persons in connection with the use of plant and machinery; the protection of persons at work against hazards to health and safety arising out of or in connection with the activities of persons at work...". The Act therefore provides for the protection of staff members, and, by indirect implication, of patients.

In 2001 new regulations regarding hazardous biological materials (Republic of South Africa, 2001) were published in South Africa. Dental practitioners should make a clear distinction between general domestic waste and that generated as medical waste in their practices. The "cradle to grave" principle is accepted

whereby the generator of the waste remains responsible for personal injury or damage to the environment as a result of negligence regarding such waste. This regulation requires control of exposure from every employer, ensuring that exposure in the working environment is prevented or controlled. Furthermore, standard precautions must be explained to reduce the risk of exposure and appropriate measures should be taken to control exposure. Appropriate work procedures must be followed and such procedures must be in writing.

Dental operators and patients are constantly exposed to contact with traumatised tissue, saliva and blood, thus increasing the risk associated with the high levels of contamination. It has been estimated that one drop of saliva may contain up to 600 000 bacteria (Harfst, 1991). No other profession is exposed to such a high risk of contamination.

1.3 Motivation for this study

The Occupational Safety and Health Administration (OSHA) and the American Dental Association (ADA) support the recommendations (Addendum A) made by the Centers for Disease Control and Prevention (CDC) on dental instrument sterilisation (Miller, 1991). The first set of complete infection control recommendations directed specifically towards dentistry was issued in 1986, with an update in 1993. The most recent recommendations from the ADA were published in 1996 (Miller and Palenik, 1998). Since 1993 it has been recommended that South African dentists adhere strictly to the United States' recommendations (Marianos, 1993). In April 2002 the Department of Health

published the *National norms, standards and practice guidelines for primary oral health care* (Addendum B). Practice guidelines include infection control guidelines for primary oral health care to be applied during clinical procedures (Department of Health, 2002).

It is not only regulatory bodies that play an integral part in infection control. Patients are becoming more aware of and more informed about infectious diseases and because of this, they are much more sophisticated in their scrutiny of the approach to infection control of medical and dental professionals. More intense media coverage of exposure incidents, infectious diseases in general, and herpes, hepatitis and human immunodeficiency virus (HIV) infections in particular, dictate that today's dental practices be obligated to use effective infection control techniques. Besides this, one malpractice settlement could be far more expensive than the lifetime cost of effective infection control (Terezhalmy and Gitto, 1998).

To provide the highest level of patient protection in dental practices, reusable instruments and handpieces must be sterilised (rather than disinfected) after use on every patient. It is impossible to monitor each instrument for sterility, and therefore the reliability of the sterilisation process performed is of the utmost importance. Many authorities have recommended the steam autoclave as the method of choice for sterilisation in dental practices (Burke *et al.*, 1998).

The protection and care of our dental patients and personnel are paramount, particularly against the background of the acquired immune deficiency syndrome

(AIDS) epidemic in South Africa. International health and safety recommendations have to be adapted to the particularly South African environment, especially taking AIDS, viral hepatitis and tuberculosis (TB) into consideration. Good infection control practice in dentistry is based on the assumption that every patient is potentially infected with an incurable disease and that standard precautions must be applied uniformly. It is therefore important that a single infection control protocol be implemented in order to ensure that infection control occurs as a routine component of every dental practice in South Africa, using standard precautions. Hopefully this study will supply enough information regarding current infection control practices in dental surgeries in South Africa in order to motivate the development of such a protocol. It may lead to a greater awareness of the importance of cross-infection control procedures, education and training and the need for the implementation of the newly published South African guidelines at the soonest possible opportunity.

1.4 Objectives

This study describes the current state of affairs of infection control in dental practices in South Africa. The primary objective of this study was to examine the hypothesis that adherence to infection control recommendations in dental practices in South Africa remains low, notwithstanding the ever-increasing HIV pandemic. In order to fulfil the primary objective, the following secondary objectives became imperative:

- ❖ the development of a reliable questionnaire suitable for obtaining information regarding quality control practices of infection control in South African dentistry;
- ❖ the determination of the methods of sterilisation used in dental practices in South Africa;
- ❖ the determination of the types of autoclaves used in South African dental practices as a method of sterilisation; and
- ❖ the determination of how autoclave sterilisation cycles are monitored, if at all.

1.5 Attitude of the researcher

Zag Ziglar once said: "People don't care how much you know until they know how much you care – about them" (Jameson, 1994).

Communication to patients about the importance of infection control and the practice's commitment to the delivery of quality health care is the cornerstone of the success of each dental practice. Furthermore, communication is fundamental to the forming of good and trusting relationships with patients. Each and every patient must be aware that all patients are treated in exactly the same way and that a simple and effective infection control protocol is used to guarantee the safety of all patients.

CHAPTER 2

REVIEW OF THE LITERATURE

2.1 Introduction

2.1.1 A historical background of infection control

In Chapter 1 it was outlined why the protection and care of patients are paramount. To put this into better perspective, it is important to review the history and background of infection control and sterilisation.

Antony van Leeuwenhoek first used his microscope to observe "animalcules" in saliva, tooth scrapings and gutter water (bacteria, yeasts, and protozoa) in 1667. At this stage the relationship between microbes and disease had not been defined. It was only during the "Golden Age of Microbiology" (mid- to late 1800s) when the relationship between these "little animals" and disease was established by researchers like Louis Pasteur (France), Robert Koch (Germany) and Lord John Lister (England). In the USA, Willoby D. Miller became known as the "Father of Oral Microbiology". By the 1900s bacteria had been described as the cause of numerous diseases including dental caries (Miller and Palenik, 1998).

The prevention of disease through the use of *Infection Control Procedures* was also brought about in this *Golden Age of Microbiology*. Furthermore, Ignaz Semmelweis (Vienna) and Oliver Wendell Holmes (USA) provided evidence that purple fever was a contagious disease and they both outlined measures that had

to be taken to minimise the spread of illness. They were the first to recognise the importance of a procedure like hand washing in preventing the spreading of disease. Louis Pasteur and John Tindall discovered that heat destroys bacteria and resistant bacterial spores. Their technique of using boiling water to kill bacteria (called pasteurisation) is still in use today. A surgeon, Lord Lister, further reduced post-operative infections by the use of phenols. At that time his proposal to spray the air around his patients before surgery was considered as bold and outrageous. However so, it actually paved the way for sterile and aseptic techniques as practised worldwide today (Miller and Palenik, 1998).

With the introduction of the electric dental engine in the 1920s it was discovered that dental personnel were more exposed to aerosol contamination than with the previous foot-driven engines. A report in 1931 revealed that dental health care workers were more prone to airborne infections than workers in any other profession (Registrar-General of Great Britain, 1931). In 1951 the introduction of the high-speed turbine machine and ultrasonic cleaner further increased the bacteria-laden aerosol contamination in dental practices. It was only towards the early 1970s that the potential risks for cross-infection in dental surgeries became evident (Cottone, Terezhalmy and Molinari, 1996).

In the 1980s the HIV, responsible for AIDS, was discovered. Although vaccines are available for many diseases, to date there is no curative treatment, and no vaccines available for this virus (Lee and Bishop, 1997). New and better infection control procedures emerged from the late 1980s up to 1992, owing to a better understanding of the process of transmission of HIV. At that time, especially

authorities like the OSHA and the ADA increasingly urged dental practitioners to improve their infection control practices (Hazelkorn, Bloom and Jovanovic, 1996).

Burke and Wilson (1989) mentioned the fact that blood may be harboured beneath fingernails for up to five days. This finding implies that hands could be a major source of infection from the oral health care worker to the patient and vice versa. Therefore, the use of gloves, together with the correct sterilisation procedures, forms an essential part of infection control. Halsted (1894) introduced the use of gloves by surgeons at the Johns Hopkins Hospital, Baltimore USA. In 1897 another surgeon, Zoege von Manteuffel, was probably the first to realise that gloves had a second function, namely to protect the operator against infections carried by patients (Randers-Pehrson, 1930). At around the same time another advocate of gloves, Von Mikulicz, was possibly the first surgeon to wear a mask while operating. There were many refinements to these gloves, one of the major ones being the introduction of latex in 1951. The use of gloves in the dental surgery was discussed in 1974 (Randers-Pehrson, 1930). Burke and Wilson (1989) state "...failure to keep gloves on throughout all procedures and to omit to use fresh gloves for each patient receiving active treatment will increasingly be considered as unacceptable."

2.2 Standard of care for the dental patient

2.2.1 Synopsis

In dentistry occupational hazards are most commonly associated with physical, chemical and biological agents. Blood borne viruses, notably hepatitis B virus (HBV) and HIV, pose a risk for occupational exposure among oral health care workers in South Africa (Webber, 2000). The following case study may serve as a good example of the importance of practising good infection control:

The South African Dental Association published the Fédération Dentaire Internationale (FDI) report *The HIV-AIDS pandemic and dentistry* in their journal (FDI, 1997), stating that "HIV/AIDS patients should be treated like all other patients – with compassion and dignity." The ever-growing presence of HIV necessitates the dental care provider to be involved in, and be knowledgeable about, HIV/AIDS as it relates to the provision of dental care.

If recommended infection control procedures are routinely followed, there is little risk of transmission through dental treatment. The use of standard precautions is well defined and recommended when treating any patient. Based on this, the use of extra or additional precautions can be viewed as discriminatory. Although post-exposure prophylaxis can be prescribed after exposure to the HBV or HIV, standard precautions and strategies must be implemented in order to protect the oral health care professional (Webber, 2000).

2.2.2 The risks

Routinely, dental health providers are at risk of cross-contamination (the transfer of microbes from one person to another) and cross-infection (the actual occurrence of infection following cross-contamination). One of the biggest gaps in our knowledge about infection control is knowing the risk of acquiring an infectious disease in any given situation. If such risks are known, this will assist in justifying the importance of, or need for a particular infection control procedure. The bottom line is that we do not always know when we may be exposed to potentially pathogenic microbes (Petty, 2000).

In Petty's (2000) opinion, Canadian dentists performing dentistry while practising proper infection control according to authorities like the Canadian Dental Association (CDA), the Ontario Dental Association (ODA), the Royal College of Dental Surgeons of Ontario (RCDS), the ADA, the CDC, the Office Sterilization Asepsis Procedures and Research Foundation (OSAP) and the OSHA, or whatever authority they ascribe to, have complicated their practices and their lives. Including standard precautions, there is more than enough evidence for strict infection control and some of the reasons are, amongst others, the following:

- ❖ we KNOW that many viruses are not as easy to inactivate as we once thought (Sattar and Springthorpe, 1991);
- ❖ we KNOW that live blood cells, bacterial and viral particles can survive inside handpieces even after thorough disinfection (Lewis *et al.*, 1992);

- we KNOW that handpieces traumatically inoculate material into tissue (Lewis, 1991);
- we KNOW that dental unit waterlines and evacuation system lines are grossly contaminated (Williams *et al.*, 1993);
- we KNOW that our patients can easily suck back bacteria from saliva ejectors (Watson and Whitehouse, 1993);
- we KNOW that cross-contamination of X-ray films can occur in the processor (Stanczyk *et al.*, 1993);
- we KNOW that toothbrushes and dentures can transmit disease (Glass, 1992);
- we KNOW that no disease reporting system exists that is capable of detecting low frequency cross-infection (Dunn, 1977); and
- we KNOW that infectious patients lie to us about their infections (Perry *et al.*, 1993).

2.2.2.1 Hepatitis B virus infection

All intraoral surgery and many dental procedures cause breaks in the mucosa of the oral cavity or gingival tissues that may result in bleeding. Therefore, the risk of transmission of hepatitis B from the patient to the dental operator is substantial (Hu, Kane and Heymann, 1991). It is generally accepted that the dental health team is far more at risk from the HBV than from HIV that causes AIDS. They are also at greater risk of acquiring hepatitis B through contact with patients than the general population are (ADA, 1996). HBV may be transmitted both from patients to dentists and oral surgeons, as well as from oral surgeons and dentists to

patients (Siew *et al.*, 1987; Ahtone and Goodman, 1983; Mast and Alter, 1993; West, 1984).

In the past, several HBV infections have been reported among patients who have undergone surgery by oral surgeons. In each instance in which the surgeon was chronically infected with HBV, he/she had not routinely worn gloves (Hu, Kane and Heymann, 1991; Ahtone and Goodman, 1983).

Published reports from 1970 through 1987 indicated nine clusters where patients were infected with HBV associated with treatment by an infected dental health care worker (CDC, 1993). Since then no further reports of transmission of HBV from dentists to patients have been published. This coincides with the time when infection control and universal/standard precautions in dentistry were re-emphasised as a result of the discovery of AIDS and higher levels of immunity due to the use of hepatitis B vaccine (CDC, 1993).

It has been recommended that all dental health care workers (both employers and employees) who might be exposed to blood or blood contaminated substances, be vaccinated against HBV (CDC, 1993). It is estimated that approximately 5% of the general public in the United States of America is infected with HBV. Unvaccinated members of the dental team are at least two to five times more likely to become infected than the general population are (Miller and Palenik, 1998).

In South Africa the prevalence rate for HBV is high. Many acquire the infection at an early age and the HBV carrier rate has been estimated at 10% to 15% for rural populations and at 1% to 10% for urban populations (Jentsch, 1997). Yengopal, Naidoo and Chikte (2001) reported that over 88% of dentists in their study were immunised against Hepatitis B as opposed to recent studies in literature reporting rates of 46% to 93%. In contrast only 38.8% of other staff members were immunised. Taking into consideration that 84.1% of dentists in their survey used the two-handed technique to re-cap needles, it is somewhat of a relief to note that only 13.8% of them had experienced needlestick injury in the six months since being surveyed. However, two-thirds of these dentists did not follow any specific protocol following their injury (Webber, 2000).

2.2.2.2 Other Hepatitis virus infections

The risk to a health care worker sustaining a sharps injury from a hepatitis C infected patient varies from 0% to 10% (Alter, 1993). Although this figure is much lower than the 25% to 30% for the HBV (Naidoo, 2001), it must be remembered that the health care worker can be immunised against HBV but not against HCV. In the United States, injecting drug abusers accounts for one half of newly infected hepatitis C virus (HCV) patients (Marwick, 1997). If sterilisation and decontamination procedures in the dental surgery are inadequate, transmission of HCV is a real possibility (Naidoo, 2001). The high frequency of sharps injuries occurring in the dental setting places the dental worker at risk of HCV acquisition (Siew *et al.*, 1995).

Currently the HCV seroprevalence in South Africa is low and the risk of transmission following occupational exposure is 1.2% to 10% (Webber, 2000).

2.2.2.3 Human Immunodeficiency Virus (HIV) Infection, Acquired Immune Deficiency Syndrome (AIDS) and related infections

Transmission of HIV to six patients of a dentist with AIDS has been reported (CDC, 1993). Evidence suggested that HIV was transmitted from the dentist to the patients (Gooch *et al.*, 1993). Sporadic isolated cases of infection are often more difficult to link with a health care worker than outbreaks involving several patients. For both HBV and HIV the precise event or events resulting in infection in the dental setting have not been determined (CDC, 1993).

Out of 114 cases in the United States that are considered to have possible occupationally acquired HIV infections, the source of infection cannot be documented with certainty. No dental personnel are amongst any of the documented cases, but at least seven dental workers are in the group of possible occupational transmissions (CDC, 1998).

In South Africa we face serious health and economic consequences because of the HIV epidemic. The risk of transmission of HIV after occupational exposure is relatively low at 0.1 to 0.4% (Webber, 2000). Healthcare workers also need to consider the following factors:

- ❖ in many occupational exposure incidents, the HIV status of the patient may be unknown. When assessing the risks, the HIV prevalence of the particular community or population needs to be taken into account;
- ❖ many HIV-infected individuals are antiretroviral naïve; some, however can afford treatment or are participating in drug trials. This needs to be considered when prescribing post-exposure prophylaxis;
- ❖ many children and infants are infected with HIV and they often carry a higher viral load, increasing the risk of transmission;
- ❖ many individuals in South Africa may be in the sero-conversion or AIDS phase of the illness; and
- ❖ the cost of antiretroviral therapy remains a major issue, even for post-exposure prophylaxis.

(Adapted from Webber, 2000).

Naidoo (1994, 1997) and Yengopal, Naidoo and Chikte (2001) both performed studies on cross-infection control amongst dentists in private practice, in the Durban region of Kwazulu-Natal. According to these authors the prevalence rate for HIV in Kwazulu-Natal is 32.5%. Results from both studies show that adherence to universally accepted guidelines for infection control remains low within this climate of an ever-increasing HIV pandemic (Table 9). De Kock and Van Wyk (2001) were the first authors to report on infection control in South African oral hygiene practice.

South Africa has never experienced an epidemic to the magnitude of the HIV/AIDS epidemic. The Actuarial Society of South Africa (ASSA) estimates that

there were 6 million people in South Africa living with HIV/AIDS on July 2002 (Dorrington *et al.,* 2002). The World Health Organization (WHO) has classified a person who is HIV-positive according to a four-stage system. Persons infected in stages 1 and 2 will be relatively asymptomatic, those in stage 3 will be suffering weight loss and bouts of illness from opportunistic infections, and those in stage 4 will have full-blown AIDS. In South Africa 55% of HIV-infected people were in the first stage in July 2002, 20% in the second stage, 18% in the third stage and 7% with full-blown AIDS. Thus implicating that 75% of HIV-infected people are asymptomatic (Dorrington *et al.,* 2002). This explains why so few of the people who are infected know they are infected. Oral conditions are most noticeable during stages 3 and 4 (Dorrington *et al.,* 2002).

2.2.2.4 Herpes virus infections

The viruses frequently present in saliva are those agents causing latent infection, particularly the herpes group, and less commonly HBV, HCV or HIV (Dolan and Yankell, 1992). It has been demonstrated that the herpes simplex virus (HSV) can be recovered in over 50% of adults in the absence of clinical lesions (Corey and Spear, 1986). HSV is a recognised occupational hazard for dentists, oral surgeons and dental technicians (Whitener and Hamory, 1999). Because of the frequency of asymptomatic excretion of the virus in saliva, the unprotected hands of dental surgeons, dental hygienists and oral surgeons, which are bathed in saliva, are exposed to HSV (Straus, 1985).

Herpes simplex type 1 (HSV1) is usually associated with infections of the lips, mouth and face, while herpes simplex virus type 2 (HSV2) is normally associated with the genital area. Type 2 can however appear in the oral cavity. Both of these viruses are extremely contagious and spread by direct contact with a fluid-filled lesion, called a vesicle, or the fluid from this lesion (Miller and Palenik, 1998).

The virus may infect the fingers if open sores are present, and although this virus on the finger (herpetic whitlow) is rare, it is very painful. The virus can be transferred to the eye and can cause conjunctivitis or a corneal ulcer, which could result in blindness (Miller and Palenik, 1998).

In a personal communication with Dr Terry Marshall (2002) from the National Institute of Communicable Disease (NICD), she indicated that the prevalence rate of HSV1 among adults in South Africa is 95%. This is confirmed by a study where the HSV1 seroprevalence was nearly 100% in black women born in Africa (Ades *et al.*, 1989).

2.2.2.5 Tuberculosis and other respiratory infections

Many microorganisms responsible for respiratory tract infections have been isolated in dental aerosols. A positive correlation has been indicated between the incidences of common cold epidemics in patients and the oral health care providers who treated them. The risk of transmission of *Mycobacterium tuberculosis* in most dental settings is probably quite low. The basic recommendation is the establishment of a tuberculosis (TB) infection control

policy and periodic review with practice personnel. The use of newer masks with higher filtration capabilities down to 1 μm will become more common as respiratory protection continues to become a high priority for occupational safety in general. A major risk for health care workers is exposure to patients with unsuspected TB. All patients with HIV infections and undiagnosed pulmonary disease should be presumed to have TB (Molinari and Terezhalmy, 1996).

In South Africa the TBSYS (national TB register system) reporting rate for 2000 was 82.7%, ranging from 40.2% in KwaZulu-Natal to 98.8% in the Western Cape (Day and Gray, 2001). TB remains the most important communicable disease in the world and in South Africa it accounts for 80% of all notifiable diseases. The TB epidemic in South Africa is one of the worst in the world, with certain impoverished areas having the fastest growing incidence worldwide (Naidoo and Mahommed, 2002).

2.2.2.6 Other infections

Dental professionals are exposed to a wide variety of organisms in the blood and saliva of patients. These microorganisms may cause infectious diseases and according to the ADA Research Institute, there are about 40 infectious hazards for the patient and for dental personnel in the dental surgery. Other transmittable diseases of importance include: tuberculosis, oral lesions and conjunctivitis due to *Neisseria gonorrhoeae,* syphilitic lesions, hepatitis A – E, HIV infection, parotitis, meningitis due to the mumps virus, measles, rubella, influenza,

infectious mononucleosis, other herpes viruses and upper respiratory infections (ADA Research Institute, 1988; Epstein and Mathias, 1987).

It is extremely difficult to estimate the levels of risk of the mentioned diseases. Dental personnel should consider every patient as a potential source of infection, regardless of whether the patient is known to be infected or not, and should apply standard precautions to every consecutive patient.

2.2.3 Infection control approach in dentistry

The current attitudes of patients regarding infectious disease in general, especially when considering herpes, hepatitis and HIV infections in particular, dictate that the dental practice of the 21st century uses good, acceptable, agreed and implementable infection control practices (Terezhalmy and Gitto, 1998).

The general routes for transmission of microbial agents in dentistry are as follows (Molinari and Cottone, 1996):

- direct contact with infectious lesions or infected saliva or blood;
- indirect transmission via transfer of microorganisms from a contaminated intermediate object;
- splatter of blood, saliva, or nasopharyngeal secretions directly onto broken or intact skin or mucosa; and
- aerosolisation, the airborne transfer of microorganisms.

Molinari (1994) says that in many respects dentistry has led the way in addressing the challenges in health care delivery. Years before the OSHA guidelines and standards for infection control were developed, most dentists, hygienists and dental assistants had already incorporated many aseptic principles and procedures into their practice routines.

The total practice infection control program is designed to prevent or at least reduce the spread of disease from:

- patient to the dental team,
- dental team to the patient,
- patient to patient,
- dental practice to community, including the family and loved ones of the dental team, and
- community to patient.

The subdivisions of infection control are based on the five pathways of cross-contamination, and their relationship to modes of disease spread and infection control procedures as described in Table 1.

TABLE 1: Mechanisms of disease spread and prevention

PATHWAY OF CROSS-CONTAMINATION	SOURCE OF MICROORGANISM	MODE OF DISEASE SPREAD	MECHANISM OR SITE OF ENTRY INTO BODY	INFECTION CONTROL PROCEDURE
Patient to dental team	Patient's mouth	Direct contact	Through breaks in skin of dental team	Gloves/hand washing Immunisations
		Droplet infection	Inhalation by dental team	Mask Rubber dam Mouth rinsing
			Through breaks in skin of dental team	Gloves/hand washing Protective clothing Face shield Rubber dam Mouth rinsing
			Through mucosal surfaces of dental team	Mask Eyewear Face shield Rubber dam Mouth rinsing Immunisations
		Indirect contact	Cuts, punctures, or needle-sticks in dental team	Needle safety and waste management Heavy gloves for clean-up Ultrasonic cleaning rather than hand scrubbing Instrument cassettes to reduce direct handling during cleaning Antimicrobial holding solution Antimicrobial cleaning solution
			Through breaks in skin of dental team	Heavy gloves for clean-up Protective clothing Immunisations
	Patient's skin lesions	Direct contact	Through breaks in skin of dental team	Gloves/hand washing Immunisations
Dental team to patient	Dental team's hands (lesions or bleeding)	Direct contact	Through mucosal surfaces of patient	Gloves/hand washing Care in handling sharp objects Immunisations
		Indirect contact	Bleeding on items used in patient's mouth	Gloves/hand washing Instrument sterilisation Surface disinfection Immunisations

	Dental team's mouths (oral or respiratory fluids)	Droplet infection	Inhalation by patient	Mask Face shield
			Through oral mucosal surfaces of patient	Mask Face shield
Patient to patient	Patient's mouth	Indirect contact (instruments, surfaces, hands)	Through oral mucosal surfaces of patient	Instrument and handpiece sterilisation Sterilisation monitoring Surface covers Surface disinfection Hand washing and proper gloving Changing mask Decontaminating protective eyewear Changing protective clothing when needed Use of sterile or clean supplies Flushing dental unit water line anti-retraction valves Use of disposable items
Office to community	Patient's mouth	Indirect contact	Cuts, punctures, breaks in skin of dental lab, waste disposal or laundry personnel	Waste management Disinfection of impressions and appliances Proper management of contaminated laundry Hand washing
Dental team's families	Dental team's body fluids	Direct/indirect contact	Intimate contact	Immunisation
Community to patient	Municipal water	Direct contact	Patient's mouth	Use new and separate water source Periodically disinfect inside of dental unit waterlines Use water containing an approved antimicrobial agent Filter the water

U.S. Department of Labor, OSHA: Controlling occupational exposure to blood borne pathogens, OSHA 3127 (revised), Washington DC, 1996, OSHA (Miller and Palenik, 1998).

The unique nature of most dental procedures, including the instruments used for them, and the particular dental settings, require specific and unique preventive strategies to minimise disease transmission among oral health care members and patients (Webber, 2000).

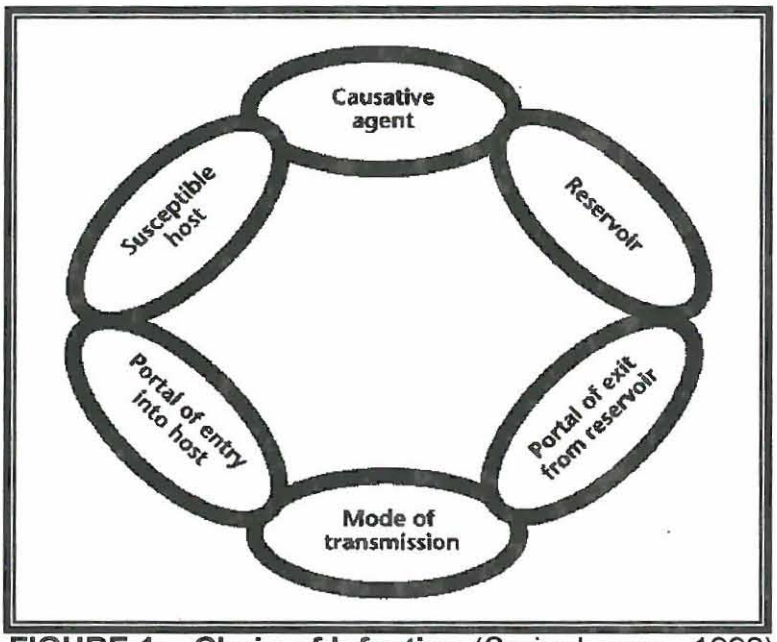

FIGURE 1: Chain of Infection (Springhouse, 1998)

An infection can occur only if the six components shown here are present. Removing any one link prevents the infection.

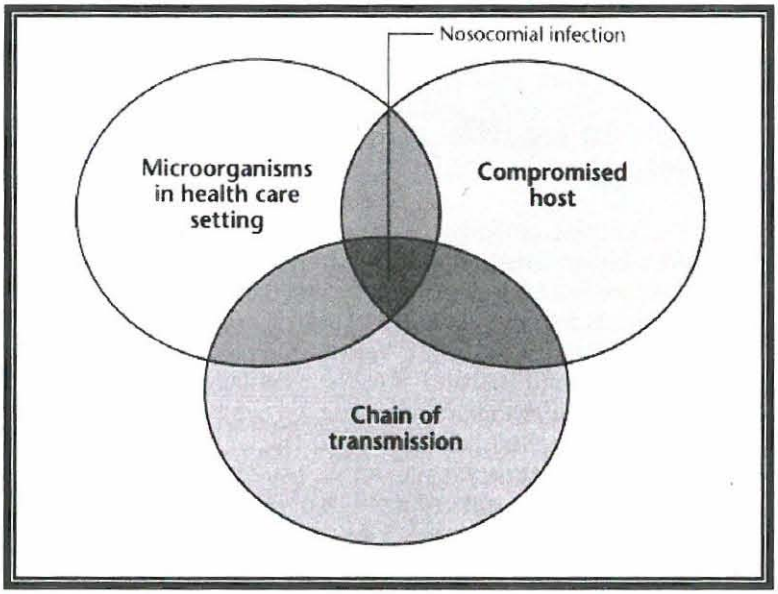

FIGURE 2: Dangerous combination (Springhouse, 1998)

2.2.4 Sources of infection control information

According to Cottone, Terezhalmy and Molinari (1991) the basic sources for infection control information for the dental practitioner are:

- advice from older practitioners whose knowledge is usually minimal or outdated;
- dental supply personnel who lack formal education in this area and could be biased towards their own product;
- a trained assistant whose knowledge is variable depending on his or her experience;
- a trained hygienist, who is usually the most knowledgeable, but who becomes discouraged in practice by statements such as "we don't do it that way here"; and
- miscellaneous articles and research reports in the literature, many of which perpetuate myths or are sometimes misleading or even wrong in their conclusions and advice as they may have been authored by individuals under the impression that they knew the basics of something as "simple" as infection control.

It is also reported that few dental training institutions include sufficient classroom and clinical teaching of infection control (Cottone, Terezhalmy and Molinari, 1991). Although the basic training is discussed in microbiology, most schools prepare and sterilise the students' instruments for them. This results in students graduating with very little experience in sterilisation and infection control. The

new graduate then embarks on a "do-it-yourself" project to develop some kind of infection control system in practice. The outcome of this system depends on a blend of factors:

- instrument disinfection;
- instrument sterilisation;
- household cleaning procedures (adapted for dental practice); and
- quality of staff members.

Infection control principles are designed to break the chain of events that ultimately results in transmission of infection (refer to Table 1).

2.2.5 Current recommendations in South Africa

In their current *General Information for Patients* from *Infection Control in Dentistry* the CDC states that these infection control techniques are not expensive and that they are of great value, especially when considering the amount of protection that is provided. Dental professionals are making visible changes in the way dental services are provided. One of the main reasons is believed to be ascribable to their concern regarding disease transmission (CDC, 2002).

In April 2002 the South African Department of Health published *National norms, standards and practice guidelines for primary oral health care.* This also includes *Infection Control Guidelines* attached as Addendum B Practice Guidelines: Guidelines for infection control for primary oral health care (Department of Health, 2002).

2.2.6 Infection control procedures in dental practices

All aspects of infection control will be reviewed with special emphasis on personal protection and instrument processing as an integral part of this study.

2.2.6.1 Personal protection

If and when an occupation demands it, and if there is potential for exposure, the employer must provide, at no extra cost, appropriate personal protection equipment (PPE). This will include gloves, protective clothing, masks, face shields or eye protection, resuscitation bags and mouthpieces, pocket masks or other ventilating devices. Such equipment will only be considered appropriate if, under normal conditions of use, it does not permit blood or saliva to pass through or reach the employee's work clothes, street clothes, undergarments, skin, eyes, mouth, or other mucous membranes (Miller and Palenik, 1998).

A. Personal protective equipment and barrier techniques

Preventing exposure means avoiding contact with microorganisms. In the dental practice a major source of microorganisms is the patient's mouth. During dental procedures and care in a patient's mouth, aerosols and splatter droplets are generated by equipment such as the dental handpieces, air-water syringes and ultrasonic scalers. This amplifies the transfer of microorganisms. However, using a rubber dam, pre-procedure mouth rinsing and also protective barriers can

reduce this. All protective attire is to be put on at the practice or work area and removed before leaving the work area. If blood or saliva penetrates clothing, it must be removed immediately or as soon as possible. When PPE is removed it must be placed in appropriate containers or in a designated area for storage, washing, decontamination or disposal (Miller and Palenik, 1998).

Gibson, Mathias and Epstein (1995) report on the changes regarding recommended infection control procedures used over a six-year period (1987 to 1993) by British Columbian dentists. They state that it is apparent that routine use of infection control protective devices can contribute significantly to the overall infection control program of the dental practice. Results included:

- recording of the medical history of each new patient increased from 70% to 99%;
- the routine use of gloves increased from 61% to 95%;
- by 1993 most dentists (91%) were using a new pair of gloves for each patient;
- routine use of face masks increased from 49% to 83%;
- high speed autoclavable handpieces were used by 83% of respondents by 1993, but only 62% sterilised these handpieces; and
- biological monitors were used by 61.6% of respondents to test the efficiency of office sterilisers by 1993.

In the following section a few known methods that contribute towards infection control are discussed:

i. Hands and hand washing

Hands are undoubtedly the most important instruments used in the dental practice, and also one of the principle modes for the transfer of microorganisms and the production of cross-infection (Field, 1994). Hand washing is an important personal hygiene procedure for everybody, but it is a primary disease prevention procedure for dental and medical health-care workers (Miller and Palenik, 1998).

Unfortunately there is only partial compliance among health care professionals, including dentists. Reasons for low rates of compliance have been identified previously as the lack of availability of sinks, the effect of hand washing on skin conditions, workload and low perceived risk. To improve compliance it is suggested that ongoing education should be encouraged, although it would be difficult to sustain change in behaviour without constant reinforcement (McCarthy *et al.*, 1999).

Effective hand disinfection is difficult to achieve when rings and watches are not removed prior to the donning of gloves. This in particular is a threat when gloves become perforated or torn, especially in the case of the immuno-compromised patient (Field *et al.*, 1996).

ii. Gloves

In routine everyday dentistry, it was only after the development of latex in 1974 that the use of gloves was introduced. Already at that stage it was recommended that a new pair of gloves should be used for each patient.

In their study of infection control practices across Canada, McCarthy *et al.* (1999) report that respondents appeared to be using gloves as a substitute for hand washing. It was somewhat reassuring to note that of the people who never wore gloves, all of them (100%) washed their hands between patients. However, the wearing of gloves does not eliminate the need for appropriate hand disinfection (Field, 1994).

In the early 1990s gloves were worn sporadically to prevent wound infections of the hands of medical and dental personnel. Today gloves are worn primarily to reduce the risk of being infected by patients and to prevent cross-infection between patients (Fiehn and Westergaard, 1993).

The above-mentioned study also investigated the physical and microscopic qualities of different types of gloves. Except for vinyl gloves (which were all perforated), the prevalence of perforations in the unused gloves was 3%. (Most standards accept a pinhole prevalence of 4%). The greatest increase in numbers of pinholes in latex gloves was reported after two hours of use. It was also stated that the physical qualities of the gloves were not changed by hand washing. Both ordinary soap and disinfectant soap were tolerated well, but soaps containing alcohol or chlorhexidine

tended to make the glove material sticky. Re-use of gloves in connection with routine clinical work was to be discouraged – this was not an acceptable practice.

Gloves must be worn in all cases where skin contact with mucous membranes or body fluids is anticipated or when touching contaminated surfaces or items. After contact with each patient, gloves must be removed and hands must be washed. Repeated use of a single pair of gloves by washing or disinfection is not acceptable. Exposure to disinfectants or other chemicals causes defects in gloves and therefore reduces their value as effective barriers. Dentists should also be aware of allergic reactions to latex gloves or cornstarch powder in the gloves. To reduce these reactions, liners under the gloves or other types of gloves (such as rubber, plastic or nitrile) can be used (ADA, 1996).

In their recommendations the CDC (1993) state that surgical or examination gloves should not be washed before use, nor should they be washed, disinfected or sterilised for re-use. Washing of gloves may cause "wicking" (penetration of liquids through undetected holes in the glove) and is not recommended. Disinfection agents, oils, certain oil-based lotions, and heat treatments such as autoclaving, may lead to deterioration of gloves.

Olsen *et al.* (1993) found that "under conditions of routine use, gloves effectively function as a protective barrier even when leaks are present...

gloves prevent hand contamination in 77% of cases during patient treatment encounters with large numbers of bacteria."

iii. Masks

In dentistry the wearing of masks is regarded as important, especially to protect the mucous membranes of the nose and mouth of the dental team from contact with the aerosols and splatter generated during clinical procedures. Some degree of protection occurs from preventing the inhalation of particles of oral fluids that may be contaminated with infectious disease agents. Some benefit is thus also provided to the patients when the dental team wear masks (Miller and Palenik, 1998).

Dentists and their assistants may have a slightly higher risk of exposure to *Mycobacterium tuberculosis* than the general public. Face seal masks have been shown to protect users against aerosolised microorganisms by reducing such exposure (Bennett *et al.*, 2000).

The efficacy of wearing surgical masks has been questioned and consequently some controversy exists. It has been indicated that simple masks are ineffective in preventing bacteria from passage. Fibreglass and polypropylene masks are more effective (Rogers, 1981).

Surgical masks should be worn when splashing or spattering of blood or other body fluids occurs, and that is during virtually all clinical dental

procedures. When a mask is used, it should be replaced between patients or even during patient treatment if it becomes wet or moist (CDC, 1993).

iv. Eye Protection

Harmful infection of the eyes may be caused by a variety of disease agents. The mucous membranes of the eyes could be entered and this could result in systemic infections, of which the herpes simplex virus is an example (Miller and Palenik, 1998). Recurrent herpetic keratitis could be a resulting infection, so too impaired vision, and in some cases, blindness (Brooks *et al.*, 1981).

As the eyes of both the patient and members of the dental team are so close to the working area, the risk of eye injury is high. In a survey among oral hygienists, 44% reported suffering the following foreign bodies in their eyes as a result of treatment procedures: pumice/prophylaxis paste, calculus, dental materials and contaminated water spray (Gravois and Springer, 1980). Protective eyewear not only prevents infection, but also prevents physical injury from aerosols and splatter, accidental trauma or flying debris. Operators as well as patients should wear protective eyewear to prevent trauma and infections (Davis and Young, 1993).

Chin-length plastic face shields or surgical masks, like protective eyewear, should be worn when splashing or spattering of blood or other body fluids is likely, as is common in dentistry. Face shields or protective eyewear should be washed with an appropriate cleaning agent and, when visibly

soiled, disinfected between patients. Appropriate use of rubber dams, high-velocity air evacuation and proper patient positioning should minimise the formation of droplets, splatter and aerosols during patient treatment. In addition, splash shields should be used in the dental laboratory (CDC, 1993).

v. Sharps injuries and exposure control

An exposure determination should be performed to identify all tasks and procedures in which actual and potential exposure to blood and other infectious materials may be anticipated and to identify all individuals who perform tasks and procedures (Terezhalmy and Gitto, 1998).

In dentistry the nature of procedures, the variety of sharp objects used routinely, the small operating field and frequent patient movement facilitate sharps injuries (Younai, 1996).

If recommended infection control practices are used, the risk of occupationally acquired infections such as HBV, HCV and HIV is limited to sharps injuries. These injuries can be limited if sharps are disposed of in puncture-proof sharps containers and if two-handed recapping of used needles is avoided (McCarthy *et al.*, 1999).

2.2.6.2 Aseptic Technique

Asepsis can be defined as the absence of infection or infectious materials or pathogens. It is usually used for antimicrobial agents that are applied to living tissues.

The core of a practical infection control plan is good aseptic technique. Appropriate use of techniques and products designed to promote basic cleanliness go a long way in minimising risks for the health care provider as well as the patient. Frequent hand washing is a fundamental application of aseptic technique. Dentistry, in many respects, has led the way in addressing the clinical infection control challenges in health care delivery. Years before the development of guidelines and standards, most dental personnel had already incorporated many asepsis principles and procedures into their daily practice routine (Molinari, 1994).

The infection control program can be tailored to the individual needs of each practice. When developing this, however, it is important that all members of the dental team be given the opportunity to contribute. Asepsis in the dental practice is only possible if all members of the team support it (Hovius, 1992).

Collectively, aseptic techniques prevent or reduce the spread of microorganisms from one site to another – such as from patient to dental team, from patient to operatory surfaces, or from one surface to another. The goal of the infection control program is 100% prevention of disease transmission throughout the

dental practice – both for the patient and members of the dental team. Because of the sensitive tissues involved, asepsis cannot be achieved within the oral cavity. Studies have shown that use of a mouth rinse with a long-lasting antimicrobial activity, such as chlorhexidine gluconate, can reduce the level of microorganisms for up to five hours (Molinari and Molinari, 1992).

In their safety measures for dental healthcare worker safety, Whitener and Hamory (1999) suggest that rinsing the patient's mouth with water before any dental examination could reduce the bacteria content of saliva. Additional reductions can be accomplished by the use of a mouth rinse.

2.2.6.3 Sterilisation in dentistry

A basic guideline for effective clinical infection control is not to disinfect when you can sterilise. In fact, Molinari, Rosen and Runnells (1996) state that sterilisation is the most important component of any infection control program.

Sterilisation refers to a validated process intended to kill all microorganisms and is the highest level of microbial killing that can be achieved.

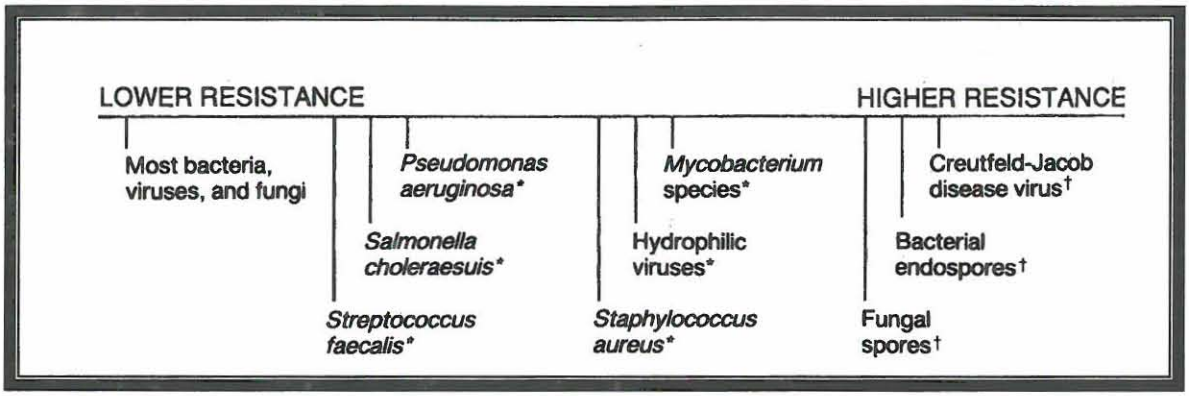

FIGURE 3: Relative resistance of microorganisms to killing with chemicals and heat. (*Higher resistance to killing with chemicals; †higher resistance to killing with both chemicals and heat.)

Note: The correct nomenclature for *Streptococcus faecalis* is *Enterococcus faecalis.*

(Adapted from Miller CH, Palenik CJ (1998). Infection Control and Management of Hazardous Materials for the Dental Team, Mosby.)

A. Sterilisation of instruments

Infected patients very often go undetected, because they do not always exhibit obvious signs and symptoms (Hazelkorn, Bloom and Jovanovic, 1996). Sterilisation provides a method of recycling instruments safely, because it can be monitored and documented to indicate that conditions for control of disease transmission have been established. Most instruments that are used during dental procedures are in contact with mucosa and/or can penetrate tissue. This fact makes it essential that instruments that will be reused be thoroughly cleaned and sterilised with acceptable methods that can be routinely checked and monitored (Crawford, 1994).

B. Classification of instruments

In their recommended infection control practices for dentistry the CDC state that:

"As with other medical and surgical instruments, dental instruments are classified into three categories - critical, semi-critical, or non-critical - depending on their risk of transmitting infection and the need to sterilise them between uses."
(CDC, 1993)

Each dental practice should classify all instruments as follows:

Critical: Surgical and other instruments used to penetrate soft tissue or bone. These instruments should be sterilised after each use and include devices such as forceps, scalpels, bone chisels, scalers and burrs.

Semi-critical: Instruments such as mirrors and amalgam condensers that do not penetrate soft tissues or bone but make contact with oral tissues. These devices should be sterilised after each use. However, if heat sterilisation is not feasible because the instrument will be damaged by heat, the instrument should receive, at a minimum, high-level disinfection.

Non-critical: Instruments or medical devices such as external components of X-ray heads that come into contact only with intact skin. Because these non-critical surfaces have a relatively low risk of transmitting infection, they may be reprocessed between

patients with intermediate-level or low-level disinfection or detergent and water washing, depending on the nature of the surface or the degree and nature of the contamination.

C. Methods of sterilisation

Before sterilisation or high-level disinfection, all dental instruments should be cleaned thoroughly to remove debris. Persons involved in cleaning and reprocessing instruments should wear heavy-duty (reusable utility) gloves to lessen the risk of hand injuries. Placing instruments into a container or disinfectant as soon as possible after use will prevent drying of patient material and make cleaning easier and more efficient. Cleaning may be accomplished by thorough scrubbing of the instruments with soap and water or a detergent solution, or by using a mechanical device (e.g. an ultrasonic cleaner). The use of covered ultrasonic cleaners is recommended, where possible, to increase efficiency of cleaning and to reduce handling of sharp instruments.

All critical and semi-critical dental instruments that are heat stable should be sterilised routinely between uses by steam under pressure (autoclaving), dry heat, or chemical vapour, following the instructions of the manufacturers of the instruments and the sterilisers. Critical and semi-critical instruments that will not be used immediately should be packaged before sterilisation.

D. Heat sterilisation of dental instruments

i. Steam sterilisation

Many authorities have recommended the steam autoclave as the best method of sterilisation of instruments used in the dental practice (Burke *et al.,* 1998). Although disinfection is still widely used, steam autoclaving is the gold standard for decontaminating dental instruments. The level of risk for invasive surgery, including dental procedures, is classified as 'critical' and therefore all instruments used must be sterile (Vickery, Pajkos and Cossart, 2000).

Although all steam autoclaves operate in a similar manner, models differ and have different features. Differences include chamber size, mechanism of air removal, steam generation, drying, temperature displays and recording devices. The typical dental practice autoclave usually operates through four cycles:

- the heating / warming cycle,
- the sterilisation cycle,
- the depressurising cycle, and
- the drying cycle.

No matter what type of autoclave is used, manufacturers' instructions should be followed for routine maintenance, loading, monitoring and safe operation (Miller and Palenik, 1998). The sterilising cycle does not begin until the chamber reaches a temperature of 121°C or 134°C. The

exposure times are set to include extra time to ensure microbial killing (safety factor). When shorter times are used, safety factors are reduced. This is of particular concern with "flash" sterilisation cycles operating in the range of 3 minutes at higher temperatures. The items in these cases are also not packed or wrapped in any way so they can have direct contact with the steam during this very short cycle. Because the item is not wrapped, it is open to immediate recontamination when it is removed from the steriliser. "Flash" sterilisation should not be used routinely as a substitute for purchasing additional instruments or simply to reduce processing time. This weakens sterility assurance and might jeopardize patient protection.

ii. Dry heat

Dry heat sterilisation involves heating air by transferring heat energy from the air to the instruments, and requires higher temperatures (160°C to 190°C) than steam or chemical vapour sterilisation. The main advantage of dry heat is that it does not corrode carbon steel items as does steam sterilisation.

a. Dry heat oven

The static air type is often referred to as the oven type dry heat steriliser. The sterilisation time may vary depending on the nature of the load and is reported to occur after 1 to 2 hours at 160°C. Usually these units do not have automatic timers and therefore it is important to add sufficient time for heating. Furthermore, care should be taken not to open the chamber

door after the sterilisation temperature has been reached, or the cycle will have to be restarted from time zero.

b. Rapid transfer dry heat steriliser

The forced air type is often referred to as the rapid transfer dry heat steriliser. The sterilisation time is reduced because heated air is transferred throughout the chamber at a high velocity and is reported to occur automatically after 6 to 12 minutes at 190°C (Miller and Palenik, 1998).

c. Chemical vapour

The unsaturated chemical vapour steriliser is called the Harvey Chemiclave. The chemical solution, containing 0.23% formaldehyde and 72.38% ethanol plus acetone, ketone, water and other alcohols, is added. The sterilisation cycle begins when the temperature reaches 132°C and is maintained for 20 minutes.

The skin and eyes should be protected from contact with the solution and the vapour should not be inhaled. Manufacturers' instructions should be followed carefully and gloves as well as protective eyewear should be worn when handling the special chemical solutions. Operation of this steriliser should also occur in a room with at least normal ventilation. A positive feature of this type of sterilisation is that corrosion of carbon steel instruments is eliminated or greatly reduced (Miller and Palenik, 1998).

d. Other methods

The hot water boiler has often been used as a steriliser, but is no longer recommended as an effective method of sterilisation. Boiling water does not kill spores. Boiling results in high-level disinfection that is useful when actual sterilisation cannot be achieved.

Glass (hot) bead or salt sterilisers are useful when sterilising small instruments such as endodontic files and rotary instruments. The unit operates at 234°C for 20 seconds for burrs and endodontic files or 30 seconds for larger instrument tips. The advantage is that contaminated root canal instruments can be quickly sterilised. The disadvantage of this steriliser is its size and limited use.

E. Verification of the sterilisation process

Heat sterilisers are normally very reliable, but it is important to monitor the sterilisation process continually because of many factors that can diminish its effectiveness. In a study by Molinari, Rosen and Runnells (1996) it was determined that 87% of cycle failure was due to human error and often included errors like improper wrapping, improper closure of the door, overloading and improper setting of time or temperature. Malfunction of the steriliser was identified as another possible reason.

In their recommended infection control practices for dentistry the CDC state that

"Proper functioning of sterilisation cycles should be verified by the periodic use (at least weekly) of biologic indicators (i.e., spore tests). Heat-sensitive chemical indicators (e.g., those that change colour after exposure to heat) alone do not ensure adequacy of a sterilisation cycle but may be used on the outside of each pack to identify packs that have been processed through the heating cycle. A simple and inexpensive method to confirm heat penetration to all instruments during each cycle is the use of a chemical indicator inside and in the centre of either a load of unwrapped instruments or in each multiple instrument pack; this procedure is recommended for use in all dental practices. Instructions provided by the manufacturers of medical/dental instruments and sterilisation devices should be followed closely."

(CDC, 1993 – attached as Addendum A)

Proper handling and storage of sterilised instruments until opened for use is critically important. Improper storage may result in contamination. Handling of sterile packages should be kept to a minimum. Those that are dropped, torn, compressed or become wet must be considered as contaminated (Miller and Palenik, 1998).

2.2.6.4 Disinfection in dentistry

Disinfection, as opposed to sterilisation, describes a process that eliminates many or all pathogenic microorganisms. It is a less lethal process than sterilisation and it does not kill bacterial endospores. Disinfection usually refers to the use of liquid chemicals to kill microorganisms at room temperature on

surfaces. Disinfectants are applied to inanimate objects such as counter tops or equipment. Some liquid chemicals are sporicidal (sterilants) under certain conditions, and nonsporicidal (disinfectants) under other conditions.

A. Chemical disinfection

Published guidelines for infection control include the use of chemical sterilants and disinfectants when it is not possible to heat sterilise or dispose of items that become contaminated during treatment. Numerous surfaces routinely become contaminated with saliva, blood and exudates (i.e. bioburden) and require surface cleaning and disinfection or placement of disposable covers (Molinari, Schaefer and Runnells, 1996).

Ideally, the chemical disinfectant should offer residual biocidal effect on treated surfaces; it should also be fast acting, odourless, economical, and easy to use. The disinfecting solution used should be registered with the Environmental Protection Agency (EPA). According to the EPA, disinfection levels are rated as high, intermediate, and low.

B. Levels of disinfection

High-level disinfection: is a term used to include mycobacteria that cause tuberculosis and enteroviruses, but not necessarily spores. Disinfectant is a chemical or physical agent, which can destroy vegetative microorganisms and

viruses (Cripps, 2000). High-level disinfectants are EPA-registered "sterilant / disinfectant" chemicals used to obtain a high-level disinfection of heat-sensitive semi-critical instruments. The manufacturers' directions regarding appropriate concentration and exposure must be followed exactly. Liquid chemical agents that are less potent than those in the "sterilant / disinfectant" category are not appropriate for processing critical or semi-critical dental instruments.

Intermediate-level disinfection: may be lethal for tubercle bacilli, vegetative bacteria, most viruses and most fungi, but does not necessarily kill bacterial spores (Rutala, 1993). EPA registered as hospital disinfectants, they are also labelled for tuberculocidal activity. Mycobacteria are among the most resistant groups of microorganisms. A germicide that is effective against them should also be effective against many other pathogens. These disinfectants should be used on counter tops and dental unit surfaces that may have become contaminated with patient material.

Low-level disinfection: kills some viruses and fungi and most of the vegetative bacteria in a practical period of time

(Rutala, 1993). It does not kill *Mycobacterium tuberculosis* or bacterial spores. They are acceptable only for general housekeeping purposes such as cleaning floors, walls, and other household surfaces.

It is very important to realise that the effectiveness of the solution depends on a number of factors (Molinari, Schaefer and Runnels, 1996):

- the concentration and nature of contaminant microorganisms;
- concentration of the chemical;
- the exposure time; and
- the amount of accumulated bioburden.

Choosing the appropriate product can be very confusing and the actual performance criteria may be obscured. Instructions from the manufacturer should be followed meticulously and the usage of approved and regulated products is recommended. The most desirable disinfectants would be tuberculocidal and virocidal. A standard classification of chemical sterilants and disinfectants by Spaulding was published in 1968 and updated by the CDC in 1985 (Alvarado, 1994), with the designation aimed at differentiating the infection risks. Patient care items and equipment are for instance placed into one of the following categories: critical, semi-critical and non-critical. The chemicals will be categorised and chosen for sterilisation, high-level disinfection, intermediate-level disinfection or low-level disinfection.

C. Methods of disinfection

A universally accepted technique for cleaning and disinfecting surfaces is the **spray-wipe-spray technique**. Chemical disinfectants may include any of the following:

i. Chlorine dioxide

Chlorine dioxide (EPA registered) is a **high-level disinfectant** that should be used only on items not subject to corrosion. The manufacturers' directions for dilution and contact time should be followed. Normally disinfection is rapid, but sterilisation takes six to ten hours.

ii. Glutaraldehyde

Glutaraldehyde (EPA registered) is used for **high-level disinfection** and sterilisation. It has a low surface tension that allows it to penetrate saliva and blood. Therefore it is often used as a holding solution for soiled instruments. Some of the solutions are corrosive to metals. The manufacturers' directions regarding the dilution and contact time for disinfection and sterilisation should be noted. Time for disinfection is normally ten to ninety minutes, while sterilisation usually takes six to ten hours. If at any time additional instruments are added to the solution, the time must be zeroed again.

iii. Sodium hypochlorite

Sodium hypochlorite can be obtained in a number of different concentrations. The concentration referred to here is the same as that of household bleach, which contains 5.25% sodium hypochlorite. The desired concentration for use in the dental practice is a 1:10 dilution. This is obtained by placing one cup of household bleach in 3.85 litres (one gallon) of water. The mixed solution is ready for use. It is highly effective as an **intermediate-level disinfectant** and is effective against a broad spectrum of microorganisms. A 1:100 dilution of ¼ cup bleach to 3.85 litres (one gallon) of water is used for general-purpose disinfection. Sodium hypochlorite works rapidly (within ten minutes) on surfaces. The solution is extremely unstable and has to be mixed daily. It is also extremely corrosive to metals.

iv. Iodophor

Iodine is one of the oldest antiseptics for application on skin, mucous membranes, abrasions and other wounds. Because of serious drawbacks such as irritation and allergic reactions, corrosion of metals and staining of skin and clothing, a synthesis of a later generation iodine compound, iodophor, was developed with added advantages and fewer disadvantages. Iodophor is used as an **intermediate-level disinfectant** – preparing oral mucosa for local anaesthesia and surgical procedures, hand washing and as a disinfectant in hospitals, clinics and other health care facilities.

Iodophor works rapidly, taking five to twenty-five minutes of surface contact to be effective. It is corrosive to some metals and has a short life span. Solutions should be changed every three days minimum to remain active.

v. Phenolics

Phenolics are used for **intermediate-level disinfection**. They are irritating to the skin and eyes. Manufacturers' directions should be followed when diluting the solution. The surface contact time is normally ten minutes. Many phenolics come premixed in spray or pump containers. They are destructive to plastic surfaces, but are effective overall surface disinfectants.

vi. Alcohol

Isopropyl alcohol was used routinely for disinfection prior to the 1980s. Essentially, it cleans the areas and has some disinfecting qualities, but it provides limited eliminating properties. *Alcohol is no longer recommended for disinfection in the dental practice.* Alcohol evaporates so quickly that it is difficult to have surface contact for the length of time necessary to be effective.

of anti-retraction valves is necessary to ensure effectiveness; the dental unit manufacturer should be consulted to establish an appropriate maintenance routine.

High-speed handpieces should be run to discharge water and air for a minimum of 20-30 seconds after use on each patient. This procedure is intended to aid in physically flushing out patient material that may have entered the turbine and air or water lines. Use of an enclosed container or high-velocity evacuation should be considered to minimise the spread of spray, spatter, and aerosols generated during discharge procedures. Additionally, there is evidence that overnight or weekend microbial accumulation in water lines can be reduced substantially by removing the handpiece and allowing water lines to run and to discharge water for several minutes at the beginning of each clinic day. Sterile saline or sterile water should be used as a coolant/irrigator when surgical procedures involving the cutting of bone are performed.

Other reusable intra-oral instruments attached to, but removable from, the dental unit air or water lines, such as ultrasonic scaler tips and component parts and air/water syringe tips, should be cleaned and sterilised after treatment of each patient. Manufacturers' directions for reprocessing should be followed to ensure effectiveness of the process as well as longevity of the instruments.

Some dental instruments have components that are heat sensitive or are permanently attached to dental unit water lines. Some items may not enter the patient's oral cavity, but are likely to become contaminated with oral fluids during

treatment procedures including, for example, handles or dental unit attachments of saliva ejectors, high-speed air evacuators, and air/water syringes. These components should be covered with impervious barriers that are changed after each use or, if the surface permits, carefully cleaned and then treated with chemical germicide having at least an intermediate level of activity. As with high-speed dental handpieces, water lines to all instruments should be flushed thoroughly after the treatment of each patient. Flushing at the beginning of each clinic day also is recommended.

2.3 Supportive, informal, relaxed and non-threatening dental environment

The prevalence of dental anxiety is high. It has also been identified as a significant barrier towards receiving dental treatment, particularly as a result of avoidance. It does not solely affect patients: general dental practitioners have identified treating nervous patients as a major source of stress (Cohen, Fiske and Newton., 2000).

One of the most cost-beneficial medical interventions available is infection control and it remains an important part of all health care professions. In dentistry both the patient and the health care provider may be exposed to a number of pathogens through exposure of blood and saliva (McCarthy *et al.,* 1999).

Dentistry has had the added advantage of impressive improvements in equipment, instrument, barrier and chemical technologies, with the result that dentistry has never been safer than it is today for patients and staff alike (Miller,

1993). Perhaps the increased level of safety in dental practice could go some way in removing some of the stress and anxiety associated with dental procedures for the dental care providers and patients.

2.3.1 Putting it all together: The patient health evaluation

In an ideal world, the health care worker should obviously be able to recognise the signs and symptoms of communicable diseases, thus ensuring proper diagnosis and treatment. The patient should be informed about his/her infections and should disclose them to the provider. In the real world however, the patient in the early stages of AIDS for instance, may not always present with obvious signs and symptoms. In addition to that, in the United States only about 50% of such patients will disclose this type of information (Perry *et al.,* 1993). Increasing and better communication with these patients will add to the protection of the clinician and personnel members. Furthermore and more importantly, it will help to ensure better diagnosis and care for the patient (Hazelkorn, Bloom and Jovanovic, 1996).

2.3.2 An atmosphere that conveys protection

Since the mid-1980s there has been a re-emphasis on infection control. This has resulted in impressive approaches to prevent the spread of infectious disease in dental practices. These approaches are directed toward patient protection and the protection of all members of the dental team. The common goal of infection control, viz., to eliminate or reduce the number of microbes shared between

people, has resulted in various approaches. These approaches vary from one practice to another. Factors like the type of dental procedure performed, the number and training of personnel, the practice design and ergonomics, the pattern of patient flow through the practice and the type of equipment used, will influence the approach and efficiency to achieve the desired end result (Miller, 1996).

Information regarding the transmission of infectious agents, new technologies, materials and equipment, as well as the impact of standards and requirements from statutory and professional bodies, today dictates the minimum requirements for practical infection control and exposure control programs in dentistry. This is for the protection of our patients and oral health care personnel alike. Information about infectious and other diseases in general is available. The patients who are interested enough are becoming more sophisticated and they tend to scrutinise the medical and dental professional's approach to asepsis. This could be a practice builder if the desired approach can be met (Terezhalmy and Gitto, 1998).

2.4 Legal and financial considerations

In their recommendations on infection control procedures over a six-year period among British Columbian dentists, Gibson, Mathias and Epstein (1995) report that patient perception and the increasing belief that one is "safer" attending a dental practice that employs current infection control methods, are important

factors. Therefore the marketing value of a good infection control program is obvious.

Communicable diseases have legal as well as medical aspects. The risk of disease transmission has led to direct regulation of dental practices. Dentists may face malpractice suits if they transmit a disease. A dentist who fails to practise adequate infection control and whose breach of professional care has caused a patient to contract a disease could be successfully sued.

As with communicable disease, the possibility of occupational exposure causes reason for concern. The epidemics of HIV and TB have led to the development of infection control regulations for health care, including dentistry. Dentists, similar to many other professionals, often have an overly simplified view of the legal system and there is considerable uncertainty regarding many legal aspects (Burris, 1996).

Within a demographically diverse country such as South Africa, the concept of cultural sensitivity needs to be taken into account. Informed consent needs to be based on the language, idiom and culture of the patient. The patient has a right to respect and autonomy (Chikte and Naidoo, 2000). In addition, the obligation to confidentiality is virtually universal in professional codes of ethics. There is an inherent conflict between the patient's interest in confidentiality and the public's interest in protection from infectious disease (Krautkramer, 2000).

There is no legal obligation for an oral health care worker (OHCW) to attend to a patient. The question of a legal duty is complex. However, health professionals take the Hippocratic oath, which affirms the ethical obligation to treatment. There is no need to modify dental care for infected patients. All patients have a right to a high standard of clinical care (Chikte and Naidoo, 2000). More than 70% of patients with HIV/AIDS have oral manifestations of the infection. OHCWs are often the first to diagnose this and need to discuss their findings with their patients. OHCWs need to acknowledge the rights of patients (Ozar, 1993) and to take a consistent approach to the ethical principles of beneficence and justice (Beauchamp, 1985).

In South Africa legislation makes it compulsory for an employer to ensure a safe working environment. The OHCW works with open wounds and is exposed to bodily fluids daily. The risk of sharps injuries is ever-present, and therefore the OHCW is probably at greatest risk of becoming infected (Chikte and Naidoo, 2000). This will also require that the employer provide protective clothing to minimise the risk of infection in the workplace (Krautkramer, 2000).

2.5 Unique conditions existing in South Africa

The protection and care of the patient is the primary objective, but unique conditions exist in South Africa (Webber, 2000):

- South Africa has the fastest growing HIV and AIDS epidemic worldwide (Department of Health, 2000);
- the prevalence of HBV within selected communities remains high and will be so for the next few years (Voigt *et al.*, 1996);

- other pathogens, such as TB, are commonly diagnosed (Jentsch, 1997); and
- South Africa has a violent society and trauma is a regular presenting feature of many patients (Gilbert, 1996).

Webber states that modifications to international health and safety recommendations are required to be adapted to the particular circumstances within South Africa. These need to be addressed and applied to each unique situation. The implementation of a national policy or standard for occupational health and safety for oral care needs to be considered urgently. Strategies must be seen within the context of dentistry practised in South Africa.

Yengopal, Naidoo and Chikte (2001) report in a South African study that the continued low compliance with standard precautions could be due to a lack of information on infection control. All the dentists (100%) in their study wanted more information on infection control and over 96% felt that infection control guidelines, as recommended by the CDC, were important. Almost all respondents (99%) used the same infection control protocol for all their patients.

2.6 Conclusion

Petty (2000) has said that absolute science may not be able to prove it, but "we are a profession that holds the safety of our patients in our hands". He quoted the Latin phrase, "*primum non nocere*", implying that one's first concern should be to do no harm. As he says: "Some people may call it overkill; I call it being safe. Our approach to overkill in the absence of confirmatory science is best summarised by what my grandfather always told me: it is better to be safe than sorry." When

used correctly, the effectiveness of most infection control procedures has been validated. When they are misused, however, increased chances for the spreading of disease can occur (Molinari, 1995).

Cottone, Terezhalmy and Molinari, (1996) on the other hand feel that infection control procedures have gone too far in many facilities, being protocols that are overly detailed and elaborated. The aim should be to reach the goal of good infection control in dentistry, namely to treat EVERY patient as though he or she is infected with an incurable disease. The method to implement this goal is to develop ONE simple infection control protocol for use: one good, acceptable, agreed upon and simple protocol to implement and use for ALL patients. If appropriate measures are taken, infection control will occur as a routine component of the dental practice.

The scene of infection control will not be the same for years to come. The techniques will be changing and new products and technology will be developed. Good infection control is a philosophy, not a series of "cookbook" steps (Cottone, Terezhalmy and Molinari, 1996). Are we prepared to make the needed changes and make a difference in the infection control of dentistry in South Africa? The application of standard precautions in a developing country like South Africa will indeed set a benchmark for acceptable norms and standards of infection control in dental surgery throughout Africa (Yengopal, Naidoo and Chikte, 2001).

CHAPTER 3

MATERIALS AND METHODS

3.1 Introduction

Very little published data on infection control practices of South African dentists exists and the published studies that are available only cover small geographical areas (Naidoo, 1994; Naidoo, 1997; Yengopal, Naidoo and Chikte, 2001; De Kock and Van Wyk, 2001). In this chapter the materials and methods selected for this study will be discussed.

3.2 Study design

In order to achieve the main objective of the study a descriptive approach was followed. The fact that availability of published data on infection control practices in dentistry in South Africa is limited to information from small geographical areas emphasised the need for a national survey, which included all dental practitioners in the country (excluding practitioners with foreign addresses).

The research objectives, as indicated, entailed the coverage of a very wide and detailed field of infection control in dentistry. All aspects could not be covered in detail. Topics such as barrier coverage and laboratory procedures were not included in the survey. More emphasis was placed on instrument processing involved with operational (clinical) procedures.

3.3 Study population

It was decided to include all dental practitioners registered with the HPCSA. Subsequently, 4 242 dental practitioners within the country were included in the study. Those with foreign addresses were not included. An electronic database containing the names of all dental practitioners was obtained directly from the HPCSA.

3.4 Selection of the measurement instrument

In order to obtain the information required, it was first necessary to decide on the most appropriate form of data collection. The options available were to use postal questionnaires, do telephone interviews, conduct personal interviews, or do observation studies in the laboratory or in a simulation of the procedure. Many studies have been conducted to show the relative merits of different forms of data collection, particularly with regard to participation rates and cost. Of course, the type of data collection directly influences the cost of a study, with the postal questionnaire being the least expensive, followed by the telephone interview, the personal interview, and with direct observation as the most expensive. In the past, personal interviews have had a far higher response rate than mail and telephone procedures, but that advantage has been somewhat eroded by the reduced willingness or availability of people to be interviewed in person and by better post and telephone procedures (Stouthamer-Loeber and Bok van Kammen, 1995).

A postal questionnaire is often the only and most practical method by means of which certain information can be obtained. This approach was selected as the measurement instrument for this study, because of the following perceived advantages:

- cost is relatively low – restricted mainly to printing and postage costs;
- freedom/anonymity of the respondent – he/she can decide whether he/she wants to complete the questionnaire, and also when, where and how much time he/she wishes to spend on it;
- time advantage – major investigations can be undertaken, including thousands of persons in a relatively short period of time;
- geographic coverage is much better than with any other type of questionnaire. This was particularly relevant for this investigation as indicated earlier; and
- acceptability of the research method to the participants.

3.4.1 Development of the questionnaire

3.4.1.1 Preliminary planning

During the preliminary planning the questionnaire was compiled and developed by the researcher in consultation with dental practitioners, the supervisors and the statistician.

During the design of the questionnaire all efforts were made to ensure that the following criteria were met:

- ❖ questions should suit the aim of the study;
- ❖ questions should suit the professional nature of the respondent;
- ❖ clarity, simplicity and unambiguousness should be ensured;
- ❖ potential errors from respondents and coders should be minimised;
- ❖ the subject of the questionnaire should interest the respondent, encourage co-operation and elicit truthful answers;
- ❖ questions should be structured in such a way that the respondent would not be led to answer in a particular way;
- ❖ questions should not alienate the respondent; and
- ❖ efficient and meaningful analysis of the acquired data should be possible.

(Adapted from Naidoo, 1994)

3.4.1.2 The questions

The questionnaire (attached as Addendum D) was divided into two sections to enable participants to answer anonymously if they preferred to, especially because of the sensitive nature of the topic. Respondents who wished to remain anonymous had the choice to complete Section A only. Section B included information from respondents using steam autoclave sterilisers in their practices and respondents were asked to provide identification in order to be included in a

follow-up study. Two prepaid return envelopes were included for this purpose. Topics selected were:

Section A (answered by all respondents)

- background and demographic details;
- training (knowledge), practice and attitude; and
- methods of infection control.

Section B (answered by respondents using a steam autoclave steriliser)

- information on autoclave usage; and
- information on possible need for an infection control service.

The length of the questionnaire and the questions asked were considered carefully. General demographic questions were introduced first, leaving the sensitive issues to be answered last.

3.4.1.3 Pilot study

A questionnaire was mailed to twelve practitioners as part of a pilot study with the following objectives:

- to test the average time needed for completion of a single questionnaire;
- to test the clarity and unambiguousness of each question; and
- to elicit any suggestions and comments that could improve the overall quality and/or practical implementation of the questionnaire.

The results obtained from this study were used to make minor changes only.

3.5 Response rate

A low response rate was anticipated. Generally one of the disadvantages of mailed questionnaires is the low rate of return, often less than 20% (Hammond and Gear, 1986). During the planning phase this fact was discussed in detail during meetings between the researcher and research supervisors, the statistician and members of the faculty and central research committees of the Technikon Free State. The costs and administrative load of including all dental practitioners on the register of the HPCSA was a weighty consideration. The sensitivity of the topic, the expected low response rate and the need to describe comprehensively the current state of infection control in dental practices in South Africa, representing the country as a whole, were key considerations. It was decided in advance that the study would be viable if a minimum of 400 responses were received and that the results would be published even if the response rate was lower than that normally acceptable. The supervisors and statistician felt that a 10% response rate that was demographically distributed would be representative of the study population. They also felt strongly about the choice given to respondents to respond anonymously if they wished to do so, especially considering the sensitivity of the issues, which might cause a defensive approach. The outcome was as follows:

Total number of questionnaires mailed:	4242
Questionnaires returned undelivered:	130
Total number of questionnaires mailed and delivered:	**4112**

Total number of questionnaires returned:	738	**18%**
Questionnaires returned by professionals not in practice:	58	**1.4%**
Total size of usable questionnaires (sample):	**680**	**16.5%**
Sample analysis:		
Questionnaires used for analysis of infection control habits:	**680**	
Autoclave effectiveness analysis:		
Number of questionnaires in which Section B was completed	**583**	

3.6 Quality of the data

Some degree of bias is inevitable in research, and in this study participation bias because of subjects choosing not to participate was a factor that was expected and anticipated. Validity and bias or search of truth - where bias is the deviation from that which is true and correct and validity is the absence of significant bias - should be evaluated in a study, but it is more important to assess the magnitude of the bias and the direction in which it is likely to alter the study findings (Katzenellenbogen, Joubert and Karim, 1999). Identification of potential biases has already been discussed under point 3.5 and attempts have been made to reduce bias in this study as far as possible. Selection bias or sampling bias has been partly avoided by including the total population of dental practitioners in South Africa, and not only a sample.

3.7 Resources

The office of the HPCSA in Pretoria provided the names of all registered dental practitioners in South Africa.

A second (reminder) letter and questionnaire were distributed to delegates attending the Dental Expo in Sandton City in July 2001.

The identities of the individuals who only completed section A of the questionnaire were kept anonymous. The identities of the individuals who completed both sections were protected by certain precautions and were treated as strictly confidential. Precautions included safe storage, data capturing being limited to the researcher and a research assistant only, and access to computers being restricted by password usage. Results were analysed and reported in aggregated/average form. No individual results would be published.

3.8 Statistical analysis

The Senior Director of the Institutional Research Institute, Technikon Free State, advised and assisted with the statistical design and analysis. It was decided that the results would be presented in tabular and/or graphic form, and would include descriptive statistics on:

- the methods of sterilisation used in most dental practices;

- types of autoclave used for sterilisation in dental practices in South Africa;
- methods used to clean instruments before autoclaving;
- frequency of testing and monitoring autoclaves; and
- service and maintenance of autoclaves.

Data has been analysed using the CSSR: STATISTICA programme and Microsoft Excel. Inferential analysis includes tests on properties and means, contingency tables and cross-table interactions.

3.9 Conclusion

In this chapter the materials and methods used in this investigation were reviewed. Focus was on the following main aspects: study design, study population, selection of the measurement instrument, development of the questionnaire, the response rate, quality of the data, resources and the statistical analysis. In the following chapter the results will be discussed.

CHAPTER 4

RESULTS

4.1 Introduction

The results of this study are presented as descriptive statistics according to the divisions used in the questionnaire.

4.2 The sample

738 responses from the 4 242 questionnaires mailed gave an 18% response rate. Although the response rate is low, useful information was gathered from the questionnaires.

4.3 Description of basic results

Section A (answered by all respondents)

4.3.1 Background and demographic detail

1. Gender:			
Male	86.3%	Female	13.4%
		No response	0.3%

2. Home Language:

Afrikaans	48.1%	Tswana	0.3%
English	48.1%	Venda	0.2%
Xhosa	0.6%	Ndebele	0
Zulu	0.7%	Siswati	0.3%
N-Sotho	0.3%	Tsonga	0
S-Sotho	0.4%	Other	1%

3. Age (in years):

< 25	1.8%	41 – 45	20.8%
26 – 30	7.8%	46-50	16%
31 – 35	14%	> 50	22.7%
36-40	16.9%		

Of the respondents 51.7% were in the age interval of 31 to 45 years of age.

4. Current degree in dentistry obtained at:

Durban-Westville	0.2%	Stellenbosch	15.7%
Medunsa	3.8%	Western Cape	8.2%
Pretoria	36.8%	Witwatersrand	24.3%
Other	11%		

61.1% of respondents qualified at either University of Pretoria or Witwatersrand.

5. Number of years since qualification (indicated in question 4 above):			
< 5	10.2%	16 - 20	17.7%
6 - 10	16%	> 20	37.1%
11 - 15	19%		

54.8% of respondents have been qualified for 16 years or longer.

6. Currently practising as:		
Dentist		92.7%
Specialists (specified)	Periodontist, prosthodontist, orthodontist, oral maxillofacial surgeons (OMFS)	7.3%

7. Province in which you are working:			
Western Cape	21.9%	Kwazulu-Natal	15.6%
Northern Cape	2.1%	North West	3.5%
Eastern Cape	6.5%	Northern Province	3.2%
Gauteng	35.7%	Free State	4.9%
Mpumalanga	6%	No response	0.6%

Of the respondents 57.6% work in either Gauteng or Western Cape.

8. Location of your main practice:			
City/Town centre (urban)	45.9%	Rural area	7.8%
Suburban area	44.9%	Other	1%
No response	0.4%		

Distribution of the location of main practices of respondents is virtually the same in city (urban) areas (46%) and suburban areas (45%). Only 8% of the respondents' practices are situated in rural areas.

9. Sector in which you are working:			
Private Sector	90.1%	Not Practising	0.2%
Public Sector	9%	No response	0.7%

10. Is your practice mostly (more than 50%):			
BHF Tariffs (Board of Health Care Funders)	73%	SADA Tariffs (South African Dental Association)	10.9%
Other	15.4%	No response	0.7%

4.3.2 Training (knowledge), practice and attitude

11. Please give an indication of the number of educational courses or CPD opportunities in infection control you have attended during the year 2000:			
0	40.9%	3 – 4	7.2%
1 – 2	44.4%	5 or more	5.3%
		No response	2.2%

4.3.3 Methods of infection control

12. Describe <u>your glove-wearing pattern</u> while treating patients:			
Always	88.4%	Never	0.9%
For some patients/ procedures	9.3%	Other	1%
		No response	0.4%

13. Describe your <u>dental assistant's glove wearing pattern</u> while treating patients:			
Always	65.8%	Never	3.2%
For some patients/ procedures	28.7%	Other	1.9%
		No response	0.4%

14. Describe your glove "changing" frequency between patients:			
After each patient	89.1%	Never	0.9%
For some patients/ procedures	5.6%	Other	3.8%
		No response	0.6%

15. Describe your dental assistant's glove "changing" frequency between patients:			
After each patient	70.9%	Never	2.8%
For some patients/ procedures	21.2%	Other	4.1%
		No response	1%

16. Mask wearing pattern while treating patients:			
Always	83.5%	Never	3.7%
For some patients/ procedures	11.2%	Other	1.2%
		No response	0.4%

17. How often do you put on a new mask while treating patients?			
After each patient	30.4%	Never	5.9%
For some patients/ procedures	36.2%	Other	25.6%
		No response	1.9%

18. Mask wearing pattern of your dental assistant while treating patients:			
Always	50.4%	Never	15.4%
For some patients/ procedures	29%	Other	4.3%
		No response	0.9%

19. Products used for washing hands while treating patients:			
Bar soap	9.9%	Alcohol / disinfectant gel	4.4%
Anti-bacterial liquid soap	83.2%	Other	2.1%
		No response	0.4%

20. Frequency of washing hands while treating patients:			
Only before each patient	23.1%	Before and after each patient	53.1%
Continuously during procedures	14.8%	Other	8.4%
		No response	0.6%

21. Do you wear protective eyewear while treating patients?			
Always	55%	Never	15.3%
For some patients/ procedures	20.6%	Other	8.7%
		No response	0.4%

22.	Does your dental assistant wear protective eyewear while treating patients?			
	Always	21.6%	Never	50.6%
	For some patients/ procedures	23.7%	Other	3.4%
			No response	0.7%

23.	Method of pre-sterilisation debridement used (to clean before sterilisation):			
	Hand-scrubbing	55.6%	Mostly hand-scrubbing with some ultrasonic	16.2%
	Ultrasonic cleaner	6.3%	Not at all	0.1%
	Mostly ultrasonic with some hand-scrubbing	13.7%	Other	7.8%
			No response	0.3%

24.	Method of instrument processing used on an instrument used for extraction (or other invasive procedure) – please choose ONE of the following:			
	Chemical solutions	4.3%	Dry heat oven (hot air)	5.8%
	Autoclave (gravity enforced – bench top models)	44.3%	Chemical vapour	1.3%
	Autoclave (flash or vacuum assisted – short cycle e.g. Statim)	40.3%	Boiling water	0.4%
	Other	3.2%	No response	0.4%

25.	Do you treat patients who are regarded as high risk for AIDS or viral hepatitis?					
	Yes	87.3%	No	9.6%	Don't know	2.4%
					No response	0.7%

4.3.4 Responsibility for infection control

26.	Person overseeing quality control of the infection control department of your practice – please choose ONE of the following:			
	Practitioner	64.1%	Dental assistant	27.7%
	Oral Hygienist	2.1%	Cleaning person	2.9%
	Other	2.5%	No response	0.7%

27.	Person actually performing the procedures of disinfection/sterilisation in your practice (mostly):			
	Practitioner	2.9%	Dental assistant	72.2%
	Oral Hygienist	5.7%	Cleaning person	17.1%
	Other	1.5%	No response	0.6%

28.	Does your practice have a practice manual with detailed protocols of sterilisation procedures, exposure control plan or infection control techniques?					
	Yes	27.6%	No	71.2%	No response	1.2%

The number of responses for questions 29 and 30 are indicated in the blocks for each question and represent the breakdown of ALL staff members working in the dental surgeries:

29. Please give us a breakdown of clinical personnel in your main practice:

		Number	%
a)	Practitioners	1159	36%
b)	Dental Therapists	25	0.8%
c)	Oral Hygienists	370	11.5%
d)	Dental Assistants (Formally trained)	508	15.8%
e)	Dental Assistants (In-office trained)	918	28.5%
f)	Dental Technicians	91	2.8%
g)	Other	147	4.6%
h)	Total clinical staff:	3218	100%

A clinical breakdown of the main practices of respondents represents a total of 1159 registered practitioners, representing 27% of the total study population. Practitioners also reported that the majority of their dental assistants (918) are in-office trained, compared to dental assistants (508) who are formally trained.

30.	Do some or all of the following have formal training in cross-infection control?	Yes	No	No response
a)	Practitioners	91.9%	5.4%	2.7%
b)	Oral Hygienists	38.8%	4.3%	56.9%
c)	Dental Assistants (Formally trained)	34.4%	7.9%	57.7%
d)	Dental Assistants (In-office trained)	35.1%	31.5%	33.4%
e)	Other	4.7%	15%	80.3%

Other staff members included cleaners and qualified nurses and only 4.7% of respondents reported that these staff members had formal training in cross-infection control.

Section B (answered by respondents using a steam autoclave steriliser)

97 respondents completed Section A of the questionnaire only.
583 respondents completed Sections A and B of the questionnaire.

4.3.5 Information on autoclave usage

31. Trade name of autoclave:

Most of the respondents (39.5%) reported use of **Statim** autoclaves in their practices. Of the respondents, (12.7%) reported using KavoClave, Kavo Sterimaster and Prestige Series autoclaves in their practices. Other trade names of autoclaves used in practices included Tuttnauer (6.5%), Accord (5.8%) and Pelton & Crane (4.1%). Other respondents (24.9%) reported using autoclaves such as Melag, SES 2000 and other trade names and types of sterilisers. Some respondents (6.5%) did not provide the names of the autoclaves.

32. Temperature, time and pressure cycle during usual operation of autoclave:

_____ °C at _____ minutes at _____ kPa (kilopascals)	49.4%
Don't know	48.9%
No response	1.7%

Approximately half of the respondents (49.4%) indicated that they were conversant with the temperature, time and pressure cycles during operation of the autoclave. However, the information provided indicated that an almost equal number of respondents (48.9%) were not aware of the operational parameters. Temperatures quoted varied from 100 °C to 400 °C, time varied from 3 to 60 minutes, and pressure cycles varied from 1 kPa to 2 500 kPa (kilopascals)/bar.

33. Age of autoclave:			
Less than one year	6.5%	7-8 years	10.5%
1-3 years	30.5%	More than 8 years	13.4%
4-6 years	37.8%	Don't know	0.3%
		No response	1%

The majority of respondents (61.7%) indicated that their autoclave was older than 4 years.

34. If autoclave is more than one year old, has it ever been serviced?			
Yes	67.9%	No	23.8%
Don't know	2.6%	No response	5.7%

35. If answered "YES" to question 34 above, state when last it was serviced:			
Less than 6 months ago	24.7%	13 to 18 months ago	12%
7 to 12 months ago	20.3%	More than 18 months ago	10.6%
		No response	32.4%

Almost 33% of respondents did not indicate when their autoclave was last serviced, 22.6% indicated that it was serviced more than one year ago.

36. If "YES" to question 34 above, also state the reason for service:

Breakdown	38.2%	Routine service (as prescribed by manufacturer)	26.1%
Don't know	0.3%	Other	3.8%
		No response	31.6%

37. Do you feel that your dental supplier provides sufficient support and information on autoclave maintenance?

Yes	46.7%	No	50.6%
Sometimes	2%	No response	0.7%

38. If "NO" to question 37 above, indicate how this can be improved:

The major issues involved the availability of information and training of personnel, service suggestions, improvements in communication (including marketing, education, newsletters, seminars, recalls and reminders), routine maintenance and service. Service contracts with the suppliers were also suggested.

39. Do you use distilled water in your autoclave?

Yes	85.9%	No	13.2%
		No response	0.9%

40. If "NO", indicate what is used:

Alternatives indicated included tap- or community water, boiled- , purified- and filtered water.

41. Number of autoclaves in practice:

One autoclave	70.3%	Two autoclaves	22.5%
Three autoclaves	3.8%	More than three autoclaves	2.9%
		No response	0.5%

42. Number of practice staff members (including practitioner) physically packing and unpacking the autoclave:

One person	20.4%	Two persons	40.5%
Three persons	22.3%	More than three persons	15.9%
		No response	0.9%

43. Number of different practitioners making use of the same autoclave for sterilisation:

One practitioner	59.5%	Two practitioners	24.2%
		More than three practitioners	15.4%
		No response	0.9%

44. Number of patients treated on an average working day (by practitioner and hygienist/s):

1 - 10	17.9%	21 - 25	14.1%
11 - 15	21.4%	More than 25	19.9%
16 - 20	26.4%	No response	0.3%

Respondents indicated that 60% treat 16 or more patients per day.

45. Frequency of autoclave runs per day (for any instruments):			
After every patient	19.6%	5-10 times per day	31.1%
1-4 times per day	28%	More than 10 times per day	19.1%
		No response	2.2%

The majority of autoclaves (50.2%) run 5 or more cycles per day.

4.3.6 Instrument and handpiece sterilisation

46. Method of sterilisation of handpieces (turbine, slow, endodontic, straight, etc.):			
Autoclave	43.8%	None	0%
Wiping / soaking in liquid chemicals	53.5%	Other	1.7%
		No response	1%

47. If answered "autoclave" to question 46, please indicate:			
After every patient	17.3%	5-10 times/day	3.3%
1-4 times/day	23.3%	More than 10 times/day	0.7%
		No response	55.4%

48.	Do you cover your instruments in any way after sterilisation:				
	Yes	73.8%	No	25%	No response 1.2%
49.	If answered "YES" to question 48, are they				
	Covered with a lid or cloth	40.8%	Wrapped	21.8%	
	Other	12.9%	No response	24.5%	

50.	Do you have a special storage facility for sterile instruments following removal from the autoclave?			
	Yes	63%	No	37%

52.	Do you check autoclave effectiveness in your practice?			
	Yes	70%	No	30%

53.	If "YES", indicate method – please choose ONE of the following:			
	1. Only by observing gauges / lights on autoclave	31.2%	3. Only biological tests: Strips / ampoules	1.2%
	2. Only by colour changes on chemical strips / tapes	14.8%	No response	26.6%
	Combination of methods 1 and 2 above			21%
	Combination of methods 2 and 3 above			0.7%
	Combination of methods 1 and 3 above			0.7%
	Combination of methods 1, 2 and 3 above			3.8%

54. Frequency of monitoring / check of method as indicated in question 53:

	With every cycle	Once per day	Once per week	Once per month	Never	No response
a) Observing gauges / lights on autoclave	44.1%	10.3%	6.5%	4%	33.6%	1.5%
b) Colour changes chemical strips / tapes	18.2%	6.7%	6.7%	8.8%	57.8%	1.8%
c) Biological tests strips / ampoules	0.7%	1%	2.4%	2.6%	90.9%	2.4%
d) Other	0.2%	0%	0.3%	0.3%	92.5%	6.7%

55. If NOT using biological tests, reasons indicated:

Questions quoted from replies of respondents indicating main reasons for not using biological indicators:

Is it necessary?

Do not know about them/if they exist.

Do not know how to use them.

Do not know where to obtain.

Other.

Other reasons also quoted from replies of respondents indicated as main reasons for not using biological indicators:

Costly and time consuming.

Uninformed – too busy to think about it.

According to supplier, strips are adequate.

Autoclave display "sterilized" failed cycle automatically aborted.

Autoclave is new.

Do not have facility.

Hi-tech equipment tends to give one a false sense of security.

Ignorance and complacency.

Lack of availability – it is not marketed.

Laziness.

Little information available.

Use pathological tests.

56. How often do you (the practitioner) feel autoclave performance should be tested by members of your practice staff?

	With every cycle	Once per day	Once per week	Once per month	Never	No response
a) Observing gauges / lights on autoclave	54.7%	13.2%	7%	6.5%	1.1%	17.5%
b) Colour changes chemical strips / tapes	23.5%	11.3%	15.6%	12.2%	2.2%	35.2%
c) Biological tests strips / ampoules	3.3%	5.5%	11.5%	19.4%	4%	56.3%
d) Other	0.3%	0.2%	0.2%	1.6%	3.4%	94.3%

57. How often do you (the practitioner) feel your autoclave should receive a routine maintenance service?

Every 3 - 5 months	5.3%	Every 6 - 11 months	20.7%
Once a year	52.8%	Ad hoc (only serviced when autoclave breaks down	18.5%
		No response	2.7%

4.3.7 Information on possible need for an infection control service

58. Would you be interested in a postal/outsourced autoclave testing service?					
Yes	60.4%	No	34.5%	No response	5.1%

59. If answered "YES" to question 58, how much would you be prepared to pay for such a service?	17.6% indicated R50 to R100 per month		
Not indicated	59.7%	Indicated	40.3%

60. Comments

A list of the most important comments quoted directly from completed questionnaires.

Positive comments as summarised from completed questionnaires included the following:

- infection control (IC) is the single most important aspect in practice building and is largely underestimated by most practitioners;
- there should be some kind of inspecting body like the radiation protection services;
- it should be made compulsory to attend a yearly IC seminar/course;
- there is a great need in private practice for the improvement of sterilisation and infection control; and
- compulsory training and education to all staff involved in infection control.

Negative comments as summarised from completed questionnaires:

- dentistry isn't fun anymore;

- payment problems with Medical Aids;
- reductions in dental fees and high increases in dental materials and maintenance;
- personnel uninformed/ignorant and something needs to be done urgently to educate all staff members; and
- dental suppliers did not mention anything about services/testing.

4.4 Statistical analysis

Various cross-tables were compiled and present the frequencies below. Performing the Chi-squared tests for independence, the relationships between the types of protective wear are tested.

The null hypothesis is H_0: Two types of protective wear are independent.

The alternative is H_a: Two types of protective wear are not independent.

Significance level $\alpha = 0.05$

4.4.1 Use of gloves, masks and eyewear

TABLE 2: 2-Way frequency table: gloves versus eyewear

Category	Eyewear Always	Eyewear Sometimes	Eyewear Never	Row totals
Gloves Always	334	131	83	548
Gloves Sometimes	34	7	18	59
Gloves Never	3	0	3	6
Totals	371	138	104	613

When comparing the frequency of donning gloves with that of eyewear in Table 2, there was a **significant relationship** ($p = 0.00263$) between the two.

TABLE 3: 2-Way frequency table: gloves versus masks

Category	Masks Always	Masks Sometimes	Masks Never	Row totals
Gloves Always	522	63	12	597
Gloves Sometimes	41	13	9	63
Gloves Never	2	0	4	6
Totals	565	76	25	666

When comparing the frequency of wearing gloves with that of masks in Table 3, there was a **significant relationship** between the two ($p = 0.0000$).

TABLE 4: 2-Way frequency table: masks versus eyewear

Category	Eyewear Always	Eyewear Sometimes	Eyewear Never	Row totals
Masks Always	324	120	76	520
Masks Sometimes	33	17	18	68
Masks Never	14	1	9	24
Totals	371	138	103	612

When comparing the frequency of wearing masks with that of eyewear in Table 4, there was a **significant relationship** ($p = 0.00184$) between the two.

4.4.2 Verification of the sterilisation process

TABLE 5: Observing gauges/lights on autoclave

	Actual	Attitude	Regulatory
	(Question 54)	(Question 56)	CDC Recommendation
Per Cycle	44.1%	54.7%	**100%**
Per Day	10.3%	13.2%	
Per Week	6.5%	7%	
Per Month	4%	6.5%	
Never	33.6%	1.1%	
No response	1.5%	17.5%	

In Table 5 data of the actual procedure and what the practitioner feels should be done, was compared with the recommendation as suggested by the CDC (1993). Although a third of respondents (33.6%) never check the lights and gauges of their autoclaves, 44.1% do check the lights/gauges with every cycle. The majority (54.7%) felt it necessary to check with every cycle. In Figures 4 and 5 the frequency of checking the lights/gauges was compared with that of the recommended checking of every cycle and a **significant relationship** ($p = 0.0000$) between the three was found.

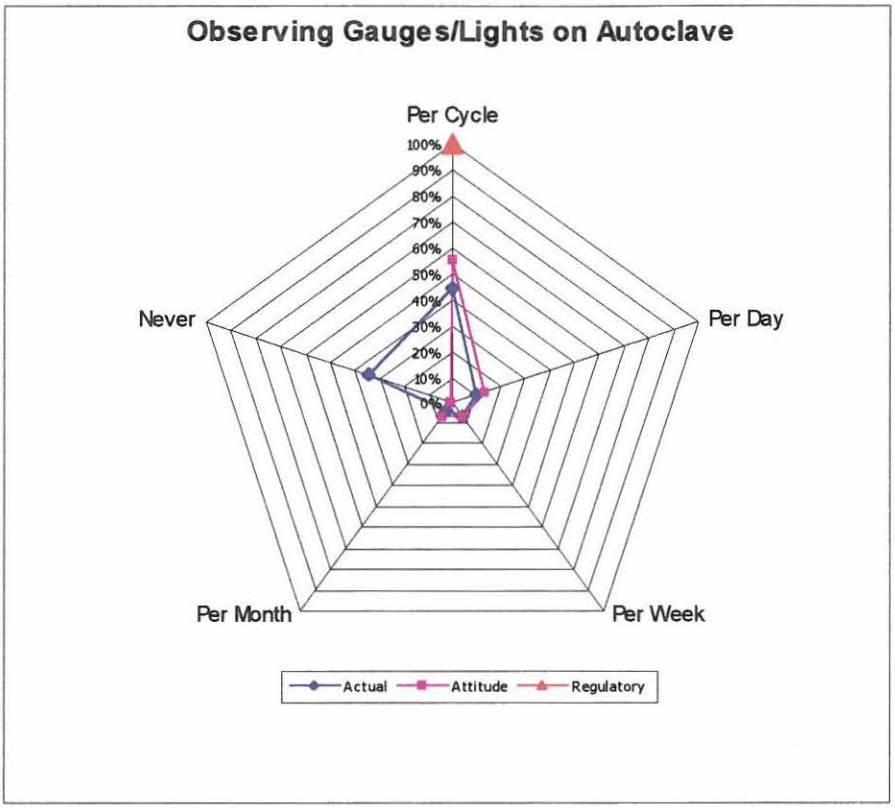

FIGURE 4: Observing gauges/lights on autoclave

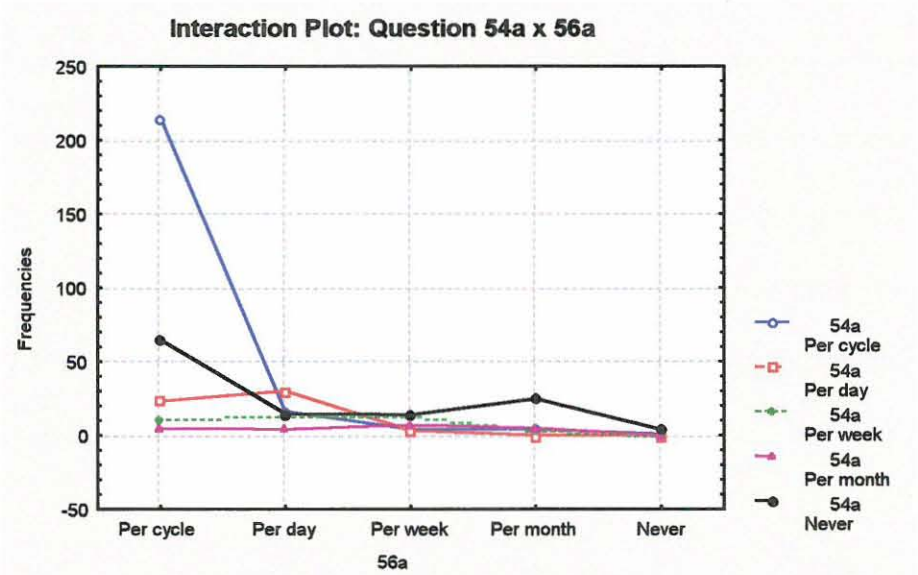

FIGURE 5: Interaction plot of observing gauges/lights on autoclave

Chi-square		df	p
Pearson Chi-square	227.150	df = 16	p = 0.0000
M-L Chi-square	201.557	df = 16	p = 0.0000

TABLE 6: Use of colour changing strips/tape in autoclave

	Actual	Attitude	Regulatory
	(Question 54)	(Question 56)	CDC Recommendation
Per Cycle	18.2%	23.5%	**100%**
Per Day	6.7%	11.3%	
Per Week	6.7%	15.6%	
Per Month	8.8%	12.2%	
Never	57.8%	2.2%	
No response	1.8%	35.2%	

In Table 6 data of the actual procedure and what the practitioner feels should be done, was compared with the recommendation as suggested from the CDC (1993). The majority of respondents (57.8%) never check their autoclaves by using strips/tape in their autoclaves, while 23.5% felt it necessary to check with every cycle. In Figures 6 and 7 the frequency of checking the autoclave by using strips/tape was compared with that of the recommended interval of checking 100% with every cycle and a **significant relationship** ($p = 0.0000$) between the three was found.

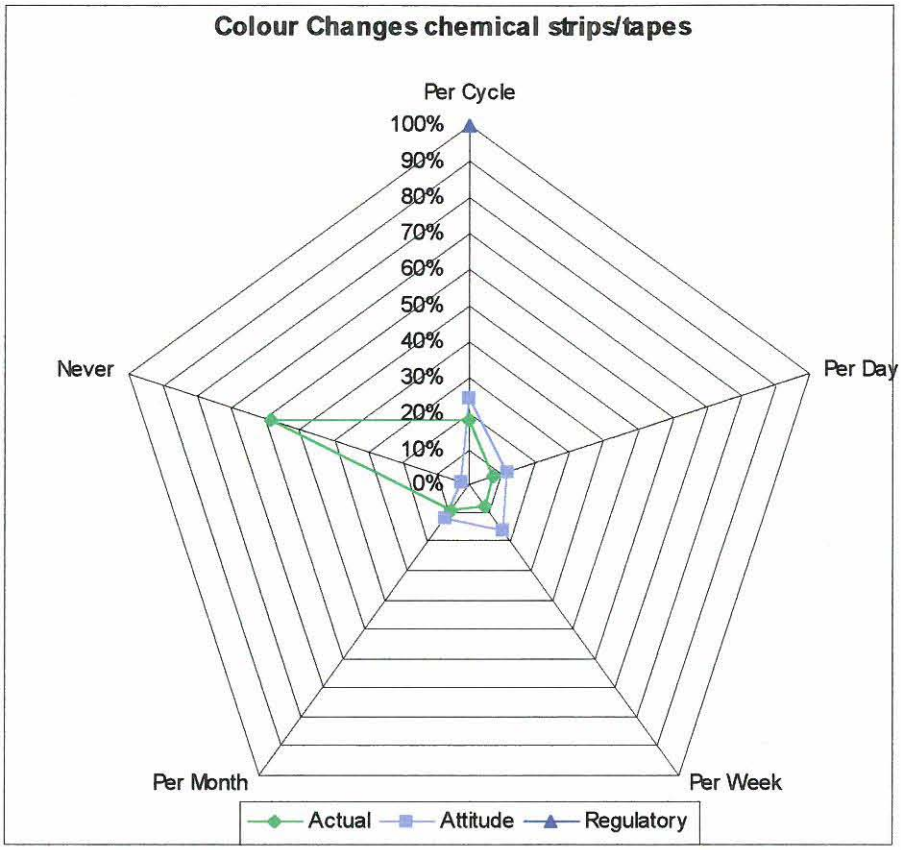

FIGURE 6: Use of colour changing strips/tape in autoclave

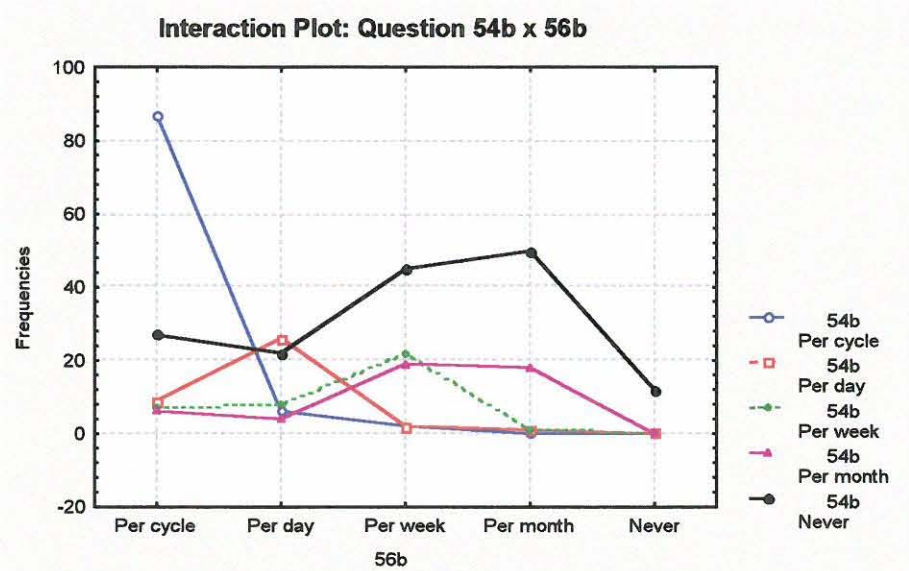

FIGURE 7: Interaction plot using colour changing strips/tape in autoclave

Chi-square		df	p
Pearson Chi-square	292.383	df = 16	p = 0.0000
M-L Chi-square	287.615	df = 16	p = 0.0000

TABLE 7: Use of biological strips/ampoules in autoclave

	Actual	Attitude	Regulatory
	(Question 54)	(Question 56)	CDC Recommendation
Per Cycle	0.7%	3.3%	
Per Day	1%	5.5%	
Per Week	2.4%	11.5%	**100%**
Per Month	2.6%	19.4%	
Never	90.9%	4%	
No response	2.4%	56.3%	

In Table 7 data of the actual procedure and what the practitioner feels should be done, was compared with the recommendation as suggested from the CDC (1993). The majority of respondents (90.9%) never check the effectiveness of their autoclaves by using biological strips/ampoules in their autoclaves. The majority of respondents (56.3%) also did not reply to the question of how often they think the biological tests should be done. In Figures 8 and 9 the frequency of checking the autoclave by using biological indicators was compared with that of the recommended interval of checking 100% once every week and a **significant relationship** ($p = 0.0000$) between the three was found.

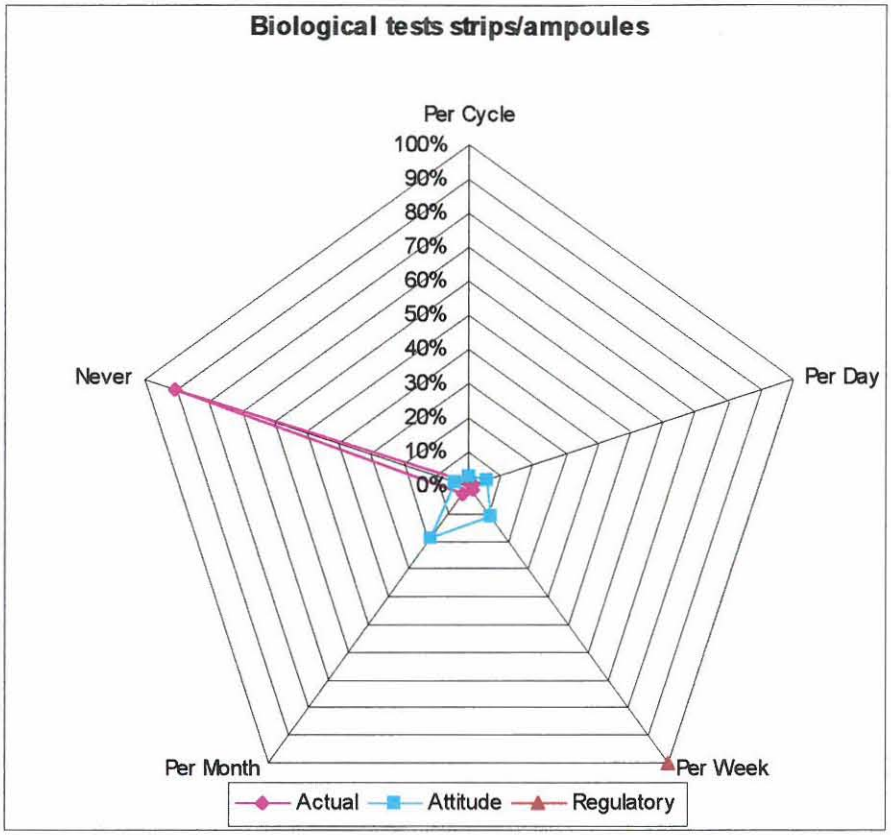

FIGURE 8: Use of biological strips/ampoules in autoclave

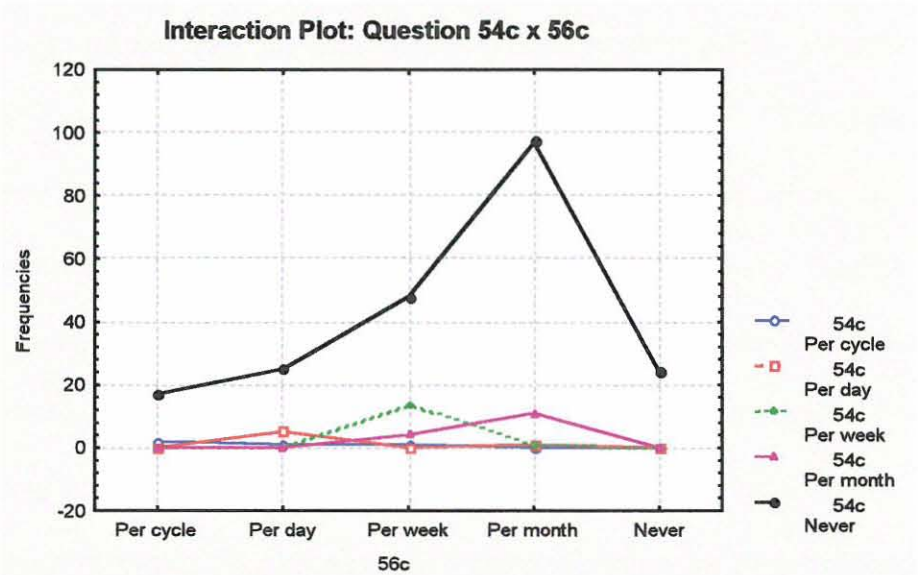

FIGURE 9: Interaction plot of biological strips/ampoules in autoclave

Chi-square		df	p
Pearson Chi-square	81.417	df = 16	p = 0.00000
M-L Chi-square	68.386	df = 16	p = 0.00000

CHAPTER 5

DISCUSSION

5.1 Introduction

In this chapter an overview of the main issues arising from this study will be presented. The main findings will be discussed and compared to national and international literature.

5.2 Response to the questionnaire

The postal questionnaire was selected as measurement instrument for this study. The advantages and disadvantages were discussed in section 3.5, and it was emphasised that the topic of infection control is a very sensitive issue. A degree of bias might have been inevitable because some of the subjects could choose not to participate. Therefore, the whole population of all South African dental practitioners registered with the HPCSA (excluding foreign addresses) was identified as the target population in an attempt to eliminate bias, and to ensure that results would be representative of the whole population. The sensitivity of the topic necessitated the freedom of the respondents to be able to answer anonymously. As indicated in Chapter 4, only a small percentage of respondents chose to remain anonymous. It is suspected, although speculative, that the main reason for this was the advantage of participating in a follow-up study.

5.3 The reality of infection control in South African dental practices

5.3.1 Background and demographic detail

5.3.1.1 Gender

Of respondents 86.3% were males and 13.4% were females. Information from the HPCSA indicated a distribution of 77% male and 23% female dental practitioners currently registered with the council (personal communication HPCSA, 2002).

5.3.1.2 Home language

In the current study 96.2% of the respondents were either English or Afrikaans speaking. It should be noted that the questionnaire was only available in these two languages. Although the other official languages in our country are acknowledged, education and training at the dental training institutions of our country is provided only in English and/or Afrikaans.

5.3.1.3 Age

The largest group of the respondents (22.7%) were older than 50 years of age. The majority of the respondents (59.5%) were in the age interval of 41 to older than 50 years of age, suggesting that interpretations and conclusions can be looked at with a sense of maturity and responsibility. Since 54.8% of respondents

have been qualified for 16 years or longer, respondents may be regarded as well established in their practices, with definite and specific ideas and attitudes.

5.3.1.4 Current practising status of respondents

Almost two-thirds of the respondents (61.1%) were graduates from the Universities of Pretoria and the Witwatersrand. The majority of respondents (92.7%) currently practise as general dental practitioners and 7.3% as dental specialists, including periodontists, prosthodontists, orthodontists and oral maxillofacial surgeons (OMFS). This figure correlates well with data published by the FDI (Zillen and Mindak, 2000), indicating that 9% of the practising dentists in South Africa are specialists.

5.3.1.5 Geographic distribution of respondents

The provincial distribution of respondents correlates with the true distribution of practices within the target population. Of the respondents 57.6% work in either Gauteng or Western Cape. Distribution of the location of main practices of respondents is almost even between city (urban) areas (45.9%) and suburban areas (44.9%). Only 7.8% of the practices are situated in rural areas. The majority of respondents (90.1%) are working in the private sector and most 73% work at BHF tariffs. Data published by the FDI (Zillen and Mindak, 2000) indicates that 68.1% of dental practitioners in South Africa work in private practice, 5.8% in public service, 4.5% in universities and 1.9% in other related occupations. It is not indicated where the remainder of 19.7% works.

5.3.2 Training (knowledge), practice and attitude

In the present study 54.8% of respondents have been qualified for 16 years or longer. Furthermore, 40.9% of respondents reported not having attended any educational courses or continuous professional development (CPD) opportunities in infection control during the previous year (2000). Yengopal, Naidoo and Chikte (2001) report that only 8.8% of dentists in their Durban study were in favour of attending training courses and/or workshops in infection control. It was also suggested in this (Yengopal, Naidoo and Chikte, 2001) study that perhaps some provision of education and training for dentists is required. This will ultimately lead to an increased adoption of the use of standard precautions in dental surgeries. The application of standard precautions in South Africa will indeed set a benchmark for acceptable standards of infection control in dental surgeries throughout Africa (Naidoo, 1994).

Of the respondents in this survey, 9.6% indicated that they are not treating patients regarded as high-risk for AIDS or viral hepatitis, and 2.4% indicated they are unaware of whether or not they are doing so. From the way respondents answered question 25 it is not clear whether the respondents understood it to mean that they are treating patients that may or may not be infected, or whether they are refusing to treat infected patients. The ambiguity of the question makes it impossible to interpret the responses and needs to be investigated further. However, in either case education in infection control would do much to address the misconception. One study suggested that **in 50% of cases the health status**

of the patient would be unknown to the practitioner, because the patient would not reveal the information to the practitioner (Hazelkorn, Bloom and Jovanovic, 1996). Without any obvious signs and symptoms of infection, the practitioner could be unknowingly treating an infected patient.

Some of the orthodontic specialists reported that they are not treating high-risk patients and are not exposed to invasive procedures. This may be debatable, as both the orthodontic patient and clinician are exposed to sharp-ended arches and wires, as well as cutting and positioning instruments. Invasions happen often, and many times by accident or because of trauma. In dentistry the nature of the procedures, the variety of sharp objects used routinely, the small operating field and the frequent patient movement, facilitate sharps injuries (Younai, 1996).

5.3.3 Methods of infection control

Dental practitioners should be more aware of the risks of cross-infection and have higher rates of compliance with current protective guidelines than many other medical colleagues. However, there are still many who admit to not taking adequate steps to prevent cross-infection during dental practice (Naidoo, 1994).

The protection and care of the patient is the primary objective, however, and as has been mentioned in Chapter 2.5, unique conditions exist in South Africa.

It is generally accepted, from the patient's point of view, that barrier protection like the use of gloves, masks and protective eyewear is the most visible precaution that can be taken by a dentist to prevent cross-contamination in the dental surgery (Yengopal, Naidoo and Chikte, 2001).

TABLE 8: Reported use of barrier protection

	Gloves %	Masks %	Protective eyewear %
Practitioners			
❖ Always	88.4	83.5	55
❖ Sometimes	9.3	11.2	20.6
❖ Never	0.9	3.7	15.3
❖ Other	1	1.2	8.7
❖ No response	0.4	0.4	0.4
Assistants			
❖ Always	65.8	50.4	21.6
❖ Sometimes	28.7	29	23.7
❖ Never	3.2	15.4	50.6
❖ Other	1.9	4.3	3.4
❖ No response	0.4	0.9	0.7

5.3.3.1 Gloves

The majority of respondents (88.4%) of this study reported routine wearing of gloves while treating patients (Table 8). Surgery and extractions are indicated as some of the procedures for which practitioners choose to wear gloves and especially when being exposed to blood. Some respondents (2.2%) also indicated that they wash gloves a few times and thus **use the same pair of gloves for more than one patient**.

The majority of respondents (89.1%) reported that they change gloves for each patient. Some respondents indicated that they change gloves more than once during procedures, especially when doing long procedures.

Approximately half of the respondents (53.1%) indicated washing hands before and after treating each patient. Five respondents also indicated that they prefer to change/wash the gloves only, thus implicating that they do not wash their hands. Today gloves are worn primarily to reduce the risk of being infected by patients and to prevent cross-infections between patients (Fiehn and Westergaard, 1993). However, the wearing of gloves does not eliminate the need for appropriate hand disinfection (Field, 1994).

TABLE 9: A comparison of infection control procedures among dentists in South Africa (adapted from Yengopal, Naidoo and Chikte, 2001)

ASPECTS SURVEYED	Naidoo (1994/5) %	Yengopal, Naidoo and Chikte (1999/2000) %	Oosthuysen (2001) %
Routine glove use	87	97.1	88.4
Routine mask use	65	82	83.5
Routine eyewear use	64	53	55
Autoclave use	68	89.7	84.5
Slow speed handpiece autoclaving	28	39	} 43.8
High speed handpiece autoclaving		45.6	
Rubber dam use	2	40.6	
Needlestick injury (previous 6 months)	18	13.8	
Use of a post-exposure sharps protocol	6	33.3	27.7
Recapping needles (two-handed technique)	74	84.1	
Hepatitis vaccine	70	88.2	
Disinfect impressions	4	53.7	
Disinfect appliances		52.4	
Proper waste disposal	75	95.4	
Cross-infection control for burrs	92	93.3	
Cross-infection control for curing light source	76	91	
Decontaminate –			
work surfaces,	90	98.5	
floor in surgery	70	80.6	
Cross-infection control for 3-in-1 tips	84	96.2	
Standard precautions, expensive but necessary	68	52.9	

Routine glove use was reported by 97.1% of respondents in the Durban study (Yengopal, Naidoo and Chikte, 2001). This compares well with other studies reported in recent dental literature. McCarthy, Mamamdras and MacDonald (1997) indicate that of their study population 92% routinely use gloves. Other authors reported a total of 94% (Woo *et al.*, 1992), 87% (Naidoo, 1997), 66.6% (Gibson, Noble and MacFadyen, 1995), 71.7% (Waddell, 1997), 95% (Gibson, Mathias and Epstein, 1995), 84% (Yablon, Spiegel and Wolf, 1989) and 94.5% (Treasure and Treasure, 1994).

In comparing this study with that of Naidoo (1994) amongst Durban dentists, several important points were noted. As indicated in Table 9 the wearing of gloves in this study (88.4%) is very similar to the figure recorded in 1994 (87%). Naidoo noted at that stage that despite the fact that all practitioners claim to charge their patients for the use of barrier protection, not all of them actually use them. The use of gloves by the dental assistant (65.8%) found in this study does not compare favourably with that of the dental practitioner (88.4%). Considering that the assistant is exposed to the same procedures and patient as the practitioner, this may seem to be a serious shortcoming.

The proportion of practitioners always wearing gloves in this **present study was compared with that of Naidoo (1994)**, by performing a hypothesis test for the equality of the two proportions (significance level $\alpha = 0.05$). It was found that there was **no significant difference** ($p = 0.7750$) between the two groups (the sample proportion of this study was 88.4% and that of Naidoo 87%). A similar comparison with **Yengopal, Naidoo and Chikte (2001) yielded a significant**

difference ($p = 0.00250$), with the present sample proportion lower than their 97.1%.

5.3.3.2 Washing of hands

The majority of respondents (83.2%) indicated that they use anti-bacterial liquid soap. **However, bar soap still is the product of choice for 10% of respondents.** The routine use of a hand washing product containing an antimicrobial agent maintains minimum levels of microorganisms on the skin. Bar soaps in soap dishes tend to accumulate skin and environmental microorganisms and are not recommended for health care facilities (Miller and Palenik, 1998).

5.3.3.3 Masks

In this study the majority of respondents (83.5%) and half of their assistants (50.4%) indicated that they wear masks routinely while treating patients. Oral health care providers or patients with respiratory infections like colds or flu and halitosis were given as main reasons for wearing masks. Only a third of respondents (30.4%) use a new mask for each patient, meaning that **masks are only changed when visibly contaminated, soiled, wet, or stained. Frequency of changing masks varies from each patient, to every 2nd, 3rd, 4th, 5th or 10th patient, morning and afternoon, daily, after four to five days or even once a week.** To maintain high filterability, wet masks should be replaced, possibly every 20 minutes (Miller and Palenik, 1998), thus suggesting that it is completely inadequate to replace masks every few days, let alone once a week.

Routine mask use improved from 65% in 1994, as reported by Naidoo, to 82.4% in 2001 reported by Yengopal, Naidoo and Chikte This compares well with other study findings in recent dental literature. McCarthy, Mamamdras and MacDonald (1997) reported that three-quarters of their study population wore masks routinely. Findings reported by other authors include: 50% (Gibson, Noble and MacFadyen, 1995), 85% (Ter Horst, 1993), 83% (Gibson, Mathias and Epstein, 1995) and 66.8% (Rydman *et al.*, 1990).

When the results of the present survey are compared to those of Naidoo in 1994, the wearing of masks has increased from 65 to 83.5% for the practitioners (Table 9). However, in the present survey as indicated in Table 8, it was reported that only half of the dental assistants (50.4%) wear masks. Miller and Palenik (1998) state that in dentistry the wearing of masks is regarded as important, especially to protect the mucous membranes of the nose and mouth of the dental team members from contact with the aerosols and splatter generated during clinical procedures. Considering that the assistant is exposed to the same procedures at the same distance from the patient, as well as the equipment producing aerosols and splatter, as the practitioner, this may be inadequate protection and a cause for concern. Dome-shaped masks are adequate protection against hepatitis B and HIV infections (Paterson, Bond and Favero, 1979), but not adequate to prevent measles, influenza and other aerosol-borne respiratory viruses or tuberculosis bacteria. Masks with the highest filtration ability are the rectangular folded types used for surgeries. For maximum protection against aerosols the

edges of rectangular masks should be pressed around the bridge of the nose and face (Christensen *et al.*, 1991).

The proportion of practitioners always wearing masks in this **present study was compared with that of Naidoo (1994)** by performing a hypothesis test for the equality of the two proportions (significance level $\alpha = 0.05$). It was found that there was **a significant difference** ($p = 0.0000$) between the two groups and **strong evidence against the null hypothesis**. (The sample proportion of this study was 83.5% and that of Naidoo 65%). A similar comparison with **Yengopal, Naidoo and Chikte (2001) did not indicate a significant difference** ($p = 0.6696$), as the present sample proportion was very similar to their 82%.

5.3.3.4 Protective eyewear

Half of the respondents (55%) in the present survey always use protective eyewear while treating patients, but 50.6% of their assistants (Table 8) never use protective eyewear. However, they do use protective eyewear during procedures like surgery, extractions, removal of fillings, prophylaxis, and when working or assisting actively. Reasons given for using no additional eyewear were claustrophobia or the wearing of prescription glasses.

In 1994 Naidoo reported a figure of 64% using protective eyewear, while in 2001 this had decreased to 52.9%, as reported by Yengopal, Naidoo and Chikte This does not compare well with other studies reported in recent dental literature: McCarthy, Mamamdras and MacDonald (1997) reported 84%, Gibson, Noble and

MacFadyen (1995) 72.4%, Ter Horst (1993) 90% and McCarthy *et al.* (1999) 70 to 100%.

When compared to the results of Naidoo (1994) it was found in this present study (Table 9) that **significantly fewer practitioners are using protective eyewear** (64% to 55%). This compares favourably with Yengopal, Naidoo and Chikte (2001) who reported 52.9%. In this survey it was also reported that only a fifth of the dental assistants (21.6%) always use protective eyewear. Considering that the assistant is exposed to the same procedures at the same distance from the patient, as well as the equipment producing aerosols and splatter, as the practitioner, this may be inadequate protection and cause for concern. Protective eyewear not only prevents infection, it also prevents physical injury from aerosols and splatter, accidental trauma or flying debris. It is advisable that operators, practitioners and assistants, as well as patients, use protective eyewear to prevent trauma and infections (Davis and Young, 1993).

Furthermore, this study compared the proportion of practitioners always wearing protective eyewear with those of Naidoo (1994) by performing a hypothesis test for the equality of the two proportions (significance level $\alpha = 0.05$). It was found that there was **no significant difference** ($p = 0.0908$) between the two groups. (This study's sample proportion was 55% and that of Naidoo 64%). A similar comparison with Yengopal, Naidoo and Chikte (2001) did not indicate a significant difference ($p = 0.7522$), with the present sample being very similar to their 53%.

5.3.4 Responsibility for infection control

Of the respondents 64.1% indicated that the practitioner sees himself/herself as the responsible person in control or overseeing quality control of the infection control department of the practice. However, in almost one-third of replies (27.7%) respondents indicated that the dental assistant holds this responsibility, 2.1% the oral hygienist and 2.9% the cleaning person of the practice. Other persons (2.5%) included Council of Health Services Accreditation of South Africa (COHSASA) accredited persons, registered nurses or infection control committees and Central Services and Sterilisation Department (CSSD).

The majority of respondents reported that the dental assistant (72.2%) is responsible for the actual performance of the procedures of disinfection and/or sterilisation in the practice. Other respondents reported that the responsible person for the actual performance of the procedures of disinfection and/or sterilisation is cleaning persons (17.1%), oral hygienists (5.8%) and other persons (1.5%), including registered nurses, CSSD staff or persons allocated to the sterilisation room.

From the breakdown of the information regarding the clinical staff members working in the main practices of respondents in this study, the results provided represent approximately 27% (1 159 practitioners) of the total target population. Practitioners also reported that the majority of their dental assistants are in-office trained, compared to the rest of the dental assistants who were formally trained. Although cleaners were indicated as staff members performing cross-infection

control procedures like cleaning and sterilisation, respondents did not include them as clinical personnel. Although it is perceived that in many practices cleaners perform all duties related to cleaning and sterilisation (author's personal observation), it is interesting to note that none were categorised under "other" in question 29g of the questionnaire. This implies that the cleaners, although identified as quality controllers and actually performing and executing the procedures, are not regarded as being role players in the infection control process, which indicates reason for great concern.

Only 27.6% of respondents have a practice manual with detailed protocols of sterilisation, exposure control or infection control techniques. Yengopal, Naidoo and Chikte (2001) reported similar findings in their survey, stating that "... two-thirds of these dentists did not follow any specific protocol following their injury". A decline in the number of needle-stick injuries was reported (13.8%). It would therefore seem appropriate to encourage dental practitioners to have written protocols for sterilisation, exposure control and infection control techniques.

5.3.5 Information on autoclave use

The majority of respondents (70.3%) of dental practices in the present study indicated that they use only one autoclave. Respondents indicated that up to seven (7) practitioners make use of the same autoclave. However, in the majority of practices (59.5%), the ratio is one practitioner one autoclave.

Approximately half of the respondents (49.4%) indicated that they were conversant with the temperature, time and pressure cycles during operation of the autoclave. However, the information provided indicated that **respondents are unaware of the operational parameters**, as these were answered incorrectly.

One-third of respondents (31.1%) make use of five to ten autoclave runs per day. If it is considered that 60.4% of practitioners consult more than 16 patients per day, it implies that the autoclave is used once for every two to three patients. The average age of autoclaves used, as indicated by respondents, is one to six years in the majority of cases (68.3%). The majority of respondents (67.9%) indicated that they service autoclaves older than one year. It was also reported by 24.7% that the autoclave in use had been serviced less than six months previously. Most manufacturers usually specify how often services should be performed. The most common cause (38.2%) of the need for a service of an autoclave has been breakdown. It was reported that only 26.1% of respondents perform preventative maintenance services on their autoclaves. The majority of respondents (50.6%) feel that dental suppliers do not provide enough support and information on autoclave maintenance.

Many suggestions for improving support and information on autoclave maintenance has been received from almost all respondents. From these suggestions, it is clear that the need for service contracts from dental suppliers as well as improvements in communication and education opportunities may be regarded as priorities. This may also serve as a marketing opportunity for dental traders.

5.3.6 Instrument and hand piece sterilisation

5.3.6.1 Sterilisation

Most instruments used during dental procedures are in contact with mucosa and/or can penetrate tissue. This fact makes it essential that instruments that will be reused be thoroughly cleaned and sterilised with acceptable methods that can be routinely checked and monitored (Crawford, 1994). The majority of the study population (84%) indicated they use the autoclave procedure to process a critical instrument in the dental operatory. Dry heat ovens or hot air sterilisers are used by 6% of the study population, 1% use chemical vapour and 4% still use chemical liquids only. Although boiling water is no longer recommended as an effective method of sterilisation, because it does not kill spores, three respondents indicated still using this method. Alarming, however, is the fact that **disinfection is still widely used to process a critical instrument.** More than half of the respondents (53.5%) used liquid chemicals as a method of sterilisation of handpieces. No monitors for liquid disinfectants/sterilants are available to determine effectively whether proper sterilisation was achieved in a liquid steriliser (Phinney and Halstead, 2000).

Hand scrubbing has been indicated as the preferred method (55.6%) used for pre-sterilisation debridement. Some practices use ultrasonic cleaners (6.3%), often in combination with hand scrubbing (29.9%), but to a lesser extent. Other methods include enzyme soaking. Although manual cleaning is simple and

cheap, it may not be effective. The added risk of injury by contaminated instruments cannot be ignored. The time involved in cleaning instruments properly in a busy practice may also be a problem. It may be appropriate to encourage more practitioners to make use of ultrasonic cleaners in order to protect their staff members and improve cross-infection control, as is recommended by authorities (CDC, 1993).

Yengopal, Naidoo and Chikte (2001) reported that 89.7% of dentists in their study were using an autoclave for infection control, compared to 82% (Gibson, Noble and MacFadyen, 1995); 97.9% (Waddell, 1997) and 92% (Treasure and Treasure, 1994) as reported in other studies. Only 39.7% of dentists reported autoclaving their slow handpieces and 45.2% their high-speed handpieces. Of these, only 25.9% of dentists reported autoclaving their slow handpieces and 14.3% their high speed handpieces after every patient. These figures are extremely low when compared to figures in recent studies in literature that indicated high rates of routine handpiece sterilisation amongst dentists: Gibson, Mathias and Epstein (1995) reported that 62% of their study population use autoclave on handpieces; Roscoe *et al.* (1991) 62% and Rydman *et al.* (1990) 84.6%. Results from these surveys have clearly indicated that infection control of handpieces falls short of acceptable standards recommended by the CDC.

This is confirmed by results from this study in which it was indicated that the majority of respondents (53.5%) use liquid chemicals as a method of sterilisation of handpieces, whereas only 43.8% use an autoclave for sterilisation of handpieces. The largest group of respondents (23.3%) also reported that they

autoclave their handpieces one to four times per day. If we consider that the 60% of respondents indicated treating more than 16 patients per day, it is estimated that, at most, handpieces are autoclaved after every four to five patients. The CDC (1993) recommends a routine between-patient use of a heating process capable of sterilisation (i.e. steam under pressure or autoclaving, dry heat, or heat/chemical vapour) for all high-speed dental handpieces, low-speed handpiece components used intra-orally, and re-usable prophylaxis angles.

Results from another South African study testing bacterial contamination of dental handpieces (Dreyer and Hauman, 2001) concluded that internal surfaces of dental handpieces do become contaminated during normal dental procedures, with water-lines displaying the heaviest contamination. Autoclaving of handpieces is possibly the only effective way of rendering both internal and external surfaces of handpieces sterile.

5.3.6.2 Disinfection

Of the respondents in the present study, 4.3% indicated using chemical solutions for instrument processing on an instrument used for extraction or other invasive procedure. Yengopal, Naidoo and Chikte (2001) reported that rinsing with water only was the preferred method for disinfection of appliances (60.6%) and impressions (66.7%) for dentists from their survey. Approximately 46% and 47.6% of dentists did not disinfect impressions and appliances before sending them to the dental laboratory.

Chemical sterilants and disinfectants are included in published guidelines for instances where it is not possible to heat sterilise or expose items that became contaminated. Environmental surfaces become contaminated with saliva, blood, other secretions or cells, and aerosols from equipment. It is very important to realise that the effectiveness of the solution depends on factors like the concentration and nature of contaminant microorganisms, concentration of the chemical, the exposure time and the amount of accumulated bioburden (Molinari, Schaefer and Runnells, 1996).

5.3.6.3 Verification of the sterilisation process

Although the majority of respondents (70%) in the present study indicated checking the effectiveness of their autoclaves, they do so by either observing gauges/lights on the autoclave only (31.2%), or by using commercially available colour changing strips/tapes (14.8%). One-fifth (21%) indicated that they use a combination of observing gauges/lights and using colour changing strips/tapes. Two-fifths (44.1%) indicated they observed gauges/lights on the autoclave with every cycle and one-fifth (18.2%) use colour changing chemical strips/tapes with every cycle as recommended by the CDC (1993). **Nine out of every ten practitioners (90.9%) indicated they never use biological or other tests to monitor autoclave effectiveness.**

Respondents reported many reasons for not using biological tests for testing their autoclave effectiveness. They could be summarised as follows:

- information – practitioners feel they are uninformed about the product or they question the recommendations for use and the availability of biological indicators;
- practitioners are concerned about the costs of using biological indicators routinely and about time-consuming effects on the practice;
- marketing – biological indicators are used routinely in hospitals, but they are not promoted in dental practices. Not many suppliers of dental products and equipment are acquainted with the product and its uses; and
- the use of hi-tech equipment, for example the Statim, may lead to a false sense of security. Flashing lights do not provide verification of the sterilisation process.

The knowledge and attitude concerning verification of the sterilisation process was also tested in the present study and more than half of the respondents (54.7%) felt that observing gauges/lights on the autoclave is necessary with every cycle. Just one-quarter (23.5%) of the respondents felt colour changing chemical strips/tapes should be used with every cycle. In contrast with CDC recommendations (1993) for at least a weekly biological verification of the sterilisation process, one-fifth (19.4%) of respondents felt biological tests/ampoules should be used once per month only.

In spite of the fact that the CDC recommends the use of autoclave tape in the centre of every load of unwrapped instruments or in each multiple instrument pack, two-thirds (61.7%) of dentists in the Durban survey (Yengopal, Naidoo and Chikte, 2001) did not use autoclave tape at all to test the efficiency of their

autoclaves. The CDC also recommends at least weekly testing with biological monitors (e.g. spore tests). Yengopal, Naidoo and Chikte (2001) found that 93% of dentists from this survey never used this method to test the efficiency of their autoclaves. This compares very poorly with recent studies in the UK (Burke *et al.,* 1998) and Canada (McErlane, Rosebush and Waterfield, 1992).

Notable sterilisation failure rates have been recorded in many countries, including the USA 15%, Norway 33%, Germany 23%, Canada 4%, Denmark 2.3 to 7.3%, and UK 2% (Burke *et al.*, 1998), emphasising the need for regular testing of autoclave effectiveness. Taking the findings of this present South African survey into account, the need for education and training of dental practitioners, as well as staff members involved in the infection control procedures and all aspects regarding autoclave use may be indicated.

5.3.7 Information on possible need for an infection control service

Almost two-thirds of respondents (60.4%) indicated they would be interested in a postal/outsourced autoclave testing service, but did not indicate how much they would be prepared to pay for such a service. Reasons given for not using biological indicators included the fact that practitioners did not know the costs involved or they felt it might be too costly. Most of the other respondents indicated that they would be willing to pay R50 per month.

Both positive and negative comments were received from respondents who participated in this study. The comments included valuable information and were

listed in chapter 4 (question 60). The following conclusions can be drawn from the comments of respondents:

- some practitioners may feel that dentistry isn't fun anymore. Infection control (IC) is a very important aspect in practice building and most practitioners largely underestimate the value of this aspect. The dental patients of today are informed and need to be assured of a supportive, informal, relaxed and non-threatening environment providing the highest quality of care. This fact may present a new challenge and opportunity to practitioners;
- the need for some kind of inspection or regulatory body such as the radiation protection services may be a consideration that can contribute largely to the protection and safety of patients and dental care providers. A great need in private practice for the improvement of sterilisation and infection control has been identified. Practitioners need some kind of auditing system to measure whether they are doing enough in this regard or not;
- training and education of all staff involved in infection control should be obligatory. Using CPD opportunities and attending a yearly IC seminar/course should be made compulsory;
- payment problems with Medical Aid companies need to be negotiated and addressed by the professional bodies involved. Reductions in dental fees and high increases in dental materials and maintenance are a reality the dental health care provider needs to face during every patient treatment. A possible alternative may be that dental care providers need to examine

their fee structures and reconsider charging medical aid tariffs. Often people are prepared to pay more if the quality of service justifies it; and

- dental suppliers may use the opportunity to improve services/testing of autoclaves. The need for better communication, education and training has been identified in this survey. As the providers and suppliers of many of the products and equipment needed for infection control, dental companies have a very important and much needed duty to fulfil. It may be advisable for the training facilities and the dental industry to work in close cooperation with each other. The demand for current and updated research may also benefit all concerned.

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

In this final chapter an overview of the main issues arising from this study will be presented. Finally, the information will hopefully benefit patients being treated in dental practices and may also encourage further research in this field.

6.2 The reality of infection control in South African dental practices

Molinari (1994) concludes that in many respects dentistry has led the way in addressing the challenges in health care delivery. Years before OSHA guidelines and standards for infection control were developed, most dentists, hygienists and dental assistants had already incorporated many aseptic principles and procedures into their practice routines. Dentistry has the added advantage of impressive improvements in equipment, instruments, barrier and chemical technologies, with the result that dentistry has never been safer than it is today for patients and staff alike if appropriate measures are exercised (Miller, 1993).

It was evident from this study that formal training of those individuals responsible for cross-infection control is inadequate. This study showed that 91.9% of practitioners received formal training, while only 34.4% of oral hygienists did. The nature of this "formal training" could not be ascertained from the questionnaire. It is known, however, that some training in infection control is included in the

current curricula for both dentistry and oral hygiene. The goal of all dental health care workers should be to treat every patient safely using universal infection control protocols. Education must be provided to every member of the dental team to enable them to treat patients with confidence and the highest professional care. Staff members need to be acquainted with the high-tech equipment that needs to be used. Every duty should be fulfilled in such a way as to provide to achieve the ultimate legal and ethical obligation to the patients. Every practice needs to train new staff members, but the question is whether they properly train all staff members, including cleaners whose everyday duty is often to perform these infection control procedures. Furthermore, accurate records should be kept of these training sessions.

The information gleaned from this study showed that areas of dental infection control that are neglected and need urgent attention are:

- development and implementation of standard operating procedures (only 27.6% of respondents indicated to have a practice manual);
- single use of gloves and masks during patient procedures and the frequency of replacement during extended procedures;
- promotion of a safe dental environment by ensuring that all handpieces and instruments are sterilised prior to use on every patient;
- education and training to practitioners and all staff members on all aspects regarding autoclave use;
- providing evidence of documented use of and verification of the sterilisation process; and

- improvement of service from dental suppliers.

6.3 Limitations of the study

The biggest anticipated limitation to the postal questionnaire was the response dependence because of the sensitive nature of the matter investigated. It was felt that a focused, scheduled, structured questionnaire would be the most appropriate way to obtain the information required. This might, however, have a distorted effect on the results, as respondents interested and concerned about the area of research could be expected to respond better than those not concerned or not complying with the matter of infection control. Furthermore, completing questionnaires and forms during the everyday busy schedule of the practitioner might cause a negative feeling and even aversion in some respondents. If the practitioner did not complete the questionnaire personally, the staff member doing it on his/her behalf might also be the person least acquainted with the procedures, say for example, a receptionist. The researcher of this study was dependant upon the goodwill and willingness of the target population for completing and returning the questionnaires. However, in order to motivate participation in this study, the following measures were taken:

- an explanatory letter (Addendum C) detailing the importance of infection control and participation in the project was included with each questionnaire; and
- there was the added advantage of being included in a further study with the incentive of a complimentary package for testing autoclaves delivered at practices. Participants were not rewarded with any other incentives.

The respondents had the freedom to decide whether he/she wants to complete the questionnaire, and also when, where and how much time he/she wishes to spend on it. This was done mainly to protect the anonymity of the respondent. Obviously the respondent interested in and concerned about the matter may choose to participate in contrast to those who neglect the issue, who may rather choose not to participate. Some degree of bias is inevitable in research, and in this study participation bias because of subjects choosing not to participate was a factor that was expected and anticipated.

The indicated compliance with any infection control procedure may in reality prove to be not quite so high. Direct observation may be the only objective way to assess real compliance. In order to be able to obtain a true assessment, those who are being watched should not be aware of this type of observation taking place. This type of observational study would certainly raise serious ethical issues and would therefore be impractical to execute.

6.4 Recommendations for future research

Naidoo (1994) reports that it is appropriate to note that early efforts by both government and professional organisations in the USA to influence dental practitioners to implement infection control guidelines were not very successful. Five factors appear to be significant in bringing about change in compliance, namely:

- Education;

- peer and social pressure;
- regulation;
- litigation; and
- patient expectations.

A national effort should be planned and implemented by government, training institutions and professional organisations to encourage and support further research in a collaborated attempt. Studies, including the present study and that of Naidoo (1994), Naidoo (1997), Yengopal, Naidoo and Chikte (2001) and De Kock and Van Wyk (2001) should be extended to provide more information on a national basis.

Improvements over a period of time should be monitored and aspects not included in the mentioned studies should also be investigated. An example of these aspects includes the wearing of uniforms and environmental barriers.

The provision of continuous training and education for practitioners and all their staff members needs to be investigated further. It is worrying to note that 40.9% of respondents have not attended any educational courses or CPD opportunities in infection control during 2000. Question also arises if the training authorities for such needs provide adequate opportunities.

Education of patients or general public (having the right to safe dental care) as well as patient expectations needs to be examined. Investigation of the reasons for decline in use of protective glasses amongst South African dental practitioners, and also including protection of the patient's eyes during dental treatment need to be addressed.

6.5 Conclusion

The author supports the vision of Webber (2000) stating that modifications to international health and safety recommendations should be adapted to the particular circumstances within South Africa. The recommendations need to be addressed and applied to each unique situation. The implementation of a national policy or standard for occupational health and safety for oral care needs to be considered urgently. Strategies must be seen within the context of dentistry practised in South Africa. Very little published data exists and the published infection control studies in dental practices in South African that do exist only cover small geographical areas.

The term "high risk", in particular in the South African situation, takes on a new meaning – especially considering the ever-present and ever-increasing risk of the transmission of diseases like HIV, HBV and TB in our country. Awareness of these problems will also assist in defining necessary areas of research and help to determine priorities for prevention.

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SUMMARY

This document updates previously published CDC recommendations for infection-control practices in dentistry to reflect new data, materials, technology, and equipment. When implemented, these recommendations should reduce the risk of disease transmission in the dental environment, from patient to dental health-care worker (DHCW), from DHCW to patient, and from patient to patient. Based on principles of infection control, the document delineates specific recommendations related to vaccination of DHCWs; protective attire and barrier techniques; handwashing and care of hands; the use and care of sharp instruments and needles; sterilization or disinfection of instruments; cleaning and disinfection of the dental unit and environmental surfaces; disinfection and the dental laboratory; use and care of handpieces, antiretraction valves, and other intraoral dental devices attached to air and water lines of dental units; single-use disposable instruments; the handling of biopsy specimens; use of extracted teeth in dental educational settings; disposal of waste materials; and implementation of recommendations.

INTRODUCTION

This document updates previously published CDC recommendations for infection-control practices for dentistry (1-3) and offers guidance for reducing the risks of disease transmission among dental health-care workers (DHCWs) and their patients. Although the principles of infection control remain unchanged, new technologies, materials, equipment, and data require continuous evaluation of current infection-control practices. The unique nature of most dental procedures,

instrumentation, and patient-care settings also may require specific strategies directed to the prevention of transmission of pathogens among DHCWs and their patients. Recommended infection-control practices are applicable to all settings in which dental treatment is provided. These recommended practices should be observed in addition to the practices and procedures for worker protection required by the Occupational Safety and Health Administration (OSHA) final rule on Occupational Exposure to Bloodborne Pathogens (29 CFR 1910.1030), which was published in the Federal Register on December 6, 1991 (4).

Dental patients and DHCWs may be exposed to a variety of microorganisms via blood or oral or respiratory secretions. These microorganisms may include cytomegalovirus, hepatitis B virus (HBV), hepatitis C virus (HCV), herpes simplex virus types 1 and 2, human immunodeficiency virus (HIV), Mycobacterium tuberculosis, staphylococci, streptococci, and other viruses and bacteria -- specifically, those that infect the upper respiratory tract. Infections may be transmitted in the dental operatory through several routes, including direct contact with blood, oral fluids, or other secretions; indirect contact with contaminated instruments, operatory equipment, or environmental surfaces; or contact with airborne contaminants present in either droplet spatter or aerosols of oral and respiratory fluids. Infection via any of these routes requires that all three of the following conditions be present (commonly referred to as "the chain of infection"): a susceptible host; a pathogen with sufficient infectivity and numbers to cause infection; and a portal through which the pathogen may enter the host. Effective infection-control strategies are intended to break one or more of these "links" in the chain, thereby preventing infection.

A set of infection-control strategies common to all health-care delivery settings should reduce the risk of transmission of infectious diseases caused by bloodborne pathogens such as HBV and HIV (2,5-10). Because all infected patients cannot be identified by medical history, physical examination, or laboratory tests, CDC recommends that blood and body fluid precautions be used consistently for all patients (2,5). This extension of blood and body fluid precautions, referred to as "universal precautions," must be observed routinely in the care of all dental patients (2). In addition, specific actions have been recommended to reduce the risk of tuberculosis transmission in dental and other ambulatory health-care facilities (11).

CONFIRMED TRANSMISSION OF HBV AND HIV IN DENTISTRY

Although the possibility of transmission of bloodborne infections from DHCWs to patients is considered to be small (12- 15), precise risks have not been quantified in the dental setting by carefully designed epidemiologic studies. Reports published from 1970 through 1987 indicate nine clusters in which patients were infected with HBV associated with treatment by an infected DHCW (16-25). In addition, transmission of HIV to six patients of a dentist with acquired immunodeficiency syndrome has been reported (26,27). Transmission of HBV from dentists to patients has not been reported since 1987, possibly reflecting such factors as incomplete ascertainment and reporting, increased adherence to universal precautions -- including routine glove use by dentists -- and increased levels of immunity due to use of hepatitis B vaccine. However, isolated sporadic cases of infection are more difficult to link with a health-care worker than are outbreaks involving multiple patients. For both HBV and HIV, the precise event or events resulting in transmission of infection in the dental setting have not been

determined; epidemiologic and laboratory data indicate that these infections probably were transmitted from the DHCWs to patients, rather than from one patient to another (26,28). Patient-to-patient transmission of bloodborne pathogens has been reported, however, in several medical settings (29-31).

VACCINES FOR DENTAL HEALTH-CARE WORKERS

Although HBV infection is uncommon among adults in the United States (1%-2%), serologic surveys have indicated that 10%-30% of health-care or dental workers show evidence of past or present HBV infection (6,32). The OSHA bloodborne pathogens final rule requires that employers make hepatitis B vaccinations available without cost to their employees who may be exposed to blood or other infectious materials (4). In addition, CDC recommends that all workers, including DHCWs, who might be exposed to blood or blood-contaminated substances in an occupational setting be vaccinated for HBV (6-8). DHCWs also are at risk for exposure to and possible transmission of other vaccine-preventable diseases (33); accordingly, vaccination against influenza, measles, mumps, rubella, and tetanus may be appropriate for DHCWs.

PROTECTIVE ATTIRE AND BARRIER TECHNIQUES

For protection of personnel and patients in dental-care settings, medical gloves (latex or vinyl) always must be worn by DHCWs when there is potential for contacting blood, blood-contaminated saliva, or mucous membranes (1,2,4-6). Nonsterile gloves are appropriate for examinations and other nonsurgical procedures (5); sterile gloves should be used for surgical procedures. Before treatment of each patient, DHCWs should wash their hands and put on new gloves; after treatment of each patient or before leaving the dental operatory,

DHCWs should remove and discard gloves, then wash their hands. DHCWs always should wash their hands and reglove between patients. Surgical or examination gloves should not be washed before use; nor should they be washed, disinfected, or sterilized for reuse. Washing of gloves may cause "wicking" (penetration of liquids through undetected holes in the gloves) and is not recommended (5). Deterioration of gloves may be caused by disinfecting agents, oils, certain oil-based lotions, and heat treatments, such as autoclaving.

Chin-length plastic face shields or surgical masks and protective eyewear should be worn when splashing or spattering of blood or other body fluids is likely, as is common in dentistry (2,5,6,34,35). When a mask is used, it should be changed between patients or during patient treatment if it becomes wet or moist. Face shields or protective eyewear should be washed with an appropriate cleaning agent and, when visibly soiled, disinfected between patients.

Protective clothing such as reusable or disposable gowns, laboratory coats, or uniforms should be worn when clothing is likely to be soiled with blood or other body fluids (2,5,6). Reusable protective clothing should be washed, using a normal laundry cycle, according to the instructions of detergent and machine manufacturers. Protective clothing should be changed at least daily or as soon as it becomes visibly soiled (9). Protective garments and devices (including gloves, masks, and eye and face protection) should be removed before personnel exit areas of the dental office used for laboratory or patient-care activities.

Impervious-backed paper, aluminum foil, or plastic covers should be used to protect items and surfaces (e.g., light handles or x-ray unit heads) that may become contaminated by blood or saliva during use and that are difficult or impossible to clean and disinfect. Between patients, the coverings should be

removed (while DHCWs are gloved), discarded, and replaced (after ungloving and washing of hands) with clean material.

Appropriate use of rubber dams, high-velocity air evacuation, and proper patient positioning should minimize the formation of droplets, spatter, and aerosols during patient treatment. In addition, splash shields should be used in the dental laboratory.

HANDWASHING AND CARE OF HANDS

DHCWs should wash their hands before and after treating each patient (i.e., before glove placement and after glove removal) and after barehanded touching of inanimate objects likely to be contaminated by blood, saliva, or respiratory secretions (2,5,6,9). Hands should be washed after removal of gloves because gloves may become perforated during use, and DHCWs' hands may become contaminated through contact with patient material. Soap and water will remove transient microorganisms acquired directly or indirectly from patient contact (9); therefore, for many routine dental procedures, such as examinations and nonsurgical techniques, handwashing with plain soap is adequate. For surgical procedures, an antimicrobial surgical handscrub should be used (10).

When gloves are torn, cut, or punctured, they should be removed as soon as patient safety permits. DHCWs then should wash their hands thoroughly and reglove to complete the dental procedure. DHCWs who have exudative lesions or weeping dermatitis, particularly on the hands, should refrain from all direct patient care and from handling dental patient-care equipment until the condition resolves (12). Guidelines addressing management of occupational exposures to blood and other fluids to which universal precautions apply have been published previously (6-8,36).

USE AND CARE OF SHARP INSTRUMENTS AND NEEDLES

Sharp items (e.g., needles, scalpel blades, wires) contaminated with patient blood and saliva should be considered as potentially infective and handled with care to prevent injuries (2,5,6).

Used needles should never be recapped or otherwise manipulated utilizing both hands, or any other technique that involves directing the point of a needle toward any part of the body (2,5,6). Either a one-handed "scoop" technique or a mechanical device designed for holding the needle sheath should be employed. Used disposable syringes and needles, scalpel blades, and other sharp items should be placed in appropriate puncture-resistant containers located as close as is practical to the area in which the items were used (2,5,6). Bending or breaking of needles before disposal requires unnecessary manipulation and thus is not recommended.

Before attempting to remove needles from nondisposable aspirating syringes, DHCWs should recap them to prevent injuries. Either of the two acceptable techniques may be used. For procedures involving multiple injections with a single needle, the unsheathed needle should be placed in a location where it will not become contaminated or contribute to unintentional needlesticks between injections. If the decision is made to recap a needle between injections, a one-handed "scoop" technique or a mechanical device designed to hold the needle sheath is recommended.

STERILIZATION OR DISINFECTION OF INSTRUMENTS

Indications for Sterilization or Disinfection of Dental Instruments

As with other medical and surgical instruments, dental instruments are classified into three categories -- critical, semicritical, or noncritical -- depending on their risk of transmitting infection and the need to sterilize them between uses (9,37-40). Each dental practice should classify all instruments as follows:

Critical. Surgical and other instruments used to penetrate soft tissue or bone are classified as critical and should be sterilized after each use. These devices include forceps, scalpels, bone chisels, scalers, and burs.

Semicritical. Instruments such as mirrors and amalgam condensers that do not penetrate soft tissues or bone but contact oral tissues are classified as semicritical. These devices should be sterilized after each use. If, however, sterilization is not feasible because the instrument will be damaged by heat, the instrument should receive, at a minimum, high-level disinfection.

Noncritical. Instruments or medical devices such as external components of x-ray heads that come into contact only with intact skin are classified as noncritical. Because these noncritical surfaces have a relatively low risk of transmitting infection, they may be reprocessed between patients with intermediate-level or low-level disinfection (see Cleaning and Disinfection of Dental Unit and Environmental Surfaces) or detergent and water washing, depending on the nature of the surface and the degree and nature of the contamination (9,38).

Methods of Sterilization or Disinfection of Dental Instruments

Before sterilization or high-level disinfection, instruments should be cleaned thoroughly to remove debris. Persons involved in cleaning and reprocessing

instruments should wear heavy-duty (reusable utility) gloves to lessen the risk of hand injuries. Placing instruments into a container of water or disinfectant/detergent as soon as possible after use will prevent drying of patient material and make cleaning easier and more efficient. Cleaning may be accomplished by thorough scrubbing with soap and water or a detergent solution, or with a mechanical device (e.g., an ultrasonic cleaner). The use of covered ultrasonic cleaners, when possible, is recommended to increase efficiency of cleaning and to reduce handling of sharp instruments.

All critical and semicritical dental instruments that are heat stable should be sterilized routinely between uses by steam under pressure (autoclaving), dry heat, or chemical vapor, following the instructions of the manufacturers of the instruments and the sterilizers. Critical and semicritical instruments that will not be used immediately should be packaged before sterilization.

Proper functioning of sterilization cycles should be verified by the periodic use (at least weekly) of biologic indicators (i.e., spore tests) (3,9). Heat-sensitive chemical indicators (e.g., those that change color after exposure to heat) alone do not ensure adequacy of a sterilization cycle but may be used on the outside of each pack to identify packs that have been processed through the heating cycle. A simple and inexpensive method to confirm heat penetration to all instruments during each cycle is the use of a chemical indicator inside and in the center of either a load of unwrapped instruments or in each multiple instrument pack (41); this procedure is recommended for use in all dental practices. Instructions provided by the manufacturers of medical/dental instruments and sterilization devices should be followed closely.

In all dental and other health-care settings, indications for the use of liquid chemical germicides to sterilize instruments (i.e., "cold sterilization") are limited. For heat-sensitive instruments, this procedure may require up to 10 hours of exposure to a liquid chemical agent registered with the U.S. Environmental Protection Agency (EPA) as a "sterilant/disinfectant." This sterilization process should be followed by aseptic rinsing with sterile water, drying, and, if the instrument is not used immediately, placement in a sterile container.

EPA-registered "sterilant/disinfectant" chemicals are used to attain high-level disinfection of heat-sensitive semicritical medical and dental instruments. The product manufacturers' directions regarding appropriate concentration and exposure time should be followed closely. The EPA classification of the liquid chemical agent (i.e., "sterilant/disinfectant") will be shown on the chemical label. Liquid chemical agents that are less potent than the "sterilant/disinfectant" category are not appropriate for reprocessing critical or semicritical dental instruments.

CLEANING AND DISINFECTION OF DENTAL UNIT AND ENVIRONMENTAL SURFACES

After treatment of each patient and at the completion of daily work activities, countertops and dental unit surfaces that may have become contaminated with patient material should be cleaned with disposable toweling, using an appropriate cleaning agent and water as necessary. Surfaces then should be disinfected with a suitable chemical germicide.

A chemical germicide registered with the EPA as a "hospital disinfectant" and labeled for "tuberculocidal" (i.e., mycobactericidal) activity is recommended for disinfecting surfaces that have been soiled with patient material. These

intermediate-level disinfectants include phenolics, iodophors, and chlorine-containing compounds. Because mycobacteria are among the most resistant groups of microorganisms, germicides effective against mycobacteria should be effective against many other bacterial and viral pathogens (9,38-40,42). A fresh solution of sodium hypochlorite (household bleach) prepared daily is an inexpensive and effective intermediate-level germicide. Concentrations ranging from 500 to 800 ppm of chlorine (a 1:100 dilution of bleach and tap water or 1/4 cup of bleach to 1 gallon of water) are effective on environmental surfaces that have been cleaned of visible contamination. Caution should be exercised, since chlorine solutions are corrosive to metals, especially aluminum.

Low-level disinfectants -- EPA-registered "hospital disinfectants" that are not labeled for "tuberculocidal" activity (e.g., quaternary ammonium compounds) -- are appropriate for general housekeeping purposes such as cleaning floors, walls, and other housekeeping surfaces. Intermediate- and low-level disinfectants are not recommended for reprocessing critical or semicritical dental instruments.

DISINFECTION AND THE DENTAL LABORATORY

Laboratory materials and other items that have been used in the mouth (e.g., impressions, bite registrations, fixed and removable prostheses, orthodontic appliances) should be cleaned and disinfected before being manipulated in the laboratory, whether an on-site or remote location (43). These items also should be cleaned and disinfected after being manipulated in the dental laboratory and before placement in the patient's mouth (2). Because of the increasing variety of dental materials used intraorally, DHCWs are advised to consult with manufacturers regarding the stability of specific materials relative to disinfection procedures. A chemical germicide having at least an intermediate level of activity

(i.e., "tuberculocidal hospital disinfectant") is appropriate for such disinfection. Communication between dental office and dental laboratory personnel regarding the handling and decontamination of supplies and materials is important.

USE AND CARE OF HANDPIECES, ANTIRETRACTION VALVES, AND OTHER INTRAORAL DENTAL DEVICES ATTACHED TO AIR AND WATER LINES OF DENTAL UNITS

Routine between-patient use of a heating process capable of sterilization (i.e., steam under pressure {autoclaving}, dry heat, or heat/chemical vapor) is recommended for all high-speed dental handpieces, low-speed handpiece components used intraorally, and reusable prophylaxis angles. Manufacturers' instructions for cleaning, lubrication, and sterilization procedures should be followed closely to ensure both the effectiveness of the sterilization process and the longevity of these instruments. According to manufacturers, virtually all high-speed and low-speed handpieces in production today are heat tolerant, and most heat-sensitive models manufactured earlier can be retrofitted with heat-stable components.

Internal surfaces of high-speed handpieces, low-speed handpiece components, and prophylaxis angles may become contaminated with patient material during use. This retained patient material then may be expelled intraorally during subsequent uses (44-46). Restricted physical access -- particularly to internal surfaces of these instruments -- limits cleaning and disinfection or sterilization with liquid chemical germicides. Surface disinfection by wiping or soaking in liquid chemical germicides is not an acceptable method for reprocessing high-speed handpieces, low-speed handpiece components used intraorally, or reusable prophylaxis angles.

Because retraction valves in dental unit water lines may cause aspiration of patient material back into the handpiece and water lines, antiretraction valves (one-way flow check valves) should be installed to prevent fluid aspiration and to reduce the risk of transfer of potentially infective material (47). Routine maintenance of antiretraction valves is necessary to ensure effectiveness; the dental unit manufacturer should be consulted to establish an appropriate maintenance routine.

High-speed handpieces should be run to discharge water and air for a minimum of 20-30 seconds after use on each patient. This procedure is intended to aid in physically flushing out patient material that may have entered the turbine and air or water lines (46). Use of an enclosed container or high-velocity evacuation should be considered to minimize the spread of spray, spatter, and aerosols generated during discharge procedures. Additionally, there is evidence that overnight or weekend microbial accumulation in water lines can be reduced substantially by removing the handpiece and allowing water lines to run and to discharge water for several minutes at the beginning of each clinic day (48). Sterile saline or sterile water should be used as a coolant/irrigator when surgical procedures involving the cutting of bone are performed.

Other reusable intraoral instruments attached to, but removable from, the dental unit air or water lines -- such as ultrasonic scaler tips and component parts and air/water syringe tips -- should be cleaned and sterilized after treatment of each patient in the same manner as handpieces, which was described previously. Manufacturers' directions for reprocessing should be followed to ensure effectiveness of the process as well as longevity of the instruments.

Some dental instruments have components that are heat sensitive or are permanently attached to dental unit water lines. Some items may not enter the patient's oral cavity, but are likely to become contaminated with oral fluids during treatment procedures, including, for example, handles or dental unit attachments of saliva ejectors, high-speed air evacuators, and air/water syringes. These components should be covered with impervious barriers that are changed after each use or, if the surface permits, carefully cleaned and then treated with a chemical germicide having at least an intermediate level of activity. As with high-speed dental handpieces, water lines to all instruments should be flushed thoroughly after the treatment of each patient; flushing at the beginning of each clinic day also is recommended.

SINGLE-USE DISPOSABLE INSTRUMENTS

Single-use disposable instruments (e.g., prophylaxis angles; prophylaxis cups and brushes; tips for high-speed air evacuators, saliva ejectors, and air/water syringes) should be used for one patient only and discarded appropriately. These items are neither designed nor intended to be cleaned, disinfected, or sterilized for reuse.

HANDLING OF BIOPSY SPECIMENS

In general, each biopsy specimen should be put in a sturdy container with a secure lid to prevent leaking during transport. Care should be taken when collecting specimens to avoid contamination of the outside of the container. If the outside of the container is visibly contaminated, it should be cleaned and disinfected or placed in an impervious bag (49).

USE OF EXTRACTED TEETH IN DENTAL EDUCATIONAL SETTINGS

Extracted teeth used for the education of DHCWs should be considered infective and classified as clinical specimens because they contain blood. All persons who collect, transport, or manipulate extracted teeth should handle them with the same precautions as a specimen for biopsy (2). Universal precautions should be adhered to whenever extracted teeth are handled; because preclinical educational exercises simulate clinical experiences, students enrolled in dental educational programs should adhere to universal precautions in both preclinical and clinical settings. In addition, all persons who handle extracted teeth in dental educational settings should receive hepatitis B vaccine (6-8).

Before extracted teeth are manipulated in dental educational exercises, the teeth first should be cleaned of adherent patient material by scrubbing with detergent and water or by using an ultrasonic cleaner. Teeth should then be stored, immersed in a fresh solution of sodium hypochlorite (household bleach diluted 1:10 with tap water) or any liquid chemical germicide suitable for clinical specimen fixation (50).

Persons handling extracted teeth should wear gloves. Gloves should be disposed of properly and hands washed after completion of work activities. Additional personal protective equipment (e.g., face shield or surgical mask and protective eyewear) should be worn if mucous membrane contact with debris or spatter is anticipated when the specimen is handled, cleaned, or manipulated. Work surfaces and equipment should be cleaned and decontaminated with an appropriate liquid chemical germicide after completion of work activities (37,38,40,51).

The handling of extracted teeth used in dental educational settings differs from giving patients their own extracted teeth. Several states allow patients to keep such teeth, because these teeth are not considered to be regulated (pathologic) waste (52) or because the removed body part (tooth) becomes the property of the patient and does not enter the waste system (53).

DISPOSAL OF WASTE MATERIALS

Blood, suctioned fluids, or other liquid waste may be poured carefully into a drain connected to a sanitary sewer system. Disposable needles, scalpels, or other sharp items should be placed intact into puncture-resistant containers before disposal. Solid waste contaminated with blood or other body fluids should be placed in sealed, sturdy impervious bags to prevent leakage of the contained items. All contained solid waste should then be disposed of according to requirements established by local, state, or federal environmental regulatory agencies and published recommendations (9,49).

IMPLEMENTATION OF RECOMMENDED INFECTION-CONTROL PRACTICES FOR DENTISTRY

Emphasis should be placed on consistent adherence to recommended infection-control strategies, including the use of protective barriers and appropriate methods of sterilizing or disinfecting instruments and environmental surfaces. Each dental facility should develop a written protocol for instrument reprocessing, operatory cleanup, and management of injuries (3). Training of all DHCWs in proper infection-control practices should begin in professional and vocational schools and be updated with continuing education.

ADDITIONAL NEEDS IN DENTISTRY

Additional information is needed for accurate assessment of factors that may increase the risk for transmission of bloodborne pathogens and other infectious agents in a dental setting. Studies should address the nature, frequency, and circumstances of occupational exposures. Such information may lead to the development and evaluation of improved designs for dental instruments, equipment, and personal protective devices. In addition, more efficient reprocessing techniques should be considered in the design of future dental instruments and equipment. Efforts to protect both patients and DHCWs should include improved surveillance, risk assessment, evaluation of measures to prevent exposure, and studies of postexposure prophylaxis. Such efforts may lead to development of safer and more effective medical devices, work practices, and personal protective equipment that are acceptable to DHCWs, are practical and economical, and do not adversely affect patient care (54,55).

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Department of Health - Pretoria

02/04/19

Norms, Standards and Practice Guidelines for Primary Oral Health Care

EXECUTIVE SUMMARY

This document is divided into five parts, namely

Resource norms for primary oral health care;

Basic primary oral health care services;

Standards and criteria for primary oral health care delivery;

Standards and criteria for quality improvement in primary oral health care; and

Practice guidelines for primary oral health care.

The first part outlines the types and quantities of resources that are required for the delivery of primary oral health care. This includes facilities, personnel, equipment, instruments, transport, finances as well as consumables and essential drugs.

The second part of the document outlines what constitutes basic primary oral heath care services.

The third part describes standards and criteria to be met in order to effectively and efficiently manage the delivery of primary oral health care. The standards and criteria were developed for facilities, equipment, transport, finances, communication, health records, management, policies and procedures, as well as for health and safety.

The fourth part deals with standards and criteria that need to be met to improve the quality of care. These were developed on the utilisation of services, personnel training, papid intervention and service cost-effectiveness.

The last part deals with guidelines that have been developed for oral health personnel to ensure the safe and effective treatment of patients. The guidelines have been developed for infection control, radiation control, medical emergencies, treatment with drugs and medicines, treatment of oral manifestations of HIV and AIDS as well as for the prevention of bacterial endocarditis.

(Full document not included.)

SOUTH AFRICAN DENTAL PRACTICE GUIDELINES

Infection control guidelines for primary oral health care

Oral health personnel are exposed to a wide variety of microorganisms found in the saliva, blood, mucous membranes and skins of patients. Conversely, personnel may harbour microorganisms that they may also spread to their patients. The same may apply to the dental surgery and the equipment, from which microorganisms may also spread to patients and personnel.

The number of healthy carriers of infectious diseases (e.g. Hepatitis B) and persons with sub clinical and otherwise unrecognised infections, is far higher than that of identified cases. Hence, all personnel and patients must be regarded as potentially infectious, and meticulous infection control procedures should be strictly adhered to at all times.

Personnel are required by law to protect patients as well as themselves against any hazards resulting from their work (Occupational and Safety Act, Act 85 of 1993).

The following guidelines have been developed to protect patients and personnel against infectious diseases that might be transmitted during clinical procedures

1. Requirements for optimum infection control

- Personnel with knowledge of infection control
- Well maintained sterilization equipment which meets set specifications

- Environment and equipment that is amenable to infection control
- Autoclavable instruments and handpieces, where possible
- Adequate supply of material necessary for infection control e.g. disinfectants, protective wear etc
- Written infection control procedure.
- Infection control records.
- Equipment maintenance

2. Immunisation

Personnel should receive appropriate immunisation such as that for the Hepatitis B virus.

3. Procedure for infection control

Before patient treatment

- Obtain a thorough medical history.
- Place disposable covering over those areas and surfaces that are directly exposed during procedures.

During patient treatment

- Treat all patients as potentially infectious.
- Use protective attire and barrier techniques when contact with body fluids or mucous membrane are anticipated.
- Wear gloves, mask, protective eyewear as well as protective clothing.
- Remove attire when leaving the surgery.

- Open intra-orally contaminated x-ray film packets with disposable gloves. Avoid touching the film.
- Minimize droplet, spatter and aerosol formation during treatment procedures:
  - use rubber dam to isolate working area where appropriate;
  - use high volume vacuum evacuation/suction;
  - use rubber cups instead of brushes during polishing of teeth.
- Change gloves after every invasive procedure. For non-invasive procedures the same gloves can be used repeatedly provided gloves are washed thoroughly and disinfected between patients.

Use the aseptic technique: avoid contact with other equipment that is not in use during clinical procedures e g. telephones, cabinets, charts etc. If necessary to touch these items, use the double gloving method.

Protect hands

- Wash hands and dry them thoroughly before gloving, also wash and dry after removing gloves.
- Use appropriate hand washing technique.
- Keep nails short.
- Discard worn or torn gloves.
- Do not wear rings.
- Cover cuts or abrasions on hands with waterproof dressing prior to gloving.

- If there are exudative lesions on the hands refrain from performing invasive procedures.
- Avoid injury with sharp instruments and needles.
- Handle sharp items carefully.
- Do not bend or break used needles.
- If needles are not recapped, place separately.
- If recapping is necessary, use method that protects hands from injury (such holder for needle) or scooping the cap using the needle.
- Place used sharp disposable items into puncture-resistant containers immediately after use.

After patient treatment

- Wear heavy-duty rubber gloves
- Wash instruments thoroughly, submerging under cleaning solution.
- Sterilise instruments.
- Sterilise instruments that penetrate tissue and/or bone.
- Sterilise whenever possible, all instruments that come into contact with body fluids, mucous membranes or those contaminated with patient secretions, otherwise use appropriate disinfection.
- Clean handpieces, dental units and ultrasonic scalers.
- Sterilise all items that were used, and disinfect those that cannot be sterilised.
- Store sterilised items in sealed packages until used.
- Remove contaminated waste appropriately.
  - Pour blood and fluids into drain connected to a sanitary sewer system.

- Place solid waste contaminated with blood or saliva into in sealed, impervious bags and dispose according to the set regulations.

- Decontaminate environmental surfaces.
- Wipe working surfaces with absorbent towelling to remove debris, and dispose of this towelling appropriately.
- Disinfect with suitable disinfectant.
- Change protective coverings on light handles, x-ray unit head etc.
- Remove contaminated waste appropriately.
- Pour blood, suctioned fluids and other liquid waste into drain connected to a sanitary sewer system.
- Place solid waste contaminated with blood or saliva in sealed impervious bags and dispose according to set regulations.

Remove gloves and wash hands

Control of infection after accidental injury

Hand injuries

In the case of hand injuries caused by contaminated instruments or needles:

- remove glove;
- express blood under running water for one minute;
- wash with appropriate antiseptic; and
- apply a dressing.

Eye injuries

If splashes or foreign bodies get into the eyes:

- Rinse with sterile irrigating solution using an eye bath.

All injuries should be reported to the most senior staff member for recording and further action according to need.

Other information

- In a two-surgery clinic, reserve one clinic for surgical procedures only.
- Biological monitors should be used routinely to verify the adequacy of sterilisation cycles. Use chemical indicators for each load to be autoclaved.

Infection control for procedures outside the clinic environment

Screening

- Have adequate supply of initially sterilised instruments to allow for adequate disinfection between patients

Treatment (e.g. ART technique)

- Have adequate supply of instruments of pre-packed instruments for the number of patients to be treated.
- Follow all procedures in the clinic setting that are applicable.

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SOUTH AFRICAN GUIDELINES FOR THE MANAGEMENT OF OCCUPATIONALLY ACQUIRED HIV EXPOSURE E.G. NEEDLE STICK INJURIES WITH HIV+ BLOOD

The following recommendations will need to be reviewed on a regular basis and updated.

After one of the following exposures:

A blood contaminated needle stick injury or injury with another blood contaminated sharp instrument;
An occupationally acquired exposure of the above fluid to the mucous membranes (eye, mouth);
An occupationally acquired blood splash onto broken or diseased skin (such as 'weeping' eczema);

The following is recommended:

Immediately clean the area with antiseptic agent or rinse out the eye or mouth if these areas are exposed.

An attempt should be made, as soon as possible to determine HIV status of the source patient. If there is no record of the HIV status of the source patient, then an attempt should be made to obtain blood from the patient for this purpose. This

should be done in a proper and ethical manner with pre-test counselling and post-test counselling given to the source patient as well as the injured health worker. The source patient should be given the option of receiving or not receiving the result of the test. If the patient refuses to have his/her blood taken for an HIV test and if there is no record of a recent HIV test result, then a doctor caring for the patient should be consulted as to the likelihood of the patient being HIV positive.

Clinical signs indicating a higher likelihood of HIV infection include:

TB infection, signs of immune deficiency such as oral thrush (candidiasis) and/or hairy leukoplakia on the tongue, recent herpes zoster or molluscum contagiosum infection, Kaposi sarcoma, recurrent infectious conditions such as diarrhoeal diseases, pneumonia, meningitis, skin sepsis, unexplained weight loss, seborrhoeic dermatitis or persistent glandular lymphadenopathy.

If the source patient is HIV positive or in the absence of this information, if the patient has one or more of the clinical signs suggesting HIV infection above, antiretroviral therapy post exposure prophylaxis is recommended.

Post exposure prophylaxis (PEP)

Post exposure prophylaxis is recommended for any high-risk exposures.

High-risk exposures include:

percutaneous injuries with sharp instruments contaminated with HIV infected blood. Risk is higher if there is a large volume of blood;

if there is prolonged contact;

if the injury is deep;

if the instrument is of a hollow bore nature (e. g. syringe needle) and was previously in the source patient's vein or artery;

if the blood is actually injected;

if the source patient has clinical AIDS;

or a low CD4 cell count; and/or

a high HIV RNA viral load (titre).

Zidovudine (AZT in combination with Lamivudine should be routinely used for high risk exposures (volume of blood, deep injury, source patient features etc.) or if the source patient has been on Zidovudine for more than 6 months.

Post exposure prophylaxis should be initiated promptly, preferably immediately, within 1-2 hours after exposure. The interval after which there is no benefit from using PEP is not yet defined, however some experts consider 24-36 hours as being too late. Some experts still consider PEP 7-14 days after the exposure in cases where there is a highest risk exposure.

PEP should be continued for 4 weeks provided there are no serious drug toxicities, which may necessitate discontinuing the PEP.

In low risk exposures such as blood or other body fluids exposures to normal healthy skin, eye and mouth contamination, PEP can be given to a health worker, but this is not a strong recommendation and its use should be assessed by

balancing the lower risk of exposure with the uncertain efficacy and toxicity of the drugs.

If the source patient's HIV status is not known, initiating PEP should be decided on a case by case basis, based on the exposure risk and likelihood of HIV infection in known or possible source patients.

An ELIZA HIV test should be done and documented on the exposed health care worker at baseline (i.e. within 24 hours of the injury), at 6 weeks, 12 weeks and at 6 months. (In rare instances seroconversion can take place over a longer period than 6 months).

Tests for hepatitis B and C, syphilis, malaria etc. if deemed appropriate.

Supportive counselling should be available to the health care worker. The health worker should also consider using a barrier method for safer sexual practice. Avoidance of pregnancy in female health care workers is also recommended, until seroconversion is excluded.

If PEP is initiated, the health care worker should be seen and monitored by a clinician who has experience in HIV care and should be monitored for toxic effects from the medication.

If HIV positive seroconversion occurs, the health care worker should be referred for appropriate therapy for the HIV infection.

An appropriate and confidential reporting system should be present to document the exposure and the details of the source patient and the health care worker for medico-legal purposes and for possible compensation and insurance claims.

In addition the services should delegate responsible officials (clinic head) to oversee the provision, reporting and recording of occupationally acquired HIV exposure.

If the HIV test on the source patient is negative, then it can be assumed that there is an insignificant risk of exposure to HIV (unless there is reasonable information to suggest that the source patient is in the window period) and no further action is required except that of reporting.

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Addendum C

Cover letter to questionnaire

Addendum C

SCHOOL OF HEALTH TECHNOLOGY

2001-06-15

«Ref_No

Dr «Initials» «Surname»
«Addr1»
«Addr2»
«Addr3»
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Hierdie brief en vraelys is beskikbaar in Afrikaans, indien u dit sou verkies. Navrae sal beantwoord word per e-pos by: jeanneo@tofs.ac.za of faks 051 – 507 3354.

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Dear Dr «Surname»

INFECTION CONTROL IN DENTAL PRACTICES: IMPORTANT CIRCULAR TO ALL DENTAL PRACTITIONERS IN SOUTH AFRICA

One of the main objectives in the practice of operative dentistry is to provide the highest standard of care for the dental patient. Almost every patient going to the dental health provider will be exposed to some form of anxiety or stress. Providing a supportive, informal, relaxed and non-threatening dental environment must always be a major concern. There is an increasing emphasis being placed on assuring and demonstrating to patients that they are well protected from cross-infection within the dental practice. The universal use of protective gloves, masks, protective clothing, equipment disinfections and sterilisation of instruments now work together to provide an atmosphere that conveys protection and treatment according to the principles of infection control.

Private dentists may now charge additional fees for infection control (Tariff codes 8109 for "Infection control, per dentist, per hygienist, per dental assistant, per visit" and 8110 for "Provision of heat or vapour sterilized and wrapped instrumentation at the consulting rooms"). This is also used as a marketing tool and practice builder. Dental operators and patients are exposed to contact with traumatised tissue, saliva and blood – thus increasing the risk for cross-infection with high levels of contamination (1 drop of saliva contains up to 600 000 bacteria).

Central University of Technology, Free State

Addendum C

The protection and care of our patients and personnel is paramount, even more so with the AIDS epidemic in South Africa. International health and safety recommendations have to be adapted to the particular circumstances in South Africa (taking into consideration especially AIDS, viral hepatitis and TB).

To this effect, we would like to include you in this particular study. The aim of this study is to determine what sterilisation processes are used in dental practices in South Africa. Although we fully appreciate your busy schedule, we beg your indulgence for 15 to 20 minutes to complete the enclosed information sheet. The results will be presented at the IADR congress and published in a refereed scientific journal and will be made available to you as soon as possible.

Absolute measures will be taken to protect anonymity, and we also would like to give you the assurance that no data will be associated with any particular practice. All presentations and / or written reports will only make use of average / aggravated results, using the target practices as a whole.

Completed questionnaires should be returned no later than **20 July 2001**. The enclosed addressed envelopes can be used for return by mail (NO POSTAGE NEEDED – prepaid envelope). Return of the documentation can also be effected by calling Jeanné at 082 6024 177 or by faxing to 051-507 3354. This study will be extended in a further study of monitoring the sterilisation process effectiveness. A **complimentary package for testing** your autoclave will be delivered at you practice upon receipt of the completed forms. Depending on the demand, the testing process will be limited to a random selection due to the costs of the process.

Finally, we assure you of our continued commitment to promote safe dental practice and add to the improvement of quality services provided.

Sincerely

J. Oosthuysen

RESEARCHER IN CHARGE

Special acknowledgements to Prof. FJT Burke from the University of Birmingham for his inputs and help with the questionnaire.

Addendum D

Questionnaire

QUESTIONNAIRE ON INFECTION CONTROL TECHNIQUES USED IN SOUTH AFRICAN DENTAL PRACTICES: MONITORING AUTOCLAVES

Please complete NOW!

Completed questionnaires should be returned no later than 20 July 2001.

Please choose only ONE of the following (indicate your choice by placing "X" in the appropriate box), unless otherwise indicated:

SECTION A

1. Gender:

Male	1	Female	2

2. Home Language:

Afrikaans	1	Tswana	7
English	2	Venda	8
Xhosa	3	Ndebele	9
Zulu	4	Siswati	10
N-Sotho	5	Tsonga	11
S-Sotho	6	Other	12

3. Age:

< 25	1	41 – 45	5
26 – 30	2	46 – 50	6
31 – 35	3	> 50	7
36 - 40	4		

4. Current degree in dentistry obtained at:

Durban-Westville	1	Stellenbosch	4
Medunsa	2	Western Cape	5
Pretoria	3	Wits	6
Other (specify) _____			7

5. Number of years since qualification, in question 4 above, obtained:

< 5	1	16 - 20	4
6 - 10	2	> 20	5
11 - 15	3		

6. Currently practising as:

Dentist	1
Specialist (specify) _____	2
Not in practice (specify) _____	3
Other (specify) _____	4

7. Province in which you are working:

Western Cape	1	Kwa-Zulu Natal	6
Northern Cape	2	North West	7
Eastern Cape	3	Northern Province	8
Gauteng	4	Free State	9
Mpumalanga	5		

8. Location of your main practice:

City/Town centre (urban)	1	Rural area	3
Suburban area	2	Other (specify) _____	4

9. Sector in which you are working:

Private Sector	1	Not Practising	3
Public Sector	2		

10. Is your practice mostly (more than 50%):

Medical Aid Tariffs	1	SADA Tariffs	2
Other (specify) _____	3		

11. Please give an indication of the number of educational courses or CPD opportunities in infection control you have attended during the year 2000:

0	1	3 - 4	3
1 - 2	2	5 or more	4

12. Describe <u>your glove-wearing pattern</u> while treating patients:

Always	1	Never	3
For some patients/procedures	2	Indicate:	
Other (specify) _____			4

13. Describe <u>your dental assistant's glove wearing pattern</u> while treating patients:

Always	1	Never	3
For some patients/procedures	2	Indicate:	
Other (specify) _____			4

14. Describe <u>your glove "changing" frequency</u> in between patients:

After each patient	1	Never	3
For some patients/procedures	2	Indicate:	
Other (specify) _____			4

15. Describe your dental assistant's glove "changing" frequency in between patients:

After each patient	1	Never	3
For some patients/procedures	2	Indicate:	
Other (specify) _____			4

16. Frequency of wearing a mask while treating patients:

Always	1	Never	3
For some patients/procedures	2	Indicate:	
Other (specify) _____			4

17. How often do you put on a new mask while treating patients?

After each patient	1	Never	3
For some patients/procedures	2	Indicate:	
Other (specify) _____			4

18. Does your dental assistant wear a mask while treating patients?

Always	1	Never	3
For some patients/procedures	2	Indicate:	
Other (specify) _____			4

19. Products used for washing hands while treating patients:

Bar soap	1	Alcohol / disinfectant gel	3
Anti-bacterial liquid soap	2		
Other (specify) _____			4

20. Frequency of washing hands while treating patients:

Only before each patient	1	Before and after each patient	3
Continuously during procedures	2		
Other (specify) _____			4

21. Do you wear protective eyewear while treating patients?

Always	1	Never	3
For some patients/procedures	2	Indicate:	
Other (specify) _____			4

22. Does your dental assistant wear protective eyewear while treating patients?

Always	1	Never	3
For some patients/procedures	2	Indicate:	
Other (specify) _____			4

23. Method of pre-sterilisation debridement used (to clean before sterilisation):

Hand-scrubbing	1	Mostly hand-scrubbing with some ultrasonic	4
Ultrasonic cleaner	2	Not at all	5
Mostly ultrasonic with some hand-scrubbing	3		
Other (specify) _____			6

24. Method of instrument processing used on an instrument used for extraction (or other invasive procedure) – please choose ONE of the following:

Chemical solutions	1	Dry heat oven (hot air)	4
Autoclave (gravity enforced – bench top models)	2	Chemical vapour	5
Autoclave (flash or vacuum assisted – short cycle e.g. Statim)	3	Boiling water	6
Other (specify) _____			7

25. Do you treat patients who are regarded as high risk for AIDS or viral hepatitis?

Yes 1 No 2

26. Person overseeing quality control of the infection control department of your practice – please choose ONE of the following:

Practitioner (yourself)	1	Dental assistant	3
Oral Hygienist	2	Cleaning person	4
Other (specify) _____			5

27. Person actually performing the procedures of disinfection/sterilisation in your practice (mostly):

Practitioner	1	Dental assistant	3
Oral Hygienist	2	Cleaning person	4
Other (specify) _____			5

28. Does your practice have a practice manual with detailed protocols of sterilisation procedures, exposure control plan or infection control techniques?

Yes 1 No 2

Please apply your answers for the following questions for ALL members working in the clinical areas of your practice:

29. Please give us a breakdown of clinical personnel in your main practice:

		Number
a)	Practitioners	
b)	Dental Therapists	
c)	Oral Hygienists	
d)	Dental Assistants (Formally trained)	
e)	Dental Assistants (In-office trained)	
e)	Dental Technicians	
f)	Other (specify) _____	
g)	Total clinical staff:	

30. Do some or all of the following have formal training in cross-infection control?

		Yes	No
a)	Practitioners	1	2
b)	Oral Hygienists	3	4
c)	Dental Assistants (Formally trained)	5	6
d)	Dental Assistants (In-office trained)	7	8
e)	Other (specify) _____ _____	9	10

IF YOU DO NOT USE A STEAM AUTOCLAVE, PLEASE RETURN SECTION A BY MAIL IN THE ENCLOSED ENVELOPE MARKED 'SECTION A ONLY' AS SOON AS POSSIBLE.

This is done to protect your anonymity and these questionnaires will be processed seperately.

THANK YOU FOR YOUR TIME.

Your contribution makes a difference!

IF YOU DO USE A STEAM (HEAT UNDER PRESSURE) AUTOCLAVE STERILISER, PLEASE PROCEED TO SECTION B (e.g. Statim, Kavo Clave, Prestige Medical, Accord, Pelton & Crane and other).

Please complete both Sections A and B and return the entire questionnaire in the envelope marked "SECTIONS A & B".

If your practice has more than one autoclave, please apply your answers for this section for the autoclave used most commonly.

Section B Completed? **Yes** [1] **No** [2]

SECTION B

31. Trade name of your autoclave:

_____

32. Temperature, time and pressure cycle during usual operation of autoclave:

_____ °C at _____ minutes at _____ kPa (kilopascals) [1]

Don't know [2]

33. Age of your autoclave:

Less than one year	[1]	7-8 years	[4]
1-3 years	[2]	More than 8 years	[5]
4-6 years	[3]		

34. If your autoclave is more than one year old, has it ever been serviced?

Yes	[1]	No	[2]
Don't know	[3]		

35. If answered "YES" in question 34 above, state when last it was serviced:

Less than 6 months ago	[1]	13 to 18 months ago	[3]
7 to 12 months ago	[2]	More than 18 months ago	[4]

36. If "YES" in question 34 above, also state the reason for service:

Break down	[1]	Routine service (as prescribed by manufacturer)	[2]

Other (specify) _____ [3]

_____

37. Do you feel that your dental supplier provides sufficient support and information on autoclave maintenance?

Yes [1] No [2]

Sometimes (specify) _____ [3]

38. If "NO" in question 37 above, please indicate how you feel this can be improved:

_____

_____

_____

39. Do you use distilled water in your autoclave?

Yes [1] No [2]

40. If "NO", indicate what you use:

_____

41. Number of autoclaves in your practice: [ ][ ]

42. Number of practice staff members (including practitioner) physically packing and unpacking the autoclave: [ ][ ]

43. Number of different practitioners making use of the same autoclave for sterilisation: [ ][ ]

44. Number of patients treated on an average working day (by you and your hygienist/s):

1 - 10	[1]	21 - 25	[4]
11 - 15	[2]	More than 25	[5]
16 - 20	[3]		

45. Frequency of autoclave runs per day (for any instruments):

After every patient	[1]	5-10 times per day	[3]
1-4 times per day	[2]	More than 10 times per day	[4]

46. Method of sterilisation of hand pieces (turbine, slow, endodontic, straight, etc.):

Autoclave	[1]	None	[3]
Wiping / soaking in liquid chemicals	[2]		
Other (specify) _____			[4]

47. If answered "autoclave" in question 46, please indicate:

After every patient	[1]	5-10 times/day	[3]
1-4 times/day	[2]	More than 10 times/day	[4]

48. Do you cover your instruments in any way after sterilisation:

Yes [1] No [2]

49. If answered "YES" in question 48, are they

Covered with a lid or cloth	[1]	Wrapped	[2]
Other (specify) _____			[3]

50. Do you have a special storage facility for sterile instruments following removal from the autoclave?

Yes [1] No [2]

51. If "YES", specify facility _____

52. Do you check autoclave effectiveness in your practice?

Yes [1] No [2]

53. If "YES", indicate method – please choose ONE of the following:

Only by observing gauges / lights on autoclave	1	Only biological tests: Strips / ampoules	3
Only by colour changes on chemical strips / tapes	2		
Combination of methods 1 and 2 above			4
Combination of methods 2 and 3 above			5
Combination of methods 1 and 3 above			6
Combination of methods 1, 2 and 3 above			7

54. Frequency of monitoring / check of method as indicated in question 53:

		With every cycle	Once per day	Once per week	Once per month	Never
a)	Observing gauges / lights on autoclave	1	2	3	4	5
b)	Colour changes chemical strips / tapes	6	7	8	9	10
c)	Biological tests strips / ampoules	11	12	13	14	15
d)	Other (specify) _____	16	17	18	19	20

55. If NOT using biological tests, indicate reason:

_____

_____

56. How often do you (the practitioner) feel autoclave performance should be tested by members of your practice staff?

		With every cycle	Once per day	Once per week	Once per month	Never
a)	Observing gauges / lights on autoclave	1	2	3	4	5
b)	Colour changes chemical strips/tapes	6	7	8	9	10
c)	Biological tests strips / ampoules	11	12	13	14	15
d)	Other (specify) _____	16	17	18	19	20

57. How often do you (the practitioner) feel your autoclave should receive a routine maintenance service?

Every 3 - 5 months	1	Every 6 - 11 months	2
Once a year	3	Ad Hoc (only serviced when autoclave breaks down	4

58. Would you be interested in a postal/outsourcing autoclave testing service?

Yes 1 No 2

59. If answered "YES" in question 58, how much would you be prepared to pay for such a service?

R _____ per month

60. Comments

_____

_____

_____

_____

_____

_____

The researcher in charge will take precautions to ensure that:

Respondents who completed Section A only will remain anonymous.

Respondents who use autoclaves and completed Section B:

Only aggregated / average results are analysed. No individual survey results will be published.

To be able to test autoclave effectiveness, your co-operation in a further study will be very much appreciated. Please provide your name and physical address in order that we may supply you with a test package to test autoclave effectiveness. This includes three test packages - including chemical as well as biological indicators.

The three tests will be delivered at your practice, free of charge.

Practitioner:			
Physical address:			
	Postal Code:		
Postal address:			
	Postal Code:		
Tel no:	( )		
Fax no:	( )		
Cell Number:			
E-mail:			
Contact person:		**Capacity:**	

THANK YOU FOR YOUR TIME!!

Your contribution makes a difference!