

Workplace Health and Safety in Contemporary Dental Practice

2nd Edition



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About the author:

Laurence Walsh has been actively involved in research and education workplace health and safety for the past two decades, and has served since 1992 as an accredited workplace health and safety officer and radiation safety officer in the Faculty of Health Sciences at the University of Queensland. He has a particular interest in the safety issues associated with hazardous chemicals, non-ionizing radiation, and skin penetrating injuries. Laurence has served on a range of university, government and industry committees with responsibilities for health and safety matters, and contributed to the preparation of a number of national standards, guidelines and policies.

Disclaimer:

This manual provides general advice to dental professionals in Western Australia regarding the major health and safety matters which may impact upon their dental practice environment. It does not replace the need for expert medical or other professional advice in the event of significant problems with workplace health and safety issues.

Readers should be aware that while most occupational health matters are addressed in legislation or regulations at the WA state level, there are also national standards and local authority guidelines which may apply in some areas.

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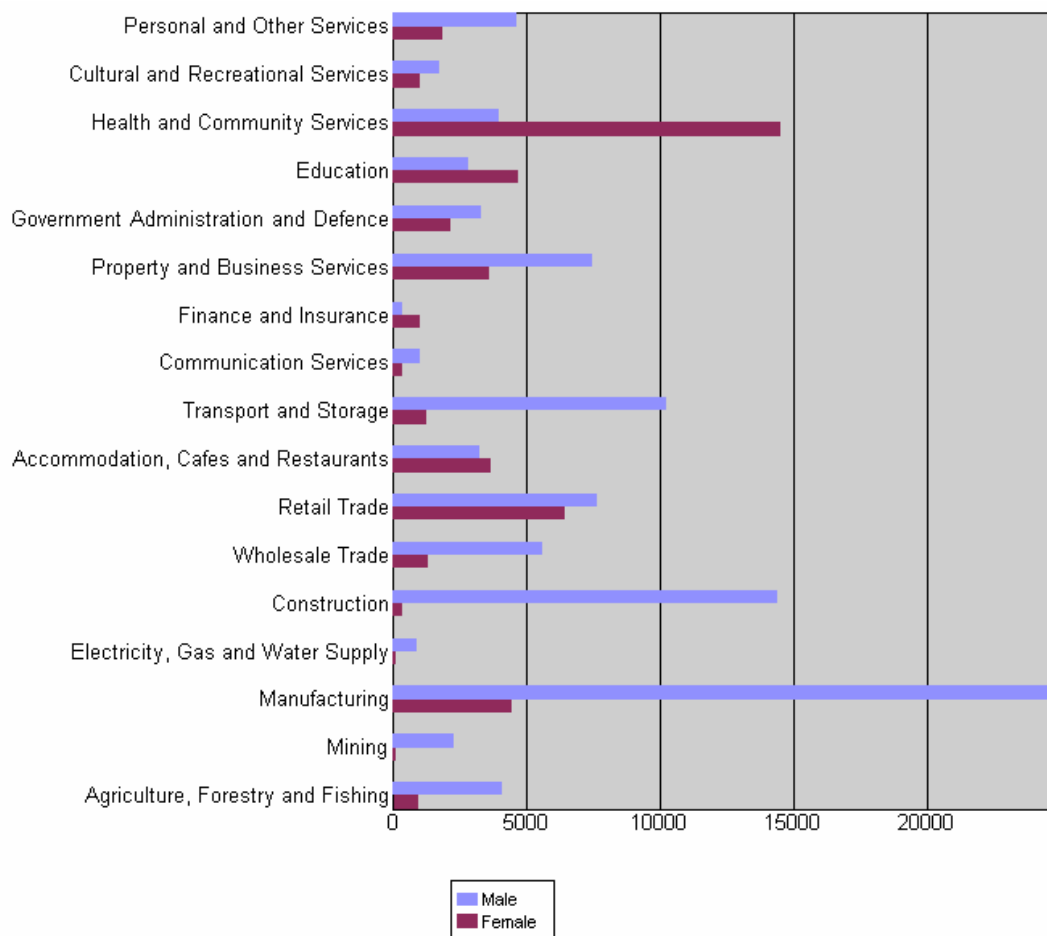
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Health and Safety Legislative Framework

Introduction

Australian health and safety law is governed by a framework of Acts, Regulations and support material including codes of practice and standards. The general purpose of these is to ensure the health and safety of all persons at work. In the dental context, this means valuing the health of people (staff and patients) as a key priority.

Despite common perceptions to the contrary, the industry grouping of “Health and Community Services” makes up a substantial proportion of reported workplace incidents, accidents and compensation claims. In the 2004-2005 financial year, nationally this industry group generated 18,485 accepted workers’ compensation claims (excluding journey claims) that resulted in a fatality, permanent incapacity or temporary incapacity with an absence from work of one working week or more. Female workers in this grouping accounted for 9.9% of all claims lodged by females, the highest figure of any industry. In WA, the health sector has had (over the 2001-2004 period) a higher rate of lost-time injuries (18.1 recorded injuries per million hours worked) than the average for all sectors of employment in WA (13.8).



Reported compensation claims for the July 2004-June 2005

Each state and territory has workplace health and safety legislation which prescribes specific obligations for employers and employees. In Western Australia, the agency charged with administering health and safety legislation is WorkSafe, which falls within the Department of Consumer and Employment Protection. The principal objectives of the occupational safety and health laws and regulations in Western

Australia are to promote and secure the safety and health of people in the workplace – employees as well as visitors, volunteers, supervisors, and members of the public.

Common law requires employers to provide their staff with:

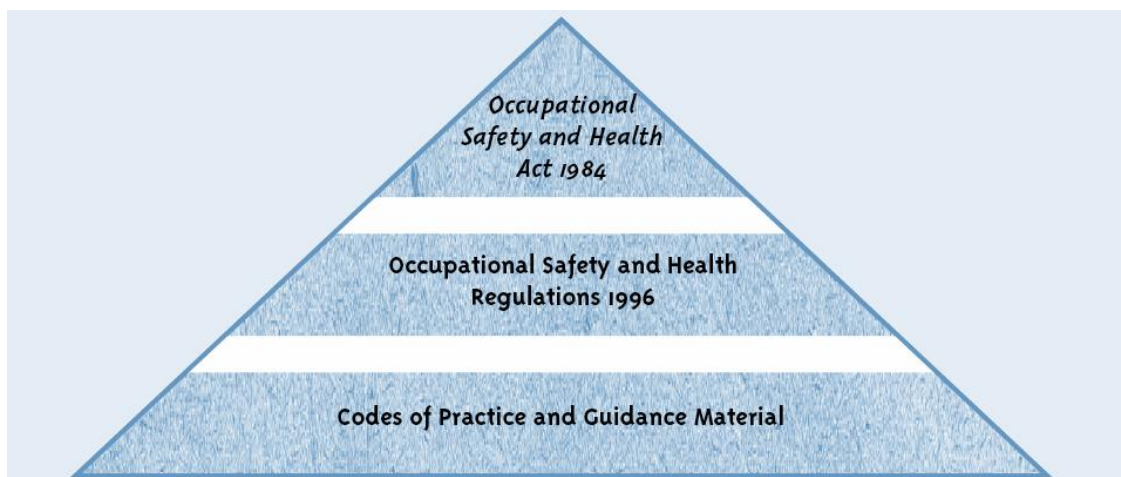
- A safe place of work
- A safe system of work
- Safe and proper plant and equipment
- Competent staff to manage and supervise.

Under common law, an injured staff member may be successful in suing for damages, if it can be shown that the injury or disease resulted from negligence on the employer's part. In addition, under criminal law there is also provision for manslaughter charges for negligence resulting in death.

The employer is in law responsible for any damage which an employee may suffer as a result of an act done by another member of staff in the course of employment if that act is negligent or otherwise constitutes a breach of duty. If any such act results in injury in circumstances which would entitle the injured person to recover this loss from the staff member, the injured person may sue the member of staff but also has the additional right to sue the employer. If a person suffers injury in circumstances in which no negligence or other breach of duty on the part of the staff member exists, the person will have no legal right against the practice or the staff member and, as a matter of law, must bear the loss personally.

Intent does not have to be proven for an employer (or employee) to be prosecuted for a breach of workplace health and safety legislation. This is also known as the principle of "absolute obligation", that is, if there are not systems in place to address workplace health and safety concerns in the workplace, negligence is established automatically.

The legislative framework is hierarchical, from Acts and Regulations forming the highest aspect (for which compliance is mandatory) through to Codes of Practice, Standards, and various Industry Specific Standards/Guidance Notes. The regulator, WorkSafe WA, looks across all areas of risk but targets eight particular areas of risk, in which lack of compliance is more likely to be followed with penalties and prosecutions. These areas are: Electricity, Forklifts, Hazardous substances, Manual handling, New and young workers, Slips and trips, Working at height, and Guarding. (see <http://www.docep.wa.gov.au/WorkSafe/>) The hierarchy in legislation is shown below, with the Act and Regulations forming the peak, where compliance with all provisions is mandatory.



OH&S Laws in Western Australia.

The Occupational Safety and Health Act 1984 established the Commission for Occupational Safety and Health which comprises representatives of employers, unions, government and experts. The Commission has the function of developing the legislation and any supporting guidance material and making recommendations to the Minister for implementation. To fulfil its functions the Commission is empowered to establish advisory committees, hold public enquiries and publish and disseminate information.

The Commission's objective is to promote comprehensive and practical preventive strategies that improve the working environment of Western Australians.

THE ACT

The Occupational Safety and Health Act 1984 provides for the promotion, co-ordination, administration and enforcement of occupational safety and health in Western Australia.

With the objective of preventing occupational injuries and diseases, the Act places certain duties on persons including employers, employees, self-employed persons, manufacturers, designers, importers and suppliers.

In addition to the broad duties established by the Act, it is supported by a further tier of statute, commonly referred to as regulations, together with lower tiers of non-statutory codes of practice and guidance notes.

Regulations

Regulations have the effect of spelling out the specific requirements of the legislation.

Regulations may prescribe minimum standards. They may have a general application or they may define specific requirements related to a particular hazard or a particular type of work.

Regulations may also be for the licensing or granting of approvals, certificates, etc.

Codes of Practice

A code of practice is defined in the Act as a document prepared for the purpose of providing practical guidance on acceptable ways of achieving compliance with statutory duties and regulatory requirements.

Codes of practice:

- * **should be followed, unless there is another solution which achieves the same or better result; and**
- * **can be used to support prosecution for non-compliance.**

Guidance Notes

A guidance note is an explanatory document issued by the Commission providing detailed information on the requirements of legislation, regulations, standards, codes of practice or matters relating to occupational safety and health.

The *Occupational Safety and Health Act 1984*

In broad terms, the purpose of the Act is to:

- promote and secure the safety and health of persons at work;
- protect persons at work against hazards;
- assist in securing safe and hygienic work environments;
- reduce, eliminate and control the hazards to which persons are exposed at work;
- foster cooperation and consultation between and to provide for the participation of employers and employees and associations representing employers and employees in the formulation and implementation of safety and health standards to current levels of technical knowledge and development;
- provide for formulation of policies and for the coordination of the administration of laws relating to occupational safety and health; and
- promote education and community awareness on matters relating to occupational safety and health. (Act, section 5).

The emphasis in the Act is that employers (and self-employed people) must ensure the health and safety of each of their workers and of themselves, and that the way their business is conducted does not affect the health and safety of other people. Workers, on the other hand, are obliged to follow safety instructions given by their employer, and to use personal protective equipment provided by the employer. They must not deliberately put the health of themselves or others at risk.

With respect to dental practice, the Act imposes workplace health and safety obligations on a wide range of persons, and in particular it applies to employers (such as practice principals or partners); self-employed people (such as contractors); supervisors (such as the senior dental assistant); other employees; volunteers; patients, and visitors (such as sales representatives).

'General duty of care' and 'general duties' are terms used to refer to the duties that the Act places upon people to ensure their own safety at work and that of others who are at the workplace or who might be injured by the work. These general duties are aimed at preventing anyone being killed, injured or contracting an illness because of work or activities at a workplace, including using plant or equipment.

The following people have general duties under the Act:

- Employers
- Employees
- Self-employed people
- Principals (people who engage contractors in the course of their trade or business)
- Contractors and persons engaged or employed by the contractor
- People who have control of workplaces or the access to or egress from a workplace
- Designers, manufacturers, importers or suppliers of plant or substances to be used at a workplace
- Erectors or installers of plant for use at a workplace
- Designers or constructors of buildings or structures for use at a workplace
- Agents who are in the business of hiring out workers (labour hire organisations) and their clients (host employers)
- Workers who are hired out to a host employer by a labour hire company
- People who are in a working relationship that mirrors a contract of employment but is not a contract of employment.
- Corporate bodies that engage workers under one of the labour relationships covered by the Act.
- Government of Western Australia
- People employed by the Government of Western Australia

The only workplaces in Western Australia which are not covered under the Act are mines, pipeline and petroleum operations, which are addressed under separate legislation [s. 50(2)]. The provision for applying for exemptions from particular regulations does exist [Regulation 2.13], however this requires demonstrating that compliance with a particular requirement of the Regulations would be unnecessary or impracticable.

Key sections of the Act are:

- s. 19. Duties of employers
- s. 20 and 41A: Duties and definitions of employees
- s. 21. Duties of employers and self employed persons
- s. 21B. Duties placed on body corporates
- s. 22. Duties of supervisors who have control of workplaces
- s. 23. Duties of manufacturers
- s. 23D. Contract work arrangements
- s. 23E. Labour hire arrangements
- s. 23I. Notification of serious injuries and diseases
- s. 23K. Reporting hazards and injuries
- s. 24-26. Resolution of workplace issues, and refusal to work on grounds of risk

A recurring logic is used throughout the Act, Regulations and Codes of Practice, namely that those who work with the hazards are best able to identify the risks and seek proper and workable solutions. This is well illustrated in part 3.1 of the regulations, which stipulates that an employer, contractor, or self employed person must, as far as practicable:

- identify each hazard to which a person at the workplace is likely to be exposed;
- assess the risk of injury or harm from each hazard, and
- consider the means by which the risk may be reduced.

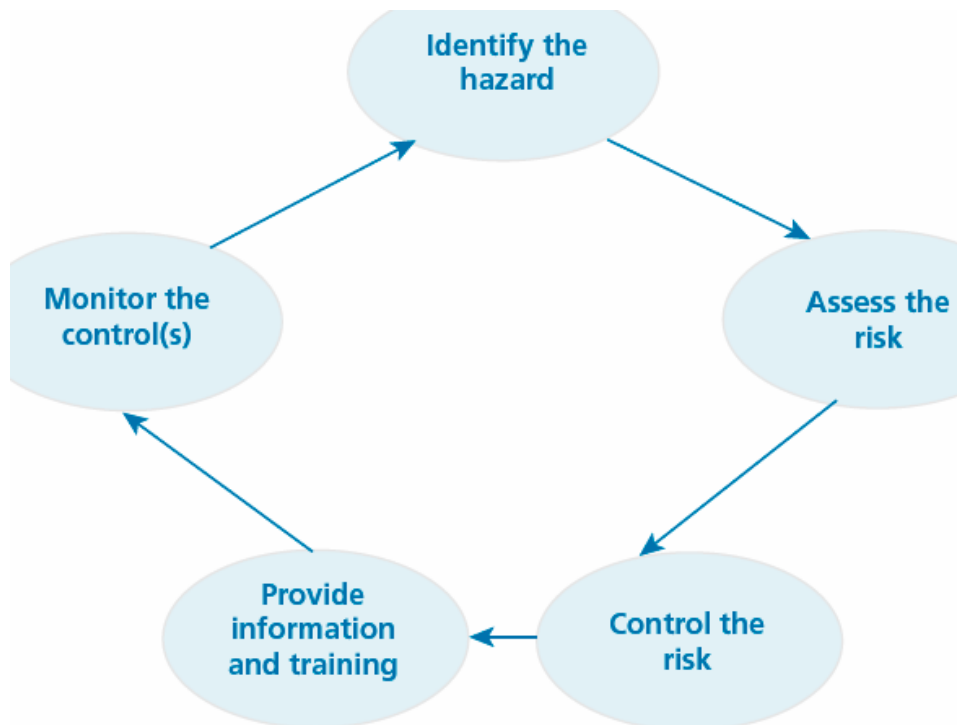
Under Section 19(1)(a) of the *Occupational Safety and Health Act*, employers have a duty to ensure, as far as practicable, that employees are not exposed to hazards at the workplace. The Regulations require employers to identify hazards, and assess and control risks.

The regulation outlines three basic steps:

- **Identification of hazards**
This involves recognising things which may cause injury or harm to the health of a person, for instance flammable material, ignition sources or unguarded machinery.
- **Assessing risk**
This involves looking at the possibility of injury or harm occurring to a person if exposed to a hazard.
- **Controlling the risk of injury or harm**
This involves introducing measures to eliminate or reduce the risk of a person being injured or harmed.

It is important to regularly review these steps, especially if there are changes in the work environment, new technology is introduced, or standards are changed.

Employers should consult with safety and health representatives, if any, and employees during these steps.



LIKELIHOOD OF INJURY OR HARM TO HEALTH	Consequences of any injury or harm to health			
	Insignificant: eg no injuries	Moderate: eg first aid/medical treatment	Major: eg extensive injuries	Catastrophic: eg fatalities
Very likely	High	Extreme	Extreme	Extreme
Likely	Moderate	High	Extreme	Extreme
Moderate	Low	High	Extreme	Extreme
Unlikely	Low	Moderate	High	Extreme
Highly unlikely (rare)	Low	Moderate	High	High

Extreme = immediate action

This means having trained and well informed staff, who are alert to hazards and aware of best practice. Employers have a legal obligation under Regulation 3.2 to, upon request, supply employees with up to date copies of the Act; the Regulations; relevant Australian Standards and NOHSC documents; and relevant codes of practice which apply to that workplace. Using the WorkSafe WA web site is a convenient way to access these materials.

Duties of employers [s. 19(1)]

Under the Act, employers must, as far as is practicable, provide and maintain a working environment in which their employees are not exposed to hazards.

A range of hazards may be present in the dental workplace. The following table lists some of the more common and generic workplace hazards.

HAZARDS	EXAMPLES	OUTCOMES (EXAMPLES OF INJURY OR HARM)
Manual handling	overexertion/repetitive movement	sprains, strains, fractures
Falls	falling objects, falls, slips and trips of people	fractures, bruises, lacerations, dislocations, concussion, permanent or fatal injuries
Electricity	electrical current, lightning	shock, burns, electrocution
Machinery and equipment	being hit, hitting objects, being caught in or between, over-turning vehicles	cuts, bruises, dislocations, fractures, amputation, permanent or fatal injuries
Hazardous substances	chemicals such as acids, hydrocarbons, heavy metals	toxic effects, dermatitis, respiratory illnesses, cancers
Extremes of temperature	effects of heat or cold	burns, frost bite, heat stress, heat stroke
Noise	excessive noise	permanent hearing damage
Radiation	ultra violet, welding arc flashes, micro waves, lasers	burns, cancer, damaged eye sight, blindness
Biological	viruses, bacteria, fungi, toxins	Hepatitis, Legionnaire's disease, Q Fever, tetanus, HIV/AIDS, allergies
Vibration	hands and whole of body	organ, nerve and muscle damage
Psychological stress	intimidation, organisational change, violence, conflict, time pressure	high blood pressure, headaches and migraine, anxiety, depression, absenteeism

The duties of employers include:

- providing and maintaining workplaces, plant, and systems of work such that, so far as is practicable, the employees are not exposed to hazards;
- providing appropriate information and training to, and supervision of, employees so that they perform their work in such a way as they are not exposed to hazards;
- consulting and cooperating with safety and health representatives (if any), and with employees, regarding occupational safety and health matters;
- where it is not practicable to avoid the presence of hazards at the workplace, providing the employees with adequate personal protective clothing and equipment, without cost; and
- making arrangements for
 - (i) the use, cleaning, maintenance, transportation and disposal of plant; and
 - (ii) the use, handling, processing, storage, transportation and disposal of substances, so that employees are not exposed to hazards.

Similar provisions apply to self-employed persons, who must take reasonable care to ensure their own safety and health at work [s. 21]. Note that coverage of the Act includes the members of body corporates (companies and similar entities), whose entities direct and control work [s. 21B]. In fact, section 55 of the Act stipulates that where a body corporate is guilty of an offence under the Act, and it occurred with

consent or neglect on the part of, any director, manager, secretary or other officer of the body, those individuals are also held to be liable. The Act also covers the situation where the building is under lease and there are maintenance and repair obligations to be appropriated to the building's owner and to the lessee [s. 22(10)]. These issues are expanded upon in parts 1.4-1.8 of the Regulations.

For employers, once workplace hazards have been identified as a "first step", there are standard ways to assess the risks arising from these hazards, as follows:

Risk assessment of the hazards identified in the first step should result in a list of potential injuries or harm and the likelihood of these occurring. The potential for fatal injury should be considered for each identified hazard. If hazards are listed they should be in the order of the most to the least serious, eg. from fatal to minor injury.

In assessing risks, consideration should be given to the state of knowledge about the frequency of injury or disease, the duration of exposure to injury or disease sources and the likely severity of the outcomes. Knowledge gained from similar workplaces or similar processes may be relevant to this risk assessment. Items to be considered include:

- **frequency of injury** - how often is the hazard likely to result in an injury or disease?
- **duration of exposure** - how long is the employee exposed to the hazard?
- **outcome** - what are the consequences or potential severity of injury?

Assessing these three factors will indicate the probability or likelihood of injury or harm occurring to workers involved in a particular work process. It also indicates the likely severity of this harm.

Risk assessment should include:

- assessing the adequacy of training or knowledge required to work safely;
- looking at the way the jobs are performed;
- looking at the way work is organised;
- determining the size and layout of the workplace;
- assessing the number and movement of all people on the site;
- determining the type of operation to be performed;
- determining the type of machinery and plant to be used;
- examining procedures for an emergency (eg. accident, fire and rescue); and
- looking at the storage and handling of all materials and substances.

This step should provide information on where and which employees are likely to be at risk of incurring injury or disease, how often this is likely to occur, and the potential severity of that injury or disease risk.

Following the risk assessment, and in conjunction and discussion with other staff members, decisions can then be made about what control measures are necessary for the particular risk, and in particular, whether the existing control measures are adequate. There is a hierarchy or preferred order in which control measures should be applied, as follows:

elimination - removing the hazard or hazardous work practice from the workplace. This is the most effective control measure;

substitution - substituting or replacing a hazard or hazardous work practice with a less hazardous one;

isolation - isolating or separating the hazard or hazardous work practice from people involved in the work or people in the general work areas from the hazard. This can be done by installing screens or barriers or marking off hazardous areas;

engineering control - if the hazard cannot be eliminated, substituted or isolated, an engineering control is the next preferred measure. This may include modifications to tools or equipment, providing guarding to machinery or equipment;

administrative control - includes introducing work practices that reduce the risk. This could include limiting the amount of time a person is exposed to a particular hazard; and

personal protective equipment - should be considered only when other control measures are not practicable or to increase protection.

Control measures are not mutually exclusive. That is, there may be circumstances where more than one control measure should be used to reduce exposure to hazards.

Duties of employees [s.20]

Employees must take reasonable care to ensure their own safety and health at work, and to avoid adversely affecting the safety or health of any other person through any act or omission. Note that contractors come under the definition of employees in the Act [s. 23D(2)], as do those under labour arrangements such as temporary staff from agencies [s. 23E and F].

Employees

- must comply, so far as they are reasonably able, with instructions given by the employee's employer for the safety or health of the employee or for the safety or health of other persons;
- must use the protective clothing and equipment provided by the employer in a manner in which they have been properly instructed to use it;
- must not misuse or damage any safety equipment;
- must report immediately to their employer workplace hazards that they cannot correct; as well as any injury or harm sustained in the course of, or in connection with, their work;
- must cooperate with the employer, and so help the employer fulfill their obligations under the Act.

Note that when notified of a safety hazard by an employee, an employer must, within a reasonable time after receiving the report, investigate the situation and determine what action, if any, is needed [s. 23K]. Where attempts to resolve an issue are unsuccessful, and where there is a risk of imminent and serious harm or injury, WorkSafe may be notified and this will trigger a visit from an inspector [s. 25(1)].

Employees may refuse to work where there are reasonable grounds to believe that to continue to work would expose them or any people to a risk of imminent and serious harm or injury [s. 26(1)], however there are a range of special additional measures which need to be addressed and these albeit rare situations are dealt with in sections 26-28 of the Act. It is an offence under section 56(1) of the Act to discriminate against an employee because they have given assistance or information to a WorkSafe inspector, or made a complaint to WorkSafe WA.

The issue of what injuries require immediate reporting to WorkSafe WA (by telephone or in writing) is addressed in section 23I(2)(a) of the Act and Part 2.4 of the Regulations. These include:

- bony fractures of the skull, spine or pelvis;
- a fracture of any major bone in the arm or leg;
- amputation of any part of a digit or limb;
- the loss of sight of an eye; and
- any other injury which, in the opinion of a medical practitioner, would prevent the employee from being able to work for 10 days.

For work in health care settings such as dentistry, where work involves exposure to human blood and body fluids, notifiable occupationally acquired diseases comprise:

- tuberculosis
- viral hepatitis
- Legionnaires' disease
- HIV (Regulation 2.5).

Duties of suppliers and manufacturers

Individuals who design, manufacture, import or supply equipment have obligations under the Act [s. 23]. Similarly, individuals who manufacture, import or supply any substances to a workplace must provide adequate toxicological data, and information on safe use, handling, processing, storage, transportation and disposal procedures, when the substance is first supplied, and thereafter whenever requested.

What to comply with? The regulator's perspective

In ensuring compliance with the Act and regulations, WorkSafe inspectors have a wide range of powers under section 43 of the Act, including the power to:

- enter, inspect and examine the workplace at reasonable times of the day or night;
- examine any equipment, substances or materials at the workplace;
- take samples, photographs and measurements;
- examine and make copies or extracts of any document;
- require that the workplace, or any part of it, be left undisturbed
- interview current staff and those who have worked during the preceding 3 years.

Under section 47 of the Act, a person cannot:

- obstruct or interfere with the work of an inspector
- use any threat or any abusive or insulting language to an inspector
- give false or misleading information, even if to do so might tend to incriminate the person or make them liable to a penalty.

To rectify areas of non-compliance, inspectors may issue improvement or prohibition notices, the latter being the more serious and employed in situations where there is a risk of imminent and serious injury [s. 49]. Under section 51 of the Act, provisional improvement notices may also be issued a safety and health representative who has completed a course of training prescribed for the purposes of this definition, when certain conditions are met including consultation with the affected individuals [s. 51AD].

Put simply, in WA, all provisions of the Act and the *Occupational Safety and Health Regulations 1996* ("The Regulations") must be complied with. Conversely, compliance with the mandatory requirements is a

defense from prosecution, since only breaches can be enforced by the regulator, i.e. WorkSafe WA. Breaches of the Act or Regulations will certainly elicit action, typically in the form of an Improvement Notice. A failure to comply with a provision of a Code of Practice (without a breach of the Act or Regulations) does not, however, place a person at risk of prosecution [s. 57(7)].

The type of enforcement action taken by the regulator depends on the circumstances of the case, in particular the seriousness of the breach. Action that could be taken includes improvement notices, prohibition notices, prosecution in the industrial courts, verbal directions, or any combinations of these. Verbal direction relates only to those situations where a breach is noted by an inspector and the breach can be rectified immediately (and this action confirmed by the inspector) whilst the inspector is still on site. If an inspector gives a verbal direction or issues a notice, this will be conveyed to the employer, safety and health representatives or safety and health committee or any other relevant individuals in person at the time of the visit.

Prosecution

In serious situations where an inspector obtains sufficient evidence to establish a prima facie case, and there is a reasonable prospect of a conviction, prosecution may be initiated, either instead of, or in addition to applying alternative enforcement actions. Such circumstances would include:

- where the issue of a notice is not sufficient for ensuring compliance with the Act or Regulations;
- where the breach either has resulted, or could have resulted, in a fatality or serious injury;
- failure to comply with an improvement or a prohibition notice;
- where a person has repeated the same offence;
- in cases of discrimination against an employee for any action in relation to occupational safety and health;
- breaches of the consultative provisions of the Act; and
- obstruction of an inspector.

Particular attention will be paid to events where gross negligence is evident, for example, where the offender knew that their actions would be likely to cause death or serious harm [s. 18A]. Fines for employers and employees for breaches of the Act are given in sections 3A and 20A. A breach of the Act does not have to result from an accident or a person being injured at work. For example, a dangerous piece of unguarded rotating machinery being used in the workplace would in itself constitute a breach.

A prosecution for a health and safety breach will be initiated by the regulator where three conditions are fulfilled: (1) the inspector obtains sufficient evidence to establish a prima facie case (i.e. whether the evidence could lead to the conclusion, *beyond reasonable doubt*, that all the elements of the offence have been proved); (2) there is a reasonable prospect of success; and (3) it is judged to be in the public interest. Where a serious injury or fatality occurs, and charges under the Criminal Code charges may be warranted, WorkSafe alerts the WA Police Service and/or Coroner's Office. WorkSafe's "Enforcement Policy" and "Prosecution Policy" are both provided in full on the Worksafe WA web site, which explains how decisions to institute and continue a prosecution are made, and how the appeals process operates.

(<http://www.worksafe.wa.gov.au/newsite/worksafe/content/worksafe/polygen10002.html>),

If a prosecution is initiated, codes of practice and Australian Standards are admissible as evidence in those proceedings [s. 53(3)]. A code of practice may include standards, rules, and specifications prepared by WorkSafe or by other body, and these codes may incorporate by reference such other documents [Act s. 57(2); Regulations part 1.12].

Further reading:

- *Occupational Safety and Health Act*, 1984.
- *National OHS arrangements*. Worksafe Australia submission: Industry Commission Inquiry into OHS arrangements in Australia. [Sydney] - Worksafe Australia. pp. 151-164. 1994.
- *OHS laws explained: The legal framework*. NOHSC, July 1998.

- T Whitty. No safety systems? Guilty as charged! *eLaborate*, May-June 2004, p. 10.
- *AS ISO 9001 & 9002*.
- *Think Worksafe: The Next Step*. Worksafe WA, WorkSafe Division of the Department of Consumer and Employment Protection.
- *WorkSafe Plan*. WorkSafe WA, 1999.

Recommended web sites

WorkSafe WA

<http://www.docep.wa.gov.au/WorkSafe/>

Links to OH&S resources

http://www.docep.wa.gov.au/WorkSafe/Content/Services/Useful_links/Useful_links.html

WorkCover WA

<http://www.workcover.wa.gov.au/>

Environmental Protection Authority (EPA) WA

<http://www.environment.wa.gov.au/>

Australian Safety and Compensation Council

<http://www.ascc.gov.au/>

ASCC Collated injury statistics – searchable database

<http://nosi.ascc.gov.au/>

Appendix 1:

The following section presents major points from WorkSafe Plan, published by WorkSafe Division of the Department of Consumer and Employment Protection.

The WorkSafe Plan can be used to:

- provide information on desirable safety management practices;
- identify the strengths and weaknesses of management systems;
- provide a measure for safety performance; and
- direct attention to areas that could be improved.

The Plan has five elements:

- Management Commitment;
- Planning;
- Consultation;
- Hazard Management, and
- Training

with 50 indicators in total.

Key indicators for dental practice settings include the following:

- There is an occupational safety and health policy that is up to date.
- Everyone in the practice understands the general requirements of OH&S laws.
- Everyone is accountable for occupational safety and health in their area of responsibility.
- The person who is the employer has identified the general responsibilities that apply to him / her under occupational safety and health laws.
- There are arrangements for the safety of visitors (including patients).
- There are emergency procedures.

- Training is organised to reduce the risk of work-related injury and disease.

(Employers need to provide all employees with training to make sure they understand and can meet their responsibilities under occupational safety and health laws. New employees and employees who have been away from work for an extended period, are particularly vulnerable to injury. It is essential these employees are given adequate training and supervision. Traditionally employees may have learnt the job by being assigned a "buddy". This method is not acceptable to satisfy the duty of care requirements. Training must be planned, systematic and assessed.)

- There is consultation regarding OH&S management, hazard management, and training needs.
- There is a process for reporting work-related injuries and diseases, including first aid treatments.
- Injuries and diseases are reported and investigated.

(It is important for the practice to investigate all work-related injuries and diseases to determine their primary causes and to take action to prevent similar events in the future. This includes minor injuries resulting in the need for first aid treatment. The extent of time and other resources to complete an investigation should be appropriate to the level of risk associated with the event).

- Recommendations to improve safety at work are acted upon.
- Work activities have been analysed to identify hazards and assess risks, and to develop safe working procedures.

(Analysis of work activities, specifically to improve safety, should focus on those work activities where there is the potential for serious injury or disease. Infrequent activities and/or work activities where there are changes to standard operating procedures must also be considered, however).

A hazard means anything that may result in injury or harm to the health of a person.

Risk, in relation to any injury or harm, means the probability of that injury or harm occurring.

- A hierarchy of controls is used to reduce risks, and these are planned in a systematic way using information from risk assessments. The hierarchy is as follows:
 1. ELIMINATION: Eliminate the hazard.
 2. SUBSTITUTION: Use a safer alternative
 3. ENGINEERING CONTROLS: Use engineering solutions to reduce the risk of injury or harm.
 4. ADMINISTRATIVE CONTROLS: Reorganise the work and provide training, to reduce the risk of injury or harm. (Changing the pace of work for inexperienced staff; job rotation; providing instruction, training and supervision; restricting access to certain areas or tasks)
 5. PERSONAL PROTECTION: Using personal protective clothing (e.g. gloves, masks, gowns, eyewear) to provide extra safety. Note that PPE is in itself the least effective way of dealing with hazards. There should be training in how to use and maintain PPE, as well as supervision to ensure it is used properly).

For further information, see www.safetyline.wa.gov.au/worksafeplan

Appendix 2: The Act

The Occupational Safety and Health Act 1984 provides for the promotion, co-ordination, administration and enforcement of occupational safety and health in Western Australia. It emphasizes the prevention of accidents and injury. The State Law Publisher provides an electronic copy of the Act and Regulations. The State Law Publisher progressively amends its documents to include any legislative changes.

The Act places duties on employers, employees, self-employed people, manufacturers, designers, importers and suppliers. The Act is supported by a further tier of statute, commonly referred to as regulations, together with a lower tier of non-statutory codes of practice and guidance notes.

Under the Act, there are three types of instruments to help individuals meet their workplace health and safety obligations - regulations, Australian Standards and Codes of practice.

- If a regulation exists, individuals must comply with that regulation before any code of practice or guidance note.
- If an Australian Standard, or part of a standard is referred to in a regulation, the standard or relevant part of the standard must be complied with.
- If there is no regulation about a risk but there is a code of practice or guidance note, the individual must either do what the code of practice or guidance note says; or adopt and follow another way that gives at least the same level of protection against the risk.

If there is no regulation or code of practice about the risk, the individual must choose an appropriate way and take reasonable precautions and exercise proper diligence to ensure they meet their obligations. Note that there is a specific code of practice for public sector employees (Occupational Safety and Health in the Western Australian Public Sector).

An important matter in terms of the legislation is the term “practicable”. If something is practicable, it is capable of being done. Whether it is also reasonable takes into account common practice and knowledge, and the cost of putting safeguards in place, measured against the consequences of failing to do so.

LEGISLATIVE FRAMEWORK IN WESTERN AUSTRALIA

How can I meet my obligations?

Under the Act, there are two types of instruments to help you meet your workplace health and safety obligations - regulations and codes of practice.

If there is a regulation about a risk – you must comply with the regulation.

If there is a code of practice about a risk, you must either:

- do what the code says; or
- adopt and follow another way that gives the same level of protection against the risk.

If there is no regulation or code of practice about the risk, you must choose an appropriate way and take reasonable precautions and exercise proper diligence to ensure you meet your obligations.

Appendix 2: Contact details

Department of Consumer and Employment Protection – WorkSafe Division
1260 Hay Street, WEST PERTH, WA 6005
Telephone: 1300 307 877
Facsimile: (08) 9321 8973
Website: www.worksafe.wa.gov.au
E-mail address: safety@docep.wa.gov.au

Health and safety management in the dental office

Hazards in the dental office can be classified as follows:

- gravity e.g. falling objects, falls of people;
- postural and ergonomic problems
- mechanical energy e.g. being caught between, struck by, struck against objects;
- strains and sprains
- cuts, lacerations, and skin penetrating injuries
- psychological stress
- assault
- fire and flammable items
- built environment (airconditioning, etc)
- manual handling of items or people
- kinetic energy e.g. projectiles, penetrating objects;
- thermal energy e.g. spills and splashes of hot matter;
- extremes of heat e.g. autoclaves, burners and hand-held mini-flames, hot water;
- extremes of cold e.g. dry ice and dichlorodifluoromethane used for pulp sensibility testing;
- non-ionizing radiation e.g. high intensity visible light, lasers;
- ionizing radiation e.g. from X-ray equipment
- sound e.g. hearing damage;
- biological e.g. bacteria, viruses, and other microorganisms;
- electrical and electromedical risks e.g. shock, burns, magnetic fields
- occupational skin disease
- repetitive strain injury
- vibration e.g. to hands; and
- hazardous chemicals.

Clearly, hazards with the highest levels of exposure to staff and the greatest biological consequences pose the highest risk and thus should attract the highest priority, e.g. infection control risks, ionizing radiation, and electrical hazards. Occupational skin disease (irritant contact dermatitis) affects more than 80 percent of dental staff, and is a significant concern even though not life threatening. At the same time, it should be remembered that postural and ergonomic problems, and occupational overuse disorders account for a sizeable proportion of chronic problems in the dental workforce which cause limitations of working hours.

Of the above hazards, the lowest risk is hearing damage. Noise level surveys in dental practices indicate that noise is rarely a problem if the equipment used is modern and is well maintained. Air turbines and ultrasonic scalers are major noise sources in the dental operatory, whilst grinding and cutting activities are the major source in the dental laboratory. Air compressors and vacuum systems can create significant noise when in operation, however these are often located externally or in confined spaces with some level of soundproofing material added to limit the nuisance noise which they create.

According to the Regulation, hearing protection is mandatory when the sound level exceeds 84 decibels (weighted to the response of the human ear) (Regulation 3.45). This is based on an 8 hour equivalent continuous A weighted sound pressure level expressed as a steady noise level, determined in accordance with AS1269. Because hearing damage is cumulative, it is prudent for dental staff to limit their exposure to self-induced intense noise sources outside the workplace, such as loud music. Early hearing loss tends to affect the highest frequencies and this makes conversations more difficult to hear when there is some level of background noise present (as is usually the case in a dental practice or dental laboratory).

Noise Level dB(A)	Exposure Time
85	8 hours
88	4 hours
91	2 hours
94	1 hour
97	30 mins
100	15 mins
103	7 ¹ / ₂ mins

Noise levels that are equal to the legal exposure limit (from the *Code of Practice: Managing Noise at Workplaces*).

Poor performance in health and safety may have tangible negative effects on the operation of a dental practice.

When considering the factors which contributed to a workplace incident or accident, a systematic approach will identify the contributory factors and in so doing provide information on preventive strategies. Many mishaps are caused by fatigue, ignorance, haste, defective equipment, carelessness, clutter, inadequate space, inadequate lighting, improper storage, stupidity, or inattentiveness.

Poor design of the workplace is a major contributor to accidents. For example, sharp corners from drawers and cabinets will eventually lead to an injury, while heavy items stored on high shelves will most likely cause a strain or impact injury when moved some time later. Electrical leads and hoses running across the floor pose a trip hazard, while spilled liquids and areas of wet flooring will likely contribute to a fall. All dental staff should be attentive to the potential hazards in their work environment, and bring such items to attention.

Immediate cause of accidents and near-miss incidents include:

- Human error, due to
 - Stresses (mental or physical) which are beyond the ability of the worker to cope
 - Poorly designed workplaces or equipment
- Substandard or unsafe conditions, including
 - Congested work spaces
 - Limited accessibility
 - Awkward posture
 - Poor working layout
 - Poor housekeeping
 - Poor lighting
 - Inadequate ventilation or excessive noise
 - Too hot/cold
 - Uneven or slippery flooring
 - Defective equipment or ineffective safety devices
- Substandard or unsafe practices (standard work procedures which are inferior to established industry standards, or are inherently dangerous)

- Using the wrong equipment
- Working at an unsafe speed
- Working without adequate training
- Not using protective equipment
- Horseplay
- Taking short-cuts

Basic causes of accidents and incidents are the reasons or factors (management failures) that permitted the existence of the above unsafe practices, unsafe conditions or human errors, include:

- Lack of training, knowledge or skills (“Why was the task performed incorrectly?”)
- Physical or mental limitations of the worker
- Lack of defined work procedure or policy
- Ineffective procedures or policies
- Lack of supervision, so that compliance is not monitored and enforced
- Failure to identify or report hazards
- Improper selection of equipment
- Inadequate construction parameters for the workplace (“Too cramped?”)

Identifying these then prompts actions to address both the immediate (obvious) and basic (underlying) causes. For example, sharps injuries during instrument cleaning are most likely to occur when dental assistants are inexperienced, tired, and under high time pressures.

The “hidden costs” of accidents include:

- The lost time of the injured worker,
- The time taken for first aid
- The cost of first aid supplies
- The time taken to prepare the accident report form and investigate the incident.
- Lost time for staff to attend an outside medical practice for serological follow-up after injuries,
- Costs of medical consultations and pathology tests, and
- Loss of discounts or rebates from workers compensation schemes (which vary according to claim history).
- Costs of serological tests and follow-up
- The financial impact of
 - lowered morale,
 - retraining,
 - staff redeployment and
 - lost productivity.

General safety advice for staff:

- For clinical procedures, always work with a third person present – either the dental assistant or another individual.
- Follow guidelines for cross-infection control, radiation hygiene and mercury hygiene stringently
- Report malfunctioning equipment and unsafe working situations promptly
- Wear appropriate personal protective equipment whenever at work in the dental surgery or sterilizing room environment
- Do not eat whilst in the dental surgery, sterilizing room, or dental laboratory areas of the practice
- Report and record all workplace injuries

For the protection of patients:

- Do not leave a patient unsupervised in the dental chair
- Check medical histories carefully and update them regularly
- Always use rubber dam for endodontic treatment

- Ensure that patients have suitable eye protection for all clinical procedures
- Never pass instruments or materials over the patient's face
- Do not place objects on the patient's bib or elsewhere on their chest

Pathways and Mechanisms:

The risk management approach to workplace health and safety involves the following steps:

- Identify the hazard:
 - What is it?
 - Have there been injuries or incidents relating to it?
 - If so, what were the basic causes of these? Poor work environment, lack of training, lack of supervision, etc? (see below)
- Assess the risk:
 - Who is at risk?
 - What types of workers?
 - How many individuals?
- What is the exposure level?
 - Rare
 - Infrequent
 - Occasional
 - Frequent
 - Continuous
- What are the possible consequences?
 - first aid treatment
 - serious illness or injury (requiring admission to hospital)
 - death
- Given the above, what is the risk score
 - High
 - Moderate
 - Low/acceptable
- What short-term/immediate control measures are needed?
- What long term control measures are needed?
 - Elimination of the hazard at its source.
 - Substitution of a less hazardous substance or practice.
 - Reduction in the hazard at its source.
 - Removal of employees from the hazard.
 - Containment of the hazard by enclosure or isolation.
 - Reduction of employee's exposure to hazard by administrative controls such as rostering.
 - Utilization of personal protective equipment.
- Apply the control measures. Do these introduce any new hazards?
- What follow-up is required to assess how effective the controls have been?

A simplified checklist for the dental practice setting

The owners and managers of a dental practice have a legal and ethical responsibility to provide staff with a safe working environment. Practitioners who are renovating their existing dental practice or intending to move to new premises need to take into account workplace health and safety issues. The following section addresses issues for the "built environment" of a dental practice.

1. Working areas (Regulations 3.13-3.15)

- Patient treatment and instrument cleaning areas should be separated.
- Staff eating and changing areas must be separate from work areas and patient treatment areas.
- An employer should provide workers with reasonable access to hygienic facilities for eating meals at work. The type of facility provided should be appropriate to the nature of the work, the number

of workers and the working environment. As a minimum requirement, access to a separate area needs to be provided that is equipped with a sink, a clean and hygienic storage cupboard, an appliance in which to boil water to make tea or coffee, and running water (preferably hot and cold) for washing utensils such as crockery and cutlery.

- Food should not be stored in refrigerators with clinical specimens or medical products such as drugs.
- There should be sufficient floor area for staff to move about in their normal tasks.
- There should be sufficient toilets for the needs of females and males. The Building Code of Australia, administered by local government, requires suitable toilet facilities be provided in a convenient location within or associated with a building. Advice on calculating the number of toilets required should be sought from local government when planning a new building, adding to an existing building or altering the use of an existing building. In some small businesses where there may be only a few workers and the privacy of males and females can be assured, it may only be necessary to provide one toilet.
- Footrests should be provided for reception/office staff who would normally work in a seated position.
- Office areas where workers are seated for extended periods should be designed using ergonomic principles, to prevent injuries from twisting and reaching whilst seated. Seating must be of a type and design enabling the work to be performed in a safe and ergonomically sound working position. This means it should be fully adjustable, provide suitable body support and be appropriate to the type of work performed.
- Work practices should be arranged so that employees are protected from extremes of heat and cold.
- Heating and cooling should be provided to enable employees to work in a comfortable environment.
- Cool drinking water (< 24 degrees Celsius) must be available to staff. Drinking water supply points should be placed where they can be readily accessed. Where the water is not delivered in an upward jet, a supply of clean or disposable cups or glasses must be available.
- All water used for drinking should conform to the National Health and Medical Research Council Australian Drinking Water Guidelines (EH19, 2004).

2. Ventilation

- Ventilation should be sufficient to maintain atmospheric levels of any volatile or gaseous hazardous substances below acceptable levels.
- Temperature, humidity and air purity (to minimize dust, infectious agents and gases) should be maintained within prescribed limits (AS 1668.2).
- Air-conditioning systems should be monitored regularly and serviced by accredited service technicians, and maintenance schedules should be documented.
- Where airconditioning is used, the relative humidity should be between 25 and 60 % to maintain comfort.

3. Lighting:

- Emergency lighting should comply with AS 2293.
- Glare should be minimal, particularly on screens of computer equipment
- Lighting in the office areas and waiting room should be adequate.
- Environmental lighting should comply with AS 1680, as follows:
 - For extra fine bench and machine work (tolerances below 25 microns): minimum 1600 lux. There should be sufficient under-bench lighting in the sterilizing room.
 - For computer data entry terminals: minimum 600 lux.
 - For medium bench and machine work (tolerances to 125 microns), and routine office work (filing, reading, writing): minimum 400 lux.
 - For waiting rooms, storage areas, staff dining rooms: minimum 200 lux.
 - For corridors, aisles, indoor carparks, stairs, toilets: minimum 50 lux.

4. Floors: (Regulation 3.18)

- All floors should have non-slip coverings.
- Floors must have unbroken and slip resistant surfaces
- Floors must be free from any obstruction that may cause a person to trip or fall.
- Where there is a risk of liquids coming into contact with a floor, the floor should be designed and constructed to provide adequate drainage.
- Floors should have even surfaces and be free of tripping hazards (such as electrical leads)
- Treatment areas in office practice should not be carpeted
- Where there is likely to be direct contact with patients, or with blood and body fluids, the surface of floors and walls should be made of smooth, impermeable seamless materials, such as welded vinyl. Thus, impervious flooring material such as welded vinyl flooring is recommended for the sterilizing room and patient treatment areas.
- Lapping the flooring material up the walls, installing floor drains, and providing slip resistant matting may also be appropriate in the cleaning/sterilizing area.

5. Passageways:

- These must be kept clear of equipment and materials which would hinder safe movement of people.

6. Fire escapes:

- For a single storey building, there should be at least two exits for each tenancy.
- For a multiple story building, there must be at least two exits for each storey.
- Doors should swing outwards (in the direction of egress) where practical.
- Fire escapes must be designated by EXIT signs (green letters 100 mm high on a white background).
- Directional arrows should mark the exit doors where these are not readily apparent
- Exit doors must be kept clear of obstructions.
- There should be sufficient fire extinguishers, and these should be appropriately mounted and placarded.
- Training in the correct use of fire extinguishers should be provided annually.
- The fire alarm system should be tested on a regular basis.
- The fire alarm should be audible from every room of the dental practice.
- Fire detectors should be clear of heat sources (such as autoclaves) and of obstructions.

7. Sterilizing room:

- The instrument cleaning area must be dedicated for that purpose only.
- It must be well lit and well ventilated (see above)
- There should be sufficient bench space to accommodate the autoclave(s) and to ensure the separation of sterile, clean and soiled instruments and equipment.
- Provision must be made for handling and storage of waste, in a way that minimizes the potential for injury or exposure of staff and others.
- At least one stainless steel sink is required, and this must be deep enough to accommodate instruments and other equipment requiring cleaning.
- Double sinks are preferred.
- These sinks should be used only for cleaning equipment and instruments (NOT handwashing).
- Where filters or anti-splash devices are fitted to taps, they should be cleaned regularly.
- Clean instrument storage must be a clearly defined area, which is protected from all vapours, splashing or aerosols produced during procedures, handwashing, equipment washing, ultrasonic cleaning and reprocessing.
- Materials, equipment and instruments must be protected from contamination by aerosols created in the dental environment by
 - Storage in bags,
 - Covering instruments with an impermeable material

- Storage in closed drawers, or
 - Storage in dedicated covered containers
- Dry, sterile, packaged instruments and equipment should be stored in a clean, dry environment which protects them from environmental contamination, and protected from sharp objects that may damage the packaging.

8. Bench tops

- Unnecessary horizontal, textured and moisture-retaining surfaces, or inaccessible areas where moisture or soil can accumulate should not be used.
- Where possible, all surfaces should be smooth, non-porous, and impervious.

9. Fixtures

- All fixtures and fittings should be designed to allow easy cleaning and to discourage the accumulation of dust.
- Blinds that are easy to keep clean and do not allow the accumulation of dust are preferable to curtains.
- Both treatment areas and the sterilizing room should have smooth impervious surfaces without crevices, and suitable receptacles for the disposal of clinical waste.
- Because refillable containers and their pumps are a potential source of contamination as bacteria (such as *Pseudomonas aeruginosa*) can multiply within many products, liquid handwash dispensers with disposable cartridges, including a disposable dispensing nozzle, are recommended.
- For handwashing, no-touch taps are preferred, e.g. operated by elbow or foot controls, or sensors.
- Both hot and cold water should be supplied for handwashing.
- Taps should be fitted with an aerator filter or other anti-splash device, and these should be cleaned in accordance with the manufacturer's recommendations.
- Clinical handbasins must be provided for staff to wash their hands (as per AS 1730.11 (1996) Washbasins). These must be located at a safe distance from patients to avoid inconvenience and or splashing patients during procedures
- Clinical handbasins should only be used for handwashing not for any other purpose such as for the disposal of liquid wastes. Liquid wastes should be disposed of in a separate disposal sink (e.g. in the sterilizing room).
- Each procedural room (i.e. each operatory) should contain at least one clinical handbasin designated for handwashing only.

10. Housekeeping

- There should be sufficient racks, cupboards and racks for storage
- Work surfaces and corridors should be kept clear
- Sharps containers should be located close to the dentist's area and also in the sterilizing area.

11. Electrical equipment

- All circuits should have circuit breakers installed
- Residual current devices (RCDs) should be installed on general purpose outlets (power points) in clinical, sterilizing and laboratory areas.
- Switches and outlets must be in good condition
- Double adapters should not be used
- Multi-outlet boards should be mounted clear of floors
- Trailing equipment leads pose a trip hazard and should be eliminated

12. Radiation safety

- Appropriate warning signs must be in place (e.g. X-rays, lasers) as per AS2211 and AS4173:2004
- A written log of all radiographic exposures must be kept
- Only licensed operators are permitted to activate the X-ray exposure control button.

A general walkthrough inspection is also very important, and the following aspects should be looked for:

- Housekeeping – floors, work benches, ladders, walkways.
- First aid and amenities – first aid equipment, supply of drinking water, suitable washrooms and toilets.
- Fire and emergency safety – access and exits, firefighting equipment, alarm systems.
- Plant and equipment – cutting, crushing, or trapping hazards and unsafe conditions due to things like pressurised contents, flying particles, noise, hot or cold parts.
- Chemical hazards – personal protective equipment, ventilation, labels, containers, storage, signs, and material safety data sheets.
- Electrical – residual current devices (RCDs), the condition and location of cables, plugs, sockets and switches, tag/lock out.
- Ergonomic and manual handling – the design of work stations, height of bench tops and desks, seating, tasks involving lifting, carrying, reaching, stretching and repetition.
- Machinery guarding - barriers, fencing around moving parts.

Relevant Legislation and Guidelines:

- *Infection control guidelines for the prevention of transmission of infectious diseases in the health care setting*, CDNA, 2004.
- AS 1668.2 (1991) and Supplement 1 (1991). The use of mechanical ventilation and air-conditioning in buildings - Mechanical ventilation for acceptable indoor air quality
- AS 3666 (1995) Air-handling and water systems of buildings – Microbial control.
- AS 4187 (2003) Cleaning, disinfecting and sterilizing reusable medical and surgical instruments and equipment, and maintenance of associated environments in health care facilities.
- AS 4815 (2004) Office-based health care facilities not involved in complex patient procedures and processes - Cleaning, disinfecting and sterilising reusable and surgical instruments and equipment.
- AS 2773 (1998) Ultrasonic cleaners for health care facilities
- AS 2945 (1998) Batch-type washer/disinfectors for health care facilities
- AS 2487 (1981) Dry heat sterilisers (hot air type)
- AS 1410 (1987) and Amendments 1 and 2. Sterilisers - Steam - Pre-vacuum
- AS 2182 (1998) Sterilisers - Steam – Benchtop
- AS 2192 (1991) Sterilisers - Steam - Downward displacement
- *Code of Practice for Workplace Amenities*, 1994.
- LJ Walsh. Design Issues for Infection control in Dental Practice. *ADAQ News*, 2004.
- *Code of Practice: Managing Noise at Workplaces*.

Health and safety policy (*example policy*)

This statement of health and safety policy sets out the commitment to health and safety required by all staff in the dental practice.

It is the policy of our dental practice to strive for the highest safety standard in all our activities. Safety does not occur by chance. It is the result of careful attention to all operations by those who are directly and indirectly involved. All individuals must work diligently to execute our policy of maintaining safety and occupational health. The safety of the general public and our own staff and students is a responsibility of all individuals within our practice. Prevention of injury and illness is a goal well worth achieving.

This policy is founded on the principle that human resources are of greater importance than physical resources such as plant and equipment. Maintaining a safe workplace will reduce injuries and ill health, and thus safeguard our valuable human resources. Damage to the environment and wastage will also be reduced. All staff in the practice have a moral and legal obligation to ensure that activities under their care and control are carried out in a safe and efficient manner. Safety consciousness must be part of both thinking and planning. All individuals are expected to prevent obvious unsafe acts, to anticipate potential hazards, and to demonstrate leadership by setting a good example.

Our practice is committed to pursuing progressive improvements in health and safety performance. The legal requirements, as contained in the Act, Regulations, approved Codes of Practice, and Australian Standards, define the minimum level we must achieve. Because our dental practice is a health care facility, the requirements for infection control are of particular importance.

Our practice is committed to supporting this health and safety policy by providing adequate resources for health and safety issues, and supporting training programs for employees.

Health and safety programs are an integral part of our practice's everyday operation. These programs are designed to ensure that a safe working environment is provided for staff, patients, and visitors. Regular feedback from staff regarding issues of health and safety is important for improving our safety performance.

We recognize that several factors can contribute to poor safety performance. Basic causes of accidents include lack of staff training and education and failure to provide proper monitoring or supervision; Substandard conditions include poorly designed equipment, insufficient warning mechanisms, poor lighting, and slippery surfaces; while Substandard practices include a failure to follow accepted practices or to use protective devices. These areas are targeted in our safety initiatives.

Under the Act, specific responsibilities of individuals include: (i) using personal protective equipment as prescribed; (ii) obeying safety directions (including signs); (iii) not interfering with safety equipment; and (iv) not endangering the health and safety of any person at the workplace, including staff, patients, visitors and other members of the public.

Because these are important obligations, this policy recognises the need for dealing with wilful disregard for health and safety issues within our practice. Such situations will be treated seriously. Verbal warnings will be first line of approach. For ongoing problems, formal written warnings will follow before disciplinary action is contemplated.

Safe working procedures and protocols have been developed within our practice to assure compliance with relevant legislation and codes of practice. It is the obligation of all individuals to be knowledgeable of the standards established by these guidelines and to implement in-house rules and regulations.

HAZARDS, RISKS AND CONTROLS

Use this form to document Hazards, Risks and Controls in your workplace or devise one to suit your own needs.v

Business name:	Worksheet no:
Work area:	
Name:	Date:

No:	Hazard identified	Assess the risk (use risk table) • Likelihood • Consequence	Identify proposed action eg new controls	Responsible person	Action completed date and sign

Sample form for your own use (not for reporting to WorkSafe).

ACCIDENT/INCIDENT REPORT FORM

Record No: _____

Personal details

Name: _____

Occupation: _____

Section/Dept: _____ Date of report: / /

Accident/incident details

Date: _____ Time: _____ Date reported: / /

Location: _____ Witness: _____

Reported to whom: _____

Full accident/incident details – what happened, or in the case of a near miss, what could have happened

Injury – Nature of Injury

- | | | | |
|--|---|---------------------------------------|--|
| <input type="checkbox"/> Contusion/crush | <input type="checkbox"/> Burn | <input type="checkbox"/> Dislocation | <input type="checkbox"/> Amputation |
| <input type="checkbox"/> Laceration/open wound | <input type="checkbox"/> Superficial injury | <input type="checkbox"/> Foreign body | <input type="checkbox"/> Internal injury |
| <input type="checkbox"/> Concussion | <input type="checkbox"/> Sprain/strain | <input type="checkbox"/> Fracture | <input type="checkbox"/> Dermatitis |

Location of Injury

- | | | |
|--|--|--|
| <input type="checkbox"/> Head/face | <input type="checkbox"/> Eye | <input type="checkbox"/> Internal organs |
| <input type="checkbox"/> Hand/fingers | <input type="checkbox"/> Shoulder/arms | <input type="checkbox"/> Trunk (other than back) |
| <input type="checkbox"/> Hip/leg | <input type="checkbox"/> Foot/toes | <input type="checkbox"/> Back |
| <input type="checkbox"/> Other (state) | | |

Results of accident

Lost time injury Y / N No. of days: ____ days Workers' compensation Y / N

Treatment received: First aid Doctor Hospital

Damage to equipment/buildings/vehicles etc.

What was damaged? _____

Extent of damage: _____

Contributing factors

What were the contributing factors (if any)? _____

Corrective actions

Immediate actions _____

What controls can be put in place to prevent this from happening again? _____

Recommendations for action

Who is to implement these controls/corrective actions? _____

Date by which action is to be taken / /

Signatures

Officer: _____ HS Rep: _____ Manager: _____

Director: _____ Investigating officer: _____

Actions completed: _____ Date: / / Manager: _____

Occupational Safety and Health Act 1984

WorkSafe Western Australia Commissioner
 PO Box 294
 WEST PERTH WA 6872
 Phone: (08) 327 777 Fax: (08) 9321 8973

INJURY REPORTING TELEPHONES:
 (08) 9327 8800
 1800 198118

Section 1: Employer Details

Employer Name:		Date of Injury:
Workplace Name:		
Address:		__/__/__
Suburb/Town:		
Postcode:		
Phone Number:		Time of injury:
Fax Number:		__:__ am
WorkCover Number:		__:__ pm

Address of workplace
 where injury occurred:

Phone Number:

Fax Number:

Type of workplace
 where injury occurred:
 (eg. construction site, panel
 beating shop, etc)

Suburb/Town:	Postcode:

Section 2: Details of injured person

Surname:

Given Names:

Occupation:

Date of Birth: __/__/__ Age: ___
Sex: Male: <input type="checkbox"/> Female: <input type="checkbox"/>

Estimated time
 person is unable to
 work: ___ days

Section 3: Injury Details

Nature of injury:

Brief description of how injury occurred:

Place injured person removed to:

Name of person reporting accident:

Position:

Phone Number:

Person for liaison:

Phone Number:

OFFICE USE ONLY:	
Person receiving report:	<input type="checkbox"/> Nat.
Date: __/__/__ Time:	<input type="checkbox"/> Loc.
	<input type="checkbox"/> Ag.
	<input type="checkbox"/> Type

Occupational Safety and Health Act 1984

WorkSafe Western Australia Commissioner
 PO Box 294
 WEST PERTH WA 6872
 Phone: (08) 9327 8777 Fax: (08) 9321 8973

DISEASE REPORTING TELEPHONES:
 (08) 9327 8800
 1800 198118

Section 1: Employer Details

Employer Name:	-----	
Workplace Name:	-----	
Address:	-----	
	Suburb/Town:	Postcode:
Phone Number:		WorkCover Number:
Fax Number:		

Section 2: Details of person affected

Surname:	-----	
Given Names:	-----	
Occupation:	-----	
Date of Birth:	__/__/__	Age: ___
Sex:	Male: <input type="checkbox"/>	Female: <input type="checkbox"/>

Section 3: Diagnosis Details

Name of Disease:	-----	
Date of Diagnosis:	-----	
Name of Medical Practitioner:	-----	
Address:	-----	
	Suburb/Town:	Postcode:
Phone Number:		
Fax Number:		

Section 4: Description of work done by affected person.

Section 5:

Name of person reporting disease:	-----
Position:	-----
Phone Number:	-----
Person for liaison:	-----
Phone Number:	-----

WorkSafe

Westcentre, 5th Floor, 1260 Hay Street
West Perth, Western Australia 6005

Perth office (08) 9327 8777 or 1300 307 877

TTY (08) 9327 8838

Fax (08) 9321 8973

Great Southern (08) 9842 8366

South-West (08) 9722 2888

Mid-West (08) 9964 5644

Goldfields/Esperance (08) 9021 5966

North-West (08) 9185 0900

Email: safety@docep.wa.gov.au

New employee checklist

The following outlines the induction process for a new employee in the dental practice, in relation to workplace health and safety issues.

Personal health records

- Recent vision test (for users of screen-based equipment)
- Personal medical history
 - Rubella
 - Measles
 - Mumps
 - Varicella (Chickenpox)
 - Immune disorders or immune suppressant medications
 - Exfoliative and weeping skin conditions
- Blood-borne virus tests (Hepatitis B antibody, Hepatitis C antibody, HIV antibody) for clinically active staff

Policies and procedures

- Practice Workplace Health and Safety policy
- Personal safety matters
- Hazard reporting and supervisory responsibilities
- Incident reporting procedures (such as sharps injuries)
- Worker's compensation procedures
- First aid responsibilities
- Security system operation

- Emergency exit procedures
- Assembly point after evacuation
- Fire alarm system operation
- Fire extinguisher operation

- Radiation safety policy
- Radiation safety practices

- Infection control policy
- Infection control practices
- Personal protective equipment requirements
- Staff immunizations
- Confidentiality of patient medical records

Specific hazards in the practice, e.g.

- Hazardous substances such as etching agents and other corrosive chemicals
- Manual handling
- X-ray equipment
- Lasers and high intensity light sources

Name:		
Position:		
Date of commencement:		
Location:		
Name of person providing the induction:		

		Please tick	Yes	No	If No, why?
1.	Explain work tasks				
2.	Tour of sections				
3.	Explain				
	• OSH policy				
	• Duty of care employer and employees				
	• Consultation: OSH committee and SH Reps				
	• Safe work procedures and instructions				
	• Issue resolution procedure				
	• Hazard reporting procedure				
	• Injury/incident reporting procedure				
	• Injury management policy and guidelines				
	• Emergency procedures				
	• Manual handling procedures				
	• Hazardous substances procedures				
	• Machinery safety procedures				
	• Working from height procedures				
	• Slips and trips prevention				
	• Electrical safety				
	• Permit to work				
	• Eye protection				
	• Hand protection				
	• Foot protection				
	• Hearing protection				
	• Vehicle safety				
	• Safety procedures for working on the side of the road				
	• Procedures for good housekeeping				
	• Safety signage				
	• Procedures for working outside such as skin protection				
	• Smoke free workplace				
	• Alcohol and other drugs at the workplace				
	• Compensation claims process and rehabilitation				
4.	Provide locker, personal protective equipment, tools as required				
5.	Schedule of follow-up training				

Management of Medical Emergencies

When an emergency situation occurs, all members of staff have a responsibility to work as a coordinated team in dealing with the situation.

Patients attending for dental treatment may collapse for a number of reasons, including:

- Fainting because of
 - anxiety (vasovagal syncope)
 - sudden postural change (postural hypotension)
- Hypoglycaemia in a diabetic patient
- Epileptic seizures
- Myocardial infarct (heart attack)
- Cerebrovascular accident (stroke).

In the dental practice setting, cessation of the normal rhythm of the heart may be caused by:

- Myocardial infarction (heart attack)
- Acute anaphylaxis
- Interference with an unshielded pacemaker by electrosurgery or other radio-frequency-generating equipment.

Absent or inadequate breathing may be caused by:

- Blockage of the airway by the tongue falling backwards, or by foreign matter such as dislodged crowns and vomitus.
- Impaired breathing mechanisms, such as an acute asthma attack.
- Interruption of the brain's control of breathing, such as in electric shock, drug overdose, stroke, or head injury.
- Hyperventilation (transient correction)

The correct sequence for assessing and managing an unconscious person is:

- A: Airway
- B: Breathing
- C: Circulation
- D: Drugs, including oxygen

Death or serious brain injury may occur after 3 minutes without breathing or circulation.

If a patient or staff member collapses, the dentist or other staff members should

- Call for assistance
- Assess the collapsed person for consciousness, breathing and circulation
 - Assess responsiveness (“shake and shout”)
 - Check the airway (first open the airway by backwards head tilt and jaw support), looking (does the chest rise and fall?), listening and feeling for air coming from the nose and mouth.
 - If not breathing, give two quick breaths and assess pulse
 - If not breathing but pulse PRESENT: Initiate expired air resuscitation (EAR): There must be a good seal of the patient's airway – particularly the nose.
 - If no breathing and NO pulse: Initiate cardio-pulmonary resuscitation (CPR) by chest compressions in combination with positive-pressure ventilation, and attach a monitor/defibrillator if available. For adults, the breastbone should be depressed 50 millimeters with each compression.
 - CPR wall posters are valuable for improving retention of CPR knowledge.
- Contact the ambulance (telephone “000”), advising of the exact location of the person and the nature of the incident

An ambulance should be called if any of the following is suspected:

- Acute myocardial infarction (AMI, heart attack)
- Cerebrovascular accident (CVA, stroke)
- Anaphylactic shock
- Severe asthma
- Severe epileptic episode
- Airway obstruction.

With cardiac arrest, early defibrillation is known to increase greatly long term survival prospects.

Staff should attend resuscitation update courses on an annual basis. Basic life support and cardiopulmonary training courses are offered by many organizations, including:

- St. John Ambulance
- Royal Life Saving Society,
- Red Cross

Basic emergency drugs in the dental practice should include only what the dentists and other staff are familiar with and able to apply. Oxygen, adrenaline and a manual resuscitator are the three basic items recommended for dental practices which do conduct more complex procedures such as nitrous oxide analgesia or intravenous sedation.

Further reading:

- *2002 Codes of practice: First aid facilities and services; Workplace amenities and facilities; Personal protective clothing and equipment*
- Walsh LJ. *Management of Medical Emergencies*. School of Dentistry, The University of Queensland, 2004 edition.
- *Australian First Aid*. St. John Ambulance Association in Australia, 2002.
- *Procedure for Dealing with Emergencies*. The University of Queensland Handbook of Policies and Procedures, Policy Number: 2.15.4, June 1993.
- *Ambulance Service Act*, 1991.
- PJ Chapman. Resuscitation in the dental surgery. *ADAQ News*, February 1999, pp. 16-17.
- PJ Chapman. Medical emergencies in dental practice and choice of emergency drugs and equipment: A survey of Australian dentists. *Aust Dent J*. 42: 103-108, 1997.
- S Malamed. *Medical emergencies in the dental office*. 4th Edn. St. Louis: Mosby, pp. 106-108, 424-440, 1993.
- A Morrison & R Goodday. Preparing for medical emergencies in the dental office. *J Canad Dent Assn*. 65: 284-286, 1999.

First Aid

The aims of first aid are to:

- prevent dangerous incidents occurring,
- preserve life,
- stabilize the injured person's condition,
- promote recovery, and
- protect and comfort the injured person.

The provision of adequate First Aid equipment, trained personnel, information, facilities and services for staff and patients is a requirement under the Regulations. Relevant training units in WA include:

- HLTCPR201A – Perform CPR
- HLTF201A – Provide basic emergency life support
- HLTF301B – Apply first aid
- HLTF302A – Provide first aid in remote situations

- HLTF402B – Apply advanced first aid
- HLTF403A – Manage first aid in the workplace
- HLTF404A – Apply advanced resuscitation techniques

There should be sufficient personnel in the dental practice areas with current First Aid training. First aid certificates should be acquired or updated in the last three years. As well, all staff should have annual resuscitation (CPR) training to renew their CPR techniques.

Staff who have nominated first aid responsibilities should be:

- able to remain calm in an emergency
- reliable
- prepared to check the contents of the first aid kit on a regular basis
- sufficiently healthy to be able to perform first aid when required.

The first aid cabinet should:

- be located in a readily accessible position with adequate signage (white cross on a green background)
- be equipped and maintained with the necessary first aid supplies, including disposable eye wash packs
- have a list with current emergency services telephone numbers and addresses
- be pointed out to new staff members.
- be clearly identifiable as such.
- Have its contents checked every 6 months so that they are within their “use by” dates.

Prescription drugs must be securely locked and accessible only to properly trained personnel. Where medical oxygen is available, it should be stored away from any heat source or reactive work process, but easily available.

The recommended contents of a First Aid Kit for a small-sized workplace (less than 30 employees) are give in Appendix 3 of the Code of Practice for First Aid (2002).

- adhesive strips, in assorted sizes for dressing minor wounds
- non-allergenic (latex-free) adhesive tape (2.5cm x 5m) to secure dressings, and for strapping
- sterile eye pads, in single packs, for emergency eye cover
- triangular bandages for use in slings, and padding
- elastic crepe bandage, 2.5, 5 or 7.2 cm wide, to retain dressings, and to bandage sprains
- non-adhesive dressings, in various sizes, for dressing wounds
- safety pins, for securing bandages and slings
- stainless steel scissors for cutting dressings and clothing
- disposable dressing tray, to hold dressings and instruments
- disposable liquid container, for holding liquids such as antiseptic solutions
- sterile cotton wool balls for cleaning wounds
- disposable blood lancet, to remove foreign bodies such as splinters
- sterile/saline water (single use), for emergency eye washing and irrigating eye wounds
- face shield for resuscitation, to be used by qualified personnel for resuscitation purposes
- antiseptic solution in pre-measured single use containers
- ice pack, for the treatment of strains, sprains and bruises.

Other useful items such as:

- disposable latex gloves,
- sharps container,
- gauze squares,
- contaminated waste bags,
- absorbent disposable towels,

- sodium hypochlorite,
- sterile forceps, and
- a scalpel blade remover

are normally found in a dental practice and do not need to be specifically held in a first aid kit.

Pre-configured first aid kits can be purchased from commercial sources.

Resuscitation bags, masks and face shields should be included in first aid kits in dental practices where nitrous oxide is used. These should only be used by staff who have been trained in their use.

The first aid treatment for flame burns or scalds is to apply cold water to the affected area for at least ten minutes, then cover with a sterile dressing or clean cloth to prevent further contamination. No creams or ointments should be applied.

The first aid treatment for a chemical splash into the eye is to irrigate the eye with running water for 20 minutes and then to seek medical attention. The material safety data sheet (MSDS) should be checked for specific advice, and the details of this should be brought with the injured person to accident and emergency department or medical practitioner's office.

Further Reading:

- *Australian First Aid*. St. John Ambulance Association in Australia, 2002.
- *First aid safety guideline*. University of Queensland, 2001.

Fire Safety and the Management of Emergencies

There should be a clear procedure understood by all staff for managing emergencies such as fires and bomb threats. This emergency or accident action floor plan must be drawn up as part of a clear and logical approach to the actions of staff during a fire or bomb threat.

The plan should include the location of emergency exits, stores of flammable liquids and other hazardous chemicals, and the location of fire alarms and portable fire extinguishers. Exits must be clearly marked on the floor plan.

This accident response procedure requires careful planning to ensure earliest possible access to emergency services, such as the Police, State Emergency Service, local council, Fire Brigade, Ambulance Service, etc.

The emergency response procedures should be tested at least yearly, and must be explained to new staff. All staff must understand their assigned roles in emergency procedures. Specific staff may have certain responsibilities, e.g. First Aid kit.

The requirements of the Regulations [part 3.10] are as follows:

- There is an evacuation procedure to be followed in the event of fire or other emergency;
- The evacuation procedure is clearly and prominently displayed;
- A diagram showing the location of exits and the position of the diagram in relation to the exits is clearly and prominently displayed at the workplace;
- The evacuation procedure is practised at the workplace at reasonable intervals; and
- Individuals at the workplace who would be required to help control or extinguish a fire at the workplace are appropriately trained and have been provided with appropriate protective clothing and equipment.

Every worker should be instructed on means of escaping from the premises in case of fire, and given information regarding the location and operation of fire warning alarms and fire extinguishers when they commence employment and once per year thereafter. Emergency evacuation drills should be held at least

once each year to familiarize staff with the correct procedures. Fire extinguishers must be located in accessible positions and maintained in good working order.

In order to ensure a clear path of exit, objects should not be placed or vehicles parked within 2 metres of an exit leading out of the building.

It should be remembered that evacuation procedures may be necessary for reasons other than fires, for example, explosions, chemical spillages, structural faults, or bomb threats.

Clearly documented and practiced evacuation procedures are recommended strongly. Systems for the safe and orderly evacuation of staff and patients are particularly important in high rise buildings, where emergency exits may become clogged if people panic in an emergency. It is critical that evacuation is coordinated floor-by-floor to ensure an orderly flow by means of the emergency stairs. The lifts **MUST NOT** be used.

In such larger buildings, fire wardens for each floor will be appointed. These individuals carry the responsibility for checking the source, type and severity of any emergencies. They also advise the Building Warden of the emergency on their floor and the proposed action required. If evacuation of the floor is necessary, the floor warden will direct the occupants to the nearest accessible exit or escape stairs, through which they should proceed to the designated assembly area. Provided it is safe to do so, they will make a thorough search of the whole floor to ensure that no people remain.

The last person to leave each room should close the door to prevent spread of fire and smoke. Many larger buildings (and most hospitals) are equipped with fire doors, which will close automatically when an evacuation alert has been initiated. Other than to allow the exit of people, these doors must be kept closed to hinder progress of the fire.

In addition to the above, it is recommended that instructions to new and existing staff should include the following:

- Notification procedures for the local Fire Brigade and other emergency services as appropriate
- The location and method of other items of fire fighting equipment other than extinguishers which may be present in the building, for example hoses and fire blankets
- Procedures for evacuation of staff and patients, including handling frail, elderly or medically compromised patients who will require assistance during an evacuation.
- Alternative routes for escape, should the main exits be blocked
- The locations for marshalling people in a safe place away from the premises. The practice should designate an assembly area, where both staff and patients should be directed to assemble when required to evacuate the building in an emergency. This will facilitate checking that all persons are safe and accounted for, and will assist in a speedy return to work when the "all clear" signal is given. The building warden or floor wardens will brief the fire service upon arrival regarding the nature, location and scale of the emergency.

Exit doors

Doors and other passageways, that are neither exits nor access to an exit but located where they may be mistaken for exits, must be appropriately marked. Similarly, the pathway to an exit door, when not immediately apparent, should be marked with signs

All exit doors should be marked with an exit sign, with green lettering on a white background. Doors that must be passed through to reach an exit must always be unlocked to eliminate the possibility of a person being accidentally locked inside.

The equipment and furniture should be arranged so that people are able to move safely within the workplace, and passages are free of obstructions (Regulations 3.6-3.8).

Employers must provide regularly maintained and efficient portable fire extinguishers to control any fire likely to arise from the work being done at the workplace, and ensure that portable fire extinguishers are located and distributed at the workplace in accordance with AS 2444.

Sources of heat in a dental practice which may contribute to fires include:

- Electric motors
 - Airconditioning systems
 - Laboratory handpieces
 - Compressors
 - Suction motors
 - Refrigerators
 - Model Grinders
- Heating elements
 - Autoclaves
 - Bar/Fan heaters
 - Toaster, Electric Jug and other kitchen appliances
 - Touch-n-Heat ceramic heaters and gutta percha guns
- Naked flames
 - Gas bunsen burners
 - Alcohol burners
- Exothermic chemical reactions
 - Setting of methyl Methacrylate resins
- Electrostatic charges
 - Televisions
 - CRT Monitors
 - Computer equipment
 - Video recorders and DVD players
- Lamps
 - Curing lights
 - Operating lights
 - Halogen lamps in overhead and feature lighting

Major sources of combustible items in a dental practice include:

- Solids
 - Paper and cardboard
 - Latex gloves
 - Dental masks
 - Furniture and furnishings
- Liquids
 - Bonding agents based on alcohol or acetone
 - Methyl Methacrylate liquid
 - Ethanol
 - Isopropyl alcohol
 - Acetone
 - Chloroform

Of these materials, the flash point (the temperature at which the vapour pressure of the liquid is sufficient to form an ignitable mixture with air near the surface of the liquid) is the lowest for acetone (minus 20 degrees Celsius) and ethanol (13 degrees Celsius), thus both of these will readily ignite at normal room temperatures.

Checklist for workplace safety and fire prevention:

- Are passageways and exits kept clear?
- Do major doorways open outwards (in the direction of egress in an emergency?)
- Are the potential problems for exit, such as rooms leading off blind passages, and doors leading to dead ends, such as in toilets or staff changing rooms?
- Have flammable items (such as paper and empty cardboard boxes) accumulated?
- Are flammable items stored near the suction motor or compressor motor?
- Are flammable items and oxidizers (such as hydrogen peroxide) stored separately?
- Is fire fighting equipment in its correct position?
- Is access to the portable fire extinguishers (and fire blankets) unobstructed?
- Have the extinguishers been serviced, checked and tagged (e.g. every 6 or 12 months)?
- Are the exits clearly marked?
- Do all staff know the location of alarm boxes (manual call points – break glass alarms), fire extinguishers, emergency exits and evacuation meeting points?
- Are Bunsen burners or portable gas burners left unattended?
- Are latex gloves kept away from naked flames?
- Have alternatives to naked flames been considered? (e.g. using a Touch-n-Heat for endodontic procedures, rather than using an alcohol burner)
- Are all flammable liquids kept in their original container away from sources of ignition?
- Are there large numbers of gas cylinders stored within the rooms of the practice?
- Are these secured and protected from damage or the uncontrolled release of gas while the cylinder is being used, moved, or stored? (Regulation 3.27)
- Are gas cylinders free of dents, leaks, corrosion, or other damage?

Operation of fire extinguishers

The main types of fire are classified as follows:

- Class A Ordinary combustibles
- Class B Flammable and combustible liquids
- Class C Flammable gases
- Class D Combustible metals
- Class E Electrically energized equipment
- Class F Cooking oils and fats

Of these, class E would be the most common type encountered in dental practice.

- Dry powder (Red/White) extinguishers are the most useful for the dental environment as they do not damage electrical equipment and are effective on the types of fires likely to be encountered in a dental practice. They must be pointed at the base of the fire, from as close as possible. The white powder (which includes baking soda and other agents which can smother a fire) will create a mess but it is not harmful.
- Note that there are two types of dry powder extinguisher, of which type ABE is better than BE since it is much more effective on fires involving wood, paper and plastics.
- A useful algorithm for using Dry Powder extinguishers is
 - P (Pull the locking pin out)
 - A (Aim the nozzle at the VAPOUR SPACE – space between the burning item and the base of the visible flame)
 - S (Squeeze the handle to activate the extinguisher)
 - S (Sweep the jet of powder SLOWLY from side to side to cover the burning object, then move in towards the fire increasing the speed of the sweeping action).
- Only attempt to contain or control the fire if you feel it is safe to do so. When in doubt, leave the fire fighting to the professionals. If at all possible, don't fight a fire alone.

- All extinguishers must be hydrostatically tested on a periodic basis – the interval varies according to type of extinguisher.
- Keep the escape route at your back so that you can make a quick exit if needed.
- All extinguishers have a grenade-pin locking mechanism, in which the pin must be pulled out before the activating handle can be squeezed.
- Most hand fire extinguishers will only operate for a maximum of one minute, thus it is important to carry the extinguisher to the location of the fire before activating it. A second extinguisher should be on hand for when the first one is exhausted.
- Once used, never return the empty extinguisher to its original location.
- Do not leave the site of a fire unattended as it may flare again.
- Pressurized water (all Red) extinguishers are not safe to use on electrical fires, and should only be used on wood and paper fires. These extinguishes are powered by the sulphuric acid – sodium bicarbonate reaction, and have a very limited period of operation.
- Carbon dioxide (Red/Black) extinguishers are not safe to use in confined spaces because of the risk of anoxia. Their wide exit nozzle becomes extremely cold during use, and this can cause freeze burns on skin contact. They are however suitable for electrical fires and flammable liquid fires, and will not damage dental equipment.
- Fire hoses are very difficult to control because of their back pressure, and should only be used by fire brigade staff. These hoses are generally 32 metres long and should be run out to their full length. The main water supply knob can then be turned on, and last of all the terminal nozzle can be turned on. A wide spray pattern (which achieves cooling) is more effective than a single stream or jet of water.

The following Australian Standards apply to portable fire extinguishers:

- AS 1841. Portable Fire Extinguishers
- AS 1850. Portable Fire Extinguishers – Classification, rating and Performance Testing
- AS 2444. Portable fire Extinguishers and Fire Blankets – Selection and Location
- AS 3676. Portable Fire Extinguishers – Guide to Servicing
- AS 1851. Maintenance of Fire Protection Equipment

General instructions for staff in the event of fires:

- Activate the fire alarm system (if there is a push button alarm)
- Notify the practice principal, and shout to alert other people in the vicinity
- Notify the appropriate fire emergency service, giving details of the practice's location, the type and scale of the fire, and the name and location of the caller. Remember that the telephone number for emergency services in Australia is "000", not "911". Do not hang up unless instructed to do so.
- If in a high rise building, notify the Floor Warden.
- If it is safe to do so, use the appropriate fire extinguisher to put out any fire
- Do not attempt to fight a fire if the fire is large, if you are not familiar with the use of the fire extinguishers, or if you do not have a clear exit pathway behind you.
- If you hear the evacuate mode of the fire alarm or when instructed to evacuate by the Floor Warden, walk quietly but quickly to the nearest exit and proceed to the assembly point outside the building to await further instructions.
- In order to prevent injury and possible panic during evacuation, do not run, push, or overtake.
- Always exit by using the stairs - do not use the lifts.
- If possible, turn off electrical equipment and the main gas supply while leaving.
- Close all doors.
- Account for all personnel and patients at the meeting point.
- Do not return to the building until the "all clear" is given.

- If trapped in the building, never open a hot door as the sudden influx of air will cause the fire on the other side of the door to flare dramatically.

Practical Advice:

Most modern buildings use a two tone alarm system. The ALERT alarm “beep, beep, beep” signals that an alert situation has been registered, and that the fire wardens for each floor should investigate for possible causes. No action is to be taken by other occupants of the building at this stage. If the situation is confirmed as real and of serious threat, an EVACUATION alarm will be triggered “whoop, whoop, whoop”. At this signal, all work should stop and the staff and patients should quietly and calmly assemble near the designated exit points (the fire or emergency stairs) to await the instructions of the floor warden to evacuate the area.

Further reading:

- *Fire and Emergency Evacuation Procedures*. The University of Queensland Handbook of Policies and Procedures, Policy Number: 2.15.2, April 1999.
- *Instruction of Staff in Fire Safety Procedures*. The University of Queensland Handbook of Policies and Procedures, Policy Number: Policy Number: 2.15.3, October 2004.
- Portable fire extinguisher guide. Fire Protection Association Australia (Victoria), 1999. (www.fpaa.com.au)
- AS2293.
- *Building Code of Australia*.

Bomb Threats

For telephone bomb threats, the recipient of the call should try to remain calm and record the exact details of the threat, endeavouring to obtain as much information as possible, such as:

- location of device,
- what it looks like,
- time it is going to explode,
- the kind of device,
- any actions that will trigger the device, and the
- name of the caller and their location.

Details of the caller’s voice should be recorded, e.g.

- sex,
- estimated age,
- accent,
- particular speech impediments,
- manner (calm, agitated, etc).

Any background noise should also be recorded, e.g.

- street noises,]
- aircraft noises.

The recipient should not hang up, but keep the caller on the line while the supervisor is contacted.

Personal Safety

Dental practice staff may find themselves in situations which threaten their personal safety when dealing with patients or with other staff. Threats to personal safety may include:

- shouting,
- physical assault,
- displays of anger or agitation,
- personal threats,
- bullying and harassment,
- or suspicious behaviour.

Individuals responsible for such acts may be:

- Bullies, vandals, and robbers seeking to terrorize others
- Emotionally disturbed
- Dissatisfied with the service they have received
- Mentally impaired or suffering from an acute psychiatric illness
- Intoxicated
- Under the influence of a drug
- Suffering acute dental anxiety
- Under enormous emotional pressure from relationship breakdowns etc.

Patients who have a substance abuse problem or a psychiatric illness may have an altered perception of reality, and their behaviour may be driven by underlying mood swings or psychosis. Other individuals who have an ostensibly normal grasp of reality may have completely unrealistic expectations of dental treatment, and put impossible demands on the dentist and other staff members. For example, edentulous patients may expect their dentures to look and function identically compared to their natural teeth, and dentate patients may have unrealistic cosmetic demands, or expect the immediate replacement of a broken down tooth in a very short time frame.

Listening to these patients, acknowledging their concerns, and explaining the nature and consequences of treatment at an early stage in a calm manner will increase the ownership of the patient in the treatment process and in so doing allow them to share responsibility for the final result. Whatever the nature of a patient's problems, a consistent expression of support, empathy, trust and understanding by all the staff of the practice will likely result in less negative or intense responses on the part of the patient.

To reduce the risk of actual harm or the repetition of threats, members of the staff are encouraged to report threats or violent incidents to their supervisor or the practice principal.

The practice staff should discuss and agree on safe working procedures for at risk situations, including:

- Cash handling,
- Dissatisfied patients,
- Unstable or violent patients,
- Dispute resolution between staff members.

Further reading:

- *Code of Practice: Violence, Aggression and Bullying at Work*. 2006.
- *Threats to Personal Safety at Work*. The University of Queensland Handbook of Policies and Procedures. Policy Number: 2.30.12, July 1997.
- *Violence at work: a workplace hazard*. QCCI Bulletin, Vol. 1, No. 3. 1999.
- Pitts WC. Difficult denture patients: observations and hypothesis. *J Pros Dent* 53:532-534, 1985.
- Araki NG. An analysis of anger in relation to clinical dentistry. *J Pros Dent* 53: 591-592, 1985.

Workplace stress

Stress is any demand made on a person by their environment. It can be positive (eustress) or negative (distress). All areas of life involve some stress and challenge, indeed these are important keys to personal growth. Conflict or change seen by one staff member as a stressor may be a positive challenge to another.

Workplace stress occurs as a reaction to too many demand, pressures and expectations, such as feelings of loss of control, or failure to cope.

Despite popular belief to the contrary, there is no reputable evidence which suggests that dentists or dental staff have increased rates of psychological problems, relationship instability, compared with the remainder of the population. Rates of suicide were elevated for dentists up to the 1960's and 1970's, however there is no reliable global data since that time which indicate that suicide is a major issue for dental staff.

Each work day will present stresses, and it is important to realize that a recovery phase should follow this. If stress is not relieved regularly (each day), its accumulation over time poses the risk of a major problem developing.

Stress during the working day will be affected by many factors, including:

- Dealing with patients who are:
 - Dissatisfied
 - Anxious
 - Difficult or uncooperative
 - Self-willed or impudent
 - Verbally or physically aggressive
 - Tardy at keeping appointments or who do not show at all
 - Non-compliant
 - Defaulters on fees and accounts
 - Distrustful
 - Unreasonable or demanding
 - Unappreciative
 - Negative towards dentistry
 - Suffering from chronic or complex problems for which there is no cure
- Professional practice issues such as:
 - Lack of sufficient skills to solve complex dental problems
 - Having to perform differently from the ideal treatment plan
 - Always having to be emotionally well-balanced
 - Always having to deliver perfect quality
 - The risk of making mistakes
 - The risk of a medical emergency situation
 - Experiencing the gap between perfection and what is possible
 - Undertaking technically difficult work
 - Threats of complaints
- Operational issues such as:
 - keeping to a tight time schedule (the fear of running late)
 - long working hours
 - role ambiguity
 - poor leadership
 - poor feedback on performance
 - poor physical working conditions
 - feeling isolated
 - lack of variety or challenge in the clinical work undertaken

- Financial concerns such as:
 - Increasing practice expenses
 - Balance between work delivered and financial compensation
 - High taxes
 - Time taken for administration and compliance with government authorities
 - Conflict between obtaining a worthwhile return on effort and providing care to the financially disadvantaged
- Personal ability to cope with stressors such as dealing with constant change, such as a “Type A” personality
 - Perfectionistic (high expectations of themselves and others)
 - Compulsively attentive to detail
 - Ambitious and competitive
 - Highly achieving
 - Dogmatic and aggressive
- Level of job satisfaction, and concerns regarding career progression and remuneration
- Relationships problems with other staff members, such as:
 - Conflict
 - Bullying and harassment.

Stress recovery after working hours will be influenced by a range of factors, including:

- Personality type
- Past experiences
- Amount of available leisure time
- Family responsibilities such as caring for young children and elderly parents
- The home environment, including diet and lifestyle
- Social support from friends and family
- Physical exercise
- Other forms of relaxation such as those based on visualization, breathing, and meditation
- The quality of sleep
- The individual’s general health.

Consequences of workplace stress include:

- Lowered morale
- Poor concentration and impaired memory
- Increased likelihood of accidents
- Increased anxiety
- Irritability
- Over-reaction to criticism
- Uncharacteristic behaviour such as anger, lethargy, and sloppy work
- Eating disorders
- Weight loss or gain
- Poor sleeping patterns
- Fatigue
- Headaches
- Muscular aches in the neck and shoulder region
- Jaw clenching
- Hypertension
- Increased severity of gastro-oesophageal reflux disease
- Impaired family relationships
- Increased absenteeism and unreliability

- Impaired host resistance to infection
- Greater risk of common infectious diseases (such as viral influenza)
- Excessive use of alcohol or other substances
- Burnout from failing to cope with stress
 - Emotional exhaustion
 - Depersonalization
 - Lack of personal achievement
 - Reduced productivity at work
- Depressive illness, with the attendant risk of self-harm or suicide.

Prevention and Practical Advice:

- Use stress reduction methods, such as regular exercise, visualization, controlled breathing, and meditation
- Have regular discussions with other staff members, to build strong communication and relationships between staff
- Treat patients with whom you have good rapport.
- Manage time effectively; Aim for a realistic workload and do not overbook.
- Use business principles to gain financial information and establish control.
- Determine realistic financial objectives.
- Examine those aspects of the work or workplace that are the most bothersome, and identify strategies to change these.
- Make a plan for job security, and for future career progression.
- Discuss the situation with a more experienced colleague whose opinion is valued
- Delegate duties wherever possible.
- Consider referring types of work which are difficult or excessively challenging to others.
- Treat other staff members with care and respect.
- Do not expect perfection from yourself or others.
- Ensure a balance is achieved between work and leisure time
- Reduce levels of intake of alcohol and caffeine
- Attend continuing professional education courses to learn new and more effective methods and techniques
- Attend workshops to gain new skills in communication, time management, assertion, meditation, etc.
- Seek assistance from a counselor, doctor or psychologist.

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Recreational Drug Use

Unlawful, inappropriate and irresponsible use of alcohol and other drugs can have a negative impact on professional judgment, health and safety, and personal relationships. It can cause damage to property (through accidents or vandalism), and can adversely affect the rights, comfort and enjoyment of other individuals at work, particularly through verbal, physical and sexual harassment.

Staff may experience problems as a result of their own or others alcohol and drug use. While it cannot be accepted as an excuse for poor performance, unsafe work practices or inappropriate behaviour, alcohol and drug related problems should be addressed in a supportive, confidential and constructive way for those who are willing to confront their problems and work to overcome them. For registered dental health care workers, the dental boards across Australia have specific powers in relation to impaired practitioners.

Substances of abuse are psychoactive medications, which through their effects on the central nervous system can alter a person's mood or perception. Abuse exists when these medications are used in a manner other than their normal use, e.g. at greater doses or frequencies that would be the case if prescribed medically, or the intentional abuse of domestic products such as propellants, glues, fuels and solvents. Repeated usage of psychoactive substances may lead to addiction. The addict will use the substance compulsively, with little regard for adverse effects on their general health, family situation or business.

Common drugs of abuse include:

- Alcohol
- Narcotics
 - Morphine
 - Pethidine
 - Heroin
 - Cocaine
- Hypnotics and sedatives
- Amphetamines
- Cannabis

The CAGE questionnaire (Ewing, 1984) is a simple and useful approach for identifying staff or patients who may have a substance abuse problem.

C Have you ever felt that you should cut down on your drinking or drug use?

A Have people annoyed you by criticizing your drinking or drug use?

G Have you ever felt bad or guilty about your drinking or drug use?

E Have you ever had a drink or used drugs first thing in the morning to steady your nerves, or get rid of a hang over (eye-opener)?

Answering yes to 2 or more questions indicates a high probability of underlying drug or alcohol abuse.

Risk factors for chemical dependence include:

- High levels of workplace stress
- Dysfunctional family background
- Past history of chemical dependence in the family
- Persistent low self-esteem
- Excessively high ambition for professional status.

It is important to identify that an individual who is addicted to narcotics may approach a dental practice seeking the supply or prescription of drugs (such as codeine or morphine), in order to support their drug habit, by using fictitious "dental" symptoms.

Illicit drugs

The possession and/or use of medications, including prescribed and over-the-counter drugs, is prohibited except when prescribed by a medical practitioner or permitted by law. Severe legal penalties exist under the Criminal Code for the unlawful possession, use, sale, or distribution of illicit substances, such as heroin, cocaine, lysergide (LSD), phencyclidine (Angel Dust), cannabis sativa (marihuana) amphetamines (including MDMA-Ecstasy), morphine, opium, barbiturates, and pethidine. Producing or trafficking in drugs carries penalties ranging up to 25 years imprisonment.

Alcohol

The workplace health and safety principles of safe working include the expectation that the use of alcohol and drugs will not lead to harm to individuals or property. Consistent with this is the expectation that staff will display a moderate and responsible attitude towards the use of alcohol out of working hours. Staff members who are experiencing health and behavioural problems in this area should be assessed medically so that appropriate referrals can be made to treatment and counselling services.

Dental staff should not be affected by alcohol or other drugs whilst on duty. They must also observe local, state and federal laws in relation to using, possessing, giving or selling alcohol and/or other drugs.

Smoking

An employer has a duty to provide, as far as is reasonable, a safe and comfortable environment for employees. Thus, a dental practice should aim to minimize the harmful health effects of passive smoking and its related discomfort to others. The practice should uphold the right of an individual to work in a smoke-free environment. This can be achieved by:

- Bans on smoking in basements, balconies, loading bays, or within five metres of entrances to buildings or air-conditioning units of buildings;
- Locating permanently fixed ashtrays at the edge of exclusion zones to encourage smokers to dispose of cigarette butts responsibly
- Posting signs posted in problem areas indicating a "No Smoking Area"
- Encouraging staff who smoke to enroll in "quit smoking courses"

Formal guidance on smoking is provided in Regulations 3.44A-G, which addresses accepted practices.

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Electrical Safety

Electrical hazards exist in almost every workplace. It is not only high voltage that causes electrocution – the smallest mistake can be fatal.

Of the priority areas, electricity is the most common cause of death, accounting for about 11 percent of work-related deaths in Western Australian workplaces.

People can be electrocuted by coming into contact with overhead wires, carrying out maintenance work on live electrical circuits, working with damaged electrical equipment, extension cords, plugs or sockets. Familiar appliances like toasters and microwave ovens also cause a significant number of electrical burns.

A WorkSafe study found that, with the exception of deaths caused by overhead power-lines, many electrocutions could have been prevented with the use of residual current devices (RCD).

Safety regulations require employers to fit RCDs to minimise the risk of electric shock. All electrical installations must meet Australian Standards.

If sufficient electrical current flows through the body, the normal action of nerves will be disrupted, and death may result from cardiac arrest. The physiological effects of electrical current relate to the current and frequency rather than to the voltage. The better the electrical connection to the body, the less the resistance and thus the greater the current flow. At normal mains voltage (240 Volts alternating current, with a frequency of 50 Hz), the parameters for skin contact are as follows:

- The threshold for sensation is 0.4 milliamperes (mA),
- The threshold for pain is 1 mA,
- At 10 mA, muscle contraction stops a person from letting go of the source, and
- Above 100 mA, ventricular fibrillation occurs and death is probable.

In contrast, if an electrode is passed directly into the muscles of the heart, the threshold for producing ventricular fibrillation is below 100 microamperes, more than 1000 times less than if the electrical source was applied on to the skin.

Greater electrical currents will flow if:

- The skin surface at the point of contact is covered with sweat, saline, or some other conducting fluid.
- Contact is made with moist areas of the body, such as the mouth.
- Electrolytes are present, such as saliva, which is a good conductor of electricity.

Within the dental practice environment, electrical shock can be caused by:

- Contact with exposed live parts of electrical equipment (by creation of a shock path)
- Use of unsuitable equipment in wet or other hazardous environments
- Use of inadequately maintained or unserviceable equipment
- The performance of Electrical work by unqualified or unskilled persons
- Performance of live Electrical work
- Defective protective devices (Residual Current Detectors/ Safety Switches)
- Faulty flexible cords and extension leads
- Improperly earthed equipment or installations.
- Poor maintenance which allows breakdown of insulation or loose wiring
- Overloading of circuits (particularly through overuse of double adaptors or powerboards).
- Unauthorized access to electrical wiring or the mains supply (e.g. while doing D.I.Y. repairs).

Electrical burns can be caused when current flows through a small area. Techniques such as electrosurgery and diathermy employ high frequencies (above 500 kHz), with a small contact at the handpiece, and a large contact electrode (the grounding plate) elsewhere. If poor contact occurs at the grounding plate, localized heating and possible burning of the skin can result. Damage to human tissue will occur at temperatures 5.5 degrees Celsius above normal temperatures, i.e. above 43 degrees.

Portable electrical equipment includes essentially everything that is plugged into a general purpose electrical outlet (a powerpoint). Examples include laboratory equipment such as model grinders, surgery equipment such as composite curing lights and amalgamators, tea room equipment such as electric jugs, and office equipment such as computers.

Fixed-wired devices (which will generally include dental units and large airconditioners), the wiring itself and wiring distribution systems (such as distribution boards) are covered by a range of construction industry standards, including the national "Wiring Rules" (AS 3000).

ELECTRICAL WORK is defined as manufacturing, constructing, installing, testing, maintaining, repairing, altering, or replacing of electrical equipment or parts.

A number of legislative guidelines regulate who can undertake electrical installation work, electrical repair work, electrical maintenance work, and electrical construction work, including AS/NZS 3000: 2000 *ELECTRICAL INSTALLATIONS*.

All Electrical Work at voltages in excess of extra low voltage i.e. < 50 volts alternating current (AC) or 120 volts direct current (DC) **MUST** only be carried out by appropriately licensed electrical workers. In relation to dental units, it is noteworthy that many current types of dental units employ isolation and transformer systems so that the voltage circulating to the various components within the dental unit (such as the curing lights) is extra low voltage DC.

Regulatory requirements mandate that items of specified electrical equipment in use within a workplace must be tested at varying intervals, dependant upon the class of work environment in which they are used.

Staff can also perform simple physical checks on electrical equipment, for example, checking that the equipment is free from obvious external damage, and examining equipment for any damage or component defects in the accessories, connectors, plugs or outlet sockets.

Staff should be encouraged strongly to report any items of electrical equipment

- Where the inner cores of flexible supply cords have become exposed
- Where external sheaths of supply cords have been cut, abraded or damaged
- Where there are unprotected conductors, because of loss of insulation
- Which are producing "tingles"
- Which are producing unusual noises or odd smells when operated.

Unsafe equipment must be withdrawn from service immediately, and have a label attached to it warning against further use, before being sent for disposal, or for repair by an authorized repair agent.

For 240 Volt equipment and cord extension leads, the use of clear backed or integrally moulded (i.e non-rewireable) plugs and sockets is preferred. Clear backed plugs and sockets facilitate easy inspection of the cord colours and the condition of the terminations, while integrally moulded accessories are less prone to damage and not are susceptible to misconnection (Regulation 3.59). Electrical cords should not be run under rugs or carpets where they will be damaged and may contribute to fires.

SAFETY CHECKLIST

CHECK:	YES	NO	N/A
Electrical safety is part of your staff induction			
People working with electricity have been given information, instruction and training			
There is a maintenance program in place for electrical installations			
Electrical equipment has been tested			
Residual current devices (RCD) are installed at switchboards or into fixed sockets			
Portable electrical equipment is protected by RCDs			
The RCD device is labelled and has been tested			
Flexible cord connections have either moulded or transparent type plugs			
Plugs, sockets and extension leads are in good condition			
Flexible cords are protected from water, being damaged or cut			
Switchboards are labelled correctly and protected from damage			
Light fittings are suitable for the location and protected from breakage			
Power points are suitable for the location and are positioned safely			
Safety procedures are in place for employees working near overhead power lines			
Machinery has been identified that may expose employees to electrical risk			
Site power been connected when construction site work has reached plate height			
Cords are of suitable length for the intended use			
Are there any double adaptors or three-pin plug adaptors in use			
Are portable cable stands required			
On construction sites also check:			
Portable and fixed electrical equipment has been tagged			
There is a record of previous testing			
The tester's licence number is on the tag			
All final sub-circuits, socket outlets, portable generators and equipment are protected by RCDs			
No aerial cables are fixed or attached to scaffolding			

Key factors in electrical safety

a. Grounding

Earthing conductors provide a permanent continuous path to conduct the maximum possible fault current to ground. Two common problems with earthing are when machine vibration loosens the grounding conductors, and in damp situations, when corrosion impairs the conductive path. These problems will be detected by ground impedance testing (see below).

b. Residual current devices (RCDs)

Also known as "safety switches" or Earth Leakage Circuit Breakers, RCDs are critical for ensuring the safety of staff and patients, should a live conductor carrying mains voltage come into contact with exposed metal parts of an item of equipment. It is important that the correct level of trip current is selected (generally between 5 and 20 mA for areas providing patient care). This level is many times less than the amount required at mains voltage and frequency to cause ventricular fibrillation. The fast response time of RCDs, typically 10 milliseconds, is much less than the normal duration of the wave of depolarization which causes cardiac muscle to contract under normal circumstances.

RCDs installed as protection against electric shock should also be tested and inspected at intervals prescribed within AS/NZS 3760: 2003. This regular checking is essential to their efficient operation, and is simple to do using the inbuilt "test" facility.

RCDs are susceptible to nuisance tripping in installations which have high "natural" start currents (e.g. refrigerators, water heaters) or high transient starting loads (e.g. fluorescent lights). The placement of RCDs within the distribution system should take account of this. The use of just one RCD to protect all electrical outlets in a practice will often lead to problems from nuisance tripping, and several RCDs, one to cover each work area, will generally solve this problem.

c. A properly scheduled and controlled checking and maintenance program for all electrical equipment (including powerboards and extension leads) is essential. Lower risk items are not moved (e.g. desktop computers, printers, facsimile machines), whilst higher risk equipment is moved frequently (e.g. laptop computers). These are inspected tested and tagged. The electrical worker who conducts the test (under clause 3.6, 3.7 or 3.8 of AS/NZS 3012) on an item of portable electrical equipment or a portable residual current device must ensure that the tag bears their electrical licence number (Regulation 3.62).

d. Control of access to the electric supply and distribution boards can be achieved by having locks fitted, with access by key only to authorized tradesmen.

e. Use of power isolation systems is commonplace in dental units, where transformers convert mains voltage to low voltages (usually 12 volts). A similar system is used commonly in composite curing lights and bench handpieces. The point at which the mains supply to the equipment can be interrupted with a switch should be clearly identified, as it is not uncommon for people to comment that they did not know where to find the power isolator switch in an emergency.

f. Design features such as double insulation are employed commonly with small electrical devices such as "plug-pack" adapters, since in such devices the outer surfaces are non-metallic and protective earthing cannot be used.

Electrosurgery

Electrosurgery has been used in dentistry for more than 50 years, and has been used for a range of minor soft tissue procedures, including coagulation of incisions, the cutting or ablation of oral soft tissues, and troughing of crown preparations prior to impression taking.

Electrosurgery works by the localized heating of oral tissues, using very high frequency alternating current (300-600 kHz), with voltages of 5-10 kV from peak to peak. The use of a high frequency greatly increases safety and prevents interference with the normal electrical activity of cardiac muscle or skeletal muscle. It should be remembered that all current electrosurgical units use isolated generators so that the circuit can only be completed through the dispersive or passive electrode, and not through the ground return path as with the mains electrical supply.

Tissue impedance (resistance to high frequency alternating current) dictates the flow of current and thus the level of heating. In the CUT setting, the waveform consists of alternating on/off cycles (100% duty cycle), while in the COAG setting there are large time interruptions between on/off cycles (e.g. 5% duty cycle), which limits the extent of heating of the tissue.

Most electrosurgery units used in dental practice are monopolar in operation. The active electrode (with various tips) is held in the operator's gloved hand, while the dispersive electrode is in contact with the patient and completes the circuit. This has a large surface area and thus offers a low resistance to the flow of current. As well as adhesive pads and metal plates, large non-contact pads are also available in which the circuit is completed by capacitive coupling rather than by direct skin contact.

Electrosurgery units used in operating theatres and surgical centres are bipolar, with the active electrode and the dispersive electrode in close approximation, often in a forceps or tongs design, in which the current flows between the two points.

The passage of current through the tissues of the body can interfere with implanted medical devices, particularly older-style pacemakers. Most pacemakers are replaced every 7-12 years when their lithium batteries are depleted. Newer pacemakers have a reasonable level of shielding from external sources of radiofrequency energy, however interference is still possible. The most common type of pacemaker, the so-called "demand" (synchronous or non-competitive) type, detect and monitor innate cardiac depolarization and are only triggered to operate in the absence of normal cardiac rhythm. However, electrosurgical devices and other external electrical sources (such as electric pulp testers, magneto-strictive ultrasonic scalers, and induction casting furnaces) can create electrical currents through the upper body which mimic cardiac depolarization. This "fools" the pacemaker into failing to operate, resulting in asystolic intervals accompanied by dizziness or seizure (Stoke-Adams attacks). In 1973, the American Dental Association Council on Dental Materials and Devices published a warning regarding the potential for electro-magnetic interference with cardiac pacemakers, stating that "the use of electrosurgery on (pacemaker) patients should be avoided if possible, or used with caution only after consultation with the patient's cardiologist".

The work of Miller et al (1998) demonstrated that pacemakers were inhibited by electrosurgical units up to 10 cm away, by ultrasonic cleaners up to 30 cm away and by magneto-strictive ultrasonic scalers up to 38 cm away. In contrast, operation of the amalgamator, electric pulp tester, composite curing light, dental handpieces, electric tooth brush, dental chair, radiographic unit and sonic scaler did not alter pacing.

Modern pacemakers are housed in a hermetically sealed titanium case which effectively functions as a Faraday shield to reduce interference from external electrical devices. When subjected to strong electromagnetic fields, modern demand pacemakers are designed to operate continuously until the interference has ceased, after which the pacemaker will resume normal operation. Nevertheless, pacemaker inhibition may still occur, and thus the use of monopolar electrosurgery is contraindicated.

Safe use of electrosurgery

- Prior to the procedure, the operator should check that the contact pad of the passive electrode is clean and in good contact with the patient's skin. The patient should be instructed to report immediately any sensations of warmth, heat or burning from the site of the passive electrode.
- During procedures, avoid contact with saliva (which is conductive) or with the sterile latex gloves of the operator or assistant, as the latter will pass high frequency alternating current and burns to the fingers or hands can result.

- When current flows through tissues, physical constrictions in the path of flow may cause an increase in current density to the point that tissue coagulation, burning or necrosis occurs in areas (such as the radicular pulp) where no such effect was intended. This “funneling” effect can occur when contacting dental pulp tissue, or metallic objects in the mouth. For this reason, contact should be avoided with:
 - Metallic dental instruments (Plastic evacuator tips and triplex tips should be used)
 - metallic restorations of all types
 - orthodontic appliances
 - metallic dentures and denture components
- Monopolar electrosurgery is contraindicated in the vicinity of titanium implants because of the risks of heating of bone. Similarly, direct contact with bone should be avoided.
- Because the sparking action of electrosurgery can ignite flammable materials, electrosurgery should not be used simultaneously with alcohol-based pre-procedural mouth rinses, or ethyl chloride pulp testing. Note that nitrous oxide is not flammable but will support combustion.
- Electrosurgery should not be used in the presence of high concentrations of oxygen, e.g. during the immediate recovery from nitrous oxide analgesia.
- An implanted pacemaker is an absolute contraindication to the use of monopolar electrosurgery.
- Electrosurgery units produce noxious gases from tissue (plume) which requires careful attention to ensure proper evacuation from the mouth. High volume suction should be used as close as possible to the surgical site. Dentists and their support staff who undertake ablation of lesions (particularly those linked with human papilloma virus) should wear high filtration “plume masks” to prevent inhalation of pathogenic viruses into the upper airway.

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Safety aspects of dental X-ray equipment

Xrays are a high energy form of electromagnetic radiation that can knock electrons from their orbits around the nucleus and break chemical bonds within molecules (such as DNA, RNA, and water). By way of these ionizing effects, Xray energy can impair normal tissue function and cause death of cells. Biological effects of Xrays are greatest with rapidly growing tissues such as epithelia (cancer), bone marrow (pancytopenia, cancer/leukemia), gonads (mutations), thyroid (carcinoma), and the unborn child (congenital birth defects).

While some of the cellular damage caused by Xrays can be repaired by the DNA repair mechanisms normally present inside cells, some may not be. Nevertheless, it is interesting to know that each hour human cells undergo 10 times more spontaneous or “natural” DNA damaging events than would result from the Xray dose absorbed from one OPG exposure.

Exposure to ionizing radiation is a part of normal living. The normal daily exposure from cosmic or terrestrial sources is termed “background radiation”, and is some 0.01 mSv per day, giving a total of approximately 3 mSv per year (for details of dosage units, see below).

When Xrays are generated for diagnostic imaging, there are several major types of radiation exposure:

- Primary radiation, which comes from the Xray tube itself (in a straight line), and is emitted through the cone or leaks through the tube’s metal housing.
- Secondary radiation, also known as “scatter radiation”, e.g. from the contra-lateral teeth when taking a bitewing film, or from the cervical spine when taking an OPG radiograph.

The radiation doses to staff and patients are influenced by:

- the type of Xray equipment being used,
- the radiographic workload,
- the number of re-takes,
- the extent of compliance with safe work practices,
- the extent of compliance of the Xray equipment and the practices with radiation safety standards, and
- the competency of the staff operating the equipment.

The average number of radiographs taken each week by Australian dentists is 22 intra-oral and 6 extra-oral films. It has been estimated that the threshold level at which Xray exposure would become harmful for the operator is 360 dental exposures per week of 0.5 seconds each in duration (Abbott, 2000).

Radiation risks from dental diagnostic radiology risks are small, but cannot be ignored. They can be minimized by close attention to radiation safety procedures and by practicing good radiological techniques to minimize the need for retakes.

All clinical staff need to appreciate the risks posed by dental Xrays, and should be able to answer patient queries and address patient concerns.

As will be discussed further below, a key principle of radiation safety is that the dose of Xrays used for diagnostic purposes is kept as low as reasonably achievable (ALARA).

The dose of Xrays is expressed in either of two ways:

- Grays (Gy), which is the energy deposited into the tissues. This takes into account both the volume of tissue irradiated, and the radiosensitivity of that tissue.
- Sieverts (Sv), a unit which allows biological effect comparisons of different forms of ionizing radiation (e.g. Xrays versus. Gamma radiation). For Xrays, the dose and the dose equivalent are the same, thus 1 Gy = 1 Sv. Because the Sievert is a large amount, for dental Xrays dose equivalents are normally expressed as milliSieverts (mSv).

Effects of X-Rays on the skin

- For a single intra-oral conventional film, the dose to the overlying skin is approximately 2.0 mSv, while for a conventional (intensifying screen – film combination) OPG the skin dose is 1.74 mSv at the molar region.
- An increased risk of skin cancer is not evident at dose levels less than 250 mSv, thus it can be concluded that the probability of developing skin cancer due to dental Xrays is extremely small.

Effects of Xrays on bone marrow (induction of leukemia)

- During diagnostic dental radiography, less than 1 percent of the body's total bone marrow (the marrow spaces in the mandible) is exposed to Xrays.
- The active bone marrow dosage is 0.142 mSv for full mouth film-based periapical radiographs, and 0.01 mSv for a film-based OPG.
- To induce leukemia, the required whole-body exposure is 50 mSv, thus it can be concluded that the probability of developing leukaemia due to dental Xrays is extremely small.

Effects of Xrays on the lens of the eye (induction of cataracts)

- An Xray dose of more than 2000 mSv is required for cataract induction.
- The lens dosage is 0.4 mSv for full mouth film-base periapical radiographs, and 0.09 mSv for a film-based OPG, thus it can be concluded that the probability of developing cataracts due to dental Xrays is extremely small.

Effects of Xrays on the Thyroid (induction of thyroid carcinoma)

- An Xray dose of 100 mSv is required to induce thyroid carcinoma, however the risk of Xrays causing thyroid pathology is greater in children.
- The thyroid dosage is less than 0.3 mSv for full mouth film-base periapical radiographs, and 0.04 mSv for a film-based OPG, thus it can be concluded that the probability of developing thyroid carcinoma due to dental Xrays is extremely small.
- Using a thyroid collar on an Xray apron will give a 50% reduction in exposure to the thyroid region.

Effects of Xrays on the gonads

- Gonadal dental x-ray exposure is the result of secondary (scatter) radiation.
- Gonadal scatter exposure from full mouth film-based periapical Xrays (19 films) is approximately 0.002-0.005 mSv. This is some 20,000 times less than the dose known to cause congenital abnormalities in newborns. This dose is reduced by 98% if a lead apron is worn. The gonadal dose when a lead apron is worn is then approximately 10 times less than the average background daily exposure. Lead aprons are useful for children, for accompanying persons (comforters) and in the situation where a radiograph is required in a pregnant female patient.

Effects of Xrays on the unborn child

- As with non-pregnant patients, pregnant patients should only have radiographs taken if absolutely essential for diagnosis.
- NH&MRC guidelines state that “there is no need on radiation grounds to defer dental radiography during pregnancy”, provided proper collimation and shielding is used.
- It should be borne in mind that only urgent, non-elective dental care should be provided during pregnancy.
- Based on studies of the Hiroshima atomic bomb blast, a gonadal exposure greater than 200 mSv is required to cause congenital defects.
- A single film-based Xray exposure using a lead apron gives a gonadal dose less than 0.001 mSv.
- It has been calculated that the probability of a first generation birth defect from dental Xrays is approximately 9 in one billion. White (1992) has calculated that a male would need to be exposed to at least 20 thousand full mouth surveys and a female 20 million full mouth surveys to cause defects in their offspring.

- Use of a lead apron with pregnant patients provides psychological support and should be used for both radiation protection and for medico-legal reasons in pregnant patients (Abbott, 2000). It is prudent to use lead aprons in women of childbearing age (as well as in all children).

For pregnant staff, the safety recommendations outlined below will minimize exposure to Xrays and will keep the level of exposure below the threshold of 1 mSv per year. It may be prudent to make provision for another staff member to take dental radiographs during the period of pregnancy, in order to further minimize risk.

Relativities of exposure

Whaites (1998) has estimated the risk per million of a fatal radiation-induced malignancy from various radiological procedures, as follows:

- Single intra-oral film: 0.2 per million
- OPG: 1.0 per million
- Skull: 1.7 per million.

Similarly, White (1992) has calculated the relationship between Xray exposures from dental diagnostic films and background exposure, as follows:

Examinations	Film	Collimation	Background equivalent
Full mouth	D	Round	1 week
	E	Round	4 days
	D	Rectangular	3 days
	E	Rectangular	1 day
2 Bitewings	D	Round	1 day
	E	Round	17 hrs
	D	Rectangular	13 hrs
	E	Rectangular	7 hrs

A further interesting way of assessing the challenge of dental Xray safety is to compare dental Xrays with medical diagnostic films, in terms of dose equivalents (mSv), as has been undertaken by Abbott (2000), and others:

- The average natural background radiation is 3 mSv/year (0.01 mSv/day).
- A full-mouth film-based series of periapical Xrays using D Speed Film is 0.084 mSv. With F speed film this is less than 0.033 mSv, or equivalent to 2-3 days of normal background radiation exposure.
- Taking 4 bitewing films using D speed film is 0.017 mSv, and with F speed film is less than 0.007 mSv.
- Taking an intra-oral periapical radiograph with D speed film and a round collimator gives 0.004 mSv, equivalent to 16 hours of normal background radiation exposure.
- Taking an intra-oral periapical radiograph with D speed film and a rectangular collimator gives 0.002 mSv, equivalent to 8 hours of normal background radiation exposure.
- A film-based OPG radiograph is 0.007 mSv, equivalent to 28 hours of normal background radiation exposure.
- A skull Xray is 0.1-0.2 mSv.
- A head CT scan is 2-4 mSv.
- A chest Xray is 0.01-0.05 mSv.
- A normal abdominal Xray is 0.6-1.7 mSv, and a barium series is 3-8 mSv.

Danforth and Torabinejad (1990) have compared the risks of everyday activities with the risk of developing neoplasia after taking 8 periapical films. Their results, summarized below, indicate that this risk is for many patients less than the risk of death from a road traffic accident on the way to a dental appointment.

Site	Risk of neoplasia from 8 films in an endodontic radiographic survey	Cigarettes smoked for equivalent risk of death from smoking-induced cancer	Kilometers driven for equivalent risk of death from motor vehicle accident
Bone marrow	1 in 9.09 million	0.8 cigarettes	3.0
Thyroid gland	1 in 833,000	8.7 cigarettes	34
Salivary gland	1 in 1.43 million	5.1 cigarettes	20

To put these risk levels into perspective, Langlais and Lagland (1995) have estimated the following as posing one-in-a-million risks of death:

- Natural death in a 20 minute period as a 60-year old male
- Accident whilst cycling 13 kilometres.
- Motor vehicle accident when driving 375 kilometres.
- Alcohol-related death from either 500 mL wine, or 1500 mL beer.
- Lung cancer from one cigarette.

Digital systems used in dentistry effectively reduce radiation exposure levels for the patient for INTRA-ORAL views as much as 90% compared to D-speed film, and 60% compared with E-speed film. For EXTRA-ORAL views (OPG, lateral cephalometric view), the dose reduction varies from 10-66% depending on the type of film/screen combination and the type of view being taken. It should also be remembered that digital systems should reduce the need for retakes since images which have incorrect exposure can be compensated for by adjusting the gamma (levels) in the digital image.

ALARA

The ALARA Principle (As Low As Reasonably Achievable) means that every reasonable measure should be taken to assure patients and staff receive the smallest amount of radiation possible. This can also be expressed using the statement “justify, optimize, and limit”.

Consistent with the ALARA principle, dental practices should pay particular attention to those areas which are known to be flawed or problematic, requiring films to be retaken. According to an Australian study (Monsour *et al.* 1988), these are:

- Processing problems 34.2%
- Incorrect technique 28.3% (such as cone cutting)
- Exposure problems 3.4%
- Unit not turned on 2.9%
- Film problems 1.0%

Prevention and Practical Advice:

The following are recommendations for safe Xray usage in dental practice.

- Do not take films without a clear reason. Consider whether the patient’s current radiographs are adequate. Bear in mind clinical findings and the history on an individual basis,
 - tenderness to percussion
 - discolouration of the tooth
 - the presence and extend of cavitation
 - tooth mobility
 - pulp sensibility via hot and cold tests
 - the presence of swelling or a draining sinus.

- Confirm that a similar Xray examination has not already been performed recently on the patient, within the dental practice, or elsewhere.
 - Use the highest peak kilovoltage (kVp) possible, since at higher kVp there are fewer low-energy Xrays. These do not contribute to image formation but are absorbed in the skin. Thus, while 60-90 kVp is permitted, 70-90 kVp is preferred.
 - Use an Xray source with aluminum filtration to remove low energy Xrays (e.g. layers of aluminium (with or without added rare earth elements) may be built in as an integral part of Xray tube head).
 - The Xray beam should have cross-sectional restriction (collimation) using a lead diaphragm. This limits the maximum dimension of intra-oral Xray unit beams to 60 mm in diameter. Collimation reduces scatter radiation and film fog and thus increases image quality.
 - A long cone should be used as this causes less beam divergence than a short cone. The minimum focus to skin distance permitted is 200 mm. Open ended cones produce less scatter than pointed cones and are preferred.
 - If films are used, use the fastest film consistent with image quality. E or F speed film requires up to 40% less exposure than D speed films. However, use of high speed film may compromise the diagnostic quality of the image in some situations.
 - For extra-oral and panoramic views, use rare earth intensifying screens which fluoresce during exposure (e.g. lanthanum and gadolinium), to reduce the exposure needed.
 - Use standardized seating of the patient to allow consistency of radiographic views.
 - Check patients for items of jewellery, and prostheses which may cause artifacts on the film or increase scatter, prior to positioning the film.
-
- Use film-holding devices to accurately align the radiograph, and avoid the need for retakes due to improper alignment. These also reduce the Xray dose to the patient's fingers.
 - Use lead-based protective patient aprons for child patients, comforters, and pregnant patients, to reduce gonadal exposure. Lead aprons should not be folded, and should be visually inspected for cracks and other defects.
-
- If a darkroom is used, the lighting must be appropriate, i.e. no light leaks, and a low power incandescent lamp (10-15 watts) fitted with a Kodak GBX-2 (red) safelight filter, positioned at least 1.3 metres from the working area
-
- Ensure that the operatory or other room used for radiology has adequately shielded walls.
 - Ensure that viewing windows for exposing Xrays (if used) are fabricated from leaded glass.
 - Do NOT hold films in a patient's mouth during an Xray exposure.
 - Do NOT stabilize the cone or tube head during an Xray exposure.
-
- Utilize position (away from the primary beam), distance (greater than 2 metres), and barriers (such as shielded walls) to reduce staff exposure when exposing Xrays. Xrays travel in a straight line from their source, however because of the inverse square law, the beam intensity decreases dramatically as the distance increases. The exposure switch must either be operated from behind a protective barrier, or if there is no barrier, be located in such a way that the Xray can be activated from a distance of at least 2 metres from the Xray tube. In the latter case, the operator should stand at least 2 metres from the patient, at an angle of 90-135 degrees from the central ray (since this region has the least scatter).
-
- Ensure that radiation doses are within prescribed limits. A comprehensive assessment of shielding requirements should be undertaken by a radiation physicist. In a small general dental practice where only 1mA min is produced weekly, such an assessment may reveal that double layered gyprock is sufficient without the need for lead lining. Each operatory with Xray equipment needs to have separate calculations.
-
- Ensure that an appropriate radiation warning or caution sign (black trefoil symbol on a yellow background) is present in each dental operatory where Xray equipment is located.

- Radiographs should be viewed on a viewer with even illumination, preferably with masking so that only the film is visible.
- There should be a systematic process for checking both intra-oral and extra-oral radiographs. For intra-oral radiographs, this systematic method should include the presence of screening for the presence of occlusal caries, proximal caries, root surface caries, recurrent caries beneath existing restorations, periodontal bone loss, periapical pathology, other bony pathology and finally errors of tooth position or eruption. For the interpretation of OPG films, an excellent systematic approach has been described (Dentil, Volume 1, Set 2, Radiographic Interpretation for Panoramic Films, by Paul A. Monsour. 2001, www.dentil.com).
- If films are used,
 - Maximize film performance by:
 - Storing film away from heat, light and Xray sources. Unopened boxes of intra-oral film can be stored in a refrigerator to extend their shelf life.
 - Handling film only by the edges and corners.
 - Only handling films with clean dry hands.
 - Rotating film stock so that oldest film is used first.
 - Ensuring that films are foxed adequately.
 - Ensure optimal performance of developer and fixer solutions by:
 - Replenishing developer solutions regularly (e.g. daily with heavy use, or at least every 2 weeks).
 - Containers for these solutions are thoroughly cleaned (using separate cleaning equipment) and rinsed prior to refilling.
 - Changing the fixer solution at least every 2 weeks, or earlier if the clearing time is greater than 2 minutes.
 - Always mixing developer before fixer to prevent fixer contamination of the developer.
 - Checking the temperature of the developer.
 - Using a digital timer if processing by hand.
 - Avoiding splashing developer or fixer,
 - Covering tanks with lids (floating lids are preferred) to prevent oxidation and keep dust out.

Further Reading:

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- K Abramovitch & LP Thomas. X-Radiation: Potential Risks and Dose-Reduction Mechanisms. *Compendium* 14: 642-647, 1993.
- PV Abbott. Are dental radiographs safe? *Aust Dent J.* 45: 208-213, 2000.
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- D Lovelock. Justify, optimize and limit. Dental Protection, Annual Report 1993.
- GA Raphael. Radiation protection - still a must in dental practice. *Australas Dent Pract.* 15 : 172, 2004.
- *Radiation Safety in Dental Radiography.* Eastman Kodak Company, 1998.

Relevant Legislation and Guidelines:

- AS2814, 1985.
- AS3205, 1987.
- AS1319, 1994.
- AS 3200.2.201, 1996 and 2000.
- Recommendations for minimizing radiological hazards to patients. NH&MRC
- *Code of Practice for Radiation Protection in Dentistry.* NH&MRC

Eye safety

Hazards to the eyes which may be present in the dental practice setting include:

For patients

- falling instruments and other objects when in the supine position
- spillage of liquid medicaments such as
- acid etchants during restorative procedures
- peroxide solutions during whitening treatments
- sodium hypochlorite solution during endodontic treatment
- local anaesthetic solutions
- inadvertent exposure to high intensity lights and lasers

For dental staff:

- eyestrain because of sustained, demanding and intense near visual work
- transient photo-bleaching of the eye after the use of bright light sources
- eye injury from reflections of high intensity lights and lasers used in patient care
- lacerations from contaminated material such pieces of teeth, calculus, or restorations
- projectile injuries from dental laboratory materials during trimming, grinding, cutting and polishing
- burns from molten metal spatter during casting procedures
- flying objects such as dislodged rubber dam clamps
- ocular irritation if the humidity levels of the airconditioning system are set too low
- splashes of hazardous or irritant substances
- infection from bacteria and viruses because of aerosols or splashes, such as conjunctivitis caused by herpes simplex virus from saliva, or a splash to the eyes from blood-contaminated saliva.

Eye protection is mandatory for both staff and patients, and must be worn for all clinical and cleaning procedures, and for dental laboratory work. Traditional eyeglasses provide reasonable protection to impacts and splashes, except from a sideways direction. Safety glasses and face shield afford increased protection because of their side extensions.

Employers have a duty of care to provide protective eyewear to their employees. Based on section 4.2.1 of AS1336, the following factors should be considered when selecting protective eyewear:

- The nature of the hazards and risks to the eyes.
- The condition under which the operator is working.
- The visual requirements of the task.
- The condition of the operator's eyesight.
- The appropriateness of the frame as a safety frame.
- The personal preference of the wearer for particular safety frames.

Effective protective eyewear should be:

- Comfortable to wear
- Snug fitting
- Lightweight
- Ventilated
- Able to give unrestricted vision
- Distortion free
- Optically clear
- Anti-fogging (through a permanent fog-resistant coating)
- Durable
- Easy to clean
- Able to withstand repeated cleaning

Eyestrain

Eyestrain is a common occupational concern in clinicians. While the exact mechanism is controversial, the most common understanding is that during intense near visual work, the ciliary muscle of the eye, which produces accommodation (focusing) and the extra-ocular muscles, which converge the visual axis of each eye on to the object of interest, become fatigued.

A relationship may exist in some practitioners between eyestrain and musculo-skeletal complaints, because of subconscious attempts to alter posture to improve near vision. Conversely, solutions to eyestrain (such as loupes or operating microscopes) provide a major improvement to the operator's posture. To reduce eyestrain, magnifying loupes with an appropriate working distance (e.g. between 25 and 36 centimetres) can be worn, to provide greater detail of the oral cavity (better, clearer vision) without the need to be closer to the patient. The use of loupes of either Galilean or Prismatic (Kepler) designs promotes correct upright posture by limiting the working distance, and discouraging bending the neck. In so doing, they facilitate optimal ergonomic balance and enhance both productivity and safety.

Eyestrain is primarily due to a discrepancy between the visual demands (close visual work) and the abilities of an individual, particularly above the age of 40 years. Presbyopia is a reduction in the ability to attain sharp focus for near vision. It occurs because of reduced elasticity of the lens as a consequence of normal aging. Because of this, blurred near vision occurs frequently after the age of 40 years.

Contributing factors to eyestrain include:

- The need to change focus from near to far objects, e.g. from the teeth to the bracket table, patient charts, radiographs or computer screens
- Inadequate task lighting, e.g. because of shadowing from the lips and cheeks
- Poor visual contrast between objects of interest, e.g. because of the similar hue of tooth structure and adhesive restorative materials
- Glare from reflections of the operating light from enamel surfaces
- Glare from reflections of daylight or artificial lighting from surfaces in the workplace, or from computer screens
- Frequent movement of the object of interest (e.g. tooth or instrument), which requires tracking of the eyes
- Visual problems such as presbyopia or astigmatism

Dental staff who suffer eyestrain or visual fatigue may experience the following signs and symptoms:

- Temporary blurring of vision
- Difficulties in visual accommodation
- Photophobia
- A vague discomfort in the eyes
- Feelings of heaviness of the eyes
- Dull bilateral headaches
- Bloodshot eyes
- A burning and itchy sensation in the eyes
- Increased lacrimation (tear production).

Vision testing is recommended for:

- Clinical operators (dentists, oral health therapists, and dental hygienists) before they commence wearing loupes, or using operating microscopes or Class 4 lasers
- All staff members aged more than 40 years, because of age-related changes in vision, as discussed above.
- New staff members who will be required to operate computers for a significant proportion of their working hours (>15 hours per week or 25% or more of their working hours).
- Any staff member, regardless of age, who is experiencing visual discomfort (eyestrain) during clinical or laboratory work or when using computer equipment.

For staff who experience eyestrain during their work, it is also appropriate to consider whether the level of lighting is appropriate. Under national occupational health and safety standards, for extra-fine (defined as tolerances below 25 microns), the minimum light level should be 1600 lux. For computer work, the minimum level is 600 lux, while for routine work, the minimum level is 400 lux.

Specific published recommendations for dental practice from the ISO (Viohl 1979) are for substantially higher light levels, namely:

- 8000 - 15000 lux for the oral cavity from the operating light
- 1000 lux for working areas such as the bracket table
- Less than 1200 lux towards the patient's eyes from the operating light
- 500 lux for the dental surgery room environment.

Other lighting-related factors which can contribute to eyestrain include:

- Nuisance reflections in computer screens, particularly from overhead lights
- Glare and sunlight from windows and skylights
- Reflections from shiny surfaces.

Lighting of the oral cavity can be optimized by:

- Using inbuilt fiber-optic light sources on dental handpieces.
- Using large sized double-sided front-surfaced intra-oral mouth mirrors for retraction and mirror vision.
- Using head lamps fitted to head frames or magnifying loupes.

If loupes are being considered, the following factors should be evaluated for the various systems available:

- The magnification of the system
- The design of the system (Galilean or Prismatic)
- The working distance (e.g. 35, 40, or 45 cm)
- The declination angle – this should minimize head tilt so that neck muscle fatigue does not occur.
- The weight of the loupes, and whether this will be borne on a head band or on the bridge of the nose
- The overall optical quality of the lenses
- Whether the loupes can be used with headlights or other forms of coaxial illumination.

Protection from retinal burn hazards

Specially designed glasses are needed for procedures using high intensity visible or invisible light sources, such as:

- High intensity quartz tungsten halogen lamps
- LED curing lights
- Plasma arc curing lights
- Metal halide bleaching lamps
- Visible and infrared lasers.

Quartz tungsten or xenon-halogen lamps used for curing composite resin materials emit visible blue light with a wavelength between 400 and 500 nm. Ultraviolet emissions are filtered out completely, and only small amounts of near and middle infrared "heat" energy pass through the filters and are emitted from the tip. Plasma arc curing (PAC) lights emit a broad range of wavelengths from ultraviolet through to visible and near infrared, however the filters within these lights remove all the ultraviolet and most of the infrared energy, so that the final emission is similar to a xenon-halogen curing light. LED lamps only generate narrow spectrum visible blue light, and do not need filtration.

High intensity lamps are used in "power bleaching", since light energy increases the breakdown of hydrogen peroxide, both directly and by increasing the temperature of the gel. Some light sources used for

extended bleaching treatments (e.g. “Zoom”) emit ultraviolet as well as visible light. The Zoom light is a metal halide (mercury vapour) lamp with several defined emissions in the ultraviolet range. These UV wavelengths can

- Absorb directly into proteins within soft tissue and tooth structure, and cause heating or ablation
- Scatter widely from the lamp and reflect from the surface gel
- Cause damage to the oral and gingival mucosa, lips, and facial skin (sunburn)
- Elicit photo-eruptive lesions such as dermatitis if the patient is on certain medications such as calcium channel blocking anti-hypertensive agents.
- Cause phototoxic effects on the retina if protective glasses are not worn and the patient is using certain photosensitizing medications, e.g. psoralens and sulphonamide derivatives.

Eye protection is recommended for high intensity quartz tungsten halogen lamps, LED curing lights, and plasma arc curing lights, and is mandatory for metal halide bleaching lamps, and Class 4 lasers. Tinted orange polycarbonate spectacles and perspex shields are opaque to ultraviolet wavelengths (less than 400 nanometres) as well as visible blue light (400-500 nanometres) but transmit longer visible wavelengths (such as green, yellow and red), so as not cause intense disorientation. Several studies of “blue light” hazards in dental practice have shown that the risk of retinal injury is not significant under normal conditions (i.e. where the light is directed toward the patient, rather than towards the eyes of the staff members).

The blink reflex and aversion responses operate to protect dental staff from blue and other visible light wavelengths, which may be reflected from:

- Enamel surfaces
- Highly polished metallic restorations such as gold crowns
- Stainless steel matrix bands
- Mylar strips.

If a shield is not used during restorative work with composite resins, staff should be encouraged to look away when the curing light is activated. Filtering caps placed on the tip of the curing light provide some additional benefit, however because of the high scatter coefficient of visible blue, it will be difficult for caps to attenuate the majority of the light.

Protective eyewear includes spectacles for operators and assistants, and spectacles or goggles for patients. Shields may also be used, e.g. orange Perspex paddles that attenuate the blue light used for curing composite resin materials. For metal halide lamps and lasers, both glasses and goggles should have either solid opaque sides or view windows so that harmful wavelengths of light cannot enter from the periphery. Laser protective glasses have standardized markings on their outer surface which specifies their attenuating power (optical density, OD) for the laser wavelength of choice. The higher the optical density, the greater the attenuation. Values of OD=4 are typical.

Shields and spectacle inserts can be made of the same protective material as laser goggles, to allow normal spectacles or loupes to be used during laser procedures. Similarly, filters of the same material can be incorporated into the optical path of operating microscopes. Special spectacles are not required with the CO₂ laser as this wavelength is completely stopped by the glass and plastic materials used in conventional eyewear.

Laser safety

Laser safety is based on two key Australian Standards, AS2211 and AS4173, both of which were revised and updated in 2004 period. AS2211 was first published in 1977 and AS3173 in 1994.

AS/NZS 2211.1 (2004)

- specifies requirements and procedures designed to protect people from laser radiation.
- is intended for application both by users and manufacturers of laser products.
- specifies safe working levels of optical radiation

- classifies lasers according to their degree of hazard
- sets out detailed protective and control measures appropriate to each class, such as
 - warning signs
 - protective glasses
- provides information regarding the effect of laser radiation on biological tissues
- provides a range of appendices which cover maximum permissible exposures, calculations
- describes the medical surveillance required after an eye exposure incident involving a laser
- specifies the design of warning labels and signs.

AS/NZS 4173 (2004), the “Guide to the safe use of lasers in health care”,

- is intended for application in clinics, private practices, and hospital operating rooms, wherever laser equipment is used in association with diagnosis, therapy or surgery
- outlines the various risks posed by lasers, including:
 - eye damage
 - skin injury
 - fires and explosions
 - reflection hazards
 - secondary burns from heated instruments
 - electrical hazards
 - inhalation of laser plume
- is designed to assist clinicians and their support staff with procedural and administrative controls necessary for the safety of staff, patients, maintenance personnel, and others who may be in the vicinity of the treatment room and in need of protection against inadvertent exposure to laser energy. These include:
 - access to rooms whilst the laser is in use
 - protective eyewear
 - signs
 - laser calibration
 - measures to reduce reflections, such as matt surfaces on instruments
 - correct positioning of the laser
 - window protection
 - control of the laser operating key
 - safe working procedures in small office practice
 - safe working procedures in the operating theatre environment
- outlines the requirements for laser safety training programs required as a condition for obtaining a Class 4 laser use licence for dental procedures.

Warning signs should be fitted to surgery doors or other entrances. Examples of the design of such signs are found in AS/NZS 4173:1994 and in AS 2211(Part 1):2004.

Dental laser procedures should be undertaken in such a manner that the beam is never directed towards the door of the operatory or other entrances.

Glass windows do not provide any significant protection for many common laser types (e.g. argon ion, KTP, Nd:YAG, and semiconductor diode lasers). However, glass does provide high attenuation at middle and far infrared wavelengths, especially at wavelengths greater than 5 microns, but may shatter if subjected to excessive heating from a concentrated beam at point blank range. Windows must be covered on the inside with opaque barriers if the wavelength of the laser in use is capable of penetrating glass.

Middle infrared lasers (such as the Er:YAG and Er,Cr:YSGG) and far infrared lasers (such as the CO₂ laser) absorb in water and thus an accidental exposure will cause a surface injury to the cornea of the eye should an accident occur without laser protective spectacles in place. Wet gauze is an effective protective material for the patient’s eyes and oral soft tissues when these lasers are used.

Precautions must be taken to minimize the potential for soft tissue injury from reflected laser radiation within the mouth. Numerous surfaces (e.g. stainless steel matrix bands, gold crowns, chrome-cobalt dentures, titanium implants, metallic dental instruments) are efficient reflectors of certain laser wavelengths. Such surfaces may not appear reflective to visible wavelengths and thus may not be regarded as contributing toward a hazard. Protection of the oral soft tissues by placing wet cotton rolls beyond the operating field is therefore required for intra-oral laser procedures.

Teeth, restorative materials, and implants may be damaged by unintentional exposure to some laser wavelengths. For soft tissue surgical procedures in proximity to such structures, retractors or other metal instruments must be used to provide protection from inadvertent laser exposure. The surface of such instruments should be matt to avoid specular (mirror-like) reflections.

For visible lasers (such as the KTP and argon laser) and near infrared lasers (such as diode and Nd:YAG), wavelengths of light between 400 and 1400 nm pass through the eye until reaching the retina, where they absorb into the melanin and haemoglobin within the pigment epithelium of the retina. This causes local heating and damage to the photoreceptive rods and cones, resulting in loss of vision in part of the visual field, which may or may not be permanent.

According to the principles in AS2211.1, a risk assessment should be undertaken before a laser system is introduced into a dental practice. This would include the capability of that laser system to injure personnel. There are a number of low power visible light laser systems which do NOT pose a significant risk of eye injury because of the dispersed nature of the beam or its low intensity, and laser protective glasses are not required. These are termed Class 2M devices, e.g.

- DiagnoDENT Classic from KaVo
- SaveDent PAD laser from Denfotex.

Laser welding systems used in the dental laboratory (e.g. Nd:YAG lasers for welding chrome-cobalt or titanium) are fully enclosed Class I laser devices and their design eliminates completely any risk of eye injury such that protective glasses are not required.

Prevention and Practical Advice:

A formal Radiation Safety Protection Plan (RSPP) should include:

- Details of the laser equipment (laser type, manufacturer, model, serial number, wavelength, power or power density, purpose of the device, and its location).
- An assessment of all related radiation hazards
 - Eye exposure
 - Skin exposure
 - Fire and explosions
 - Airborne contaminants
 - Secondary burns
 - Toxicity
- Responsibilities of the Laser Safety Officer and of users
- Names of authorized users and their license details.
- Access Control
- Safety devices
 - Eyewear
 - Face shield
 - Goggles and spectacles
 - Filters for operating microscopes
 - Barriers
 - Protective face masks
- Safe Work Practices
 - Administrative requirements

- Warning signs
- Control of the key switch
- Window and door protection
- Use of the laser apparatus
- Alignment of the laser
- Laser beam delivery systems
- Non-beam hazards
- Servicing, Repair and Maintenance
- Operational checks
 - Daily checks
 - Power and footswitch cables
 - Laser emission indicators
 - Beam power/pulse energy
 - Examination of optical fibers
 - Prior to each procedure
 - Obtaining the key
 - Placing a sign outside the door
 - Correct operation of self-check routine
 - Aiming beam quality
 - Articulated arm movement and physical checks
 - Coincidence of the aiming and main beam
 - Proper safety glasses
 - At the end of a procedure
 - Turning the laser power off.
 - Wiping clean the laser and any attachments.
 - Dispatching any attachments that may require sterilization before the next laser session to the instrument sterilization facility.
 - Counting and returning the laser safety glasses to safe storage.
 - Securing the articulated arm (if fitted).
 - Returning the laser key to safe storage.
 - Prior to change of the delivery system
 - Periodic checks
 - Emergency switches
 - User-accessible interlocks
 - Electrical hazards
 - Local exhaust ventilation

Further Reading:

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Respiratory disease

Indoor air quality

The proper temperature, humidity and air purity (to minimize dust, infectious agents and gases) should be maintained in the dental practice setting. AS1668.2 (1991) and its Supplement 1 (The use of mechanical ventilation and air-conditioning in buildings - Mechanical ventilation for acceptable indoor air quality and the prescribed limits) give the required parameters. Insufficient air changes may cause an elevation in levels of carbon dioxide, leading to fatigue and inattention. The system should be in operation at all times when there are workers on the premises, in order to maintain appropriate levels of comfort and air freshness. The relative humidity should be between 25 and 60 %. Lower levels of humidity cause dryness of the mucous membranes and skin, and may also increase irritability. Air-conditioning systems should be monitored regularly and serviced by accredited service technicians, and maintenance schedules should be documented.

Airway irritation

Air abrasion devices create alumina dust which can become a respiratory irritant for both staff and patients. Because physical airway irritation may be caused by these small particles, staff with asthma or reactive airways disease should pay particular care in ensuring that sufficient (additional) suction is used during air abrasion procedures.

Electrosurgery equipment and lasers used for surgical procedures create a gas mixture (plume) which contains a wide variety of noxious chemicals. The odour of plume is annoying and unpleasant, and this is an indication of the unpleasant nature of this material. Plume consists of:

- Carbon dioxide and carbon monoxide
- Toxic gases
- Remnants of carbonized tissue
- More than 50 organic chemical constituents, including acetaldehyde and formaldehyde
- Fragments of bacteria and viruses, and in some cases, intact virions.

Inhalation of this material can lead to airway irritation. In addition, some pathogenic viruses such as human papilloma virus are not inactivated by laser or electrosurgery procedures, and appropriate filtration masks and high velocity suction are necessary to prevent inhalation. Plume particulate matter ranges from 0.1 to 0.8 microns, and specially made “plume masks” are designed to handle high risk procedures such as ablation of oral warts.

Volatile organic compounds (VOC)

Potential sources of VOC in the dental environment include:

- Dental operatory (ethanol and other alcohols, acetone, various solvents).
- Dental laboratory (e.g. methyl methacrylate, solvents)
- Autoclaves and dry heat sterilizing units
- Furnaces used for porcelain work or metal casting
- Waiting room and office areas (from carpets, furnishings, paints, and building materials such as particle board and plywood – the latter two being sources of formaldehyde vapour, which can cause both irritant and allergic effects)
- Photocopiers and laser printers (These are also a source of ozone).
- Heated dental waxes

Health effects of VOC can include “sick building syndrome”, with:

- Fatigue and tiredness
- Headache and eye irritation
- Nasal irritation
- Coughing.

Symptoms of “sick building syndrome” often have no clear causes, but abate once the staff member is no longer inside the building.

Airborne infections

Many dental procedures can generate large quantities of aerosols of 3 microns or less. Aerosols can be generated in the dental environment by:

- Air-water syringes
- Air turbine and electric micro-motor handpieces
- Ultrasonic scalers
- Electrosurgery equipment and lasers (plume)
- Air abrasion devices
- Ultrasonic scalers (if operated with the lid removed).

These aerosols can contain material from the patient’s oral fluids (saliva and blood) as well as microorganisms from dental unit waterline biofilms. These various sources can contribute to pneumonic infections in both patients and dental staff, although more particularly so in patients who have compromised immunity or reduced host resistance because of impaired general health.

Factors which influence the physical extent of the aerosols created and the level of microbial contamination from patient-derived microflora include:

- The patient’s level of dental hygiene, specifically whether the patient brushed or flossed before the appointment
- Whether the patient has used a pre-procedural disinfectant mouthrinse
- The type of procedure being undertaken
- Whether rubber dam is used
- How often the air turbine or ultrasonic scaler is used

Of greater importance, a wide number of diseases are transmitted by the airborne route or through droplet nuclei formed from respiratory secretions, and for this reason there are a number of conditions in which “standard precautions” used for infection control are NOT adequate in terms of the level of protection required:

Airborne transmission:

- Pulmonary tuberculosis
- Measles
- Varicella (Chickenpox)
- SARS

Droplet transmission

- Pertussis (Whooping cough)
- Influenza
- Measles
- SARS
- Rubella
- Streptococcus pyogenes (Scarlet fever)
- Meningococcal infection

Patients with these conditions CANNOT be treated safely in the normal general dental practice setting.

Biofilms form in dental equipment immediately the equipment is connected to a water supply which is not sterile. Dental unit waterlines (DUWL) provide an ideal environment for microbial colonization and proliferation because the high surface area to fluid volume ratio results in stagnation and low flow. Because

of the laminar flow characteristics of narrow bore tubing (a central high flow rate, but a low flow rate on the periphery), water-borne organisms are dispersed onto the surfaces of the tubing, where they can then attach. In untreated waterlines, levels of contamination in the output water may exceed 1,000,000 colony-forming units per milliliter of water (CFU/ml). This water is not only delivered into the patient's mouth (where it can come in contact with wounds, or can be swallowed) but it is also aerosolized by handpieces, air-water syringes and ultrasonic scalers, giving a respiratory exposure to bacteria. As listed below, the microorganisms in DUWL biofilms include both overt and opportunistic pathogens, such as Legionella (pathogenic and non-pathogenic species), Cryptosporidium, Klebsiella, Nocardia, Moraxella, Serratia, and several species of non-tuberculous Mycobacteria (several species). *Pseudomonas aeruginosa* is a ubiquitous organism in water systems and is found in high levels in many DUWL biofilms. It may cause a severe life-threatening pneumonia in patients with existing lung disease.

Organisms in Dental Unit Waterlines
(Adapted from Pankhurst and Johnson, 1998)

Bacteria	Fungi	Protozoa
<i>Achromobacter xyloxidans</i>	<i>Phoma spp</i>	<i>Acanthamoeba spp</i>
<i>Acinebacter spp</i>	<i>Penicillium spp</i>	<i>Cryptosporidium spp</i>
<i>Actinomyces spp</i>	<i>Cladosporium spp</i>	<i>Mircosporidium spp</i>
<i>Alicaliogenes dentrificans</i>	<i>Alternaria spp</i>	<i>Giardia spp</i>
<i>Bacillus spp</i>	<i>Scopulariopsis spp</i>	
<i>Bacteriodes spp</i>		
<i>Burkholderia cepacia</i>		
<i>Caulobacter spp</i>		
<i>Flavobacterium spp</i>		
<i>Fusobacterium spp</i>		
<i>Klebsiella pneumoniae</i>		
<i>Lactobacillus spp</i>		
<i>Legionella pneumophila</i>		
<i>Legionella spp</i>		
<i>Micrococcus spp</i>		
<i>Moraxella spp</i>		
<i>Mycobacterium avium</i>		
<i>Mycobacterium spp</i>		
<i>Nocardia spp</i>		
<i>Pasteurella spp</i>		
<i>Proteus vulgaris</i>		
<i>Pseudomonas aeruginosa</i>		
<i>Streptococcus spp</i>		
<i>Staphylococcus aureus</i>		
<i>Xanthomonas spp</i>		

For DUWL biofilms, the potential sources of contamination are

- the municipal reticulated public water supply
- supplies of distilled or purified water (which are not sterile) used for self-contained water systems
- environmental contamination of “clean water” system bottles
- retrograde contamination from patients – via aspiration through handpieces and triple syringes into DUWL, or venturi suction systems.

The extent of DUWL biofilm can be assessed by culturing exit water using commercially available test kits such as Millipore ® Heterotrophic Plate Counter dip-sticks (MHPC10025). These estimate the number of

free floating aerobic mesophilic heterotrophic bacteria in the water. Once a sample is taken, 2-3 days incubation at room temperature is required before the plates can be read. Commercial or hospital-based microbiology laboratories can undertake specific culture-based tests of water samples for pathogenic Legionellae or *Pseudomonas aeruginosa*, although it needs to be borne in mind that the former tests have a long reporting time (typically 10 days).

Studies conducted by the author of water from dental unit water provide evidence that biofilm control remains a concern. A total of 60 dental units in 40 dental practices in South-East Queensland were sampled at two time intervals, with tap water samples from the same locations analyzed in parallel. Over 86 per cent of dental unit water samples contained more than 500 colony forming units (CFU)/mL, which is the accepted standard for drinking water quality, while only 12% of water samples were under target level of 200 CFU/mL recommended in the 2004 CDNA Infection Control Guidelines for the treatment of immune compromised patients. As would be expected, factors which influenced water quality were the age and brand of the dental unit, quality of input water, and the flushing and purging protocols used. In some cases, high concentrations of bacteria were found in tap water in some shopping centres, with an adverse influence on biofilm levels in the dental practices in those locations.

Because dental unit waterlines may become contaminated with Legionella, dental staff may be exposed to these bacteria by inhalation of aerosols during dental treatment. There are nearly 50 species of Legionellae, however one species, *Legionella pneumophila*, is associated with disease, both the mild flu-like form (Pontiac fever) and the life-threatening atypical pneumonia known as Legionnaire's disease. The major symptoms of Legionnaire's disease include fever, chills, and cough, while additional signs and symptoms may include myalgia, fatigue, abdominal pain, headache, diarrhea and loss of appetite. In healthy patients, relatively few cases are fatal (approximately 12%).

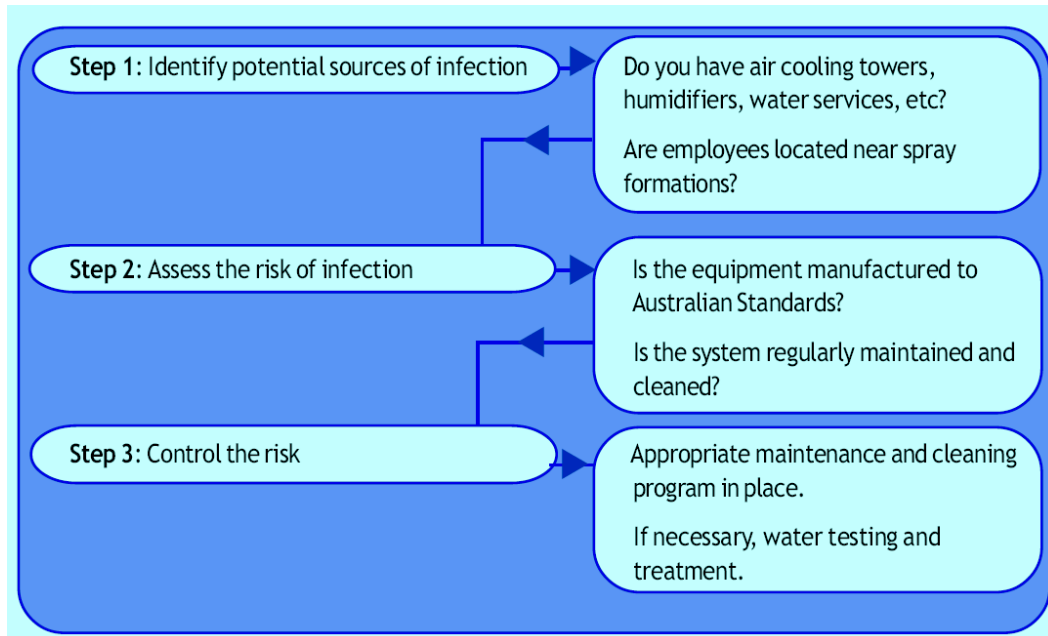
Risk factors known to be associated with contracting Legionnaire's disease include:

- Male sex
- Age greater than 50 years
- Smoking
- Alcoholism
- Diabetes
- Chronic respiratory disease
- Renal disease
- Cancer.

Legionellae occur in environmental water sources (such as rivers, lakes and dams), and from the municipal water supply can colonize dental unit biofilms in dental units connected directed to mains water, or if tap water is used to refill the bottles in self-contained water systems. Legionellae require nutrients and thus cannot grow in sterile water. The reported prevalence of legionellae in dental unit waterlines varies widely, however the main pathogenic species *L. pneumophila* has been isolated from dental units in both public and private practice settings. In public clinics, a major risk factor is where cold water is stored in large tanks. A particular risk situation in general practice is where legionellae are present in the hot water system because the operating temperature is set too low, and can be released from taps used for handwashing or instrument cleaning. Legionellae grow in temperatures from 20-45 degrees Celsius, but cannot survive for more than a few seconds above 60 degrees Celsius.

Serum antibodies to *L. pneumophila* have been reported in dental staff in the UK, USA, and Europe, indicating that the dental workplace is associated with some level of exposure, however it appears that exposure to low levels via aerosols may "immunize" the staff but is insufficient to cause frank infection. There has been to date only one case report of a dental staff member contracting fatal Legionnaire's disease by the occupational route, with the causal organisms recovered from the dental unit waterlines in high levels.

Note that in WA there is a specific code of practice relating Legionnaire’s disease, which includes in its scope not only major airconditioning plants but other potential sources of infection. This code provides a management protocol for water services, as follows:.



Maintenance Plan

WATER SYSTEMS INCLUDING STAND-BY INSTALLATIONS			
	Inspection	Cleaning	Disinfection
HOT	At least annually. Monthly for water treatment units.	Cleaned and flushed at least annually.	Maintain hot water temperature. Flush outlets with hot water.
WARM	Monthly for water treatment units. Other-wise at least annually.	Cleaned and flushed monthly when necessary. Weekly for irregularly used shower heads/taps.	Chlorination or heat disinfection.
COLD	At least annually.	Cleaned and flushed initially annually, then as necessary.	Chlorination.

Preventive measures

To ensure a good quality of air from the air conditioning system in the dental practice, contamination of the intake air must be avoided by:

- Locating intakes away from vehicle emissions and sources of dust
- Placing “No smoking” signs near air intakes
- Ensuring regular maintenance of the system (including filters)

Dental staff should wear suitable masks during any procedure where there is potential for splashing, splattering or spraying of blood or saliva, or where there is potential for airborne infection. Surgical masks which conform to AS 4381 will block particles of 3 microns in diameter.

Surgical masks are designed to prevent a staff member's respiratory secretions from contaminating the operative site, and to reduce the risk to staff from splashing and spraying of body fluids from the patient. Dental staff should be aware that the efficiency of a conventional surgical mask declines with time, particularly after 20 minutes in an aerosol environment.

Because conventional surgical masks are loose fitting without a tight air seal, they are not efficient in preventing the wearer from inhaling airborne particles. It is important to realize that a conventional surgical mask does not provide sufficient protection for the safe treatment of patients with active pulmonary tuberculosis (or other conditions such as SARS). For actively tuberculous and SARS patients, a particulate filter personal respiratory protection device with a tight seal, capable of filtering out up to 95% of particles 0.3 microns or greater must be worn – e.g. an N95 mask. A range of other 'additional precautions' are also required, such as negative air pressure ventilation. These are addressed in the 2004 CDNA *Infection Control Guidelines*.

Patient-derived aerosols can be reduced by:

- Having patients brush and floss before appointments
- Pre-procedural mouthrinsing (e.g. with Chlorhexidine or essential oil mouthrinses)
- Use of rubber dam, which gives an up to 70% reduction in airborne particles within a 1 metre range of the patient's mouth.

Biofilm levels in dental equipment waterlines can be limited by a range of methods which have biocidal action, such as:

- Oxygen-releasing compounds such as hydrogen peroxide and peroxyborates,
- Silver compounds,
- Combination products such as ICX™,
- Sodium hypochlorite, and
- Electro-chemical activation.

Actions which physically disrupt the biofilm include:

- Flushing at the start of the day,
- Flushing between patients, and
- Purging the system at the end of the day.

Other actions which improve water quality include:

- Using anti-retraction valves on handpiece and triplex waterlines
- Installing water filters where mains water enters the dental practice
- Monitoring water quality by microbiological testing.

Backflow prevention serves to prevent water flow back into the mains reticulated water system due to negative pressure or back-siphonage in some part of the system. Various backflow prevention devices are available on the market, according to the hazard level, and these are discussed in AS 2845.1 (Water supply-Backflow prevention devices) and AS/NZ 3500. Water supplying dental equipment is classed as high hazard, since contamination by patient fluids into the potable water supply may have the potential to cause death. These lines must have permanent labels indicating non-potable water (not for drinking) and must comply with AS 1345 and AS 1319 for the distribution of pipes and outlets.

High hazard device options which protect from back-siphonage include:

- Registered break tank (RBT)
- Registered air gap (RAG)
- Reduced pressure zone (RPZ)
- Reduced pressure detector assembly (RPDA).

The most common back flow prevention device fitted in modern dental practices is the RPZ valve. This must be installed by a registered plumber, and as with all backflow prevention devices, these require registration with the local government authority and must be tested for proper operation at least every 12 months.

Further Reading:

- RM Atlas, *et al.* Legionella contamination of dental unit water. *Appl Environ Microbiol* 61: 1208-1213, 1995.
- CL Pankhurst, *et al.* Prevalence of Legionella waterline contamination and *Legionella pneumophila* antibodies in general dental practitioners in London and rural Northern Ireland. *Brit Dent J* 195: 591-594, 2003.
- LJ Walsh. *Microbiology*, 4th Edn. Sydney: RACDS, 2003.
- LJ Walsh. Risk reduction for dental unit biofilms. *ADA News Bulletin*, 283: 30-32, 2000.
- L Samaranyake. SARS and dentistry: lessons for the future. *Dental Asia*, January 2004: 10-18.
- CL Pankhurst & NW Johnson. Microbial contamination of dental unit waterlines: the scientific argument. *Int Dent J* 48: 359-368, 1998.
- AS1668.2 (1991) and Supplement 1 (The use of mechanical ventilation and air-conditioning in buildings - Mechanical ventilation for acceptable indoor air quality and the prescribed limits)
- *Code of Practice for Workplace Amenities*. 1994.
- *Guide to Indoor Air Quality*. 1995.
- Indoor Air Quality Management Plan: The University of Queensland. 2000.
- Surgical smoke: clinical update. Pall Medical, Ann Arbor, Michigan, USA. 2000.

Relevant Legislation and Guidelines:

- AS 1668.2 Mechanical ventilation for acceptable indoor air quality
- AS 1677 Refrigerating systems
- AS 3666 Air handling and water systems of buildings – Microbial control
- AS 3666.3 Air handling and water systems of buildings – Microbial control. Part 3: Performance-based maintenance of cooling water systems
- AS 1324 Air filters for use in general ventilation and air conditioning'
- HB 32 (Standards Australia) Control of microbial growth in air-handling and water systems in buildings
- *Building Code of Australia (BCA)* (1996)
- *Exposure Standards for Atmospheric Contaminants in the Occupational Environment*. National Occupational Health and Safety Commission (NOHSC) 1995.

Neck and back issues

Neck and lower back disorders are a major occupational concern in dental practice.

Contributing factors to neck and back disorders in clinical dental staff include:

- Challenging access to and visibility of the oral cavity
- Postural problems
- Seated posture
- Sustained awkward postures, in which the shoulder or neck are subject to high stationary loads, e.g. elevating the elbows during a procedure
- Attempts to increase visibility by
 - Bending the neck (leaning forward, and balanced on the front edge of the stool)
 - Twisting the neck to increase visibility
 - Tipping the shoulders to one side
 - Twisting the torso
- Poor positioning of the patient (i.e., patient located too close, too high or too far forward)
- Use of the wrong stool (no lumbar support) or the wrong stool height
- Prolonged static neck flexion from an incorrect working position
- Shoulder abduction (elbows drawn away from the midline)
- Forceful hand or arm exertions in some procedures
- Repetitive actions
- Increased lower body mass with age
- Lack of upper arm support
- Mental strain
 - Time pressures with a fixed schedule
 - Workplace stress
 - Length of the working day
- Injuries sustained outside the dental workplace, e.g. from hobbies or sporting activities

It is now commonplace that most procedures in dentistry are performed with the operator seated and the patient supine or semi-supine for treatments in the maxilla and mandible, respectively. Working from the seated position provides several advantages over using a standing posture:

- It is less energy consuming
- It places less stress on the legs
- It lowers the hydrostatic pressure in the legs, and thus reduces the occurrence of varicosities in the venous circulation of the legs.
- It provides greater stability for tasks that require high visual control and fine motor work.
- In particular, it facilitates efficiency through 4-handed dentistry.

However, if the seated operator adopts a posture where their lower back unsupported, this exerts much greater loads on the intervertebral discs of the lumbar spine than if the operator were standing. Intervertebral discs have poor blood and nerve supply, and thus have poor healing, and do not produce pain with small repeated injuries on a daily basis. Discs can eventually rupture (prolapse) as the end result not of one incident but as the accumulation of many events over many years which have caused damage to the annulus, the fibrous outer layer of the disc.

Twisting while seated provides a strong shear force which over time can rupture fibers within the intervertebral discs of the lumbar spine. For example, right-handed operators tend to rotate their head to the right hand side while simultaneously twisting their torso to the left hand side to gain better visibility. When this action is repeated many times a day, over time, the muscles responsible for right hand head rotation and left hand torso rotation will become both stronger and shorter, while the opposing (stabilizer) muscles become weaker and elongated, leading to muscle imbalance.

Such adaptations explain the “rounded shoulder” posture seen in some members of the dental profession, which has developed from shortening of muscles in the anterior region of the neck and in the upper chest, with corresponding muscle weakness between the shoulder blades – because of using a working position that is in front of the operators face but well below their eye level.

The impact of ergonomic problems can be seen in terms of:

- Pain and suffering
- Poor circulation, leading to problems in intravascular pressure such as haemorrhoids
- Reduced lung capacity
- Long term deformities of the spine
- Physical injuries sustained by staff, e.g.
 - Intervertebral disc problems affecting the back or neck, because of poor posture over an extended period
 - Bursitis and shoulder muscle pain, because of working with the elbows or shoulders raised
- Reduced efficiency and productivity
- Lost work days
- Early retirement
- Medical costs
- Worker’s compensation claims
- Reduced morale.

Prevention and Practical Advice:

An ergonomic environment (designed along the lines discussed below), should protect the well-being of dental staff, improve clinical efficiency, and increased comfort for both staff and dental patients. Using a video camera to record posture and envelopes of movement is a simple and illuminating means of identifying habitual postures which are sub-optimal.

General preventive actions include:

- Conducting in-service awareness and education regarding musculo-skeletal problems for all members of the dental team
- Undertaking regular exercise to maintain flexibility of the torso and extremities. This can occur during small natural interruptions, such as waiting for materials to be mixed or local anaesthesia to work. When exercising, the operator should avoid the anterior neck and upper chest muscles, deltoid muscles and upper trapezius muscles, since these tend to be over-strengthened, and concentrate instead on the head extensors, mid-back muscles, spinal extensors, and the muscles between the shoulder blades, since these stabilizer muscles tend to be weaker.
- Arranging consumable items and equipment so that frequently used items are close at hand.
- Arranging the operating light to achieve a shadow free working field.
- Using magnifying loupes. The look-down angle of loupes can keep head tilt less than 25 degrees, which keeps the head and neck muscles in a neutral position and decreases fatigue in those muscles as well as lower back pain.
- General principles for ensuring optimum access, visibility, comfort, and control:
 - Keep forearms parallel to the floor
 - Use hand and finger rests wherever possible
 - Use an upright posture and avoid bending at the neck or arching the spine
 - Avoid remaining in one position for an extended period of time
 - Avoid leaning forward or to the side
 - Do not twist at the torso as this creates a high shear force on the intervertebral discs
 - Do not lean laterally as this is unstable
 - Rest the elbows and upper arms against the side of the operator’s body

- During chairside work, all members of the dental team should aim to achieve, as often as possible, that neutral posture in which the least amount of muscle activity is required to maintain the position. Remaining in or returning to the neutral posture will give balanced use of muscles. This neutral posture occurs when:
 - The arms are neither moved away from nor directed toward the body's midline, nor turned laterally or twisted.
 - The elbows are close to the waist
 - Wrists and hands are in the hand-shake position
 - The weight of the head is supported by the spine
 - The nose is not positioned further forward than the toes
- To ensure the correct working position of the operator,
 - Adjust the backrest of the operator's stool to provide lumbar support
 - Avoid raising or lowering the arms for extended periods, rather keep the elbows even with the patient's occlusal plane
 - Maintain a proper distance between the patient and the operator's eyes, typically 37 cm. Using magnifying loupes enforces a proper distance and reduces visual strain.
 - The dentist's element (bracket table), handpiece cradles, and operating light should be positioned to allow easy access
 - For a right-handed operator, there should be clearance around the patient from the 10 o'clock to the 12:30 position, so that the operator can work in this space, while the assistant remains in the 1 to 3 o'clock area.
- Dental staff who work in a seated position should take short breaks every 30-60 minutes to stretch and/or walk.
- To minimize upper body muscular stress in the operator, the patient should be positioned at the correct height so that the operator can position their torso beneath the dental unit to gain clear vision of the oral cavity without having to bend their neck.
- Both operator and assistant stools should have
 - 5 feet with castors for maximum stability. (Note that some brands of chairs have gravity sensitive castors that prevent an unoccupied chair from "free-wheeling").
 - Adjustable height through simple mechanisms such as gas lift.
- The a recommended seating sequence is as follows
 - Firstly ensure at the start of the session that the operator's stool is set to the correct height (so that the operator's thighs are parallel to the floor).
 - Secondly, set the assistant's stool to place their eye height 12 cm above that of the operator.
 - Thirdly, before the patient enters the operatory, position the height of the dental chair so that the patient can slide their buttocks onto the chair, and not "fall into" it.
 - Fourthly, adjust the chair tilt to the ideal position for the maxillary or mandibular arch (see below)
 - Fifthly, adjust the height of the dental chair so that the patient's head is either near the elbow height of the operator, or the operator's mid-sternum location (either is acceptable from the ergonomic standpoint).
 - Finally, adjust the headrest to give proper neck extension and occlusal plane orientation, before positioning the dentist's element and the assistant's element.
- The correct seating position of the operator is:
 - Feet firmly on the floor, and thighs parallel to the floor, so that the knees are at or slightly below the level of the hips.
 - Buttocks as far back in chair as possible, to gain positive lumbar support from the rear of the stool.
 - Legs abducted (apart), to position the knees under the patient's chair

Conventional dental stools will have a 5 star base with a heavy base (low centre of gravity), adjustable height and lumbar support. Some novel stool designs such as saddle chairs (e.g. Bambach saddle seat™) and sit-kneel chairs promote an upright posture when used correctly, and increase awareness of proper posture. Before using such novel designs, expert ergonomic advice should be sought. There are some concerns that long term use of saddle chairs may have untoward effects on reproductive health (Slough, 2003).

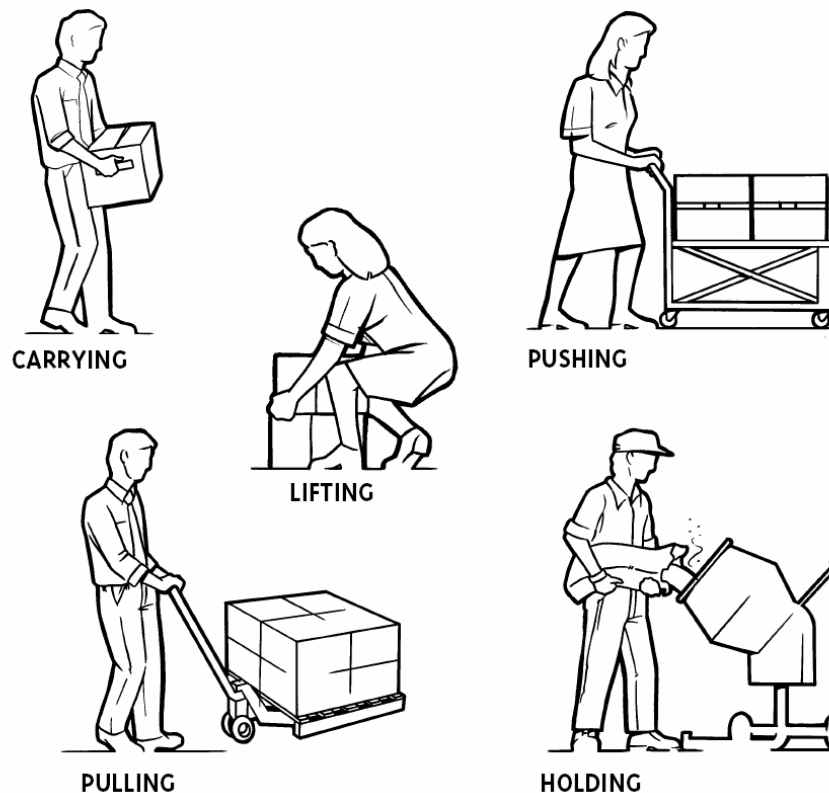
- In relation to the dental unit,
 - When considering a new dental chair, designs which are narrower and thinner are preferred because these allow the operator and assistant to sit closer to patient, reducing the need to bend or reach.
 - The operating controls for the dental chair should be readily accessible.
 - The dentist's element (bracket table) should be positioned to reduce the need for movement when obtaining or replacing instruments.
 - The dental assistant's element (work area) should normally be positioned behind the patient, to allow the assistant to reach forward for instruments, rather than behind or to the side.
- For working in the maxillary arch, the patient should be placed in the supine position, with the maxillary occlusal plane at right angles to the floor so that the patient is looking directly upwards towards the ceiling. It may be necessary to adjust the chair rotation or the position of the patient's chin to ensure that the maxillary occlusal plane is vertical. The operating light is then positioned at arm's length just slightly forward from the directly overhead position. This will give maximal illumination for mirror vision in the maxilla.
- For working in the mandibular arch, the back of the dental chair should be lowered from the starting (upright seating) position into a semi-supine position, so that the mandibular occlusal plane is parallel to operator's elbows. The patient should then lower their chin and/or turn their head to the appropriate side for optimum visibility.
- For the dental assistant,
 - The preferred seating position is near the patient's shoulder, with the knees near the headrest, facing toward the patient's head.
 - The assistant's eye level should be 12 centimeters (six inches) above the operator's eyes, to give maximal vision of the oral cavity.
 - The assistant's head should be as upright as possible.
 - Their feet should be placed on the platform or ring at the base of the stool, not on the floor.
 - The assistant's feet should rest on the stool or a foot rest, so that the back can be straight and the thighs parallel to the floor.
 - The lower part of the assistant's left arm and part of their lower back should be supported by the abdominal bar of the stool.

Receptionists and dental technicians may both spend significant periods of their day working from a seated position, so correct seating (with foot support) and maintaining correct posture is essential. As with clinical staff, sitting too high and leaning forward will increase the stress on the spine and result in lower back, shoulder, and neck discomfort.

Seated staff should use ergonomic chairs with a separate seat and backrest, with 5 feet (with castors) and easily adjustable height and lumbar support. Depending on the work environment, armrests which can support the forearms and thereby take the weight of the arms off the shoulders when not working should be considered.

For data entry work, the proper work surface height is that when the hands are by the side, the elbows are the same height as the work surface. Either the bench height or the stool height must be adjustable in order to achieve this goal for individuals of varying height. A footrest is required when height from the floor prevents the individual's feet from resting flat on the floor, in order to achieve the desired 90 degree angle between the knee and the hip.

Manual handling of objects



MANUAL HANDLING - LIFTING

Lifting is the single most common cause of manual handling related injury in Western Australia. On average, employees with injuries from manual handling take the longest time to recover and return to work.

Jobs involving physical stress or repetitive movements have the highest rates of manual handling injuries, with over half the lost time injuries involving nurses, health care workers, cleaners, packers and store persons. Lifting boxes is also responsible for a high percentage of injuries.

The weight of an object is only one of many factors to consider in avoiding injuries to your employees. Other things to take into account include: how often and how quickly a task is performed; the age and physical strength of the employee; and the size and shape of the object.

Injuries can be the result of gradual wear and tear from frequent or prolonged lifting or sudden damage from a single lift of something very heavy or awkward.

The Commission for Occupational Safety and Health *Code of Practice for Manual Handling* is an important guide, which includes strategies to help employers find or design solutions for lifting hazards.

Injuries such as sprains and strains can occur when lifting objects in the dental workplace. Risk factors for such incidents include:

- Having items placed too far away or stored at the wrong height, so that the worker over-reaches and attempts to lift the item away from their body, using their arm and back muscles rather than their leg muscles..
- Attempting to lift or move large, heavy, unstable or awkward items, which are beyond the capacity of one person to move safely.
- Twisting while lifting or carrying items.
- Tripping while carrying or lifting items.
- Using an insecure grip.
- Not using proper lifting techniques.
- Walking backwards with a heavy load.

Safe working recommendations are as follows:

- List any activity requiring the use of force exerted by a person to lift, lower, push, pull, carry or otherwise move, hold or restrain a person, or object. Then identify each hazard that is likely to arise from manual handling at the workplace; assess the risk of injury or harm to a person resulting from each hazard, and consider the means by which the risk may be reduced [Regulation 3.4].
- Store heavy items so that they are below shoulder height but above mid-thigh or knuckle height; but not on the floor.

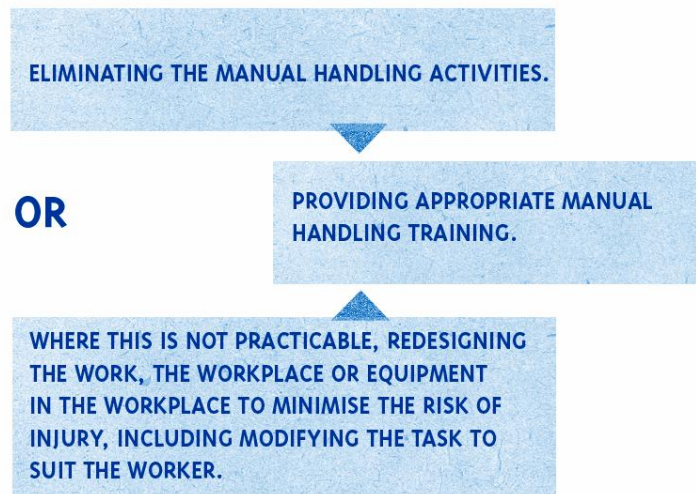


- Do not attempt to lift loads of more than 16-20 kg unaided.
- Order heavy consumable items such as plaster and paper in smaller container sizes to reduce the load.
- Design storage areas to limit the need to reach.
- Do not store items above shoulder height.
- Use trolleys to move stock over longer distances within the practice.
- If is necessary to lift an item,
 - First size up the load (test its weight, surface texture and stability).
 - Determine if assistance is needed to move it safely.
 - Ensure that the path forward is clear of obstructions and hazards.
 - Face the load.
 - Place the feet as close as possible to the object and adopt a balanced position, with the back straight.
 - Bend the knees to a comfortable position.
 - Grasp the object on opposite corners to gain a good grip.
 - Lift the load SLOWLY keeping it close to your body, using the leg muscles to lift the load.
 - Avoid sudden accelerations or jerky movements when lifting or carrying items.

**LIFTING
SAFETY CHECKLIST**

CHECK:	YES	NO	N/A
Training in manual handling covers all the requirements of the <i>Code of Practice for Manual Handling</i> and is part of your staff induction			
Information, instruction and training in safe lifting has been provided			
Employees understand manual handling risk factors and are aware of risk management procedures			
The weight of the object or person to be lifted before lifting is done to assess the lifter's capability			
Alternative ways of lifting and carrying have been considered, eg using a mechanical hoist or trolley			
Employees have been asked for suggestions on safer ways to do the job			
Practical control measures have been put in place and maintained to eliminate or reduce the risks as far as possible			
Control measures are reviewed after accidents have occurred			
Assessments have evaluated all the factors that affect the risk			
All manual handling-related accidents have been adequately investigated			

This checklist should be used in conjunction with the
Commission for Occupational Safety and Health *Code of
Practice for Manual Handling*



Desk and office environments

The following matters relate specifically to work that may be undertaken in the reception and office areas of the dental practice.

Sitting for extended periods with poor posture (slumped or leaning forward) and poor positioning of the keyboard and mouse can result in a number of disorders such as carpal tunnel syndrome, eye strain, lower back pain, and muscle imbalance in the neck and shoulder region. To reduce these risks, it is important that the staff member vary their activity with other tasks such as collecting and retrieving patient files, which require them to stand and walk.

It is important that workstations for computer work are designed to account for the needs of the worker. Frequently used items should be located within comfortable reach - while the arms are still relaxed and close to the chest. Less frequently used items can be located within arms reach with the arm maximally extended, or within a few steps of the workstation. At the reception desk, the items which should be considered in such planning may include:

- Patient files
- Appointment book
- Appointment cards and business cards
- Notepad
- Telephone
- Intercom
- Calculator
- Computer keyboard and mouse
- Computer screen
- EFTPOS terminal
- Printer
- Forms for patients to complete such as medical history forms, consent forms and information sheets about the practice.
- Pens and other small items of stationery
- Supplies of dental items if these are sold by the practice.

How to accommodate these together with a computer screen on a single desk poses a significant challenge. Some suggestions are to:

- Place rarely used items such as fax machines and scanners, and spare office stationery away from the main desk or in separate office areas.
- Use a tower computer that can be placed on the floor, to free up desk space.
- Use a radio keyboard and mouse, or a radio keyboard with an integrated trackball, to eliminate trailing leads across the desk.
- Use a desk return on the right hand side of the desk, if the receptionist is right handed.
- Use a thin-film-transistor liquid crystal display (LCD), rather than a cathode ray tube (CRT) monitor, as LCD displays:
 - are thinner,
 - occupy less desk space,
 - attract less dust (and thus present a lower fire risk) and
 - are more energy efficient.
- Regardless of the type of screen,
 - It should be located approximately 60-70 cm from the eyes, and the centre of the screen should be at shoulder level so that it is not necessary to tilt the head to read the bottom of the screen.
 - A dark screen desktop image should be used to improve contrast with desktop icons.
 - The font size for system fonts should be set for maximum readability, e.g. using large fonts for a monitor resolution of 1024X768 pixels.
 - If the on screen image flickers, the video card refresh rate is too low and needs to be increased.
- Ensure that the worker is seated a comfortable distance from the keyboard, so that the wrists are not bent or cocked when using it. If the keyboard surface is too high and cannot be adjusted, the worker should sit higher to gain a 90 degree flexure at their elbows. They should then support their feet using a foot rest. The keyboard should be positioned 6-7 cm from the edge of the desk so that the hands can be supported when not keying.

Computer workstations should be equipped with:

- A comfortable, cloth-covered 5 castor-based ergonomic chair with adjustable height and back support, and adjustable arm rests
- A foot rest
- Adequate lighting (without glare from windows or overhead lights)
- A low profile optical (wheel-less) mouse, with a central scroll wheel
- A document holder (if required)
- A lightweight adjustable headset if considerable telephone work is undertaken whilst simultaneously using the computer, in addition to a regular telephone handset.

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Occupational Overuse Syndrome (OOS)

Introduction:

OOS is a significant contributor to reduced working hours and premature retirement by dentists and dental hygienists. It is also termed repetitive strain injury (RSI), repetitive motion injury, cumulative trauma disorder, and work related musculoskeletal disorder. OOS is a collective term for a range of conditions characterized by discomfort or persistent pain in muscles, tendons and other soft tissues, with or without physical manifestations. It is usually associated with tasks that involve repetitive or forceful movements or both; and/or the maintenance of constrained or awkward postures.

Disorders included within the definition of OOS include:

- Carpal tunnel syndrome
- Myalgia
- Stenosing tenosynovitis crepitans (Trigger finger)
- Tendonitis
- Ganglionic cyst
- Peritendinitis
- Tenosynovitis
- Vibration hand-arm syndrome
- Epicondylitis.

In dental practice, OOS can develop from highly repetitive work involving force (with or without vibration) in which there is an extreme wrist posture in combination with force. The problem is most likely to occur in staff undertaking long periods of scaling and root planning using hand instruments, however the problem is not limited to this one activity. It could for example, also develop from long periods spent undertaking endodontic treatments with hand files, or forceps extractions, because of the repetitive nature and high force required, respectively.

Costs of OOS to the individual and to the dental practice can be substantial, and include:

- Reduced productivity,
- Costs of re-training,
- Increased worker's compensation premiums, and
- Costs of medical care.

All dental staff in clinical contact wear gloves, and in this regard it needs to be remembered that natural latex rubber is an elastic material, which will resist the movements of the fingers and hands away from the original position used when the gloves were formed on a mould. When grasping an instrument, the muscular effort to resist this elastic recoil to the rest position results in muscle fatigue.

Restorative dental care requires co-ordinated and controlled muscle activity of the wrist and fingers (especially of the dominant hand which operates the handpiece). However, the fingers and wrist have only limited capacity to sustain activity. Accumulation of lactic acid and other metabolites can lead to

discomfort and fatigue. When using mirror vision, the precise location of the mirror using the non-dominant hand requires static muscle loading of the shoulder and elbow, leading to fatigue and discomfort in these areas. Using hand instruments with small diameter shanks may contribute to inflammation of the synovial sheaths surrounding flexor tendons, leading to increased pressure in the carpal tunnel.

The classical presentation of OOS in dental personnel is carpal tunnel syndrome (CTS). This occurs following compression of the median nerve as it passes through the carpal canal formed by the wrist bones and the transverse carpal ligament. The major symptoms occur in the dominant hand and include: pain, paraesthesia (tingling) and numbness along wrist and hand, particularly affecting the palmar surface of the thumb, index and middle fingers. Other symptoms of CTS include: weakness in grip, a perception of swelling of the fingers (when no swelling is present), and altered touch or temperature sensations. Loss of manual dexterity and loss of hand function can occur over time, leading to tenderness and a tendency to drop items.

The symptoms tend to worsen at night (and on waking) and with repetitive activity.

OOS is more likely to occur in:

- Pregnant women
- Women beginning use of birth control pills
- Women with premenstrual syndrome
- Menopausal middle-aged women
- Men and women who suffer from
 - Rheumatoid arthritis
 - Diabetes mellitus
 - Gout
 - Amyloidosis
 - Systemic lupus erythematosus
 - Hypothyroidism
 - Myxedema (advanced hypothyroidism)
 - Acromegaly (abnormal enlargement of skeletal extremities due to hypersecretion of growth hormone)
 - Oedema resulting from fluid retention
 - Obesity
 - High levels of job stress
 - High usage of tobacco, alcohol and caffeine.
 - Poor overall physical fitness.

Prevention and Practical Advice:

- Limit the use of the fingers as much as possible.
- When root planning,
 - Use lightweight (hollow) instruments with knurled shanks. The handles should be round, and knurled to increase grip.
 - Instrument handles should be large enough to distribute pressure over a larger area than directly over the carpal tunnel of the wrist.
 - Maintain a neutral wrist position, with the wrists in lines with the forearm.
 - Use a light grasp.
 - Use gripping rather than pinching actions to hold instruments.
 - Move the entire hand, wrist, and forearm as a unit
 - Use hard-tissue fulcrum close to cutting edge of instrument.
 - Use a slow, deliberate, applied force in a directed manner allowing relaxation between strokes.
 - Maintain sharp instruments since these require fewer and less forceful motions.
 - Use an ultrasonic scaler where appropriate for gross debridement.

- At natural breaks in the appointment, stretch the fingers, and rotate wrist in small circles.
- Alternate between scaling and polishing to provide variation and rest.
- Fingers should not pinch or be used with the tip joints bent backward.
- Fingers should be slightly flexed to avoid ligament stress.
- Maintain the wrist in a neutral position as much as possible.
- Rest the forearms as much as possible.
- Avoid using side-to-side motions.
- Avoid long periods of flexed/extended positions; adopt a "neutral" hand position where possible.
- Take periodic breaks.
- Alternate tasks and alternate treatment procedures.
- Alternate difficult with easy patient appointments.
- Wherever practicable, adjust the patient position to ensure the best working posture for the operator. This is particularly important when working on different quadrants.
- Avoid prolonged static working postures by assuming the various "clock" positions during the one appointment.
- Perform fist and finger extension exercises on a regular basis.
- Perform upper body stretching exercises and shoulder shrugs during breaks between patients.
- Use a glove size that does not resist the normal movements of the hands. Used sized gloves to ensure that there is sufficient freedom of motion in BOTH hands. Ambidextrous gloves are designed with the thumb in a neutral position, thus during any work the glove exerts a continuous, counteracting elastic force against the thumb. Because of this, the use of ambidextrous gloves for extended periods may result in muscle fatigue.
- Consider using Nitrile gloves that release stress and adapt to the shape of the operator's hand as they warm to body temperature.
- Be aware of non-occupational factors that may contribute to OOSD, e.g. knitting, tennis, typing, writing or other hobbies that utilize similar muscle groups to those being used constantly at the dental workplace.
- Cables and hoses which supply handpieces should have adequate length and should be sufficiently pliable or be equipped with a swivel action to permit rotation with minimal effort by the user.

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Relevant Legislation and Guidelines:

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- *National Code of Practice for Manual Handling.* NOHSC:2005. 1990.
- *National code of practice for the prevention of occupational overuse syndrome.* NOHSC: 2013. 1994
- *Guidance note for the prevention of occupational overuse syndrome in keyboard employment.* NOHSC: 3005. 1989.
- *Guidance note for the prevention of occupational overuse syndrome in the manufacturing industry.* NOHSC: 3015. 1996

Skin conditions, particularly related to glove wearing

Employers have a duty to provide appropriate personal protective equipment to staff members (Regulations 3.34-3.35). While gloves are used routinely for clinical and related activities, it should be remembered that the physical and chemical properties of gloves can vary from one manufacturer to the next. For example, the latex protein content of natural rubber latex (NRL) gloves can vary 3000-fold among manufacturers.

Patient examination gloves could be:

- Natural rubber latex (NRL)
- Nitrile
- Nitrile blended with NRL
- Nitrile blended with Neoprene (chloroprene)
- Neoprene (for surgical gloves)
- Polyvinyl chloride (PVC, vinyl)
- Polyurethane

Latex is the sap from the rubber tree, *Hevea brasiliensis*. As a material, it is comprised of proteins (5%), rubber (cis-1,4-polyisoprene) and water (60%). As will be discussed further below, allergenic latex compounds are present in NRL gloves, in addition to stabilizers and polymerizing agents. Nitrile gloves may also contain processing chemicals which could contribute to delayed-type hypersensitivity reactions.

Utility gloves used in the sterilizing area could be:

- NRL blended with Nitrile or chloroprene (Neoprene)
- Butyl rubber
- Fluoroelastomer
- Polyethylene and ethylene vinyl alcohol copolymer

The latter 2 types have the highest chemical and puncture resistance.

Factors to be considered when choosing gloves include:

- Shape: To maximize comfort and fit, graded sizes should be used. It may be necessary to wear a larger glove on one hand since hand size is not equal. Right handed individuals will have a larger right hand than on the left side, for instance.
- Strength and tear resistance: This relates to glove thickness as well as to the type of material and the extent of polymerization. Thin gloves will break more readily.
- Powder: Powder-free gloves are preferred, because powdered latex gloves release fine particles of latex materials into the breathing zone when gloving and ungloving.
- Allergenicity: Powdered examination gloves have highest protein content and allergen levels, because cornstarch particles adsorb latex allergens (as well as bacteria from the skin), and then cause respiratory exposure to latex proteins when these particles become aerosolized during gloving and degloving. It has been shown that the protein/powder particles can remain in the air for up to 12 hours after changing gloves. Gloves which are rated as “hypo-allergenic” will have reduced levels of polymerizing or accelerating agents because of better washing and leaching treatments. The lowest levels of allergens (latex and other substances) will be in powderfree gloves that have undergone additional treatments such as washing and chlorination to remove or alter such allergens.

During normal use, latex gloves deteriorate, especially in the region of the fingertips where the material receives the greatest stress. During use, micro-porosities develop, and the frequency of these increases with

the time of wearing. Glove permeability to viruses is dramatically increased when latex gloves are exposed to certain materials such as:

- Acrylic monomer (methyl methacrylate)
- HEMA and related compounds in dentine bonding agents
- Chloroform
- Detergents
- Ethanol and Acetone (used as solvents in dentine bonding agents).

Irritant dermatitis

Irritant contact dermatitis to gloves is a well known clinical entity, being first recognized in 1933. Irritant dermatitis is a common problem in dental staff, and represents a non-allergic response to detergents (such as sodium lauryl sulphate) and disinfectants. It occurs with gloves OF ALL TYPES and is not limited to latex gloves. Contact with these is a particular problem when excessive amounts of handwash are used, leaving residues on the skin, which are then held in contact with the epidermis under occlusion by the glove material. Irritant reactions are particularly common in atopic individuals who wear powdered gloves, where glove powder causes mechanical irritation of the skin or occludes the pores of the skin.

In addition to sodium lauryl sulphate and various other soaps and detergents, other common materials which can cause irritant dermatitis include:

- Ethanol
- Eugenol, eucalyptol, and other essential oils
- Orthophosphoric acid
- Pumice
- Calcium carbonate (chalk)
- Benzalkonium chloride
- Epoxy resins (such as AH26).

Irritant contact dermatitis manifests as dry fissured skin, which may be dry, scaling, “chapped”, and itchy. Should this develop, the staff member should check their hand care protocol, and reduce the use of irritant handwash whilst improving rinsing and drying of the hands before gloving. Use of a water-based hand cream is also recommended. If these measures do provide resolution, changing the brand/type of handwash and then the brand/type of glove should be considered.

It is important to identify and control irritant contact dermatitis since the breakdown in skin integrity may enhance direct absorption of latex proteins, which by systemic exposure could accelerate the onset of delayed type hypersensitivity to the polymerizing agents, or to true allergy to latex proteins. This can occur because latex proteins are water soluble, and when in contact with the skin under occlusive conditions will dissolve in perspiration and traces of moisture.

Delayed hypersensitivity (allergic contact dermatitis)

Reactions to gloves can also be of an immune nature, of which the most common is a cutaneous delayed-type (Type IV) hypersensitivity, which is mediated by sensitized T lymphocytes. This is usually caused by materials used in glove manufacture such as:

- Accelerators used to catalyze the cross-linking of elastomeric particles
 - Thiurams
 - Mercaptobenzothiazoles
 - Carbamates.
- Latex preservatives (e.g. ammonia)
- Antioxidants (e.g. phenylenediamine)
- Organic pigments
- Vulcanizing agents (e.g. sulfur).

Thiurams are the most common cause of allergic contact dermatitis to latex gloves, accounting for up to 83% of cases. In response to this, some major glove manufacturers (such as Ansell) have recently altered their methods of glove manufacture so that their brands of latex gloves are now thiuram-free.

Such reactions will become most notable some 1-2 days after recommencing work, as the immune response produces changes in the dermis. The skin will show vesicles (blistering) and crusting, with itching and redness evident at 6 hours after contact. Low level degranulation of mast cells in the superficial dermis occurs in this response, which leads to the clinical symptom of subtle itching approximately one hour after exposure to the glove material. Changing to a glove brand rated as “hypo-allergenic” is recommended, as is expert assessment by a dermatologist. Random switching between different glove brands is not advised.

If subsequent exposure to the causal allergen is avoided, allergic contact dermatitis should resolve within four to five days. With repeated chronic exposure to the allergen, the condition may progress to lichenification of the skin, with deep painful cracking and intermittent bleeding. This will render the staff member unable to work in clinical contact and the condition may take some months to resolve fully.

Health care workers can manifest a Type IV reaction to latex proteins, which may then progress at some future time (with repeated exposure to latex) to a Type I reaction. Symptoms of a Type IV reaction to latex may include conjunctivitis and rhinitis (as well as dermatitis), because of the degranulation of mast cells in these mucosal sites.

Skin testing by a clinical allergist can be used to confirm the diagnosis of Type IV (delayed) hypersensitivity. A test panel of suspected allergens is applied, and the result (the “patch test”) read from 1-3 days later.

It is important to recognize at this stage that an emerging latex sensitivity in a dental staff member is a serious health problem with major implications for their future working life. Should an individual develop a severe latex allergy, they will need to use non-latex gloves for all their work and will have to restrict their exposure to environments where latex proteins may be aerosolized.

A range of materials other than latex proteins can cause allergic contact dermatitis, including:

- Mercaptoenzothiazoles (in Band-aids)
- Glutaraldehyde and formaldehyde
- Nickel, cobalt and chromium
- Iodine and povidone-iodine
- Methyl methacrylate
- Benzoyl peroxide (in resins)
- Chlorhexidine
- Colophony resin
- Quinone compounds in Xray developer
- Eugenol
- Lanolin and fragrances (in skin care products).

Latex allergy

The most severe reaction to glove materials is true latex allergy. This is an immediate (Type I) hypersensitivity, where the eliciting antigen which triggers mast cell degranulation is a latex protein (>30 kDa in size). A wide number of different latex proteins can be responsible for latex allergy, with 7 of these linked to Type I hypersensitivity, including heveamine, hevein and rubber elongation factor.

There are several routes of exposure which may have led to the latex allergy developing, such as:

- Inhalation of aerosolized latex proteins adsorbed onto powder over an extended time. This route of exposure is probably the most significant for dental (and medical) staff.
- Cutaneous absorption, by direct contact with gloves, particularly if the skin permeability has been increased by loss of normal surface lipids, or if the individual has severe dermatitis

- Urogenital exposure, by urinary catheters and vaginal examinations
- Other mucosal exposure, by rectal exams, dental procedures, and surgery
- Parenteral exposure, by intravenous lines.

The clinical presentation of latex allergy is characteristic of explosive degranulation of mast cells and basophils, and may have an onset ranging from several seconds to 20 minutes:

- contact itching (urticaria, hives),
- flushing (redness)
- oedema (peri-oral or peri-orbital swelling),
- excessive lacrimation,
- abdominal cramping and nausea,
- bronchospasm (wheezing).

These may progress rapidly to full blown anaphylaxis (with tachycardia and dysrhythmias progressing to hypotension, collapse and cardiopulmonary arrest). Immediate medical management is essential. Milder reactions may be managed with corticosteroids (such hydrocortisone) and antihistamines (e.g. diphenhydramine), while anaphylaxis will require life support as cardiac arrest can occur (both oxygen and adrenaline will be administered, with the latter as an intramuscular or intravenous injection).

Staff who are suspected of having developed latex allergy require expert assessment by a clinical allergist. This may involve both laboratory tests as well as skin tests. Anaphylaxis and death from latex exposure was first reported in 1989, and since that time there have been numerous reports of latex allergy with more than 50 cardiac arrests and 17 deaths reported. A staff member who has developed an anaphylactic response to latex proteins will have substantial problems continuing on in clinical practice, because of the high number of latex products which they may encounter (see below). If their career ends because of this occupational condition, the loss of income will likely lead to actions related to compensation.

Several groups of patients are recognized to be at increased risk of latex allergy:

- Prolonged mucosal exposure to latex:
 - Neural tube defects and spina bifida
 - sacral/lumbosacral agenesis
 - urogenital abnormalities
 - neurologically impaired bladder function
 - frequent catheterization (especially urinary catheters)
 - spinal cord injury
 - neurosurgery
 - cerebral palsy
 - multiple major operations, particularly from early childhood
- Occupational exposure to latex (through wearing latex gloves)
 - Health care workers
 - Rubber product workers
 - Hair dressers
 - House cleaners
 - Emergency service personnel
 - Embalmers
- Individuals with atopy (an inherited tendency to develop allergic responses)
 - Asthma, atopic eczema, allergic rhinitis (hay fever)
 - Myelodysplasia
- Patients with allergies to foods which share some antigens with latex
 - Avocado, banana, kiwi fruit, chestnut
 - Potato, apricot, grape, papaya, passion fruit, pineapple, peach, cherry, tomato.

All patient medical histories should include a question regarding latex allergy. True allergy can be confirmed by a skin prick test (NOT a patch test) using panels of antigens from glove products. There will be a rapid response which is read instantly (in minutes). The positive control is a non-immunological agent

which elicits mast cell degranulation, to give a “wheal and flare” response. The prick test does pose the risk of severe reactions (and indeed even of anaphylaxis), and in the light of this there is increasing interest in various *in vitro* (laboratory) tests such as the radioallergosorbent test (RAST) which do not pose any risk to the patient. Such tests are safer and more convenient than the skin prick test, but have a lower sensitivity and specificity. A negative RAST result does not formally exclude allergy to natural rubber latex.

For patients or staff with a history of Type I or Type IV reactions to latex, it is essential to have proper medical assessment and to then use a latex-free environment, e.g.

- Non-sterile non-latex gloves, such as Nitrile (Ansell Nitra-Tex), or neoprene for routine procedures
- Sterile non-latex gloves, such as synthetic neoprene (Ansell Derma-Prene)
- Non-latex rubber dam, such as Roeko Flexi-Dam
- Non-latex prophylactic cups
- LA using Citanest with Fellypressin
- Silicone elastic bands

Latex sources in the dental practice should be identified so that exposure can be prevented. These include:

- Natural rubber latex gloves
- Latex rubber dam
- Gutta percha
- Rubber base impression material
- RA masks
- Blood pressure cuff tubing
- Stethoscope tubing
- Rubber stoppers on endodontic files
- Rubber prophylactic cups
- Rubber bite blocks
- Rubber orthodontic elastics
- Latex-based plungers in LA cartridges (with the exception of Citanest with Fellypressin).

Other latex sources include:

Medical products:

- Catheters and drains
- Dressings and tapes
- Tourniquets
- ECG pads
- Oximeter probes
- Airways used for general anaesthesia
- Nasogastric tubes
- Bellows of breathing bags
- Plungers of disposable syringes

Domestic products made from natural rubber:

- Balloons
- Condoms and diaphragms
- Rubber bands
- Rubber components of furniture, upholstery, tools and kitchen utensils

Prevention:

The most important preventive action for latex allergy is avoidance of exposure to latex. To achieve a low allergen environment, powderless gloves with low extractable protein content should be used routinely

rather than powdered gloves. All dental staff should protect themselves by preventing and treating irritant (non-allergic) and allergic contact dermatitis to latex or other glove components.

It should be remembered that dental staff can develop contact allergy to a range of substances which may be encountered in dental practice, such as:

- Nickel (as in Ni-Ti wires),
- Colophonium (the resin in Duraphat fluoride varnish),
- Methyl methacrylates,
- Other acrylates such as HEMA used in bonding agents,
- Aromatic amines in composite resins,
- Eugenol,
- Formaldehyde and glutaraldehyde
- Quinones in X-ray developers and composite resins, and
- Metallic mercury.

To prevent the development of irritant and allergic reactions, the following measures are recommended.

- Educate all practice staff regarding the clinical signs and symptoms of occupational skin disease and latex allergy.
- Fingernails should be short, and manicured, to reduce the development of weakness and porosity in gloves.
- The skin of the hands should be protected against cuts and abrasions outside of work hours, particularly when doing hobby activities such as gardening by wearing protective gloves.
- Most importantly, dental staff must minimize skin contact with detergents, organic solvents and irritant chemicals in their domestic duties, since these will remove the normal protective fatty acids from the skin surface. The increased permeability of the skin which results will increase the likelihood of developing irritant reactions to detergents in handwash products and to other substances used occupationally.
- Use powder-free latex gloves, which should also be low-protein or hypoallergenic.
- Ensure that any areas that may have become contaminated with latex glove powder are cleaned regularly by vacuuming using disposable bags (upholstery, ventilation ducts and plenums, cupboards, telephone, etc).
- Do not use oil-based hand creams or lotions, since these will cause latex gloves to deteriorate.
- Use aqueous (water-based) moisturizing hand creams regularly.
- Use non-latex gloves (such as Nitrile) for domestic activities and hobbies, where there will not be contact with infectious agents.
- Remove gloves slowly; do not “snap” them off as this may release allergens into the atmosphere.
- After removing gloves, wash hands with mild soap or liquid detergent and dry them thoroughly.
- Include a question regarding latex allergy on all new staff employment forms and on all patient medical histories. Consider referring patients or staff at high risk to true latex allergy to an allergist for assessment. Patients or staff with proven anaphylactic reactions to latex may need to wear a medical alert bracelet and carry self-injectable adrenaline (e.g. Epi-needle).
- Substitute latex-containing products with known latex-free products in the dental operator for the treatment of any known or suspected latex-reactive patients.
- Treat latex-reactive patients as the first patient of the day, to reduce the potential for exposure to latex proteins from glove powder in the air. Because gowns can also become contaminated with the same powder, disposable paper gowns should be worn when treating such patients.

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Biological hazards

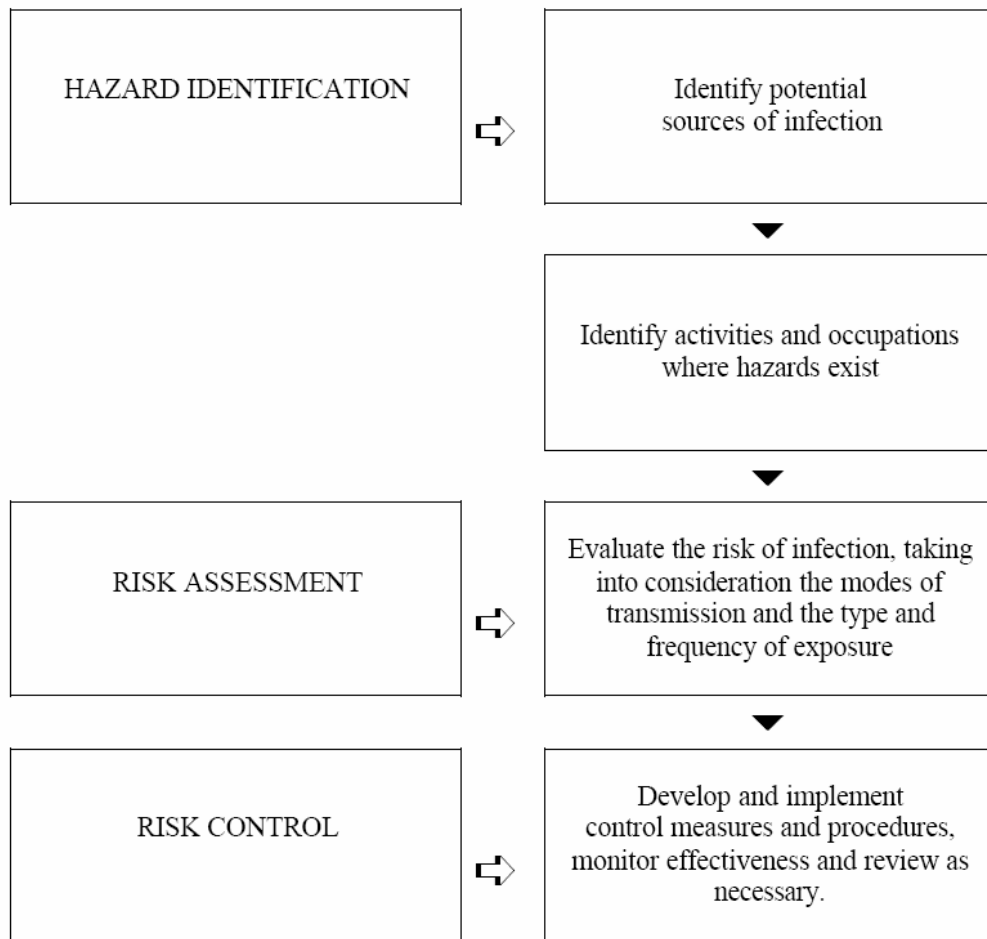
A range of diseases can be transmitted contact with oral fluids or within the dental office environment from dental unit water microorganisms (*).

DISEASE	CAUSATIVE AGENT
The Common Cold	Rhinovirus, Adenovirus
Influenza	Influenza virus
Respiratory infections	Parainfluenza virus Respiratory syncytial virus Coronavirus (SARS) Cytomegalovirus
Legionnaire's disease	* Pseudomonas aeruginosa * Legionella pneumophila
Tonsillitis	Streptococcus pyogenes
Tuberculosis	Mycobacterium tuberculosis
Chickenpox	Varicella Zoster virus
Herpangina	Coxsackie virus
Rubella (German measles)	Togavirus
Mumps	Paramyxovirus
Salivary gland infection	Cytomegalovirus
Herpetic Infections	Human Herpesvirus 1 and 2
Gonococcal Infections	Neisseria gonorrhoea
Condyloma Acuminatum	Human papilloma virus
Syphilis	Treponema pallidum
Infectious mononucleosis	Epstein Barr virus
Hepatitis B	Hepatitis B virus
AIDS	Human immunodeficiency virus (HIV)
Candidiasis (Thrush)	Candida albicans

These infectious agents may gain access to the human host through a wide variety of exposure events, as summarized in the following table:

Area of exposure	Risks	Protection
Head	Inhalation, ingestion, irritation, needlestick, absorption through cuts, open sores, skin pores	Masks, shields, protective head coverings
Eyes	Splashes, squirts, irritation	Protective eyewear
Hands	Absorption, irritation, needlestick, absorption through cuts, open sores, skin pores	Protective gloves, protective barrier substance (cream, lotion)
Feet	Irritation, needlestick, absorption through cuts, open sores, skin pores	Protective footwear
Whole body	Inhalation, ingestion, irritation, needlestick, absorption through cuts, open sores, skin pores	Protective clothing, aprons, gaiters

In WA, the 2000 *Code of Practice on the Management of HIV/AIDS and Hepatitis at Workplaces* stipulates a management pathway which can be applied to a range of biological risks in dental practice, and not only to viral bloodborne diseases.



Risk assessment should include:

- modes of transmission of HIV and hepatitis in the workplace. Transmission may occur when:
 - sharps contaminated with infected blood or body fluids penetrate the skin; or
 - infected blood or body fluids splash into the eye or other mucous membranes, onto broken skin or into a cut;
- type and frequency of exposure to blood or body fluids including:
 - the amount of blood or body fluid;
 - the probable route of transmission;
 - the type of body fluid encountered; and
 - consideration of multiple exposures;
- factors contributing to exposures and their recurrence;
- risks of exposure to blood or body fluids associated with workplace layout, design and work practices;
- potential for serious health effects resulting from HIV or hepatitis and access to medical and first aid services;
- assessment of the knowledge and training of employees regarding HIV and hepatitis, including safe work practices;
- assessment of the availability and use of personal protective equipment;
- assessment of the suitability of equipment for the task and whether or not the use of the equipment is likely to lead to exposures to blood or body fluids; and
- assessment of other current risk control measures and the need for new risk control measures.

This code has a number of requirements which are directly relevant to dental practice, as shown in the following section in italics:

Employers must ensure hand washing facilities are provided with running water, soap and single-use towels. A high standard of personal hygiene is essential and the practical applications listed below apply to all contacts between workers and other persons:

- *Hands must be washed after contact with blood or body fluids and before eating,*
- *drinking or smoking;*
- *Gloves must be readily available to all workers likely to be exposed and should be worn when handling blood or body fluid. The wearing of gloves substantially reduces the risk of hands being contaminated with blood and body fluids.*
- *Hands must be washed immediately after removing gloves (gloves cannot be guaranteed to remain intact during use);*
- *Gloves contaminated with blood or body fluids must be changed between patients.*
- *Waterproof aprons or gowns should be worn when clothing is likely to be soiled with blood or any body fluid;*
- *A mask and protective eyewear should be worn where eye and/or mucous membrane exposure to splashed or sprayed blood or body fluid is likely, eg. dental and surgical procedures, cleaning soiled equipment;*
- *Cuts or abrasions on any exposed part of a worker's body must be covered with waterproof dressings at all times whilst on duty.*
- *Needles and disposable sharp instruments used in the treatment of any person must be discarded directly into an impermeable container designated for the disposal of sharps which complies with AS/NZS 4031 Non-reusable containers for the collection of sharp medical items used in health*

care areas and AS/NZS 4261 Reusable containers for the collection of sharp items used in human and animal medical applications.

Instrument cleaning

- *Cleaning should be done with detergent and water.*
- *Gloves should be worn during cleaning. Items should be washed and scrubbed to remove all visible contaminants.*
- *Care should be taken during cleaning to avoid splashing. Eye protection should be worn if splashing is likely to occur.*
- *Cleaning must always precede disinfection or sterilisation.*
- *There are three levels for cleaning, disinfecting and sterilising reusable equipment.*
- *The choice of method depends on what the equipment is used for.*
 - *(i) If the equipment is to have contact only with intact skin, then it requires cleaning. However, if this equipment is contaminated with blood, then it should be cleaned and disinfected.*
 - *(ii) If the equipment is to have contact with mucous membranes, then it requires cleaning and high level disinfection.*
 - *(iii) If the equipment is to have contact with normally sterile tissue, then it should be cleaned and sterilised.*

Spill management

- *Spills should be assessed and attended to immediately. The procedures for managing blood or body fluid spills are dependent on the nature and size of the spill as well as the location.*
- *Workers involved in cleaning or disinfection must wear disposable gloves. If a spillage covers a large area, a waterproof apron (or gown) and overshoes may also be needed to prevent contamination of clothing.*
- *Soiled areas must be cleaned thoroughly with water and detergent using a disposable cloth.*

Waste management

- *All linen soiled with blood, excreta or body fluid should be treated as potentially infectious and must be placed in a clear plastic bag provided for "foul" linen before being put into a standard linen laundry bag.*
- *Procedures should be developed to ensure blood, body fluid, or potentially infectious material is disposed of safely. Procedures should cover:*
 - *the initial disposal of waste in the area where waste is generated;*
 - *collection, transport and storage of waste at the workplace;*
 - *transport of waste for final disposal; and*
 - *disposal of waste in accordance with health and local council requirements.*

Dental staff – general requirements

- *As employers have a duty to inform employees about hazards at their workplace, employees who are identified as at risk need to be included in a confidentiality net of knowing the blood-borne viral risk status of a patient or client who is in their care.*
- *Pregnant employees should not be assigned to the direct care of patients with HIV/AIDS. Pregnancy increases susceptibility to many hazards. The foetus could be at risk from any secondary infection that the patient may have. Secondary infections may include cytomegalovirus, tuberculosis and herpes zoster.*

- *If work activities do not involve contact with blood or body fluids, there is generally no need for protective clothing. However, if such contact is involved, employers should ensure employees are protected in accordance with standard precautions.*

Annual staff training and new staff induction in biological hazards in dentistry, i.e. infection control, should address the following topics:

Requirements for:

- Immunization
- Work clothing
- Uniforms
- Footwear (closed footwear)
- Hair management and hair nets
- Personal protective equipment for dental assisting (eyewear, mask, gown, gloves)
- Personal protective equipment for the sterilizing area
- Personal medical records
- Handcare (no jewellery, rings or bracelets)
- Handwashing (normal assisting and oral surgery)
- Personal hygiene
- Hazard reporting
- Incident and accident reporting

Correct procedures for:

- Handling and disposal of sharps
- Surgery change-over between patients
- Surgery set-up, cleaning, maintenance and close-down
- Biofilm and waterline management
- Instrument cleaning
- Operation of the ultrasonic cleaner
- Loading and unloading of the autoclave
- Packaging of sterile items
- Handling hazardous materials

Knowledge and understanding:

- Interpretation of physical (printout) data and chemical indicators
- Validation using spore tests or enzymatic indicators

Vaccination recommendations are outlined below. For further information refer to the *Australian Immunization Handbook*.

Hepatitis B:

Demonstrated immunity is essential for dental staff with clinical contact. While the initial course of 3 injections gives lifetime immunity in most individuals, boosters may be required after a sharps injury if antibody levels have declined below threshold levels.

Hepatitis A:

The vaccine is recommended for staff who contact risk groups, particularly children, refugees, indigenous patients, and patients with disabilities. A combination Hepatitis A and Hepatitis B vaccine is available.

Influenza:

Annual administration of vaccine is needed because of frequent changes to the strains of influenza virus.

Combined Diphtheria Tetanus (and Pertussis – whooping cough):

20 year booster injections are recommended as a follow-up to childhood immunization. A single booster injection of the adult vaccine diphtheria-tetanus-pertussis (DTPa) is available, and many adults would have been immunized using a similar “triple antigen” in childhood.

Measles Mumps Rubella (MMR):

This vaccine uses attenuated viral strains, and requires 2 injections spaced 4 weeks apart. MMR should be offered to all staff borne since December 1985 who are either without immunization records or who are sero-negative upon screening.

Varicella:

This vaccine uses an attenuated strain of the virus and requires 2 injections spaced 6 weeks apart. It should be offered to all new staff if there is no definite history of chicken pox or shingles, or if serological tests for antibodies to the virus are negative.

Poliomyelitis:

This orally administered vaccine requires boosting following initial immunization in childhood. The vaccine is contra-indicated in pregnant females.

Tuberculosis:

Immunization against tuberculosis is no longer a routine requirement, but should be considered in staff who work with at-risk populations (e.g. patients infected with HIV). BCG vaccine should only be given after Mantoux testing. Repeat Mantoux testing is contraindicated. It should be noted that this vaccine is not 100% protective against infection.

Key resources used:

- LJ Walsh. *Microbiology* 4th Edn. Sydney: RACDS. 2003.
- *Infection Control Guidelines*. CDNA, 2004.
- *The Australian Immunization Handbook*. NH&MRC, 2003.
- *Code of Practice on the Management of HIV/AIDS and Hepatitis at Workplaces, 2000*.
- *Blood and Tissue (Transmissible Diseases) Regulations 1985*

Sharps management

A sharp is defined as “any object having acute rigid corners/edges that is capable of cutting or penetrating the skin”. Because sharp items are used often in patient care, and frequently become contaminated with blood and saliva, the risk of transmission of viral bloodborne disease is a significant concern in dental practice. Procedures for the correct handling of sharps play an important role in preventing skin penetrating (percutaneous) injuries by contaminated sharps.

The following provides a summary of the types of sharps which may be encountered in a dental practice or laboratory

Re-useable sharps

- Hand Instruments
 - Probes
 - Scalers and curettes
 - Carvers
 - Chisels, hatchets, and knives
 - Scissors
 - Wax knives
 - Forceps and elevators
- Endodontic instruments
 - Finger pluggers and spreaders
 - Tungsten carbide and diamond burs
 - Rotary endodontic files
 - Gates-Glidden burs

Disposable sharps include:

- Matrix bands
- Wedges
- Hand endodontic files and reamers
- Lentulo-spirals
- Scalpel blades
- Suture needles
- Broken glass LA cartridges and glass vials
- Stainless steel burs
- Orthodontic wires, bands and brackets
- Broken instruments with sharp edges

Biological sharps include:

- Fragments of bone
- Root tips
- Extracted teeth and tooth fragments

Dental Sharps

There must be a visible sharps container in every surgery, and this should be located close to the normal working position of the dentist or oral health therapist, since it is the responsibility of the clinical operator to dispose of their own sharps, such as local anaesthetic needles.

In particular, clinical operators must be aware of the correct method for recapping LA needles. A one-handed method must be used, such as the bayonet (scoop) technique. Any two-handed methods, such as grasping the needle cap with artery forceps, pose a risk of sharps injury. There are a range of devices which offer improved safety for sharps handling, such as self-sheathing needles (e.g. the Safety-Smart system).

It is essential that dental staff know how to handle sharps properly. Needles should never be bent, broken, or removed by hand before disposal. In endodontic procedures requiring irrigation, a disposable needle and disposable syringe unit should be used. Once empty, this can be disposed of directly into the sharps container as one unit. If further irrigation is required, a new needle and syringe is then used (pre-filled with the appropriate irrigant). Dental LA cartridges are classed as a single use device, and must never be refilled with sodium hypochlorite, EDTA, or other endodontic irrigants as this poses the risk that these materials may accidentally be injected into a patient's soft tissues.

When cleaning up, the operator must ensure all the disposable sharps have been placed in a sharps container (or in a kidney dish or tray) before removing their gloves. Dental assistants must check visually for sharps before approaching the bracket table or other working surfaces to remove waste or materials.

There should be set procedures for loading, passing, and disposing of sharps in the surgery. The established procedures should be rehearsed from time to time.

Educating new staff members about the correct management of sharps is essential prior to their commencing employment. It is also important to remember that in larger dental facilities, support staff such as cleaners also require appropriate education and training in relation to sharps handling.

Each dental practice should have its own clinical and related waste management plan established with regard to minimizing, disposing of, segregating, treating and recycling of the waste that it generates. This plan should also include staff training programs. The plan should be regularly reviewed at least once every 5 years and updated if necessary.

Sharps waste is one of the designated waste streams from a dental practice. Sharps containers should only be collected by a medical waste contractor, and should adhere to the *Australian Dangerous Goods (ADG) Code*.

Safe Disposal of Sharps

It is critical that sharps are not disposed of into normal waste bins. Staff members who do not dispose of sharps appropriately are in breach of both the workplace safety and health legislation as well as environmental protection legislation.

All disposable sharps containers must be labelled clearly and must comply with AS4031. They must be coloured yellow, and carry the black international biohazard symbol for clinical waste. They must be made from puncture-proof material which can be incinerated. The opening must be wide enough to allow easy disposal of items using one hand, but at the same time small enough to prevent the insertion of a child's hand.

Smaller sharps containers should be secured to the wall or benchtop using a bracket to ensure their stability if knocked accidentally. Ideally they should be located 1 metre or more above floor height to prevent access by children.

Sharps containers must not be over-filled, but rather replaced when 3/4 full. Inserting items above the maximum fill line may cause a sharps injury from the contents, and also may prevent adequate closure. If a chute is used in a benchtop to a hidden sharps container in a cupboard beneath, the sharps container must be inspected each daily to ensure that it is not over-filled.

There should be documented procedures for cleaning sharp instruments such as probes and curettes. The use of instrument cassettes and mechanical cleaning of instruments (in an ultrasonic cleaner or thermal disinfectant) is known to reduce the risk of sharps injuries to dental staff during instrument reprocessing.

Protocol for exposure incidents (including sharps injuries)

The definition of an exposure is

- *an injury that involves direct skin contact with blood or saliva visibly contaminated with blood AND there is compromised skin integrity such as an open wound (including a skin penetrating injury), abrasion or dermatitis, OR*
- *direct mucous membrane contact (eye or mouth) with blood or blood contaminated saliva .*

For exposure to skin, the larger the area of skin exposed and the longer the time of contact, the more important it is to verify that all the relevant skin area is intact.

An exposure incident record must be completed, and this should include the following details:

- name of the injured person
- their date of birth
- exposure details (body site affected, extent of the exposure, severity of the injury)
- nature of the exposure (percutaneous or mucous membrane exposure),
- location in the practice,
- activity or procedure being undertaken at the time,
- implement causing the injury (e.g. instrument, ligature wire, bur, needle),
- identifying details of the source patient and their blood borne virus risk
- infectious agent involved if known,
- details of treatment and prophylaxis given,
- procedures for investigating the circumstances of the incident and measures to prevent recurrence (this may include changes to work practices, changes to equipment, and/or training)
- outcome of the incident.

The exposure should be documented on a standard incident or accident reporting form AND reported to the practice principal. This documentation ensures a record for the employer and the insurer, should there be a later claim. It also provides valuable information about potentially unsafe practices, environments, or equipment.

Staff should be educated to report occupational exposures immediately after they occur, whether or not they involve contamination. Sharps injuries may occur which do not involve contamination, e.g. when setting up fresh instruments prior to a patient visit, or when handling orthodontic wire which has not been in contact with the oral environment. Such “clean” sharps injuries must be documented and followed up with investigation of the causes, but it is NOT necessary to undertake serological testing of the injured person.

Testing should be offered following all occupational exposure to blood or body substances, particularly all “contaminated” sharps injuries, *e.g. those involving exposure to blood or blood-contaminated saliva via an instrument, bur, or contaminated wire*. Baseline serum should be collected from the injured staff member AND the patient, and expert counselling provided on the implications of the event.

The practice principal should ensure that there is access to appropriately experienced counselling services for staff who may become anxious about their health as a result of exposure to a potential hazard, whether actual or perceived.

This counselling and the collection of blood samples would normally be undertaken outside the practice, e.g. at a nearby hospital by an infectious diseases physician.

e.g Following a sharps injury and other blood or body fluid incidents, it is essential to know the following key pieces of information:

1. Who is the physician, medical officer or other suitably qualified professional who will be contacted?

(INSERT NAME AND TELEPHONE NUMBER HERE)

2. Who is the alternative on call / after-hours provider (e.g. an on-call infectious diseases physician)?

(INSERT NAME AND TELEPHONE NUMBER HERE)

3. What is the local sharps injury hotline information service (recorded information)?

(INSERT TELEPHONE NUMBER HERE)

4. Which pathology laboratory will process the blood samples?

(INSERT NAME AND TELEPHONE NUMBER HERE)

5. Which pharmacy stocks prophylactic medication?

(INSERT NAME AND TELEPHONE NUMBER HERE)

SHARPS INJURY PROTOCOL

Step 1. Administer First Aid

- Clean the wound/site with soap and water.
- Further management of wound is dependant on nature of injury (e.g. suturing, application of a dressing).
- Consider whether a booster immunisation for tetanus is indicated (e.g. If the exposure involves an injury from an object which may be contaminated with soil or dust).
- There is no advantage to the use of a stronger solution than soap and water for cleaning, as some disinfectants may inhibit wound healing.
- For a splash to the eyes or mouth, flush the mucous membranes/conjunctiva with copious volumes of normal saline or water. If contact lenses are worn, remove after flushing the eye and clean as usual.

Step 2. Assess the severity of the exposure

- The risk assessment will determine if post-exposure prophylaxis (PEP) is warranted. The risk assessment is urgent, as initiation of PEP may potentially prevent a life-threatening disease. On the other hand, PEP is also expensive and may have significant side effects, so an accurate risk assessment is also important in ensuring PEP is only recommended when warranted.
- Because this step is crucial to the management process, the exposed person must be immediately relieved from duty to be assessed.
- The practice principal must be aware of how to access a person who is able to assess risk. *The initial risk assessment may be by telephone.*

Factors which influence whether an exposure has the potential to transmit a blood-borne virus (BBV) infection include:

- the type of exposure (mucosal splash vs. a deeply penetrating skin injury)
- the type of body substance (e.g. how much blood is present in the saliva)
- the volume of blood or body fluids
- the length of time in contact with blood or body fluids
- the time which has elapsed since the exposure

In addition, after a sharps injury, the following factors should be considered:

- the presence of visible blood or body substance on the device causing the injury
- the type of device involved
- whether a hollow bore needle or solid sharp object was involved
- the procedure for which the device was used (for example, into a vein or artery)
- the gauge of the needle or device
- whether the injury was through a glove or clothing
- whether a deep injury occurred in the exposed person; and
- whether the source patient is viraemic, e.g. with advanced / terminal HIV disease or a high viral load.

Step 3. Test the injured staff member (baseline tests)

The exposed person (staff member) should be tested at the time of the injury, to establish their serological status at the time of the exposure for

- HIV antibody,
- HCV antibody and
- antibody to Hepatitis B surface antigen (Anti-HBs)

This testing should be done as soon as possible after the injury (ideally the same day), and certainly within 2 weeks, bearing in mind the window period of the tests.

These baseline test results are essential for the purposes of enabling Work Cover insurance in the unlikely event of transmission of infection.

If the staff member has ever had a blood test which demonstrates Hepatitis B immunity (anti-HBs antibodies > 10 IU/mL) (whether from vaccination or past infection), they are protected, and there is no need for hepatitis B immunoglobulin after a potential or confirmed exposure to hepatitis B.

In the event of sero-conversion for Hepatitis C or HIV, all reasonable attempts should be made to confirm that the virus strain transmitted is identical in both the patient and the source.

If the source patient is found to be positive, additional testing of the injured staff member will be required, and other matters will need to be addressed. This point is expanded upon below.

Step 4. Test the source patient

- If a situation arises where there is a need to know the infectious status of a patient (such as a sharps injury), the 2004 CDNA Infection Control Guidelines state that *“the patient has a responsibility to provide information or consent for testing that enables the practice or responsible health professional to ensure the safe management of the injured staff member.”*
- A designated person in the practice should explain to the source patient the reasons for the tests, and advise them of the types of tests that may be needed and the necessary arrangements (e.g. that they will need to see a medical practitioner).
- Informed and voluntary consent must be obtained before taking a blood sample to test for any purpose. When the responsible medical practitioner is obtaining this consent, the patient should be offered pre-test counselling to provide details on the test procedure, and the long- and short-term consequences to the patient of the test results. Post-test counselling may also be required, particularly if the result is positive.

The source individual should be tested for:

- HIV antibody,
- HBsAg (hepatitis B surface antigen), and
- HCV antibody (hepatitis C antibody).

If the source individual tests positive for either of these hepatitis B or C markers, additional tests would usually then be ordered to assess infectivity, e.g. Hepatitis B “e” antigen, and Hepatitis C RNA (the latter by polymerase chain reaction assay).

If the source is unknown:

- Reasonable efforts should always be made to identify the source. The source individual may sometimes not be identifiable, *e.g. when a staff member is injured by an instrument in the sterilising room and it is not known on whom it was used.*
- If the source remains unknown, appropriate follow-up should be determined on an individual basis depending on:
 - the type of exposure;
 - the likelihood of the source being positive for a blood pathogen; and
 - the prevalence of HIV, HBV and HCV in the community of the likely source on whom the instrument or item was used. The prevalence of HCV antibody positivity in random blood donors in Australia is 0.3 %.

If the source refuses testing:

- Patient refusal for testing should be documented.
- In this case, treat the situation the same as the “positive patient” scenario below, and consider whether post-exposure prophylaxis and appropriate long-term follow-up should be offered.

If blood tests show that the source patient is negative:

If the source person is found to be HIV, HBV and HCV negative, no further follow-up of the exposed person is generally necessary, unless there is reason to suspect the source person

- is sero-converting to one of these viruses, or
- was at high risk of blood-borne viral infection at the time of the exposure (because they have recently engaged in behaviours that are associated with a risk for transmission of these viruses).

The window period causes a FALSE NEGATIVE test result. The patient may be infectious, but this is undetectable by testing. The window period for HIV is usually three months but it can, very rarely, be longer. The use of the polymerase chain reaction (PCR) testing for HIV/viral RNA can identify 90% of infections within four weeks, significantly reducing this window period. The window period is 6 months for Hepatitis B and Hepatitis C.

If the source is KNOWN or SHOWN to be positive for Hepatitis B surface antigen (HBsAg):

If the staff member is immune to Hepatitis B (anti-HBs antibodies > 10 IU/mL), they are protected. If levels of immunity are relatively low (i.e. between 10 and 100 IU/mL), a booster injection would be prudent.

If the staff member is NOT IMMUNE (e.g. has never been immunised, did not seroconvert to the vaccine (a non-responder), or has antibody levels to HBsAg less than 10 IU/mL), the correct treatment is to

1. Give a single dose of hepatitis B immunoglobulin (HBIG) within 48–72 hours, AND
2. Start a course of HBV immunisation. HBV vaccine should be given within 7 days of exposure, and then repeated at 1–2 months and again at 6 months after the first dose. Following the final vaccine dose, the level of immunity (antibodies to surface antigen) should be checked 2-4 weeks later.

If this HBV prophylaxis is not undertaken, the risk of transmission of HBV is 6.3% if the source is “e” antigen negative, but more than 30 % if the source is hepatitis B ‘e’ antigen positive.

If the source is KNOWN or SHOWN to be positive for antibodies to Hepatitis C:

- There is no effective post-exposure prophylaxis (PEP) for Hepatitis C, however interferon alpha and ribavirin may be employed to intercept HCV infection if seroconversion occurs. Treatment with these two antiviral agents during the acute phase of the disease may prevent establishment of the carrier state.
- If the HCV antibody test of the source patient is positive, then HCV RNA polymerase chain reaction (PCR) assay should be performed to test for HCV RNA. Not all anti-HCV antibody-positive subjects are currently HCV infected.
- The risks of transmission after a sharps injury from a positive source varies according to whether active viral replication is occurring. If the source is HCV RNA negative by PCR assay, the risk is 1.8-3.1%; however the risk increases to 10% if the source is PCR positive.

The injured staff member should be re-tested for HCV antibodies at 3 and 6 months, in addition to their baseline test.

In addition, regular liver function tests such as ALT and AST (e.g. at 2, 3 and 6 months) and the monitoring of clinical signs and symptoms should be undertaken by an infectious diseases physician or gastroenterologist, and specific therapy (such a ribavirin and alpha interferon) considered if appropriate.

If the source is KNOWN or SHOWN to be positive for antibodies to HIV

(or is at high risk of seroconverting):

The risk of seroconversion is as follows:

- after a sharps injury with HIV-infected blood: 0.3 %
- after a mucous membrane exposure to HIV-infected blood: 0.09 %

As only a small proportion of occupational exposures to HIV result in transmission of the virus, the toxicity of HIV post-exposure prophylaxis (PEP) must be carefully considered against its efficacy.

PEP is only indicated if there has been a significant exposure, and a proper risk assessment has been undertaken by a medical practitioner experienced in HIV management. This person will gather information on the stage of infection in the source, and current and previous anti-retroviral therapy, in order to decide on an appropriate prophylactic regimen.

HIV PEP is an experimental, not a proven, therapy. There is some evidence that taking Zidovudine reduces the risk of transmission of HIV after an occupational exposure. Nevertheless, there are also documented cases of seroconversion, despite early use of Zidovudine. It is the exposed individual's choice whether or not to take PEP, and they can stop at any time

- PEP is recommended for percutaneous (skin penetrating) exposure to potentially infectious blood or body fluids (because of the increased risk of HIV transmission).
- PEP should be offered (but not actively recommended) for exposure of ocular mucous membrane or non-intact skin to potentially infectious blood or body fluids (as there is less increased risk of HIV transmission).
- PEP should not be offered for an exposure to non-bloodstained saliva (as this is not potentially infectious for HIV).

HIV PEP is typically 2 or 3 orally administered anti-retroviral drugs (e.g. Zidovudine [AZT/ZVD] or Lamivudine, and a protease inhibitor), and should be administered to the recipient within 24–36 hours after exposure (preferably within 2 hours). This therapy should be continued for 4 weeks, on the advice of an infectious diseases physician.

If the source is known to be on anti-HIV medications, the treatment history will influence the medications prescribed by the infectious disease physician. An individual would normally only be commenced on HIV PEP on the advice of a physician specialising in HIV or infectious diseases.

Follow-up blood tests for the injured person should be undertaken at 1, 3 and 6 months, and follow-up undertaken to detect any febrile illness occurring within 3 months of exposure (possibly representing a HIV seroconversion illness).

All anti-retroviral agents may cause significant side effects, particularly gastrointestinal. There can be difficulties taking PEP (especially if working). Up to 40% of individuals do not complete the course of PEP due to side effects. It is important that the exposed person knows the difference between PEP side effects and HIV seroconversion symptoms.

Discussions as to the value of HIV PEP in exposed females should include the possibility of pregnancy. Anti-retroviral therapy is safe during pregnancy, and is effective at reducing the risk of transmission of HIV to the unborn child.

Some people find the experience of an occupational exposure to HIV very distressing, and they should be given the opportunity for immediate counselling to address anxieties. The exposed person should be

advised on ways to prevent transmission of blood-borne viral diseases to others. This will include advice about safe sex, safe injecting / safe needle use, breastfeeding, blood donation and safe work practices. A staff member who has been exposed to HIV (or Hepatitis C) should not donate blood, semen, organs or tissue for six months, and they should not share implements that may be contaminated with even a small amount of blood (e.g. razors or toothbrushes).

Special issues for exposure incidents in females

Both the employer and pregnant members of staff have an obligation to reduce risks to the foetus. In general, adherence to standard and additional precautions, vaccination and high standards of general hygiene in the workplace should protect pregnant members of staff. It is the responsibility of pregnant staff to advise their medical practitioner and employer of their pregnancy.

If the source patient is positive for HBV, HCV or HIV, pregnancy testing should be offered to women of child-bearing age who have been exposed and whose pregnancy status is unknown. If the exposed person is pregnant, she should be informed about the available limited data on the toxicity of anti-HIV post-exposure prophylaxis in pregnant women.

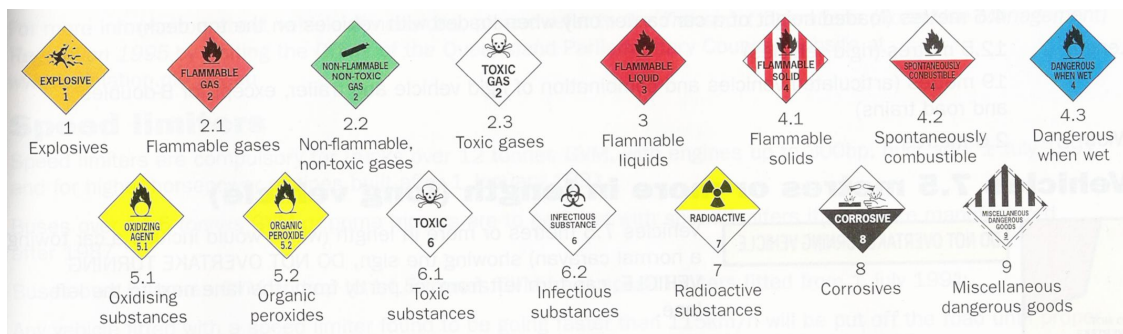
Further Reading:

- *Infection Control Guidelines*. CDNA, 2004. (Particularly sections 22.4 and 23.5)
- LJ Walsh. *Sharps Injury Protocol*. ADAQ, 2003.
- *Australian Code for the Transport of Dangerous Goods by Road and Rail, 6th Edn.*

Hazardous substance management (Regulations 5.1-5.21)

Hazardous substances are an important issue in the dental workplace since if not managed appropriately they may contribute to acute or chronic health problems. The term “hazardous substances” is a narrower classification than the term “dangerous goods” which is used to define specific issues for transporting and storing items.

According to the *Australian Code for the Transport of Goods by Road and Rail* (the ADG Code), dangerous goods are divided into 9 classes, each of which has a unique colour-coded diamond symbol which indicates the dangerous goods class and the nature of the hazard. Note that this classification also includes infectious substances (class 6.2).



(Australian Dangerous Goods Code, 6th edition)

The following types of substances may be found in a dental workplace:

- Flammable gases (Dangerous goods class 2.1), (e.g. town gas or butane used in gas burners)
- Non-flammable, non-toxic gases (class 2.2) (e.g. carbon dioxide, nitrous oxide)
- Flammable liquids (class 3): (e.g. Ethanol, Acetone, Methyl Methacrylate)
- Oxidising substances (class 5.1) (e.g. Hydrogen peroxide)
- Corrosive substances (class 8) (e.g. Orthophosphoric acid).

Some chemicals and harmful substances can cause allergic reactions, such as dermatitis or other medical conditions, or can be flammable, corrosive or toxic.

As an employer you must identify all chemicals and harmful substances being used in your workplace using a hazardous substances register.

Material Safety Data Sheets (MSDS) must be provided in the workplace for each chemical and harmful substance, listing the ingredients and giving health information and instructions for their safe storage, use and handling. MSDS are available from manufacturers and suppliers of chemicals and harmful substances. **Further guidance on MSDS is available on the WorkSafe website.**

Examples of a hazardous substances register and a risk assessment form for a hazardous substance are available on the WorkSafe website.

Under the Regulations, it is essential to have a listing of the hazardous substances maintained at the workplace. This should include the name of the product, and should identify the hazardous substances. For inventory purposes, the approximate amount held and location will also be useful. This information could be kept in a book, or managed using a computer database package, with a printout serving as the hard copy.

Note that not all “chemicals” are designated hazardous substances. If you are unsure as to what is a hazardous substance, either (a) contact the supplier or manufacturer, (b) check the documentation that came

with the product, or (c) check in the National Occupational Health and Safety Commission (NOHSC) List of Designated Hazardous Substances, either the published version or on the NOHSC website (www.nohsc.gov.au). Note that hazardous substances do not include substances brought into a workplace by an individual for personal or sanitary use not related to a work activity.

Listed below are substances which may be found in a dental practice which are included in the NOHSC listing of designated hazardous substances:

- Acetic acid (in developer solutions in automatic X-ray processors)
- Aluminium chloride (an astringent/haemostatic agent)
- Ammonia solution (in a first aid kit)
- Beryllium (in casting metals)
- Calcium hydroxide (in endodontic medicaments)
- Chloroform (in the dental laboratory)
- Ephedrine (in an emergency drugs kit)
- Formaldehyde (as a fixative solution for biopsies)
- Hydrofluoric acid (in acidulated fluoride gels, and porcelain etch)
- Hydrochloric acid (in the dental laboratory for pickling of castings)
- Hydrogen peroxide (bleaching solutions)
- Mercury (in amalgam capsules)
- Methacrylates (denture base resins)
- Nitrous oxide (gaseous anaesthesia)
- Phosphoric acid (acid etchant)
- Silver nitrate
- Sodium fluoride (only if > 3 %)
- Trichloroacetic acid (astringent)
- Turpentine (solvent)
- Zinc oxide powder (in ZOE)

Schedule 5.1 of the Regulations provides the classification system used for hazardous substances:

Type I ingredients

A “**type I ingredient**” is an ingredient which is present in a quantity which exceeds the lowest relevant concentration cut-off level specified for the hazards classification in the *Approved Criteria for Classifying Hazardous Substances* [3rd Edition: NOHSC: 1008 (2004)] and -

- (a) is described in the *Approved Criteria for Classifying Hazardous Substances* as carcinogenic, mutagenic, teratogenic, a skin or respiratory sensitiser, corrosive or very corrosive, toxic or very toxic, a harmful substance which can cause irreversible effects after acute exposure, or a harmful substance which can cause serious damage to health after repeated or prolonged exposure; or
- (b) has an exposure standard listed in the *National Exposure Standards* [NOHSC: 1003 (1995)].

Type II ingredients

A “**type II ingredient**” is an ingredient which is present in a quantity which exceeds the lowest relevant concentration cut-off level specified for the hazard classification in the *Approved Criteria for Classifying Hazardous Substances* [3rd Edition: NOHSC: 1008 (2004)] and is described in the *Approved Criteria for Classifying Hazardous Substances* as a harmful substance, but which does not meet the criteria for a type I ingredient.

Type III ingredients

A “**type III ingredient**” is an ingredient which does not meet the criteria for either a type I ingredient or a type II ingredient.

(see the Guidance note “Provision of information on hazardous substances at workplaces - Material safety data sheets (MSDS)” available from the WorkSafe WA web site).

A master copy of all MSDS's should be kept on file. As well, a legible copy of the relevant MSDS's should be available near the place where the hazardous substance is used (e.g. a photocopy in a plastic sleeve), so that staff have immediate access to it in the event of a spill or accident.

Under the Regulations, manufacturers or importers of a hazardous substances MUST prepare an MSDS for each hazardous substance they make or supply, to the employer at a workplace

- when first supplying the substance for use at the workplace;
- when later supplying the substance after an amended MSDS becomes available; and
- on request by the employer or an employee.

Duties of employers can be summarised as follows:

- to obtain MSDS's from the supplier;
- to place MSDS's in a register immediately upon receipt;
- to ensure that the information on the MSDS is not changed (i.e. altered or defaced);
- to keep a copy of the MSDS close enough to the place where it is being used so that employees can have ready access to it.
- to check that labels have been fixed to the containers (this should have been done by the supplier);
- to prevent labels from being interfered with;
- to ensure proper labelling of any containers into which hazardous substances are transferred (unless the contents of the second container are used immediately);
- to conduct a proper risk assessment (see below);
- to institute control measures;
- to provide and maintain personal protective equipment;
- to arrange for monitoring and health surveillance if required (see below);
- to provide for safe storage, handling, and disposal of hazardous substances
- to provide induction and ongoing training;
- to maintain records within a register.

Risk assessment

All staff potentially exposed to the hazardous substance should participate in the risk assessment process. There is a set format for this assessment, as outlined below.

An assessment must be made of the health risks associated with the use of each new designated hazardous substance used in the practice, as soon as is reasonably practicable after it is first used.

The assessment for each hazardous substance must include:

- the identification of the hazardous substance;
- a review of the substance's MSDS or available equivalent information;
- a review of the information on the package's label;
- a statement of the risks associated with the hazardous substance
- an assessment of the probability that exposure will occur, the timing of the exposure (occasional or continuous), and the consequences of exposure
- a decision regarding which employees may be exposed to the substance;
- a decision about the control measures, health surveillance and monitoring needed in relation to the substance.

Each risk assessment must be reviewed at least once every 5 years, and when any of the following happen:

- the work practice involving the substance is significantly modified;
- new information about the substance's hazards becomes available;
- health surveillance or monitoring of staff shows that control measures to reduce exposure are inadequate and need to be reviewed;
- new or improved control measures are implemented.

**CHEMICALS AND
HARMFUL SUBSTANCES
SAFETY CHECKLIST**

CHECK:	YES	NO	N/A
Chemicals and harmful substances are part of your staff induction			
People working with chemicals and harmful substances have been given information, instruction and training			
Your record of training includes: health effects, controls, safe work methods and personal protective equipment/clothing			
There is an easy to find and read list/register of all chemicals used			
MSDS are available for employee reference and included in the hazardous substances register			
Original containers have the manufacturer's label			
Decanted containers are labelled with name, risk and safety instructions. You know the risk for all chemicals and harmful substances stored and used at your workplace			
The risk assessment is recorded in your list/register			
Assessment reports are available to monitor significant risks			
Actions have been taken to control risks. For example, an investigation to find out whether an alternative safer chemical is available			
A medical practitioner is available to monitor the health status of employees			
There are appropriate first aid and emergency facilities and employees are aware of them			

If the risk assessment shows that the risk to health is significant, a record must be made of the following information:

- the date of the assessment;
- the substance's product name or other identification;
- a statement that the review of the MSDS has been done;
- that the degree of risk is significant;
- the control measures for use of the substance;

- the type of monitoring that is needed and the intervals at which the monitoring must be done;
- the type of health surveillance that is needed and the intervals at which the health surveillance must be done.

If the risk assessment shows that the degree of risk is NOT significant, a record must be made containing:

- the date of the assessment;
- the substance's product name or other identification;
- a statement that the appropriate reviews have been done;
- a statement that the degree of risk is not significant; and
- the control measures (if any) for use of the substance.

These records must be made as soon as practicable after the risk assessment has been completed. WorkSafe inspectors may request to see these records as part of a safety audit.

The following two examples illustrate how the assessment procedure is followed up:

Example (1). A hazardous substance has been identified (e.g. from an MSDS or from the NOHSC listing). The risk assessment concludes that the risk is not significant now and is not likely to increase in the future. Adverse effects on health are unlikely.

The reasons for this are, for example:

- the amounts or rate of use of a hazardous substance are too small to constitute a risk, even if the controls fail;
- the operation obviously and strictly conforms to the safety information contained in the MSDS and on the label;
- similar assessments in the past have confirmed the risks were not significant, and present work conditions are unchanged.

What to do:

- Record the assessment in the register.
- Review the risk assessment in five years or if the situation changes.
- Maintain training and supervision.

Example (2). A hazardous substance is in use. Risks are rated as significant, but are effectively controlled. There is the possibility that risks could increase in the future, due to:

- a failure to use adequate protective equipment;
- human error (lack of awareness, lack of training, inadequate monitoring)
- changes in work practices, or
- an increased amount of hazardous substance is used.

What to do:

- Determine what extra precautions are necessary.
- Determine what additional control measures are required.
- Implement the control hierarchy:
 - Elimination: can the work be done without the substance?
 - Substitution: use a less hazardous material
 - Isolation: separate the material from people by distance or by physical barriers
 - Engineering controls: e.g. local exhaust ventilation
 - Administrative controls: e.g. work rotation, keeping lids on containers, regular cleaning of contaminated areas
 - Use of personal protective equipment: the least desirable option.
- Record the details of the risk assessment in the register.
- Review the assessment in five years or if the situation changes.
- Maintain training and supervision.

The key record keeping requirements are:

- a listing of hazardous substances;
- current MSDS's;
- risk assessment records;
- risk assessment reviews;
- results of health monitoring and surveillance (if appropriate).
- records of training in the correct use of hazardous substances.

General points regarding chemical safety

- Total chemical stocks should be kept to a minimum.
- Flammable liquids must not be stored near oxidizing agents (such as peroxides).
- All chemical containers should have intact readable labels and be in good condition.
- Quantities of flammable liquids should be kept to a minimum.
- The number of gas cylinders kept inside rooms should be kept to a minimum.
- Gas cylinders must be securely restrained.
- Poisons and drugs should be stored separately from other chemicals.

A checklist for hazardous substances management:

- Is there a register of designated hazardous substances?
- Has there been a check of inventories?
- Has there been a check of substances used in ancillary work (e.g. cleaning, X ray processing, dental laboratory facilities)?
- Have risk assessments been conducted for all currently held hazardous substances?
- Are risk assessments conducted for all new hazardous substances?
- Do employees participate in the risk assessment process?
- Is a complete set of MSDS's available?
- Are MSDS's kept in a central register?
- Are new products checked for hazardous substance identification?
- Do employees know to access MSDS's and interpret them?
- Can they recognise and interpret information on labels including safety directions?
- Are employees aware of Poisons schedules and dangerous goods classifications?
- Are there copies of relevant MSDS's available in the area of use (e.g. a photocopy in a plastic sleeve)?
- Are all hazardous substances stored properly?
- Is disposal of hazardous substances appropriate?
- Are there unlabelled containers / unknown substances?
- Are there written procedures for dealing with hazardous substances?
- Have all employees received training in the hazardous substances they may be exposed to?
- Do all workers attend such training sessions?
- How are the effects of training assessed?
- Are records of training maintained?
- Is the use of PPE and other exposure control measures supervised?
- Are existing control measures adequate?
- Are engineering controls working (ventilation systems etc)?
- Is management of chemical accidents and spills included as part of the emergencies and first aid training?

Further reading:

- LJ Walsh. Hazardous substances in the workplace. Part I. Overview of responsibilities. *ADAQ News* 395: 28-32, 1995.
- LJ Walsh. Hazardous substances in the workplace. Part 2. Practical implementation. *ADAQ News* 396: 26-27, 1995.
- LJ Walsh. Glutaraldehyde: latest information for a safer work place. *ADAQ News* 392: 30-33, 1995.
- Australian Dangerous Goods Code, 6th edition.

Nitrous oxide

Nitrous oxide (N₂O), also known as *laughing gas*, is a colourless gas with a slightly sweet, pleasant odour and taste. It does not irritate the mucosa of the respiratory system. Nitrous oxide has analgesic, anxiolytic and psychosedative properties, and also produces mild skeletal muscle relaxation. It is a weak anesthetic agent, but a potent analgesic for ischaemic muscle pain. It provides only limited analgesia for pain provoked by dental treatment and thus conventional local anaesthetics are used with nitrous oxide sedation. Since the pioneering work of two dentists, Horace Wells and William T.G. Morton in the mid-19th century, nitrous oxide mixed with oxygen has been used for the safe and effective management of anxious and apprehensive dental patients for more than 150 years.

Patient safety issues associated with nitrous oxide sedation are:

- Diffusion hypoxia if there is sudden removal of nitrous oxide. Using a minimum oxygen concentration of 30 % co-administered with nitrous oxide, and commencing and stopping nitrous oxide slowly will reduce the likelihood of hypoxia.
- Nausea and vomiting in 15% of patients, and
- Inactivation of methionine synthetase, an enzyme required for DNA synthesis.

These effects from short-term exposure during a dental appointment are reversible and do not present a significant health risk to the patient. Of interest, the analgesic and sedative effects of nitrous oxide can be blocked by the opiate antagonist naloxone, which is used to treat opiate overdoses. Nitrous oxide has minimal effects on respiration and cardiovascular parameters in normal healthy patients. It is problematic in patients with coronary vascular disease because of decreased myocardial activity, and in patients with emphysema or chronic obstructive airways, since the co-administration of oxygen with nitrous oxide will depress the respiratory drive in these patients.

Use of nitrous oxide is contra-indicated in patients who are:

- uncooperative
- pregnant
- suffering from a blocked nasal airway or chronic bronchitis
- affected by a severe psychiatric disorder
- claustrophobic.

Although nitrous oxide is non-flammable, it does support combustion. This is an issue if patients are having general anaesthesia procedures with nitrous oxide maintenance, and the naso-pharyngeal tubes are ignited by lasers or electrosurgical equipment. Specially constructed oral and nasal GA tubes which are designed to withstand such sources of combustion can be used to eliminate this risk.

Nitrous oxide should never be allowed to contact aluminum, tungsten carbide, or a number of other materials (including oils, organic peroxides and ammonia) as a violent chemical reaction may occur.

Nitrous oxide is supplied to the dental practice in a pressurized steel cylinder in a liquid form. The material has a melting point of -91 degrees Celsius and a boiling point of -88.5 degrees Celsius. Accordingly, inside the cylinder, the liquid will be in equilibrium with a gas phase. When the gas phase is released, the liquid

vaporizes rapidly to maintain the equilibrium. Because of this, the gas pressure at the top of a cylinder of nitrous oxide is constantly maintained at 53.6 bar (750 psi) until the liquid is fully depleted. Measuring the weight of the cylinder and comparing this to the known empty weight is the most accurate means of estimating the amount of nitrous oxide left in the cylinder. The pressure reading cannot be used as this always reads 53.6 bar until the material is fully depleted.

Dental staff are at risk of chronic exposure to nitrous oxide, which at high concentration can cause irreversible and toxic changes. The main route of exposure of both dental staff and patients to nitrous oxide is by inhalation, as it is absorbed rapidly by this route.

In addition to unintended exposure, it should also be pointed out that nitrous oxide is prone to abuse. Nitrous oxide exerts similar actions to morphine, possibly by stimulating the release of endorphins, but it is not a controlled drug. If nitrous oxide is abused, substantial neurological damage will result. The affected individual will have impaired motor and cognitive skills and will be unfit to practice. Nitrous oxide abusers develop a myeloneuropathy causing sensory impairment, Lhermitte's sign (shooting pains when the neck is flexed), leg weakness, ataxia, impotence and loss of sphincter control. As with other substances of abuse, dependence on nitrous oxide will have a destructive effect on the individual's dental practice and on their family life.

Pathways and Mechanisms:

Nitrous oxide can be released into the dental surgery atmosphere because of:

- poorly fitting or loose masks
- movement of the patient, including talking and crying
- exhalation via the mouth by a patient with a nasal mask, that is not captured by a scavenger system
- leaks from equipment including fittings and hoses
- inadequate surgery ventilation (air recirculation or insufficient air changes).

Nitrous oxide oxidizes the cobalt ion in reduced vitamin B12. Because of this, symptoms of chronic nitrous oxide exposure resemble those caused by vitamin B12 deficiency:

- paraesthesias
- diminished proprioception
- decreased cutaneous sensation
- motor weakness in muscles
- intellectual or behavioral impairment, and
- impaired vision
- bone marrow depression (anemia, granulocytopenia and neutropenia).

One half-hour session of nitrous oxide sedation in a poorly ventilated operatory without a scavenging system can produce an atmospheric level of nitrous oxide well in excess of 100 parts per million (ppm) for several hours. Studies using human volunteers have shown impaired memory performance, visual perception, cognition, and dexterity with exposure to nitrous oxide at levels of 50 ppm over a 2 hour period. Volunteers exposed to 25 ppm did not demonstrate the same deficits (Henry, 1992). This finding was instrumental in causing national occupational health and safety bodies to recommend 25 ppm as the standard for maximum exposure in the work place, however subsequent research has not been able to reproduce all of the results obtained by Henry.

Vitamin B12 is important for the enzyme methionine synthetase, which is involved in DNA synthesis. Thus, chronic exposure to nitrous oxide can suppress the turnover of rapid dividing cells, such as in the bone marrow. The level of impairment of methionine synthetase will depend on:

- The frequency of exposure to nitrous oxide.
- The level present in the dental surgery atmosphere
- Body stores of methionine
- Dietary intake of methionine which compensates for lack of this amino acid.

Reproductive problems from chronic exposure to nitrous oxide were documented by the work of Cohen (1980) who reported the following:

- A 2.3 fold increase in the rate of miscarriage in dental assistants who were chronically exposed to nitrous oxide.
- A 1.5 fold increase in spontaneous abortion in the wives of dentists who were exposed to nitrous oxide for more than 8 hours per week.

Cohen also noted a higher incidence of liver and kidney problems with chronic exposure to nitrous oxide, in particular:

- Increased formation of renal calculi (kidney stones), and a 1.7 fold increase in liver disease in males.
- Increased rates of genito-urinary infection, and a 1.6 fold increase in liver disease in females.

Other studies have reported that nitrous oxide may:

- inhibit spermatogenesis, leading to a low sperm count in males.
- interfere with the hypothalamic-pituitary-gonadal axis in females by preventing the action of luteinizing hormone releasing hormone (LHRH), which is important for ovulation.
- cause foetal abnormalities and growth retardation.

Cohen *et al.* conducted one of the most important studies about the effects of chronic exposure to nitrous oxide in 1980. In this study, he compared the fertility, spontaneous abortion, neurological defects, malignancy, liver and kidney problems in dentists and dental assistants who were chronically exposed to nitrous oxide to a normal population.

The more recent study by Rowland *et al.* (1992 and 1995) examined the relationship between occupational exposure to nitrous oxide and the occurrence of spontaneous abortion in female dental assistants. Women who worked with nitrous oxide at least 3 hours per week in dental practices that did not use scavenging equipment had a 2.6 fold increased risk of spontaneous abortion. Risk was not increased in female workers in dental practices where scavenging equipment was in use. This study demonstrated that scavenging equipment caused a dramatic reduction in exposure levels, and was effective in protecting the reproductive health of these women.

Exposure to nitrous oxide should be avoided in staff and patients in the following categories:

- Pregnant females in the first trimester of pregnancy
- Infertile individuals who are using *in vitro* fertilization procedures
- Individuals with neurological illnesses or complaints
- Immune compromised patients
- Patients with leukaemias or other bone marrow disorders.

Prevention and Practical Advice:

Nitrous oxide is supplied to the dental practice in steel cylinders with a blue colour valve end and a blue colour body. The mixture Entonox, which is 50 % oxygen and 50 % nitrous oxide has a blue/white valve end and a blue body. These cylinders have a 3-pin index for the valve to prevent misidentification.

Nitrous oxide cylinders should be stored in a well-ventilated place and should be kept away from heat and sunlight. Nitrous oxide is heavier than air, and will accumulate in the locality of a leak. It is an asphyxiant which displaces oxygen. As with all compressed gases, the cylinders should be properly secured above their centre of gravity (at two thirds of their vertical height), both when in storage and when in use. The cylinder valve should be closed when the cylinder is not in use and when it is empty. As large cylinders present a manual handling (lifting/moving) hazard, some consideration should be given to using small cylinders, or if larger cylinders are deemed necessary, using a small wheeled trolley to move the cylinders. This not only reduces the manual handling hazard but also prevents the cylinders being dropped or damaged.

Where practicable, cylinders can be stored outside the building, with the gas reticulated to outlets in the surgery. Externally stored tanks should be located on a firm level base, and secured against damage and tampering by a galvanized iron roofing canopy and a chain mesh security fence. If stored internally, the cylinders should be kept clear of corridors, exits, and combustible materials, and secured to a wall to prevent their tipping over.

Nitrous oxide is a designated hazardous substance. A material safety data sheet (MSDS) must be on site and this must be reviewed as part of the risk assessment. The national Exposure Standards for Atmospheric Contaminants in the Occupational Environment [NOHSC:1003 (1995)] specifies that nitrous oxide exposure over an 8-hour period (time weighted average) should not exceed 25 ppm.

The following safety measures are recommended:

For patients:

- Use a fail-safe device, so that should the oxygen supply fail, the flow of nitrous oxide is cut off automatically and the patient supplied with normal room air.
- Use nitrous oxide systems equipped with an emergency (100%) oxygen button to supply pure oxygen should hypoxia develop.
- Monitor the patient's pulse regularly
- Monitor the patient's blood oxygen level using a pulse oximeter
- Administer 100 % oxygen for 3-5 minutes after turning the nitrous oxide off, to prevent diffusion hypoxia. This will accelerate recovery from the sedative effects of nitrous oxide, and will also flush residues of nitrous oxide from the tubing of the gas delivery system.

For staff:

To limit the accumulation of nitrous oxide in the dental surgery atmosphere, the following preventive measures are recommended:

- Nitrous oxide should only be used where necessary for clinical or psychological reasons, such as:
 - Needle-phobic patients
 - Anxious child patients.
- Before the first use each day, check all items of nitrous oxide equipment (wall connectors, quick connect fittings, cylinder valves, reservoir bag, masks, connectors and tubing) for visible cracks, holes or tears, to minimize leakage of nitrous oxide into the atmosphere.
- Every time a gas cylinder is changed or every 3 months, test the connectors tubing for leaks by painting on a non-oil based soap solution and looking for bubbles. An alternative but more expensive method is to use a portable infrared gas analyzer. These checks should be recorded in a logbook.
- Reduce leakage by using a correctly sized mask with a close and comfortable fit. There should be a variety of mask sizes on hand to ensure a proper fit for individual patients.
- Encourage patients breath in and out using their nose (rather than their mouth), and to avoid talking if possible.
- Use an active scavenging system with a flow rate of 45 litres per minute attached to the nasal mask, and connected to a dedicated vacuum pump or to the high velocity suction. Regardless of which format is used, the exhaust from the scavenging system must be to the outside of the building, but well away from the air intakes of the airconditioning system and any open windows. Such systems can reduce the amount of nitrous oxide inhaled by dental staff by as much as 97%.
- Assess the ventilation arrangements in the dental operator. Fresh air should be delivered by ceiling outlets, and exhaust air removed at or near floor level. This is important since nitrous oxide has a vapour density of 1.53 and thus will accumulate at floor level. Smoke tubes can be used to show air movements within a room.

- Personal dosimeters for nitrous oxide in a badge format can be worn during working hours, to track occupational exposure to nitrous oxide. Real-time measurements of nitrous oxide levels can be made using a portable infrared spectrophotometer.
- The practice should conduct each year training and educational programs for all staff, which address safety aspects of nitrous oxide, including gas labelling systems, and the use of scavenging and other work practices to minimize levels of nitrous oxide in the operatory. Records should be kept of this training.
- Seek immediate medical consultation if any staff members develop symptoms of occupational exposure to nitrous oxide.

Further Reading:

- EN Cohen *et al.* Occupational disease in dentistry and chronic exposure to trace anesthetic gases. *JADA* 101: 21-31, 1980.
- AJ Rowland *et al.* Reduced fertility among women employed as dental assistants exposed to high levels of nitrous oxide. *New Engl J Med.* 327: 993-997, 1992.
- AJ Rowland *et al.* Nitrous oxide and spontaneous abortions in female dental assistants. *Am J Epidemiol.* 141: 531-538, 1995.
- DL Jackson & BS Johnson. Inhalational and enteral conscious sedation for the adult dental patient. *Dent Clin North Am.* 46: 781-802, 2002.
- R Primosch *et al.* Effect of scavenging on the psychomotor and cognitive function of subjects sedated with nitrous oxide and oxygen inhalation. *Pediatr Dent.* 19: 480-483, 1997.
- WR Howard. Nitrous oxide in the dental environment: Assessing the risk, reducing the exposure. *JADA* 128: 356-360, 1997.
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- AS2896, 1991.

Mercury in dentistry

Mercury has been used in dentistry for many years as a component of dental amalgam. Mercury is found in all pre-dosed amalgam capsules, and residues of mercury may be present in used amalgam capsules. Note that, in contrast to elemental mercury, amalgam alloy powder is generally considered non-hazardous. The use of dental amalgam as a restorative material has been declining markedly in recent years, as alternative posterior restorative materials with better physical characteristics have become available. Patient concern regarding the presence of mercury in silver amalgam alloy is a significant issue in contemporary dental practice. In a 1995 poll of 1010 Australian adults, over one third (37.5%) expressed concern and some 16.2% requested fillings that did not contain mercury (Thomson *et al.* 1997).

In recent years, media stories and websites have raised concerns about the use of dental amalgam, however repeated worldwide reviews of the scientific evidence have been unable to causally link the use of dental amalgam directly with ill health. A very small number of people may experience local side effects due to an allergic reaction to mercury or another component of dental amalgam, causing inflammation in the tissues surrounding the tooth. Such local effects appear quickly, and can be recognized as such, and the diagnosis confirmed by a clinical allergist or specialist in oral medicine. In some cases, the patient may have existing lesions of oral lichen planus on their posterior buccal mucosa which are exacerbated by the rough surface of old and corroded dental amalgam restorations. In such cases, clinical changes will be seen if the restorations are polished to reduce the trauma which they are producing. Similarly, the identification of oral galvanism due to differential metals coming into electrical contact is straightforward.

Very small amounts of mercury are released from the surface of dental amalgam restorations, mainly as mercury vapour. Grinding teeth, chewing and tooth-brushing all remove the surface-passivating layer and thus allow mercury to be released in vapour and elemental form into the oral cavity. Some of the vapour is breathed out, while some is breathed in. Some vapour may dissolve into the saliva and then be swallowed. However, the mercury levels involved are very low, so the amount of mercury absorbed into the body from such activities is very small. It has not been demonstrated that people experience any clinical effects from the small additional body burden of mercury from dental amalgam via the above route. Of importance, the amount of mercury released from amalgam restorations is greatest when these are placed or removed. Mercury levels in the blood and urine spike during placement or removal of amalgams and subsequently decline over several days or weeks.

According to Eley (1997), the available data from controlled studies indicate that no health hazard can be identified from the amounts of mercury released from dental amalgam. Moreover, there is no persuasive evidence that the mercury doses produced by amalgam restorations can cause the wide variety of non-specific symptoms that have been attributed to fillings in anecdotal reports or that cure or health improvement can be achieved after their removal.

Of the mercury found in the body, much less is likely to have come from dental amalgam than from other sources. Mercury is present at low levels in the environment as a naturally occurring element in air, water and food. Mercury in food, particularly in fish, is often in the form of organo-mercurial compounds that can be more easily absorbed by the body (in contrast to the elemental mercury from dental amalgam).

There is growing epidemiological evidence that in response to the normal presence of small amounts of mercury in the natural environment, in humans there is a threshold level for mercury exposure below which there is no response or observable adverse health effects (Jones 1999).

In 1999, the World Health Organization produced the following statement on dental amalgam:
“There is no scientific evidence showing that general symptoms are relieved by the removal of amalgam restorations. In fact, there are disadvantages to having amalgam fillings replaced — replacement can be expensive; it almost always causes more of the natural tooth to be lost; and, mercury levels in the body rise immediately after amalgam fillings are replaced due to the manipulation of the amalgam. If you decide to have amalgam fillings replaced, your exposure to mercury can be reduced by using a rubber shielding device called a ‘dental dam’ and having extra suction during the removal. Dentists can also cut away, rather than drill out the amalgam filling, to help reduce exposure to mercury.”

Metallic mercury is a silvery liquid with a metallic luster. It has a high density (specific gravity: 13.5939) and produces odourless toxic vapours even at room temperature (vapour pressure: 0.002 mm Hg @ 25 degrees C). For this reason, all containers must be kept tightly closed. Under Australian national (NOHSC) guidelines, metallic mercury is regarded as harmful at concentrations > 3.0%, and toxic at concentrations > 25%.

Material safety data sheets (MSDS) for mercury can be obtained from suppliers or manufacturers of pre-dosed amalgam capsules (and can usually be downloaded from the manufacturer's web site).

Pathways and Mechanisms:

Mercury exposure in dental practice can occur through direct skin contact and by inhalation. Significant non-occupational mercury exposure can also occur by ingestion of seafoods containing organo-mercurial compounds (particularly methyl mercury) formed from bio-transformation of mercury by bacteria and their subsequent incorporation into the food chain.

Sources of mercury vapour in the dental surgery environment include:

- Leaking supplies of mercury (such as damaged capsules)
- Amalgam scrap and used capsules (if not stored correctly)
- Spillages of mercury
- Defective amalgamators
- Autoclaving of instruments contaminated with amalgam
- Placement, replacement and polishing of dental amalgams.

The level of exposure of staff working chairside will be influenced by the frequency of amalgam placement or removal in the practice (which is declining), the impact of working hours/ staff rosters, and any additional preventive measures used in the practice (e.g. an enclosed environment for the amalgamator).

Typical levels of mercury in the air are as follows (in micrograms per cubic metre)

- In suburban air: 0.05
- After mixing of an amalgam capsule: 1 – 2
- During removal of amalgam using water spray and high volume suction: 25 - 20

Mercury may be toxic by either acute or chronic exposure. For example, direct contact with mercury liquid may cause irritation and redness of the eyes and the respiratory tract. Skin contact may also cause irritation and (in some individuals) an allergic reaction. With large or repeated exposures, mercury may be absorbed through intact skin to cause toxicity.

If mercury is ingested in large amounts, burning of the mouth and throat, thirst, nausea and vomiting may occur. However metallic mercury is not usually well absorbed and thus these acute effects are unlikely.

Inhalation of high concentrations of mercury vapour may cause dyspnoea, cough, fever, nausea, vomiting, headache, excessive salivation and metallic taste, cardiac abnormalities, pulmonary irritation and pneumonitis, oedema, fibrosis and death. Allergic reactions, kidney and brain damage may also occur because of cumulative toxic effects from inhalation of high levels of mercury vapour for prolonged periods. Mercury accumulates in certain organs, particularly the kidneys and the nervous system, with the latter producing signs such as mood swings, memory loss and development of tremors.

Prolonged overexposure to mercury may cause a form of neuro-toxicity termed *mercurialism*, which is characterized by fine tremors and erethism (manifested by abnormal shyness, depression, despondency, irritability or excitability). In severe cases hallucinations, loss of memory and mental deterioration may occur. Other documented effects include kidney damage, stomatitis, increased tooth mobility, blue pigmentation of the gingivae, diarrhoea and weight loss. The phrase '*mad as a hatter*' came about because the hat makers of the 19th century were exposed to high levels of mercury by the cutaneous and respiratory routes, because of their practice of rubbing mercury onto cloth as a preservative. A parallel situation has

been documented (in rare instances) in dental practices with completely absent mercury hygiene, in which liquid mercury accumulated in carpets within the dental operator and produced high levels of vapour because of central heating. Inhalation of high levels of atmospheric mercury over extended periods then produced neurological deficits along the lines of “*mad hatter*” disease. The most recent episode of this type was documented in Surrey (UK) in 1975.

Mercury is reported to cause reproductive toxicity but it is not regarded as a carcinogen. Pre-existing respiratory, kidney and nervous system disorders may be aggravated by exposure to mercury. Other heavy metals with the same target organs may cause additive adverse health effects.

Prevention and Practical Advice:

Mercury hygiene is a well recognized component of modern dental practice. According to the control measures used in the practice, a formal risk assessment process (discussed below) may determine that the risk is not significant now and is not likely to increase in the future, and that adverse effects on health are unlikely because the amounts or rate of use are too small to constitute a risk, and the procedures and controls in place strictly conform to the safety information contained in the Material Safety Data Sheet.

Safe work practices for the dental office setting include:

- Training staff members in mercury hygiene and in spill management. All members of staff should be encouraged to report immediately any mishandling or spillage incidents involving mercury.
- Avoiding eye contact, skin contact, and inhalation of vapour during handling.
- Wearing protective gloves (“no touch technique”), a surgical mask and protective eyewear.
- Removing gowns when leaving the clinical area.
- Using pre-measured disposable amalgam capsules, storing them in a cool area, and protecting them from breakage. Amalgam capsules (either used or unused) must not be stored in food containers.
- Not disassembling unused or used amalgam capsules.
- Not using powered devices such as ultrasonic condensers when placing amalgams.
- Covering amalgam scrap with radiographic fixer solution (sodium thiosulphate) (NOT water) and keeping it under this liquid in an unbreakable airtight closed container, which is stored away from heat. The sodium thiosulphate will form a surface layer of black mercuric sulphide on the surface of the scrap amalgam particles, which reduces their vapour pressure. Radiographic fixer is far more effective than water at reducing vapour during storage.
- Salvaging amalgam scrap and residues for recycling according to local regulations.
- Not wearing clinical clothing home.
- Using enclosed (capsule) systems for dental amalgam.
- Using rubber dam as appropriate.
- Using high volume evacuation and copious water spray when placing, removing or polishing amalgams.
- Having the filters in room airconditioners cleaned or replaced at regular intervals.
- Not using infrared lasers to ablate dental amalgam.
- Cutting away amalgam restorations to permit their removal in pieces, rather than drilling out the entire bulk of the restoration.
- Disposing of extracted teeth with amalgam restorations appropriately – these should not be incinerated as this will result in mercury vapour release into the environment.
- Using a sedimentation-type or centrifugal-type amalgam separator within the dental unit. The latter are more efficient collectors but are more expensive to operate. The waste residue generated during placing or replacing dental amalgam restorations contains approximately 50% mercury by weight, and this material will be released into the sanitary sewer system if no separation of solids is undertaken.
- Using appropriate flooring in the dental surgery patient treatment areas (not carpets, but rather impervious flooring such as welded vinyl).
- Using amalgamators with a fully enclosed mixing arm.

- Storing used capsules appropriately by recapping them and then placing them in an air tight container.
- Removing amalgam residues from instruments before thermal disinfection or autoclaving.

There is no scientific evidence that dental amalgam can cause birth defects or harm to breastfeeding infants, however the general principles of risk control dictate that exposure of certain patient groups to any potentially toxic agent should be limited.

Thus, dental amalgam should be avoided in the following patients and situations:

- Pregnancy, since elective dental procedures are contra-indicated during pregnancy, particularly during the first trimester. Placement or replacement of dental amalgam restorations in a pregnant female will cause a transient elevation in the level of mercury in the blood. Mercury can cross the placenta and enter the bloodstream of the foetus.
- Breastfeeding: Women who are breastfeeding should not have amalgam restorations inserted or removed, because mercury can be passed to the newborn infant through breast milk.
- Children, since there are better alternative materials and techniques (e.g. resin reinforced glass ionomer cements in small posterior restorations, and stainless steel crowns for larger areas of destroyed tooth structure).
- Kidney disease, because high levels of exposure to either elemental or inorganic mercury may reduce kidney function, and also because excretion of mercury compounds will be reduced in patients with kidney disease.

Relevant Legislation and Guidelines:

Because mercury is included in the National Occupational Health and Safety Commission List of Designated Hazardous Substances, in order to comply with the current Workplace Health and Safety Regulations, dental practices which use dental amalgam must conduct a risk assessment for mercury and must have the written report of this available for inspection.

The risk assessment must include:

- a review of the manufacturer's MSDS;
- evaluation of which employees may be exposed;
- a decision about the control measures;
- a decision whether health surveillance or monitoring is needed (e.g. urinalysis for mercury in cases of excessive exposure).

Spill management

Similarly, it is important to thoroughly clean up all mercury if capsules break. Gloves must be worn, and the spilled mercury collected using a mercury spill kit or suction pump and aspirator bottle. Do not use a regular vacuum cleaner, or methods which break up liquid mercury into smaller droplets. A small volume syringe or adhesive tape can be used to capture small droplets. To reduce vapour release, spilled droplets can be covered with powdered sulfur, or a 20% solution of sodium thiosulphate (the substance used to make radiographic fixer solutions). The droplets should be collected into a closed container. It is also important to prevent spilled material from entering drains or sinks.

First aid:

In cases of eye contact, immediately flush with water, and continue for 15 minutes, lifting the upper and lower lids. For accidental skin contact with mercury, immediately remove contaminated clothing and wash

thoroughly with soap and water. If a significant exposure occurs from inhalation of vapour, immediately move the affected person to fresh air, and give artificial respiration if breathing has stopped.

If mercury is ingested, if the victim is conscious, give water to drink, induce vomiting and seek immediate medical attention. Never give anything by mouth to or induce vomiting in a person who is unconscious or convulsing. In the case of other illnesses, contact a doctor or the Poisons Information Centre and seek immediate medical attention.

Fire and explosion issues:

Metallic mercury is not combustible, however as noted above mercury vapour is highly toxic. Firefighters require self-contained breathing apparatus. Amalgam capsules may burn or shatter at high temperatures.

Documentation

The employer should make a risk assessment record which contains the following information:

- the date of the assessment;
- the product name (e.g. Kerr Tytin);
- a statement that a review of the MSDS and any other relevant information has been done;
- a statement whether the degree of risk is significant or not;
- a listing of the control measures in place;
- a decision as to whether health surveillance is required.

These records must be made immediately after the risk assessment has been completed. Inspectors may request to see these records as part of a safety audit. The employer should ensure that the written risk assessment is reviewed at least once every 5 years, and when any of the following happen:

- work practices are significantly modified;
- new information about health hazards becomes available;
- monitoring shows that control measures to reduce exposure are inadequate and need to be reviewed;
- new or improved control measures are implemented.

All staff who may be exposed to mercury must receive training about its hazards and the mercury hygiene and related control measures used in the practice. Records of this training must be kept.

Further reading:

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Methyl methacrylate

Methyl methacrylate (MM) (chemical formula C₅H₈O₂) is listed in the Worksafe Australia List of Designated Hazardous Substances, and as such is a hazardous substance according to the definitions of the current legislation and codes of practice.

Within dentistry, MM is found in:

- orthodontic adhesives,
- bracket primers (> 90% by volume);
- denture base resins (>95% by volume);
- dentures and orthodontic appliances
- occlusal splints
- fissure sealants and composite resin materials
- custom-made impression trays
- provisional crowns and bridges, and
- cyanoacrylate and other adhesives (generally < 5% by volume).

Beyond dentistry, MM is used in acrylic products such as sheets, mouldings and extrusions. Various polymers and copolymers of MM are also used in surface coatings, adhesives, sealants, floor and textile finishes, surgical bone cements, synthetic fingernails and orthotic shoe inserts. It is important to recognize that these other potential sources of free monomer exist should a contact allergy develop to the material, since like nearly all other types of methacrylates, it is an effective contact sensitizer and can induce type IV (delayed type) cutaneous hypersensitivity (allergic contact dermatitis). This is a particular issue in dental technicians, but can also occur in clinical staff including both dentists and dental chairside assistants. It is also noteworthy that there can be other causes of allergic contact dermatitis in dental technicians, for instance natural rubber latex, formaldehyde, and nickel.

While MM liquid is the most concentrated source of the allergen, in processed dental prostheses and appliances, residual monomer remaining because of incomplete polymerisation of the acrylic resin can trigger allergic contact dermatitis. This occurs to some extent with all three current methods of polymerization of MM (namely chemical, light, microwave), since even under ideal laboratory conditions, at least 0.2% of the free MM monomer will be present after polymerization.

Its major physical and properties are as follows:

The monomer is a clear liquid with a characteristic acrylic odour, and a vapour density of 3.46 (Air =1). This means that vapours are much heavier than air. Commercial MM (e.g. *Vertex liquid, Palavit L*) is typically more than 90% MM, with traces of the breakdown products methacrylic acid (0.003%) and water

(0.03%). Trace amounts of several inhibitors are added for the purposes of storage and transportation, typically methyl ether or hydroquinone.

As a hazardous substance, the major route of entry is by inhalation. While the primary hazard classification of MM is as an irritant, a number of other health effects should be recognised (see below). Within the body, MM is rapidly metabolized (first to methacrylic acid) and eventually to carbon dioxide gas via the tricarboxylic acid cycle. It is completely cleared from the body in 10 days and does not accumulate to any significant degree.

Containers of MM should be tightly sealed to prevent inhalation (due to evaporation of the contents) or skin contact from spills. They should be stored in a cool place and kept in a well ventilated area. Similarly, MM should be used in a well ventilated area, ideally with local exhaust ventilation. It exerts irritant effects on the upper respiratory tract. Signs/symptoms can include soreness of the nose and throat, coughing and sneezing. Illness may occur after a single overexposure by inhalation to relatively large quantities of MM vapour. Prolonged exposure can lead to headaches, nausea, drowsiness and unconsciousness. The First Aid for MM vapour is to remove the affected person to fresh air. If breathing is difficult, seek immediate medical attention.

MM is a moderate eye irritant. Signs/symptoms can include redness, swelling, pain, tear formation, and hazy vision. Eye exposure can be prevented by wearing protective eyewear where there is a risk of splashing MM liquid into the eye. For accidental contact, the eyes should be flushed immediately with large amounts of water, and immediate medical attention sought.

MM is a skin irritant when present in concentrations greater than 20% by weight. Moreover, sensitization to MM can occur with repeated exposure to mixtures having greater than 1% MM by weight. Signs/symptoms of prolonged exposure or allergic reaction can include redness, swelling, itching, and dryness, and blistering. Irritation and allergy can be prevented by avoiding skin contact.

MM is an excellent organic solvent, and can break down natural rubber latex gloves, vinyl, and polyethylene gloves over approximately one minute. Nitrile gloves have a penetration time of approximately 2.5 minutes. Solvent-resistant, butyl rubber, or Neoprene gloves can be used in situations where there is a risk of contact or splashing.

MM should not be touched with unprotected skin. For accidental skin contact, the skin should be flushed with large amounts of water. If irritation persists, seek medical attention.

A common practice which poses a risk of skin contact with MM is the fabrication of special impression trays. The material can be mixed with powder in a small flexible bowl, using the mixing action of a spatula combined with squeezing the mixing bowl, until the doughy mix reaches the desired consistency. If sufficient dough is made, it should be possible to construct both the custom tray and the handle at the same time, by quickly moulding the dough on to the model. By eliminating a separate tray handle construction step and the need for adhesion of this handle, the potential for contact with MM liquid is minimized. If it is necessary at any stage to paint MM monomer on to the tray, this can be done using a small brush rather than a finger.

Upon mucosal contact with MM, sensitization and true allergies can occur, as well as irritant responses. Signs/symptoms include redness, swelling, bleeding, blistering, and pain of the oral soft tissues.

In ingested, MM has relatively low toxicity. Swallowing a relatively large amount of this material is unlikely to produce serious illness or death. Irritation of gastrointestinal tissues may occur following ingestion. Signs/symptoms of this can include pain, vomiting, abdominal tenderness, nausea, blood in vomitus, and blood in faeces. First Aid for accidental ingestion is to drink two glasses of water to dilute the MM, and then seek medical attention.

MM does not cause cancer and is classed as a non-carcinogen.

MM poses a substantial fire hazard as both the monomer liquid and its vapour are flammable. It is classified as a flammable liquid, and thus as a class 3 dangerous good. MM poses both fire and explosion hazards. To prevent explosion, MM should be stored away from heat, sparks, open flames, and other sources of ignition. Suitable extinguishing media for MM fires are water spray; carbon dioxide; and dry chemical. Because MM vapours are heavier than air, they may travel long distances along the ground or floor to an ignition source and flash back.

MM containers should be stored in a cool place (away from heat), as sealed containers exposed to heat may rupture. The containers should be kept in well-ventilated areas. Smoking in the area where MM is being used is not permitted.

Following a spill of MM liquid, evacuate the area, and eliminate ignition sources. Wear protective clothing, and use an inert material to dilute and absorb the spilt material.

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Corrosive agents and other hazardous substances

Strong acids

A number of strong acids are employed in dental practice, in particular:

- Orthophosphoric acid for etching enamel and dentine,
- Hydrofluoric acid for etching porcelains,
- Hydrochloric acid for enamel microabrasion, or for picking metal castings,
- Trichloroacetic acid for controlling soft tissue bleeding and exudation.

These materials:

- are highly corrosive,
- can cause severe burns to the eyes and to the skin,
- are damaging to the gastric mucosa if ingested, and
- may produce pungent fumes (in the case of hydrofluoric and hydrochloric acid).

Skin burns from these agents may heal very slowly (particularly for hydrofluoric acid), resulting in scarring and disfigurement of the skin.

As well as personal protective equipment, it is important to consider whether an antidote should be available for immediate application in the event of accidental exposures, for example sodium bicarbonate or calcium gluconate solutions.

Hydrogen peroxide

A number of products in a dental practice may contain hydrogen peroxide, including, in decreasing order of concentration:

- Kits for in-office power bleaching kits,
- dentist-prescribed home bleaching kits,
- over the counter (OTC) tooth whitening products,
- mouthrinses, and
- dentrifices (toothpastes).

Hydrogen peroxide is regarded as hazardous when present at concentrations above 5%. The liquid component used in power bleaching kits may contain 35-50% hydrogen peroxide, and thus poses the greatest risk to staff and patients from accidental exposure. It is essential that gloves, protective safety glasses, a mask and gown are worn when mixing bleaching gels.

It is noteworthy that hydrogen peroxide solutions above 20% are classed as harmful if inhaled. The vapour can irritate the upper respiratory tract and cause pulmonary oedema as well as nausea and headache. Containers of peroxide must be kept firmly closed, and stored away from heat and light which will cause the pressure inside the container to build up (because of the production of oxygen).

At these high concentrations, hydrogen peroxide is unstable and has a limited shelf life if not refrigerated. The material decomposes quickly when exposed to light or heat, releasing a range of oxygen radicals (depending on the pH) as well as molecular oxygen and water.

Hydrogen peroxide is chemically incompatible with most organic or other readily oxidizable materials and combustibles. Contact with these may cause combustion or explosion. Incompatible materials include iron, copper, brass, bronze, chromium, zinc, lead, and silver.

If splashes of hydrogen peroxide liquid contact the skin, there will be a tingling feeling which is immediately accompanied by whitening of the area. If the hydrogen peroxide is not removed, redness and blister formation will follow. Washing the skin followed by the immediate application of a potent anti-

oxidant such as Vitamin E cream will reverse the whitening and underlying inflammatory changes within a period of 20 minutes, so that no permanent injury results. It is recommended that dental practices which undertake in-office power whitening keep a tube of Vitamin E cream or liquid in their refrigerator. Vitamin E can be used in the same way should oral soft tissues of the lips or gingival come into contact with strong solutions of hydrogen peroxide.

In the current WorkSafe Australia, hydrogen peroxide it is not classified as a carcinogen. For a detailed discussion of the issues of carcinogenicity and mutagenicity with hydrogen peroxide, the reader is referred to a recent review of these issues (Walsh, 2000).

Sodium hypochlorite (NaOCl)

Also known as domestic bleach, or “Miltons” when in a stabilized form, sodium hypochlorite is used for irrigation during endodontic procedures, and is the chemo-mechanical caries removal technique (Carisolv). It is a rapidly acting and broad spectrum antimicrobial agent, is non-flammable and inexpensive. Nevertheless, the potent proteolytic and oxidizing properties which may sodium hypochlorite so effective at destroying bacteria and dissolving proteinaceous debris make it irritant and toxic on contact with the oral, gastric or ocular mucosa, or periapical tissues. Skin contact is less problematic because of the protection afforded by the overlying keratin. Hypochlorite solutions are high reactive with metals and cause rapid corrosion of carbon steel, stainless steel, and nickel-titanium alloys, and care must be taken to limit contact between sodium hypochlorite and re-useable metallic instruments.

All sodium hypochlorite solutions contain other ingredients, such as salts of sodium or other metals, including sodium chloride which gives the solution a longer shelf life. Other factors which affect shelf life include temperature, pH, exposure to air, and exposure to light.

The following advice relates to the safe use of sodium hypochlorite in dental practice:

- Check that a tight cuff of rubber dam is present before using sodium hypochlorite as an endodontic irrigant.
- Do not force the needle into the root canal or irrigate with force, since a positive seal will increase the likelihood of solution being forced beyond the apex by hydraulic pressure.
- Use disposable syringes of appropriate size (5, 10, or 20 mL) pre-loaded with sodium hypochlorite solution and a short needle. Do not refill or attempt to recap these, rather dispose of immediately into a sharps container.
- Never put sodium hypochlorite (or other materials) into used local anaesthetic cartridges.
- Use protective glasses for all procedures, to help prevent splash injuries.
- Ensure that the first aid kit contains sterile eye irrigant, for use in the event of a splash to the eyes of a patient or staff member.
- Always wear gloves and protective gowns when handling sodium hypochlorite solutions.
- Keep containers of sodium hypochlorite firmly closed.
- Do not pour large volumes of sodium hypochlorite over spills of blood or saliva. The use of sodium hypochlorite in the routine management of spills is no longer recommended (CDNA Infection Control Guidelines, 2004).
- Never mix sodium hypochlorite with acids or cleansing agents, since the resulting chemical reactions may release large concentrations of toxic fumes, including chlorine gas and chloramines respectively, both of which are toxic to the lungs.
- Never store hypochlorite solutions in metal containers because of the risk of corrosion and leakage.
- Do not store sodium hypochlorite solutions near wooden floors or acids.
- Always store sodium hypochlorite solutions in a light-proof airtight container to maximize the shelf life. Refrigeration extends the self life of these solutions.
- Discard sodium hypochlorite solutions after their use-by date.

If ocular exposure to sodium hypochlorite occurs, the injury will develop a penetrating character as the outer cells become necrotic and the integrity of the outer epithelial layer is lost, allowing direct contact of deeper tissue layers with sodium hypochlorite. Eye exposure will be accompanied by intense burning pain, increased lacrimation, and redness of the conjunctiva. The injured person should be tilted back and have their eye irrigated with a gentle, continuous flow of sterile saline solution for 20 minutes. The saline solution will help to decrease oedema and will facilitate clearance of the solution from the membranes of the eye. Rapid first aid in the form of an eyewash within 30 seconds after the exposure to sodium hypochlorite will prevent permanent injury, with only mild conjunctival oedema that will resolve after 1-2 days.

Developer and Fixer solutions used in dental radiography

The contents of a typical developer are:

- Reducing agents: Hydroquinone with either or both Metol (Kodak trade-name "Elon") and Phenidone
- Preservative: Sodium sulphite or potassium sulphite
- Accelerator: Sodium carbonate and/or either Sodium hydroxide or Potassium hydroxide
- Buffer: Boric acid with sodium hydroxide, or Sodium carbonate with sodium bicarbonate
- Restrainer: Potassium bromide
- Anti-foggant: (Organic restrainer used with Phenidone): Benzotriazole
- Wetting agent: Diethylene glycol
- Solvent: Water

The contents of fixer are:

- Fixing agent: Sodium thiosulphate or ammonium thiosulphate
- Acidifier: Acetic acid
- Preservative: Sodium sulphite
- (Note that Sodium metabisulphite or Potassium bimetabisulphite will perform both acidifier and preservative functions)
- Buffer: Sodium acetate with acetic acid, or sodium sulphite with sodium bisulphate
- Hardener: Aluminium chloride
- Anti-sludging agent: Boric acid
- Solvent: Water

Automatic processors use similar chemicals, in different proportions. Developer also contains substantial levels of glutaraldehyde (as much as 25%). This poses a major risk of respiratory irritation and sensitization of the skin and respiratory mucosa if splashes occur when replenishing the automatic processor tanks with fresh solution.

Occupational risks in the dental laboratory

The identified risks to health in the dental laboratory which have not been addressed specifically elsewhere include:

- Benign pneumoconiosis, from the accumulation of dust in the lungs,
 - due to hard metals (except beryllium), particularly cobalt dust
 - due to inert dusts (such as plaster, stone, and components of investments)
- Pulmonary fibrosis
 - From inhalation of crystalline silicate dusts when sandblasting or using grinding wheels
- Malignant pneumoconiosis
 - From fibrogenic dusts such as silica, asbestos fibers, and beryllium
- Chronic beryllium intoxication
 - From casting, scarping and polishing chrome-cobalt alloys

- Fibrogenic dusts
- Occupational asthma from fumes and vapours
 - such as methyl methacrylate
- Allergic contact dermatitis
 - From methyl methacrylate
 - From benzoyl peroxide
 - To formaldehyde or glutaraldehyde from the vapours of hot wax
- Reactions to chromium or cobalt
 - Allergic contact dermatitis
 - Rhinitis, bronchitis, and asthma
- Reactions to nickel
 - Allergic contact dermatitis
- Eyestrain
 - If workplace illumination is inadequate
- Mechanical hazards
 - From rotary cutting and grinding equipment
 - From lathes and polishing equipment
- Respiratory infections
 - From bacterial contamination of pumice slurry, e.g. *Pseudomonas aeruginosa* and *Legionella pneumophila*.
- Hearing damage
 - From extended grinding and cutting activities
- Potential exposure to hazardous substances
 - Noxious gases during casting, welding and soldering
 - E.g. sodium cyanide used in silver-plating dies, if the material comes into contact with a strong acid and cyanide gas is produced.
- Chemical burns to the skin
 - From corrosive acids particularly hydrochloric and hydrofluoric acids
- Thermal burns to the skin
 - From naked flames, hot instruments, hot wax, and other hot items

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Guidelines to be available for access by persons working at workplaces

[Regulation 3.2(e)]

Date of publication in <i>Gazette</i>	Title
30 July 1996	The General Duty of Care in Western Australian Workplaces
30 July 1996	Election of Safety and Health Representatives, Representatives and Committees and Resolution of Issues
30 July 1996	Guidance Note for the Assessment of Health Risks Arising from the Use of Hazardous Substances in the Workplace [NOHSC:3017(1994)]
30 July 1996	Guidance Note for the Control of Workplace Hazardous Substances in the Retail Sector [NOHSC:3018(1994)]
30 July 1996	Guidance Note on the Interpretation of Exposure Standards for Atmospheric Contaminants in the Occupational Environment [NOHSC: 3008 (1995)]
30 July 1996	National Guidelines for Occupational Health and Safety Competency Standards for the Operation of Loadshifting Equipment and Other Types of Specified Equipment [NOHSC: 7019 (1992)]
30 July 1996	Plant Design: A Guide to Risk Management for Designers, Manufacturers, Importers, Suppliers and Installers of Plant (National Occupational Health and Safety Commission)
30 July 1996	Plant in the Workplace: A Guide to Managing Risks from Plant in the Workplace for Employers and Employees (National Occupational Health and Safety Commission)

Australian/New Zealand Standards

[r. 1.3]

AS or AS/NZS Number	Title	Regulation Reference
AS/NZS 1200:2000	Pressure equipment	4.1, 4.43, Sch. 4.3
AS 1319-1994	Safety signs for the occupational environment	1.3, 3.11, 3.34, 3.36, 4.1
AS 1674	Safety in welding and allied processes	3.96
AS 2030	The verification, filling, inspection, testing and maintenance of cylinders for storage and transport of compressed gases	4.1, 4.43, Sch. 4.2, Sch. 4.3
AS 2030.1-1999	Cylinders for compressed gases other than acetylene	
AS/NZS 2161	Occupational protective gloves	3.33
AS/NZS 2161.1:2000	Selection, use and maintenance	
AS/NZS 2161.2:1998	General requirements	
AS/NZS 2161.3:1998	Protection against mechanical risks	
AS/NZS 2161.4:1999	Protection against thermal risks (heat and fire)	
AS/NZS 2161.5:1998	Protection against cold	
AS/NZS 2161.8:2002	Protection against ionizing radiation and radioactive contamination	
AS/NZS 2161.10.2:2002	Determination of resistance to penetration	
AS/NZS 2161.10.3:2002	Determination of resistance to permeation by chemicals	
AS/NZS 2211	Laser safety	4.49
AS/NZS 2211.1:1997	Equipment classification, requirements and user's guide	
AS/NZS 2211.1 Supplement 1:1999	Application guidelines and explanatory notes	
AS 2444-2001	Portable fire extinguishers and fire blankets— Selection and location	3.9
AS/NZS 3000:2000	Electrical installations— Buildings, structures and premises (known as the SAA Wiring Rules)	3.101, 4.27