

# Workplace Safety and Health Guidelines

## Healthcare



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## 1 Introduction

The healthcare industry in Singapore is growing and adapting to new challenges in order to meet the growing healthcare demand. Due to heightened awareness of quality healthcare services, a rapidly greying population, longer life expectancy and greater economic growth, the healthcare industry will need to review its work processes and ensure that the lives of their employees and patients are safe and healthy.

Healthcare employees are as vulnerable to workplace safety and health (WSH) hazards as any other employee. A safe and healthy work environment can boost the wellbeing, morale and productivity of these employees. Poor WSH practices can contribute to illness, absenteeism, productivity loss, disability and even death. The WSH Act covers all workplaces including healthcare facilities, and all stakeholders must take reasonably practicable measures to ensure the safety, health and wellbeing of every individual.

Recognising that healthcare employees are exposed to a wide array of work-related safety and health risks, this set of guidelines was developed in 2008 and subsequently revised in July 2015 to provide useful guidance on the proper management of WSH risks in healthcare facilities. This second issue of the guidelines highlight information on potential common hazards faced by healthcare employees as well as good industry WSH practices to prevent and control these hazards. The guidelines is applicable to various public healthcare clusters, private hospitals, community hospitals, private general practitioner (GP) clinics, nursing homes, Tradition Chinese Medicine (TCM) clinics and veterinary clinics.

## 2 Commitment from Top Management

The leadership and commitment from management is essential in establishing a safe and healthy workplace. Active involvement from leaders is critical to the success of workplace safety and health (WSH) management initiatives. A clear WSH policy endorsed by top management would be a good start to demonstrate the organisation's commitment to employees' safety, health and wellbeing.

*(Name of Organisation)*  
**Workplace Safety and Health Policy**

**All Management and Employees pledge to**

- Comply with relevant Workplace Safety and Health (WSH) regulatory and other relevant requirements;
- Create a safe and healthy workplace for all employees, customers and members of the public;
- Improve and sustain WSH performance; and
- Develop a positive WSH culture within the organisation.

Figure 1: Sample WSH policy.

Management can appoint champions at various organisational levels to promote awareness and build capabilities in WSH. A member of senior management could also be identified to ensure that all workplace issues are looked at from all perspectives including WSH and the impact of work on health and vice-versa is considered.



# Managing Workplace Safety and Health in Healthcare



### 3 Managing Workplace Safety and Health in Healthcare

A systematic approach where the management of WSH goals is integrated with the organisation's management objectives is essential to manage risks and prevent accidents and ill-health in a healthcare facility. Each facility should have some form of safety and health management system in place that covers safety, health and wellbeing of all employees in the workplace.

Regardless of the size of the facility, an effective WSH management system should include five key elements (see Figure 2).

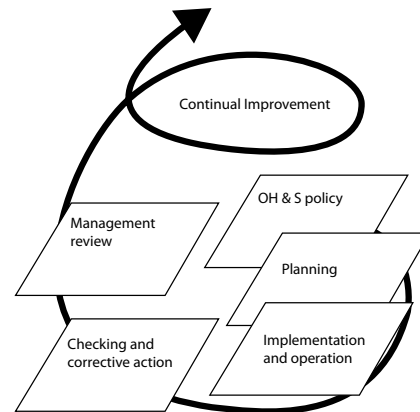


Figure 2: Key elements of a WSH management system<sup>2</sup>.

#### 3.1 Workplace Safety and Health Policy

The leadership and commitment from management is critical for an effective WSH management system. The management should develop a clear WSH policy that communicates the healthcare facility's overall safety and health objectives and how it aims to achieve its commitment.

The policy should be:

- Endorsed by the facility's top management;
- Suitable to the nature and scale of the facility's WSH risks;
- Understood by all employees;

- Communicated effectively to all employees to ensure that they are aware of their individual WSH obligations;
- Made available to interested parties;
- Reviewed periodically to ensure it is relevant to the facility; and
- Committed to the protection of the safety and health of all members of the facility by preventing work-related accidents, ill-health and incidents; continual improvement and compliance with current applicable legislation (e.g. WSH Act, Biological Agents and Toxins Act, etc.) and other requirements to which the facility subscribes to.

#### 3.2 Planning

A plan with clear objectives and standards is essential to maintaining a consistent approach in the implementation of a WSH management system. Adequate and appropriate planning based on initial review, subsequent reviews and other relevant data should include:

- WSH objectives to protect the safety and health of employees;
- Responsibilities and performance criteria indicating what is to be done by whom and when;
- Selection of measurement criteria to confirm the objectives are met; and
- Allocation and provision of adequate resources such as time, money, manpower etc.

Together with the plan, all employees must be aware and understand all significant WSH hazards within the organisation. The risks posed by these hazards must be reduced through the implementation of control measures. This will form the foundation of an effective WSH management system.

Procedures should be established in the WSH management system for the identification of hazards, assessment of risks, and implementation of necessary control measures.

The procedures to conduct risk assessment (RA) are explained in Chapter 5.2.

<sup>2</sup>Source: SS506 – Part 1: Specifications

### 3.3 Implementation and Operation

All facilities, regardless of size, should implement relevant procedures to address:

- Recordkeeping and notifications (includes incidents, accidents and dangerous occurrences, illnesses, risk assessments (RA) and training records);
- Emergency response plans (includes fires, chemical spills, airborne release of hazardous substances and natural disaster emergencies, etc.);
- Regular review of WSH programme(s);
- Management of change (modification or introduction of new work methods, materials, processes or machinery);
- Exposure monitoring (includes monitoring of workplace levels of chemical, noise hazards and/or medical surveillance and action plans);
- Preventive maintenance programme (includes critical equipment and systems); and
- WSH training for employees (includes induction and periodic training and assessment for competency).

The following may be included in the WSH management system, depending on the size of the facility and needs of the organisation.

- A WSH committee (members should come from different functions and levels such as management, operations, clinical professionals, human resource, and safety and health);

- Regular WSH Inspections or workplace visits; and
- Management of contractual, outsourced and insourced work, medical students, temporary staff and volunteer work.

Access to specialised advice such as occupational hygiene, occupational medicine, etc can be made available on a need-to basis. The roles and responsibilities of personnel who manage the WSH management system or are involved in any of its sub-elements should be clearly defined, documented and communicated to ensure an effective implementation. All personnel should also be trained competently to perform their roles effectively. Training procedures should also take into account the responsibilities and abilities of these personnel.

All facilities should also have procedures to make sure that important WSH information is communicated between employees and other interested parties. Examples of these communications (but are not limited to) include:

- Review of WSH policies, RA and risk control measures and supporting programmes;
- Safe work procedures (SWPs);
- Selection, use and maintenance of personal protective equipment (PPE); and
- Emergency procedures for the healthcare facility.

### 3.4 Checking and Corrective Actions

All facilities should establish procedures to monitor and measure WSH performance on a regular basis for continual improvement. Checks on the WSH management system should be done periodically by the facility and by conducting regular audits of the system. WSH personnel should look out for unsafe acts and conditions above and beyond those notifiable to the Ministry of Manpower (MOM). Corrective and/or preventive actions should be taken to eliminate the causes of actual and potential accidents or incidents of ill-health.

A review of an existing WSH management system should assess the performance against key indicators such as:

- Compliance to relevant legislation;
- Number of WSH programmes implemented;
- Number of workplace accidents, incidents and ill-health recorded; and
- Percentage of control measures implemented.

Following the WSH performance assessment, proposed improvements to the system and its connecting processes should be reviewed through RA process prior to implementation.

Any changes in the documented procedures resulting from corrective and preventive actions should be documented and communicated to affected employees to ensure continuity. Evaluation of the residual risk should be performed to ensure that the risk was reduced.

Procedures should be established for periodic audits of the WSH management system. This is necessary to determine if the system:

- Conforms to what was specified in the procedures and documents;
- Implemented and maintained properly; and
- Meet the facility's policy and objectives.

Wherever possible, audits should be conducted by personnel who are independent of the processes or activities that are being examined (e.g. internal auditors from another Department). The audit results should then be documented and communicated to the management and personnel responsible for follow up actions.

## 3.5 Management Review

The facility's top management should review the WSH management system to ensure its suitability, adequacy and effectiveness. Reviews should be conducted at intervals set by the management and of duration suitable for the type of facility. The results of periodic audits will help the management to focus on areas of concern during such reviews.

Taking into consideration the audit results, changing circumstances and need for continual improvement, the review should address potential changes to:

- WSH policies;
- Objectives and targets;
- Elements of the WSH management system; and
- WSH programmes.

### Further information can be obtained from:

- Singapore Standard SS506: Occupational safety and health (OSH) management system  
Part 1: 2009 Requirements  
Part 2: 2009 Guidelines for the implementation of SS506: Part 1  
Part 3: 2013 Requirements for the chemical industry
- British Standard (BS) OHSAS 18001 Occupational Health and Safety Management
- International Labour Organisation (ILO) Guidelines on Occupational Safety and Health Management Systems

## 4 Incident Reporting and Investigation

The WSH (Incident Reporting Regulations) requires employers to report accidents, dangerous occurrences and all work-related traffic accidents involving their employees. Employers and doctors must also report occupational diseases at workplaces.

Employers are advised to submit the report within 10 days of the incident to MOM through the electronic reporting system, iReport (<http://www.mom.gov.sg> iReport).

Employers must submit notifications of occupational diseases within 10 days of receipt of a written diagnosis. Reports or notifications made under the Regulations must be kept for at least three years from the time of reporting.

Employee injuries and illnesses which are not reportable to MOM could be recorded and kept by the facility for monitoring purposes. These records can provide insight into the WSH performance of the facility as well as the effectiveness of its WSH programme(s).

Other useful information that could be captured in such a monitoring log can include:

- Severity of the injury or illness;
- Date and time of the occurrence;
- Brief description of the occurrence;
- Particulars of the employee(s) involved; and
- Lost time associated with the injury or illness.

### Reportable Incidents, Accidents and Occupational Diseases

- (1) An accident in the course of work that results in:
  - Fatality; and
  - Hospitalisation for at least 24 hours; or
  - the injured is given more than three days of medical leave (cumulative)
- (2) Work-related traffic accidents involving employees
- (3) A dangerous occurrence such as:
  - Explosion or fire;
  - Collapse of structure or equipment; and
  - Machinery damage
- (4) An occupational disease (regardless of whether any medical leave was given). Refer to Appendix A for the list of notifiable occupational diseases

Figure 3: Reportable incidents, accidents and occupational diseases.

After being notified of an accident or incident, the management should review the information collected and decide on the next course of action. The facility should develop and implement effective procedures for investigating accidents, occupational illnesses and incidents. The purpose of accident/incident investigation is to prevent recurrence of similar situations. These procedures could include, but not restricted to the following.

- Process for capturing information and record keeping;
- Type of events to be investigated e.g. those that have led or could lead to serious harm;
- Process of investigation;
- Identification and implementation of corrective and/or preventive actions; and
- Review of follow-up actions for effectiveness.

Refer to the WSH Guidelines on Investigating Workplace Incidents for SMEs for guidance on incident investigation methods and their related tasks.

## 5 Risk Management

Safety, health and wellbeing should be managed holistically, both at the workplace and of the employees. Under the WSH (Risk Management) Regulations, organisations are required to conduct RA to identify, evaluate and control safety and health risks posed to

any person who may be affected by the activities in the workplace, prior to the commencement of the work. RA aims to reduce workplace incidents and improve the overall safety, health and wellbeing of everyone in the workplace.

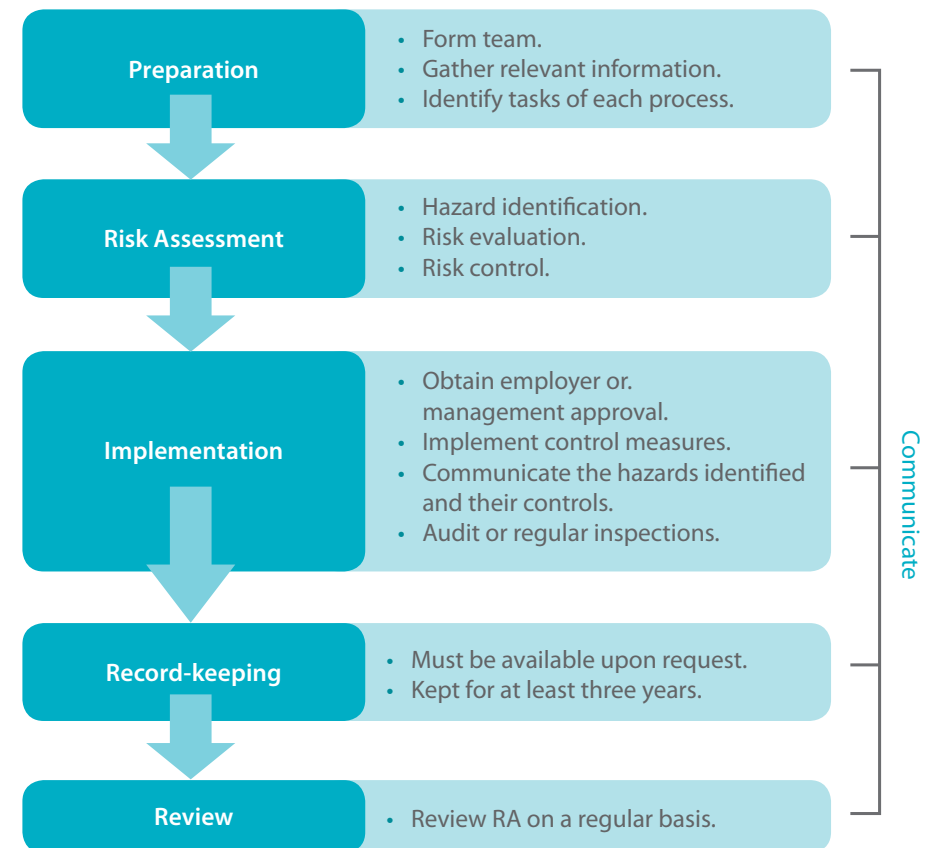


Figure 4: Risk management process.



## 5.1 Preparation

A multi-disciplinary RA team should be formed, consisting of personnel who have different job responsibilities for the work operations, personnel who are familiar with the potential hazards and risks of the work activities such as WSH officers, healthcare professionals and human resource representatives.

Relevant information pertaining to the work and operations such as a list of work activities should also be collated beforehand to facilitate better understanding by the team.

After completing the preparatory work, the workplace risks are then assessed in three simple steps: hazard identification, risk evaluation and risk control.

1. Hazard Identifications	2. Risk Evaluation	3. Risk Control
<ul style="list-style-type: none"> <li>Identify hazards.</li> <li>Identify potential accidents or incidents.</li> </ul>	<ul style="list-style-type: none"> <li>Estimate the risk levels of the workplace hazards identified.</li> <li>Prioritise the hazards to be controlled.</li> </ul>	<ul style="list-style-type: none"> <li>Formulate the control measures according to the Hierarchy of Controls (see Figure 4)</li> <li>Analyze and evaluate residual risks.</li> </ul>

Figure 5: Three steps to assess workplace risks.

## 5.2 Risk Assessment

All activities within the facility should be assessed and the information should be kept up-to-date. The activities should include:

- Routine activities (e.g. disposal of biohazardous waste);
- Non-routine activities (e.g. testing of backup generator, equipment maintenance);
- Emergency conditions (e.g. spillage of chemotherapeutic drugs during transport);
- Activities of all personnel having access to the facility including volunteers, medical students, subcontractors and visitors; and
- Facilities at the workplace, whether provided by the facility or others.

### 5.2.1 Hazard Identification

When identifying hazards, three aspects should be considered and evaluated side by side. These aspects are the physical work environment and processes, work organisation and individual health factors. The possibility of exposure to hazards from other work processes in the facility and the behaviour or work practices of employees at work should also be considered. Figure 6 illustrates the three aspects with some possible examples or areas to consider.

Types of hazards that could be faced by healthcare employees in the course of their work are further described in Chapter 6.



Figure 6: Three aspects of hazard identification.

### 5.2.2 Risk Evaluation

For each hazard identified, estimate the risk levels of the hazards and determine their acceptability. The outcome of a risk evaluation will help in prioritising actions to control the hazards and minimise safety and health risks to the affected employees.

When estimating the risk level associated with each hazard, predict the severity of the hazard and estimate the likelihood of the accident or ill health by taking into consideration existing risk controls. Once the severity and likelihood have been established, the risk level can be obtained by using a risk matrix.

Figure 7 gives an example of how severity and likelihood help to determine the risk level via a 5x5 risk matrix with risk prioritisation numbers (RPNs).

Severity \ Likelihood	Rare (1)	Remote (2)	Occasional (3)	Frequent (4)	Almost Certain (5)
Catastrophic (5)	5	10	15	20	25
Major (4)	4	8	12	16	20
Moderate (3)	3	6	9	12	15
Minor (2)	2	4	6	8	10
Negligible (1)	1	2	3	4	5

Level	Severity	Description
5	Catastrophic	Fatality, fatal diseases or multiple major injuries.
4	Major	Serious injuries or life-threatening occupational diseases (includes amputations, major fractures, multiple injuries, occupational cancer, acute poisoning).
3	Moderate	Injury requiring medical treatment or ill health leading to disability (includes lacerations, burns, sprains, minor fractures, dermatitis, deafness, work-related upper limb disorders).
2	Minor	Injury or ill health requiring first-aid only (includes minor cuts and bruises, irritation, ill health with temporary discomfort).
1	Negligible	Not likely to cause injury or ill health.

Level	Likelihood	Description
1	Rare	Not expected to occur but still possible.
2	Remote	Not likely to occur under normal circumstances.
3	Occasional	Possible or known to occur.
4	Frequent	Common occurrence.
5	Almost Certain	Continual or repeating experience.

Risk Prioritisation Number (Severity x Likelihood)	Risk Level
1 - 3	Low Risk
4 - 12	Medium Risk
13 - 25	High Risk

Figure 7: Risk evaluation using a 5x5 matrix with corresponding risk prioritisation numbers (RPNs).

### 5.2.3 Risk Control

Based on the risk level or RPN determined, risk controls should be selected to reduce the risk to an acceptable level. Figure 8 suggests the acceptability of risk for the different risk levels and the recommended actions. The most effective way to reduce risk is to tackle the risk at the source. This can be achieved through upstream

risk controls starting by eliminating the risk, followed by substitution, and implementation of engineering controls, according to the Hierarchy of Controls (see Figure 9). Engineering controls are physical means to reduce exposure to the hazards such as mechanical guards or local exhaust ventilation, etc.

Risk Level	Risk Acceptability	Recommended Action
Low	Acceptable	<ul style="list-style-type: none"> <li>No additional risk control measures may be needed.</li> <li>Frequent review and monitoring of hazards are required to ensure that the risk level assigned is accurate and does not increase over time.</li> </ul>
Medium	Tolerable	<ul style="list-style-type: none"> <li>A careful evaluation of the hazards should be carried out to ensure that the risk level is reduced to as low as reasonable practicable within a defined time period.</li> <li>Interim risk control measures such as administrative controls or personal protective equipment (PPE) may be implemented while longer term measures are being established.</li> <li>Management attention is required.</li> </ul>
High	Not acceptable	<ul style="list-style-type: none"> <li>High risk must be reduced to at least medium risk before work commences.</li> <li>There should not be any interim risk control measures. Risk control measures should not be overly dependent on PPE.</li> <li>If practicable, the hazard should be eliminated before work commences.</li> <li>Management review is required before work commencement.</li> </ul>

Figure 8: Recommended actions for risk levels.

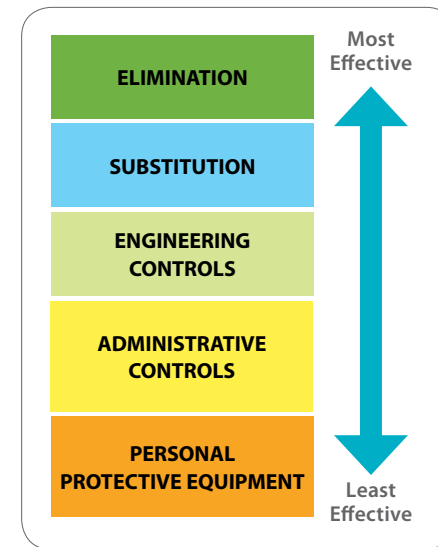


Figure 9: Hierarchy of Controls.

## 5.3 Implementation and Review

The risk control measures once approved by the management should be implemented immediately. For risk management (RM) to be effective, the hazards and their control measures must be communicated to the employees performing the work. The manager who oversees the work area, function or activity where the risks exist should ensure that all persons who will be exposed are informed about the risks and the associated mitigating measures.

Regular inspections or audits can be carried out to verify the effectiveness of the control measures put in place.

This will ensure that the measures are current and working to manage the risks at the workplace.

RA must be reviewed or revised at least once every three years. It must also be reviewed after an accident, incident or occurrence of an occupational disease as a result of exposure to a hazard, a significant change in the work processes that could affect the safety and health of employees e.g. introduction of a new clinical procedure.

## 5.4 Record-keeping

All WSH RAs and related documents should be kept for at least three years and must be made available upon request by the Commissioner for WSH.

For more information on RM, refer to the WSH Council's Code of Practice on WSH Risk Management at [www.wshc.sg](http://www.wshc.sg).



# Hazards in the Healthcare Environment

## 6 Hazards in the Healthcare Environment

The range of workplace hazards that exist in healthcare facilities can differ from other types of healthcare establishments and is dependent on the size and range of medical services provided. This chapter focuses on both common healthcare hazards (e.g. ergonomic risk factors, slips, trips and falls, and sharps) and hazards that are specific to certain medical services (e.g. mercury waste from amalgam removal, exposure to anaesthetic gases and chemotherapeutic agents).

The following sections describe the different types of hazards in detail.

### 6.1 Chemical Hazards

Chemicals exist in different forms and they can elicit varying toxic responses on the human body from mild irritations to potentially serious or even fatal damage to body tissues and organs. Many factors can influence the risk of human exposure to chemicals used in healthcare facilities and these include:

- Toxicity and physical properties of substances used;
- Nature and duration of exposure;
- Routes of entry into the human body;
- Aggregated effects of combined exposures;
- Work practices; and
- Susceptibility of the individual.

#### 6.1.1 Management of Hazardous Chemical Programme

Where hazardous chemicals are used, handled or produced, a management programme should be established and implemented to safeguard the safety and health of persons who are liable to be exposed to these chemicals. The Management of Hazardous Chemicals Programme (MHCP) should form part of the overall WSH management system of the facility. The MHCP must cover the safety and health aspects throughout the life cycle of the hazardous chemicals that are used or produced, transportation, storage, handling, usage and disposal of the chemicals. The programme should include the objectives, targets, record-keeping process and written SWPs.

The facility which uses or handles any hazardous chemical may choose to implement the relevant elements or components of the MHCP depending on the nature of its work, operation or process carried out, and the hazardous chemical(s) used or handled. As a minimum, the programme should cover RA and hazardous communication through safety data sheets (SDS) and labelling as these are essential for chemical safety management. Facilities are encouraged to adopt the Globally Harmonised System of Classification and Labelling of Chemicals (GHS) for GHS SDS and product labels for the chemicals that they are using.

To understand more about the establishment and implementation of the MHCP, refer to the WSH Guidelines on the Management of Hazardous Chemicals Programme.

### 6.1.2 Anaesthetic Waste Gases and Vapours

#### Uses

Anaesthetic gases are used to provide inhalation anaesthesia in adults and children undergoing surgery, dental and obstetric procedures. The common agents used are nitrous oxide and halogenated agents such as isoflurane, desflurane, sevoflurane, enflurane and halothane. Healthcare workers can be exposed to waste anaesthetic gases (WAGs) when they leak out from various sections of the anaesthetic circuits or when patients in the recovery room exhale the gases into the air.

#### Effects of Exposure

Exposure to high levels of WAGs may occur with the use of unscavenged systems and/or poor general ventilation. Common symptoms of exposure include effects on the central nervous system such as mood disorders, headaches, fatigue and impaired neuropsychological performance. Though rare, occupational diseases such as hepatitis due to halothane, bronchial asthma due to enflurane and allergic contact eczema due to halothane or isoflurane can occur.

#### Locations where Used/Found

Healthcare workers can be exposed to WAGs and vapours in:

- Operating rooms;
- Recovery rooms (post anaesthesia care units);
- Intensive care units;
- Obstetric delivery rooms; and
- Dental facilities.

Exposures can be higher in paediatric surgery, otorhinolaryngologic (ENT) surgery and dental surgery. In ENT and dental surgery, the close proximity of the surgeon and attendant staff to the patient's mouth results in increased exposure to the exhaled anaesthetic vapours. Levels of WAGs are higher when mask anaesthesia is used and the mask does not fit the patient properly.

#### Workers at Risk

- Anaesthetists;
- Anaesthetic nurses and assistants;
- Post anaesthesia care nurses and staff;
- Surgeons and surgical staff;
- Dentists;
- Dental nurses, assistants and attendant staff;
- Recovery room nurses and other staff;
- Delivery room staff such as obstetric nurses;
- Medical technicians;

- Operating room personnel;
- Emergency room staff; and
- Radiology department personnel.

#### Routes of Exposure and Sources of Leaks

The main route of exposure is through inhalation. In operating theatres, the main sources of leaks include:

- Tank valves;
- High and low-pressure machine connections;
- Connections in the breathing circuit;
- Defects in rubber and plastic tubing;
- Hoses;
- Reservoir bags;
- Ventilator bellows; and
- Y-connectors.

In addition, selected anaesthesia techniques and improper practices can also contribute to the escape of WAGs into the atmosphere of the operating room such as:

- Leaving gas flow control valves open;
- Leaving vaporisers on after use;
- Spillage of liquid inhaled anaesthetics;
- Poorly fitted patient face masks; and
- Improperly inflated tracheal tube and laryngeal mask airway cuffs.

In recovery rooms, obstetric and dental facilities, the main source of WAGs is from the vapours contained in the air that patients exhale.

#### Management of Waste Anaesthetic Gases

Anaesthetic gases are widely used in healthcare facilities such as obstetrics departments, operating theatres and dental facilities. As there is a potential for side effects on the neurological and reproductive systems with excessive exposure, a management system should be in place to ensure that employees are protected.

#### Management Policy

A policy stating the responsibility and commitment of management in protecting employees from exposure to WAGs must be written and implemented. This policy should be communicated to all employees. Specific policies on the exposure to pregnant and lactating employees should also be included.

#### Risk Assessment

Areas where anaesthetic gases are used or could be present should be identified and documented. Employees at increased risk for exposure to WAGs should be identified.

Exposure to WAGs can be quantified by various means including:

- Measuring airborne concentrations of WAGs;
- Identifying sources of leaking or waste anaesthetic gases; and
- Personal sampling measurements of exposed staff.



## Control Measures

The control of exposure to waste anaesthetic gases should follow the hierarchy of controls. The use of engineering controls is preferred, followed by safe work practices as the reduction of the hazard at source is generally the most effective.

## Engineering Control Measures

### Scavenging system

An effective system to collect and dispose of anaesthetic gases in both operating and non-operating theatre settings must be put in place. WAGs should be exhausted to the outside atmosphere. In the operating theatre, an active scavenging system attached to the site of overflow in the breathing circuit with a minimum flow rate of 40 l/min is an effective method of reducing exposure to WAGs. The presence of a volumetric buffer regulation system is preferred.

All gases in the anaesthetic system should be channelled to the exhaust and then to the scavenging system.

### Reduction of leakages

The amount of leakage in anaesthetic machines should be reduced to as low as practically possible. Where possible, an automatic leakage detector should be installed; otherwise, regular tests for leaks should be performed and the results documented and necessary actions are being taken.

### General ventilation

There should be adequate ventilation in the operating theatres or other rooms where anaesthetic gases are used to ensure there is additional dilution ventilation of the WAGs. The rate of air change should be more than 15 air changes per hour or as stipulated by national regulations.

## Safe Work Practices

### Anaesthetic practices

Exposure to high levels of anaesthetic gases can occur during the induction and emergent phases of anaesthesia.

### Preparation of anaesthesia

- An anaesthesia system should be chosen to minimise leakage and allow active scavenging of WAGs.
- Use of a low flow or minimum flow system for fresh gas is preferred.
- Before anaesthesia is administered, a complete inspection of the anaesthesia apparatus should be done daily before the commencement of the first case and an abbreviated check before every case.
- Face masks should be properly fitted and sealed to minimise leakage.
- Face masks should only be used if laryngeal or tracheal tubes cannot be used.
- If tracheal tubes, laryngeal masks and other airway devices are used, they should be positioned properly with the cuffs inflated adequately.

- For intubation without a cuff, choose a tube size that induces minimum leakage.

### Induction of anaesthesia

- Exposure to WAGs can be reduced by using either intravenous induction or a double mask system.
- Check that the scavenging device is correctly connected before each patient is anaesthetised or whenever the apparatus is moved.
- Start using the scavenging system during the induction phase of the anaesthesia.
- Turn on the supply of the anaesthetic gases after the face mask is placed properly or after the tube is connected to the patient system.

### Maintenance of anaesthesia

- In mask anaesthesia, the effectiveness of the seal of the mask should be checked constantly.
- When patient is disconnected from the breathing system, the exhaust valve should be opened while the open end should be closed. Alternatively, the gas supply should be cut off briefly and the anaesthetic gases in the buffer balloon is emptied via the scavenging system.

### Emergence from anaesthesia

- Before removal of the mask or tube, oxygen should be administered at the end of the anaesthesia at a high flow rate to flush any anaesthetics out of the anaesthesia system and the patient's lungs.

- The washed out anaesthetic gases should be removed by the scavenging system.
- The supply of anaesthetic gases should be turned off at the end of the anaesthesia.

### Filling of vaporisers

- Handling of anaesthetics such as filling of vaporisers should not be done in the recovery room.
- Use safety devices when filling vaporisers to minimise the opportunity for spills of volatile anaesthetic agents.
- Vaporisers should be filled in a well ventilated area. Use of a closed system for filling of vaporisers is preferred.
- Routine procedures for detection of leaks should be present.

### Maintenance Programme

There should be a regular preventive maintenance programme for the following equipment carried out by trained individuals.

- Anaesthetic apparatus, hoses, connections, reservoir bags, etc.;
- Wall plugs;
- Anaesthetic gas piping;
- Anaesthetic gas scavenging systems; and
- Ventilation systems.

During maintenance, points to note are:

- Care should be taken to assemble the equipment properly;

- Connectors should be close-fitting, gas-specific and appropriate to the specific anaesthetic equipment;
- Parts that are damaged or of inferior design should be replaced;
- Regular checks for the proper functioning of the scavenging system should be in place; and
- Records of maintenance should be kept.

In addition, there should be an established, written maintenance plan and scheduling of maintenance for the various components of the air-conditioning and exhausting systems.

### Administrative Measures

#### Record keeping

The following records should be adequately kept:

- Types of anaesthesia apparatus and volatile agents in use;
- Daily inspections of apparatus and scavenging systems in use;
- Written work instructions for proper use of anaesthetic apparatus, scavenging systems, procedures for filling of vaporisers, spill or leak management, safe work practices and maintenance of apparatus;
- Records of preventive maintenance and checks;
- Incident investigation reports;
- Action plans, if any;

- Monitoring records of WAGs, if available; and
- Medical surveillance results, if any.

### Training and education

All staff handling or using volatile anaesthetic agents should be regularly trained in the following aspects:

- Health effects of exposure to these agents;
- Rationale of engineering control measures;
- Proper use of anaesthetic equipment;
- Safe work practices;
- Use of appropriate PPE; and
- Management of spills or leaks.

The training should be updated whenever there is a change in equipment, processes or an incident occurs.

#### Personal Protective Equipment

Personal protective equipment (PPE) should not be used as a substitute for engineering control measures, safe work practices or administrative controls in protecting employees from exposure to WAGs. In the event of a spill, PPE should be used in conjunction with engineering measures, safe work practices and administrative controls to contain and clean up the spill. Choice of appropriate PPE such as chemical resistant gowns, gloves, goggles and respirators depends on the type of agents used. Information in the SDS should be consulted.

### Management of Spills and Disposal of Liquid Anaesthetic Agents

Spills of small amounts of liquid anaesthetic agents would probably have evaporated at room temperature before a cleanup can be initiated. There should be a written procedure for the containment, clean up and disposal of large spills. Only adequately trained and equipped staff should be allowed to respond to such spills. If you are unsure of the specific procedures and appropriate PPE, consult the SDS or the manufacturer.

General guidelines to help minimise exposure of employees to waste liquid anaesthetic agents are:

- Wear appropriate PPE – chemical protective gowns, gloves, respirator and goggles;
- Ventilate the area where possible;
- Persons without PPE should not be present until the area is deemed safe by trained personnel;
- Collect spilt liquid and absorbent materials used and put in a tightly capped glass or plastic container. Seal and label the container; and
- Container should be handed over to the proper waste disposal contractors and should be disposed of according to national or international regulations.

### Monitoring

#### Monitoring exposure at the workplace

Measuring the airborne levels of anaesthetic gases at the workplace is a method of evaluating workplace exposures. Different methods and types of measurements can be used. Choice of method and sampling strategy would depend on the objective of the sampling and staff are advised to consult technical experts and manuals for the appropriate method. Data obtained from the monitoring can be used to assess effectiveness of control measures so as to ensure the lowest levels of WAGs.

#### Reporting and record keeping

There should be a reporting system in place so that staff exposed to WAGs can report incidents. Exposure records and biological tests of exposed staff should be properly kept and maintained. As WAGs may have effects on the reproductive system, the organisation should develop a policy regarding exposure of all staff particularly vulnerable workers such as those pregnant, lactating and planning for a pregnancy.

#### Medical surveillance

The organisation may want to put in place a surveillance system for early detection of health effects from exposure to WAGs.

Recommended elements to be included in the programme are:

- Baseline or pre-placement medical questionnaire including:
  - A detailed occupational history;
  - Past exposure to WAGs;
  - Past medical history with emphasis on hepatic (liver), renal (kidney), neurological (nervous system), cardiovascular (heart and circulation) and reproductive functions;
- Medical evaluation including history and physical examination; and
- Suitable laboratory tests where applicable;
- Annual questionnaire emphasising the above systems;
- Appropriate laboratory/biological tests if necessary;
- Case finding to allow for reporting of health effects by employees;
- Incident reporting in the event there is exposure to high levels of anaesthetic agents such as spills or leaks, etc.;
- Reproductive hazards policy to address worker exposure and reproductive effects in both male and female employees;
- Final review if a worker requests for a job transfer or leaves the job;
- Maintenance of SDS for all anaesthetic agents in use;

- Exposure and medical records of employees who may be exposed to anaesthetic agents should be properly kept and maintained; and
- Information in the surveillance system should be used to review working conditions and control measures.

**Further information can be obtained from:**

- US Occupational Safety and Health Administration (OSHA): Anesthetic Gases: Guidelines for Workplace Exposures
- Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health (CDC, NIOSH): Waste Anesthetic Gases Occupational Hazards in Hospitals
- CDC, NIOSH: Control of Nitrous Oxide in Dental Operatories
- WSH Guidelines on the Management of Hazardous Chemicals Programme
- WSH (General Provisions) Regulations

### 6.1.3 Sterilising and Disinfecting Agents

Healthcare facilities use a variety of sterilising solutions to sterilise/disinfect a variety of heat-sensitive instruments, such as endoscopes, bronchoscopes, and dialysis equipment. These solutions may also be used as biological tissue fixative and as a component in X-ray film developers.

Common sterilising agents include glutaraldehyde, ortho-phthalaldehyde (OPA) and ethylene oxide.

#### Glutaraldehyde

Trade names of glutaraldehyde-based products include but not limited to, Cidex®, Sonacide®, Sporidicin®, Hospex®, and Omnicide®. Inhalation of vapours and aerosols can cause nose, throat and lung irritation. Respiratory sensitisation can cause allergic rhinitis and asthma-like reactions. In addition to causing respiratory effects, glutaraldehyde acts as a contact allergen, giving rise to contact dermatitis, usually on the hands but occasionally on the face. Individuals who become sensitised to glutaraldehyde can develop dermatitis after coming into contact with solutions containing as little as 0.1% glutaraldehyde. The permissible exposure limit for glutaraldehyde is 0.2 ppm<sup>3</sup> (short term).

#### Ortho-Phthalaldehyde (OPA)

OPA (Trade name Cidex® OPA) is a clear blue solution with little odour. It is a potential irritant that can cause stinging, excessive tearing, coughing and sneezing to the eyes, skin, nose and other tissues. It is a potential skin and respiratory sensitiser that may cause dermatitis. Staff who have prolonged or repeated contact may develop occupational asthma or pre-existing bronchitis or asthma may be aggravated. In addition, the product stains proteins on surfaces to grey/black.

Exposure to such sterilising solutions can occur during the following activities:

- Activating and pouring sterilising solution into or out of a cleaning container system (e.g. soaking basin in manual disinfecting operations and reservoir in automated processors);
- Opening the cleaning container system to immerse instruments to be disinfected;
- Agitating the sterilising solution;
- Handling of soaked instruments;
- Removing instruments from the container system;
- Rinsing the channels of instruments containing residual sterilising solution;
- Flushing out instrument parts with a syringe;
- Drying instrument interiors with compressed air;

<sup>3</sup>Parts per million

- Performing maintenance procedures such as filter or hose changes on automated processors that have not been pre-rinsed with water;
- Cleaning up sterilising solution spills; and
- Aerosolisation of solution (e.g. with spray bottles to spray-wipe surfaces).

## Control Measures

Hierarchical approach	Examples of control measures to reduce exposure
<b>Elimination/Substitution</b>	<ul style="list-style-type: none"> <li>• Substitute with a less hazardous chemical.</li> </ul>
<b>Engineering Controls</b>	<ul style="list-style-type: none"> <li>• Store soaking basins and processing units in enclosed areas.</li> <li>• Provide local exhaust ventilation (e.g. laboratory hoods) for open soaking.</li> <li>• Automate the transfer of sterilising solution from drums into process containers using pumps and closed transfer lines.</li> <li>• Provide general dilution ventilation (10 air changes per hour, ANSI/AMMI 1996) for rooms where disinfection or sterilisation are carried out.</li> </ul>
<b>Safe Work Practices</b>	<ul style="list-style-type: none"> <li>• Ensure that all containers containing sterilising solution are covered at all times with tight-fitting lids.</li> </ul>
<b>Administrative Controls</b>	<ul style="list-style-type: none"> <li>• Provide eyewash stations in all areas where sterilising solutions are handled.</li> </ul>
<b>Personal Protective Equipment</b>	<ul style="list-style-type: none"> <li>• Use of PPE to prevent skin contact such as gloves (nitrile rubber gloves, butyl rubber gloves, and 100% copolymer gloves may be used), sleeve protectors, safety eyewear and fluid-resistant gowns or aprons.</li> </ul>

Healthcare personnel who will come into contact with these agents include those who work with cold sterilisation equipment (e.g. within endoscopy department and operating theatres, theatre sterile supply units (TSSU), central sterile supplies units (CSSU) and dental clinics).

Disposal of CIDEX OPA: CIDEX OPA should be neutralised prior to disposal. Either glycine (free base), at the minimum rate of 33 g per 5 L of Cidex® OPA solution, or an approved neutralising agent may be used as a neutraliser prior to disposal. The minimum recommended neutralisation time for glycine is one hour.

For other approved neutralising agent, refer to the manufacturer's instructions on neutralisation time. Discard neutralised solution into drain. Flush drain thoroughly with water.

### Further information can be obtained from:

- US OSHA: Best Practices for the Safe Use of Glutaraldehyde in Health Care
- Society of Gastroenterology Nurses and Associates, Inc. (SGNA): Guideline for Use of High Level Disinfectants & Sterilants for Reprocessing Flexible Gastrointestinal Endoscopes
- CDC, NIOSH: Glutaraldehyde – Occupational Hazards in Hospitals
- Occupational Safety and Health Service, Department of Labour, New Zealand: Guidelines for the Provision of Facilities and General Safety and Health in the Healthcare Industry
- SA Health: Guideline for the Safe Use of Ortho-phthalaldehyde (OPA)
- WSH Guidelines on the Management of Hazardous Chemicals Programme
- WSH (General Provisions) Regulations

## Ethylene Oxide

Ethylene oxide (EtO) is commonly used as a sterilising agent for medical devices and equipment that are heat and moisture-sensitive and thus cannot be sterilised by steam. High vapour concentrations of ethylene oxide (in the order of 1000 ppm) can cause irritation and damage to the eyes and upper respiratory system, hoarseness, cough, headache, nausea and recurrent vomiting, fatigue and pulmonary oedema. Less frequently reported effects include muscular weakness, abdominal discomfort and diarrhoea, and nervous system disorders. Ethylene oxide liquid has the capacity to cause burns, blisters and dermatitis when it comes into contact with skin. Ethylene oxide is toxic in various body systems. It is also a mutagen, an established animal carcinogen and a human carcinogen (International Agency for Research on Cancer (IARC), 2007) that may have adverse reproductive effects on humans. The permissible exposure limit for ethylene oxide is 1 ppm (long term).

Healthcare personnel who work in operating rooms, central supply, renal dialysis units, respiratory therapy departments and areas where ethylene oxide is used such as autoclaves will be prone to these hazards. The odour of EtO cannot be detected below approximately 700 ppm, therefore workers who are exposed to high concentration of this compound may not be aware.

Routes of exposure to ethylene oxide include:

- Inhalation of ethylene oxide gas in air;
- Skin, eye or mucous membrane contact with the liquid or with ethylene oxide absorbed in solid materials;
- Oral – residual ethylene oxide in ingested material; and
- Intravenous leaching of ethylene oxide from inadequately aerated medical devices inserted intravenously.

## Control Measures

Hierarchical approach	Examples of control measures to reduce exposure
<b>Engineering Controls</b>	<ul style="list-style-type: none"> <li>• Store supply cylinders in a ventilated enclosure (either a ventilated cabinet or a hood that covers the point where the cylinder is connected to the steriliser supply line).</li> <li>• Keep the steriliser enclosed either in a mechanical access room or a cabinet, and the enclosure should be exhausted to a dedicated ventilation system.</li> <li>• Cover floor drains with an anti-siphon air gap. The air gap, at the junction of the vacuum pump discharge line with the floor drain should be enclosed. Dedicated exhaust ventilation should be provided for the enclosures.</li> <li>• Local exhaust ventilation sufficient to effectively remove ethylene oxide should be as close as possible to the top of the steriliser door.</li> <li>• Provide appropriate local exhaust ventilation (e.g. laboratory hoods) for sterilisers using cartridges or glass ampoules.</li> <li>• Provide general dilution ventilation for rooms where sterilisation is carried out.</li> <li>• Provide real-time monitoring devices with audio and visual alarm for ethylene oxide sterilising facilities.</li> </ul>
<b>Administrative Controls</b>	<ul style="list-style-type: none"> <li>• Centralise sterilising operations and access to steriliser rooms should be restricted.</li> <li>• Develop a maintenance plan which includes regular checks of door gaskets, valves, tubing, and piping connections for all steriliser units.</li> </ul>
<b>Personal Protective Equipment</b>	<ul style="list-style-type: none"> <li>• Provide proper PPE to prevent skin or inhalation exposures.</li> </ul>



### Further information can be obtained from:

- CDC, NIOSH: Current Intelligence Bulletin 52: Ethylene Oxide Sterilizers in Health Care Facilities - Engineering Controls and Work Practices
- WSH Guidelines on the Management of Hazardous Chemicals Programme
- WSH (General Provisions) Regulations

## Formaldehyde

Formaldehyde is a tissue sterilising agent and preservative often used in dialysis units, histopathology laboratories and operating theatres. Formaldehyde is often combined with methanol and water to make formalin. Formaldehyde vapour can cause irritation to the eyes and the respiratory tract. In liquid or solution form, it can cause both primary irritation and sensitisation dermatitis and rarely, occupational asthma.

Formaldehyde is recommended to be handled as a known carcinogen (International Agency for Research on Cancer (IARC), 2006) in the workplace. The short term permissible exposure limit of formaldehyde is 0.3 ppm (short term). There is no long-term safe exposure level.

Healthcare personnel who are at risk include laboratory technicians, nurses, surgeons/dentists and pathologists etc., where formaldehyde is used, e.g. operating theatres, pathology laboratories or dialysis centres.

## Control Measures

Hierarchical approach	Examples of control measures to reduce exposure
<b>Engineering Controls</b>	<ul style="list-style-type: none"> <li>• Provide local exhaust ventilation over work stations using formalin or specimens preserved in formalin.</li> <li>• Provide eyewash station in all areas where formalin is handled.</li> <li>• Provide traps in floor drains.</li> <li>• Provide spill-absorbent bags for emergencies.</li> </ul>
<b>Safe Work Practices</b>	<ul style="list-style-type: none"> <li>• Ensure that all containers containing formalin are covered at all times with tight-fitting lids.</li> </ul>
<b>Administrative Controls</b>	<ul style="list-style-type: none"> <li>• Purchase small quantities of formaldehyde in plastic containers for ease of handling and safety.</li> </ul>
<b>Personal Protective Equipment</b>	<ul style="list-style-type: none"> <li>• Use of PPE to prevent skin contact such as respirators, gloves (nitrile rubber gloves, butyl rubber gloves, and 100% copolymer gloves may be used), face shields, fluid-resistant aprons and boots.</li> </ul>

### 6.1.4 Solvents

There are a wide range of solvents used in healthcare facilities and they are reagents used in medical laboratories, cleaning agents and paints used in equipment maintenance workshops, cleaning agents used in housekeeping and renovation works (e.g. xylene, toluene and alcohols). Most solvents can be absorbed through the skin or by inhalation and ingestion. Many solvents act as central nervous system depressants, causing headaches, dizziness, weakness, nausea, and other symptoms. Solvents may also irritate eyes, skin and the upper respiratory tract. Prolonged contact may result in defatting and dehydration of the skin.

Long-term exposure to some solvents has been associated with cancer, adverse reproductive effects, cardiovascular problems, and damage to the liver, kidneys, central nervous system and hematopoietic system.

Healthcare personnel at risk include laboratory technicians, workshop technicians, contractors and housekeeping staff. Dentists, surgeons and their assistants can also be exposed to volatile organic compounds and solvents such as methacrylate and chloroform.

#### Control Measures

Hierarchical approach	Examples of control measures to reduce exposure
<b>Elimination/Substitution</b>	<ul style="list-style-type: none"> <li>Substitute hazardous solvents with less hazardous alternatives.</li> </ul>
<b>Engineering Controls</b>	<ul style="list-style-type: none"> <li>Provide local exhaust ventilation and enclosure of solvent vapour sources for controlling exposures to solvents in laboratories.</li> </ul>
<b>Administrative Controls</b>	<ul style="list-style-type: none"> <li>Provide warning signs and labelling of solvent containers with information on the hazards of exposure to solvents and the precautions to take.</li> </ul>
<b>Personal Protective Equipment</b>	<ul style="list-style-type: none"> <li>Use protective equipment to prevent skin contact and inhalation such as gloves, respirator (for organic vapours) rubber aprons, goggles, and boots.</li> </ul>

### 6.1.5 Mercury

Mercury can be found in equipment such as thermometers, blood pressure apparatus and sphygmomanometers. Mercury is also used in dental amalgams. Exposure to mercury in the hospital is usually the result of an accidental spill arising from breakage of mercury-containing equipment and apparatus. Although inhalation is the major route of entry for mercury, the element can also be absorbed through the skin.

Exposure to short-term high levels of mercury can produce severe respiratory irritation, digestive disturbances and marked renal damage. Long-term exposure to low levels of mercury results in the classic mad hatter syndrome, named for the makers of felt hats who used mercury in processing.

This syndrome is characterised by emotional instability and irritability, tremors, inflammation of the gums, gingivitis, excessive salivation, anorexia, and weight loss. Mercury has also been reported as a cause of sensitisation dermatitis. The permissible exposure limit for mercury vapour is 0.025 mg/m<sup>3</sup> (long term). Employees who are exposed to or are handling mercury or its compounds are required to undergo medical examinations. The test required is urine mercury and this must be conducted by a Designated Workplace Doctor and the results submitted to the MOM.

#### Control Measures

Hierarchical approach	Examples of control measures to reduce exposure
<b>Engineering Controls</b>	<ul style="list-style-type: none"> <li>Provide exhaust systems to prevent the accumulation or recirculation of mercury vapours in equipment maintenance rooms/biomedical workshops.</li> </ul>
<b>Administrative Controls</b>	<ul style="list-style-type: none"> <li>Provide mercury spill clean-up kits and training for emergency response staff.</li> <li>Establish emergency procedures for handling mercury contamination including procedures for cleanup and for respirator selection.</li> </ul>

### 6.1.6 Natural Rubber Latex

A number of proteins that make up natural rubber latex (NRL) can cause the development of occupational asthma and dermatitis in people exposed to them. In powdered NRL gloves, the proteins are easily carried on the cornstarch powder can become airborne and inhaled. Chemicals, also known as accelerators, are added to latex in the processing phase. Chemicals most likely to cause reactions are thiurams, dithiocarbamates and mercaptobenzothiazoles (MBT). Healthcare workers are also exposed by direct contact to NRL or chemicals in rubbers and plastics.

#### Exposure Situations/Procedures

- Healthcare workers in direct patient care where the use of gloves is required and NRL gloves are used – clinics, operating theatres, clinical and research laboratories, wards, ICUs and autopsy rooms.
- Use of rubber containing equipment such as IV bungs, catheters, sphygmomanometers, drains, dental dams, anaesthesia masks, stethoscopes etc.

- Rubber containing consumer products e.g. rubber bands, washing up and other utility gloves, stress balls, erasers etc. kitchens, toilets and other general facilities, clinical areas, offices.
- Stretchy rubber products pose a higher risk than dry rubber products.

#### Workers at Risk

- Healthcare workers using NRL gloves particularly the powdered type – doctors, dentists, nurses and related staff, laboratory staff, research staff and pathologists.
- Kitchen staff, waste disposal staff, security staff.
- Workers with past history of multiple surgical procedures.
- Workers with history of certain food allergies such as banana, avocado, kiwi and chestnut.
- Workers with atopic allergic diseases.

### Control Measures

Hierarchical approach	Examples of control measures to reduce exposure
<b>Elimination/Substitution</b>	<ul style="list-style-type: none"> <li>• Substitute natural rubber latex gloves with alternatives such as vinyl or other non-latex gloves.</li> <li>• Use low protein, powder free gloves.</li> <li>• Provide appropriate non-latex gloves in non-clinical tasks.</li> </ul>
<b>Administrative Controls</b>	<ul style="list-style-type: none"> <li>• Educate and raise awareness.</li> </ul>
<b>Personal Protective Equipment</b>	<ul style="list-style-type: none"> <li>• Provide appropriate latex-free PPE.</li> </ul>

#### Further information can be obtained from:

- Health and Safety Executive (HSE), UK: Latex allergy – Occupational aspects of management – A national guideline
- CDC, NIOSH: NIOSH Alert: Preventing Allergic Reactions to Natural Rubber Latex in the Workplace

## 6.2 Biological and Infectious Hazards

In treating and caring for patients, healthcare workers and supporting staff are exposed to various infections such as Hepatitis B, Hepatitis C, HIV, Mycobacterium tuberculosis, varicella zoster (VZV), measles, mumps, rubella, gastrointestinal infections and scabies. In addition, exposure to animals and vegetable matter can cause allergies, dermatitis and asthma.

### Infectious Diseases

Healthcare workers are exposed to infectious agents by inhalation, injection, ingestion or dermal contact. As infectious agents have the potential to multiply, breaking the chain of transmission is important in the control of infection.

Factors to determine if the healthcare worker has been infected are:

- How the infection is spread;
- Dose of the organisms;
- Duration of exposure;
- Virulence of the infectious organisms;
- Availability of vaccines;
- Immune status of healthcare worker;
- Availability of post-exposure prophylaxis where applicable; and
- How well the organism survives in the environment.

### 6.2.1 Infectious Disease Management Programme

Facilities should implement a health and safety management programme for infectious diseases to protect the health of the workers. This means taking an active role in carrying out risk assessments, setting health and safety standards and developing policies, together with monitoring of standards and enforcement of compliance. Specific functions such as carrying out risk assessments may be assigned to the management line.

#### Management Policy and Strategy

The policy is a written statement of a facility's intent to provide a safe and healthy environment and should enlist the support of employees in achieving its aims. The policy should detail the health and safety responsibilities within the facility. There should be systems and procedures in place for ensuring health and safety of its employees. All areas where there is potential exposure to biological hazards such as wards, clinics, operating theatres, sterilising departments, cleaning, housekeeping, laundry and portering and so on should be included.

#### Register of Work Activities

A register of all processes related to infection control should be documented including routine, non-routine work, disposal of infectious matter,

housekeeping, laundry and maintenance of contaminated equipment. This register should also include information on the staff who may be exposed and the areas in which they work.

#### Risk Assessment and Risk Control

Management should ensure that suitable and sufficient RA are made for all activities where there is handling or exposure to infectious agents. RA is a means of determining the risk associated with exposure to a particular hazard or work.

The steps in doing RA include:

- Hazard identification;
- Determine workers who are at risk and how harm could arise;
- Likelihood of harm arising, assessment of adequacy of existing precautions;
- Document findings and control measures selected as well as any other steps necessary to reduce exposure to risk; and
- Review the RA if there is a change in the nature of work or process.

The coverage of the risk assessments should include:

- Routine work;
- Non-routine work;
- Emergency situations;
- Activities of personnel with access to the facility such as visitors, volunteers, subcontractors and workers;

- Vulnerable persons such as expectant mothers and those with impaired immune systems; and
- All facilities at your workplace.

Risks should be controlled at source and control measures should follow the hierarchy of controls viz elimination or substitution, engineering control measures, administrative measures and PPE.

Documentation of RA and controls should be kept up-to-date. These should be reviewed periodically or whenever there is a change in the nature of the process, substances or equipment used or on the occurrence of an incident or an occupational disease.

#### Safe Work Procedures

There should be written procedures on any work where there is exposure to infectious matter and should include emergency areas, patient care areas, operating theatres, laboratories, housekeeping and laundry, mortuary waste disposal and biomedical maintenance.

The SWPs should include the correct use of appropriate PPE and the safety and health precautions to be taken in the course of work. Existing programmes such as infection control programme, tuberculosis (TB) infection control, standard precautions for prevention of bloodborne infections, contact, airborne and droplet precautions can be incorporated into the infectious disease management programme.

The use of standard precautions applies to all patients in any health care facilities. It is based on the premise that blood, body fluids, secretions, excretions except sweat, non-intact skin and mucous membranes may contain transmissible infectious agents. The components are hand hygiene, use of PPE such as gloves, fluid resistant gowns, mask, eye or face shield and proper handling of potentially contaminated equipment. The extent of PPE used depends on the risk of healthcare workers – patient interaction. Healthcare workers should ensure that PPE's are not brought out of clinical or laboratory areas.

### Environmental Infection Control

Certain infections can be transferred by direct contact with contaminated surfaces. There should be a programme for cleaning and decontaminating clinical contact areas in order to reduce transfer of infections to healthcare workers and other patients. Maintaining a clean environment by good housekeeping would also reduce disease transmission.

### Disposal

Operations where biological/infectious wastes are generated should be governed by a waste management system that include proper labelling according to national or international codes, proper storage, treatment, transport and disposal of such wastes.

### Personal Protective Equipment

Personal protective equipment (PPE) includes respirators, safety glasses, face shields, overalls, aprons, gloves and boots. Selection of PPE should be based on transmission routes of infection, risk group of the organisms, other concomitant hazards and the nature of work. To ensure that employees are effectively protected, PPE should be properly selected, correctly used, comfortably fitted and regularly maintained. A suitable PPE programme should be implemented taking into account the above elements.

### Emergency Planning

Emergency planning is required for incidents, accidents or emergencies that might occur such as sharps injuries, aerosolisation of highly infectious organisms, spills of organisms outside of biological safety cabinets. The plan should describe what needs to be done.

For example, emergency procedures, first aid procedures, use of safety equipment and appropriate PPE, decontamination and cleaning, and proper waste disposal. Emerging infectious diseases is another area that should be catered for.

### Post-Exposure Programme

A post-exposure programme should be implemented to cope with employees who are infected with or occupationally exposed to infectious diseases. Treatment given would depend on the nature and type of infection the worker

has been exposed to. The programme should also address if a healthcare worker should be restricted from work and determine when he/she would be fit to return to work.

### Health Surveillance

Surveillance is defined as an ongoing, systematic collection, analysis, interpretation, and dissemination of data regarding a health-related event for use in public health action to reduce morbidity and mortality, and to improve health.

A system should be put in place to detect early signs of work-related ill health in employees exposed to certain health risks and to act on the results.

### Vaccinations (Immunoprophylaxis)

Employees at increased risk of exposure to vaccine-preventable infections such as Hepatitis B, influenza, varicella zoster and rubella might benefit from the implementation of a vaccination programme. The programme should incorporate information on the epidemiology of such infections and include inputs from an infectious disease consultant in accordance to the institution's policy or any other regulatory guidelines.

### Case Finding

A facility should have a system for active case finding of healthcare workers with clusters of fever symptoms, gastrointestinal or other symptoms,

or single cases of sharps injuries, occupational asthma, dermatitis and other occupational diseases. A systematic epidemiologic investigation should be done to determine commonalities in persons, place, and time; and guide implementation of interventions and evaluation of the effectiveness of those interventions.

### Records

A facility should keep exposure records of its employees who work with more hazardous organisms in the laboratories or in clinical areas. Information in the records should include type of work, location of work done and specific incidents or exposures that occurred. Where required by current legislation, occupational diseases should be reported to MOM. All records should be properly kept and maintained for at least five years.

### Monitoring and Review

Information on occurrence of infectious diseases should be monitored and analysed with regard to frequency, health effects, absenteeism and performance of the safety and health management system. The safety and health management team should review the overall policy, planning and implementation of the infectious disease management programme regularly to ensure its effectiveness and relevance.



## Education and Training

All employees should be given suitable and sufficient information about the biological agents they could be exposed to and the risks due to the exposure. They should also be informed of the results of the RA, the measures to take, usage of PPE, emergency and first aid procedures, infection control policies, vaccinations, post-exposure prophylaxis and reporting procedures for occupational accidents and diseases. A health and safety training programme should be implemented to ensure that SWPs are known and understood by all staff.

## 6.2.2 Bloodborne Pathogens

Healthcare workers are potentially exposed to bloodborne pathogens such as Hepatitis B, Hepatitis C and HIV. They are at risk to these diseases from getting infected by needlestick injuries or cuts from other sharp objects contaminated with an infected patient's blood or through contact of the eyes, nose, mouth or non-intact skin with an infected patient's blood or bodily fluids. Hepatitis B, Hepatitis C and HIV/AIDS are the most common infections that can be transmitted to healthcare workers by blood and bodily fluids. The main routes of exposure are by percutaneous inoculation or permucosal means i.e. contact of an open wound, non-intact skin or mucous membranes (due to spills and splashes).

## Exposure Situations/Procedures

- Procedures resulting in a percutaneous injury or contact of mucosal membrane or non-intact skin with infected blood, tissues or bodily fluids such as needlestick or sharps injuries, spills or splashes and human bites;
- Venepuncture e.g. in wards, clinics and operating theatres;
- Laboratory work e.g. in clinical laboratories, research laboratories, animal facilities;
- Surgery e.g. in operating theatres;
- Resuscitation e.g. in emergency departments, wards, operating theatres;
- Transport of injured patients who have open bleeding wounds;
- Post-mortem procedures – autopsy rooms;
- Disposal of biohazardous waste e.g. in wards, clinics, operating theatres, laboratories, waste holding and treatment areas; and
- Repair of medical and dental equipment.

## Workers at Risk

- Doctors;
- Nurses;
- Phlebotomists;
- Laboratory workers;
- Emergency room staff;
- Waste handling and disposal workers;

- Ambulance and related staff;
- Biomedical technicians and engineers; and
- Mortuary staff.

## Control Measures

Hierarchical approach	Examples of control measures to reduce exposure
<b>Elimination/Substitution</b>	<ul style="list-style-type: none"> <li>• Eliminate use of needles or sharps for IV drug delivery.</li> <li>• Consider use of alternative IV delivery systems.</li> <li>• Consider substitution of non-needle systems for certain types of blood prick tests.</li> <li>• Explore other routes of medication delivery e.g. oral.</li> <li>• Review specimen collection procedures.</li> </ul>
<b>Engineering Controls</b>	<ul style="list-style-type: none"> <li>• Engineer sharps or needles with built-in sharps injury prevention features.</li> <li>• Adopt a needleless intravenous (IV) delivery systems.</li> <li>• Use blunt tipped suture needles where appropriate.</li> <li>• Use blunt-ended scissors.</li> <li>• Place proper sharps disposal containers in convenient locations.</li> </ul>
<b>Safe Work Practices</b>	<ul style="list-style-type: none"> <li>• General safe work practices:               <ul style="list-style-type: none"> <li>- Prohibit eating, drinking, smoking and the application of cosmetics in areas where there is a risk of contamination;</li> <li>- Prevent puncture wounds, cuts and abrasions, especially in the presence of blood and body fluids;</li> <li>- Cover all breaks in exposed skin by using waterproof dressings and suitable gloves; and</li> <li>- Procedures for administration of medications to confused or combative patients.</li> </ul> </li> <li>• Use standard precautions:               <ul style="list-style-type: none"> <li>- Hand hygiene before and after procedures; and</li> <li>- Safe handling of needles and sharps - no recapping, bending, breaking needles.</li> </ul> </li> </ul>

Hierarchical approach	Examples of control measures to reduce exposure
	<ul style="list-style-type: none"> <li>• Safe injection practices:               <ul style="list-style-type: none"> <li>- Practise basic principles of aseptic technique for the preparation and administration of parenteral medications;</li> <li>- Use sterile, single-use, disposable needle and syringe for each injection given;</li> <li>- Prevent contamination of injection equipment and medication;</li> <li>- Use single-dose vials (preferred over multiple-dose vials);</li> <li>- Dispose glass ampoules properly as soon as withdrawal of contents is completed; and</li> <li>- Proper patient handling techniques for phlebotomy on uncooperative patients.</li> </ul> </li> <li>• Control contamination of surfaces:               <ul style="list-style-type: none"> <li>- Contain the infectious agents;</li> <li>- Use appropriate decontamination procedures by heat or chemical means; and</li> <li>- Proper management of spills and other forms of contamination.</li> </ul> </li> <li>• Safe handling and disposal of waste:               <ul style="list-style-type: none"> <li>- Use appropriate sharps containers i.e. puncture-resistant plastic containers.</li> </ul> </li> <li>• Work in operating theatres:               <ul style="list-style-type: none"> <li>- Use instruments, rather than fingers, to grasp needles, retract tissue, and load/unload needles and scalpels;</li> <li>- Give verbal announcements when passing sharps;</li> <li>- Avoid hand-to-hand transfer of sharps; use a basin where appropriate;</li> <li>- Use alternative cutting methods such as blunt electrocautery and laser devices when appropriate;</li> <li>- Substitute endoscopic surgery for open surgery where possible; and</li> <li>- Use round-tipped scalpel blades instead of sharp tipped blades.</li> </ul> </li> </ul>

Hierarchical approach	Examples of control measures to reduce exposure
	<ul style="list-style-type: none"> <li>• Maintain and ensure proper cleaning and decontamination of equipment.</li> <li>• Adopt infection control practices for special lumbar procedures.</li> </ul>
<b>Administrative Controls</b>	<ul style="list-style-type: none"> <li>• Develop a management policy on healthcare workers infections for HBV, HCV and HIV and exposure prone procedures.</li> <li>• Screen HBV, HCV and HIV for healthcare workers especially those who perform exposure prone procedures:               <ul style="list-style-type: none"> <li>- Provide counselling for above workers.</li> </ul> </li> <li>• Education and awareness:               <ul style="list-style-type: none"> <li>- Staff should be aware of the hazards of bloodborne infections and trained in safe work practices.</li> </ul> </li> </ul>
<b>Personal Protective Equipment</b>	<ul style="list-style-type: none"> <li>• Use appropriate PPE such as:               <ul style="list-style-type: none"> <li>- Impervious gowns;</li> <li>- Gloves;</li> <li>- Eye protection such as face shields/goggles/safety spectacles/visors where splashes are possible; and</li> </ul> </li> <li>• Rubber boots or plastic overshoes where the flooring/ground is likely to be contaminated.</li> </ul>

#### Further information can be obtained from:

- Ministry of Health (MOH) Singapore: Guidelines for Preventing Transmission of Bloodborne Infections in a Healthcare Setting

### 6.2.3 Infectious Agents other than Bloodborne Pathogens

Pathogens of various classes such as bacteria, viruses, fungi, parasites, prions can cause infections. The routes of infection vary with the organism and type of infection. Some organisms can also be transmitted by multiple routes and not all organisms are transmissible from person to person.

#### Droplet Infections

Respiratory droplets (usually more than 5µm in diameter) carrying infectious pathogens transmit infections when they travel directly from the respiratory tract of the infectious individual to the mucosal surfaces of the susceptible recipient, usually over short distances. This usually happens when infected patients cough, sneeze or talk and healthcare workers inhale the particles. Examples of infections spread in this way are SARS-CoV, Mycobacterium tuberculosis (TB), influenza, adenovirus, rhinovirus, Group A Streptococcus, Mycoplasma pneumoniae, Bordetella pertussis and Neisseria meningitidis.

#### Exposure Situations/Procedures

- High risk situations where there is aerosolisation of patient's respiratory secretions such as endotracheal intubation, bronchoscopy, sputum induction, performance of laryngeal swabs, cough induction by chest physiotherapy, cardiopulmonary resuscitation, surgical procedures, autopsy etc.

- Caring for infective patients i.e. individuals with infections such as SARS, TB, influenza etc.
- Generation of aerosols of infected laboratory samples.
- Dental procedures.

#### Workers at Risk

- Healthcare workers in direct patient care particularly departments of respiratory medicine, infectious diseases, emergency care, and areas involving care of immunocompromised patients.
- Clinical and research laboratory workers.
- Mortuary workers and autopsy room staff.
- Dental healthcare workers including dentists, assistants and technicians.

### Control Measures

Hierarchical approach	Examples of control measures to reduce exposure
<b>Engineering Controls</b>	<ul style="list-style-type: none"> <li>• Negative pressure rooms are desirable.</li> <li>• Consider use of microbiological safety cabinets for laboratory work such as immunomagnetic separation and inoculation of biochemical test kits that may generate aerosols.</li> </ul>
<b>Safe Work Practices</b>	<ul style="list-style-type: none"> <li>• Droplet precautions:               <ul style="list-style-type: none"> <li>- Provide single occupancy room for patient is preferred;</li> <li>- Cohorting of patients if single room is unavailable – to discuss with infectious disease consultant;</li> <li>- Spatial separation of more than one metre between beds in multi-bed wards;</li> <li>- Keep curtain drawn between beds in multi-bed wards;</li> <li>- Use of fluid resistant mask for close contact with infectious patient;</li> <li>- Wear a mask before entering a room;</li> <li>- Change protective attire and perform hand hygiene between contact with patients in the same room; and</li> <li>- Adhere to the proper sequence of removing PPE.</li> </ul> </li> <li>• Patients to wear a fluid resistant mask (if tolerated) when being transported outside the room and to follow respiratory hygiene/cough etiquette.</li> <li>• A respiratory hygiene/cough etiquette programme should be:               <ul style="list-style-type: none"> <li>- Used with any patients and accompanying persons with undiagnosed transmissible respiratory infections; and</li> <li>- Applied to those with cough, congestion, rhinorrhea, or increased production of respiratory secretions when entering a healthcare facility.</li> </ul> </li> <li>• Elements of a respiratory hygiene/cough etiquette programme are:               <ul style="list-style-type: none"> <li>- Educate healthcare facility staff, patients and visitors;</li> <li>- Source control measures such as covering the mouth/nose with a tissue when coughing and prompt disposal of used tissues;</li> </ul> </li> </ul>

Hierarchical approach	Examples of control measures to reduce exposure
Administrative Controls	<ul style="list-style-type: none"> <li>- Use surgical masks on the coughing person when tolerated;</li> <li>- Ensure hand hygiene after contact with respiratory secretions; and</li> <li>- Spatial separation, ideally more than one metre, of persons with respiratory infections in common waiting areas when possible.</li> </ul>
Personal Protective Equipment	<ul style="list-style-type: none"> <li>• Education and training on hazards and effects as well as safe work practices.</li> <li>• Use surgical masks (fluid resistant).</li> <li>• Use impervious gowns.</li> <li>• Use gloves.</li> <li>• Ensure eye protection such as face shields/goggles/safety spectacles/visors where splashes are possible.</li> <li>• Wear rubber boots or plastic overshoes where the flooring/ground is likely to be contaminated.</li> </ul>

## 6.2.4 Airborne Infections

Airborne infections are transmitted when the infectious aerosols (such as airborne droplet nuclei or small particles) are small enough to remain airborne for a longer time and distance. Microorganisms can be carried by air currents and be dispersed over longer distances and infect individuals who are not in the vicinity of infected individuals. Such infections include Mycobacterium tuberculosis (TB), rubeola virus (measles) and varicella zoster (chickenpox). Variola (smallpox) can also be transmitted by this route under certain conditions.

Limited airborne transmission of SARS-CoV, influenza, rhinovirus, norovirus and rotavirus has also been demonstrated.

Healthcare workers can become infected when they inhale the infectious particles.

### Exposure Situations/Procedures

- High risk situations where there is aerosolisation of patient's respiratory secretions such as endotracheal intubation, bronchoscopy, sputum induction, performance of laryngeal swabs, cough induction by chest physiotherapy, cardiopulmonary resuscitation, surgical procedures and autopsy etc.
- Caring for infective patients such as individuals with infections such as SARS, TB, influenza.
- Outpatient clinics, physicians' offices.
- Emergency departments.

- Respiratory and infectious disease departments.
- Aerosolisation of infected laboratory samples.
- Performing post mortems of infected patients.
- Dental procedures.

### Workers at Risk

- Healthcare workers in direct patient care particularly departments of respiratory medicine, infectious diseases and emergency care, and areas involving care of immunocompromised patients.
- Emergency room staff.
- Surgical staff.
- Clinical and research laboratory workers.
- Biological waste handlers including cleaners.
- Housekeeping staff.
- Mortuary workers and autopsy room staff, particularly if using an oscillating saw.
- Dental healthcare workers including dentists, assistants and technicians.
- Ambulance crew.

## Control Measures

Hierarchical approach	Examples of control measures to reduce exposure
<b>Engineering Controls</b>	<ul style="list-style-type: none"> <li>• Ventilation design.</li> <li>• Laminar flow.</li> <li>• Use high efficiency particulate air (HEPA) filters.</li> <li>• Use biological safety cabinets in the laboratory when performing aerosol generating tests.</li> <li>• Use airborne infection isolation rooms (AIIR) (negative pressure to the atmosphere); a single room is preferable.</li> <li>• In airborne infection isolation rooms (AIIR):               <ul style="list-style-type: none"> <li>- Ensure that the air pressure is checked visually daily with the use of smoke tubes or flutter strips; and</li> <li>- At least 12 air changes per hour (new facility) or 6 air changes per hour (old/existing facilities).</li> </ul> </li> <li>• During resuscitation, use of mouthpieces, pocket resuscitation masks with one way valves, and other ventilation devices.</li> </ul>
<b>Safe Work Practices</b>	<ul style="list-style-type: none"> <li>• Maintain proper hand hygiene between contact with patients.</li> <li>• Adhere to the proper sequence of PPE removal.</li> <li>• Use standard precautions:               <ul style="list-style-type: none"> <li>- In waiting rooms, separate infectious patients such as those with cough or sneezing in a separate enclosed room away from others; and</li> <li>- Maintain a distance of at least one metre between symptomatic and non-symptomatic patients in the waiting room.</li> </ul> </li> <li>• Implement a respiratory hygiene/cough etiquette programme which should be:               <ul style="list-style-type: none"> <li>- Used with any patients and accompanying persons with undiagnosed transmissible respiratory infections; and</li> <li>- Applied to those with cough, congestion, rhinorrhea, or increased production of respiratory secretions when entering a healthcare facility.</li> </ul> </li> </ul>

Hierarchical approach	Examples of control measures to reduce exposure
	<ul style="list-style-type: none"> <li>• Elements of a respiratory hygiene/cough etiquette programme are:               <ul style="list-style-type: none"> <li>- Educate healthcare facility staff, patients and visitors;</li> <li>- Source control measures such as covering the mouth nose with a tissue when coughing and prompt disposal of used tissues;</li> <li>- Use surgical masks on the coughing person when tolerated;</li> <li>- Ensure hand hygiene after contact with respiratory secretions; and</li> <li>- Spatial separation, ideally more than one metre, of persons with respiratory infections in common waiting areas when possible.</li> </ul> </li> <li>• Safety equipment:               <ul style="list-style-type: none"> <li>- Biological safety cabinets should be used for laboratory work where necessary; and</li> <li>- Type and specifications of such cabinets would depend on the risk level of the microbiological agents and procedure being performed.</li> </ul> </li> </ul>
<b>Administrative Controls</b>	<ul style="list-style-type: none"> <li>• Educate and train staff on hazards and effects as well as safe work practices.</li> </ul>
<b>Personal Protective Equipment</b>	<ul style="list-style-type: none"> <li>• Fit-tested particulate respirator N95 or higher;</li> <li>• Appropriate eye protection such as safety goggles or face shields depending on the risk.</li> <li>• Use impervious aprons.</li> <li>• Use appropriate gloves.</li> <li>• Wear rubber boots or plastic overshoes where the flooring/ground is likely to be contaminated.</li> </ul>



## 6.2.5 Infections Transmitted by Direct Contact

Healthcare workers can become infected when they come into direct contact with blood, bodily fluids and body parts; respiratory secretions and excretions of patients; excreta such as faeces, urine and vomit; and direct skin contact with infected patients.

Infections transmitted by direct contact include gastrointestinal infections such as *Salmonella typhi*, Norovirus, *E. coli* O157, *Clostridium difficile*, *Campylobacter jejuni*, Hepatitis A; skin and soft tissue infections such as *Staphylococcus aureus*, Methicillin resistant *Staphylococcus aureus* (MRSA), ringworm, orf, scabies (mites), herpes simplex virus (HSV); and viral respiratory tract infections such as respiratory syncytial virus (RSV). For more examples of infections and routes of transmission, refer to Appendix B.

### Exposure Situations/Procedures

Caring for infectious patients without using proper precautions in:

- Wards;
- Outpatient clinics or physicians' offices;
- Emergency departments;
- Operating theatres; and
- Dental procedures.

Not using proper precautions in the following situations:

- Performing post mortems of infected patients;
- Maintenance of contaminated biomedical equipment;
- Clinical and research laboratories;
- Housekeeping and laundry; and
- Waste handling and disposal.

### Workers at Risk

- Healthcare workers caring for infectious patients.
- Dental healthcare staff such as dentists, dental nurses and assistants.
- Operating theatre staff.
- Clinical and research laboratory staff.
- Housekeeping staff.
- Waste handling and disposal staff.
- Biomedical technicians and engineers.

## Control Measures

Hierarchical approach	Examples of control measures to reduce exposure
<b>Engineering Controls</b>	<ul style="list-style-type: none"> <li>• Isolate patients in a single room is preferable.</li> <li>• Use disposable protective sheaths/sleeves for patient care where appropriate.</li> <li>• During resuscitation, use a mouthpiece, pocket resuscitation masks with one way valves, and other ventilation devices.</li> </ul>
<b>Safe Work Practices</b>	<ul style="list-style-type: none"> <li>• Use standard precautions.</li> <li>• Ensure proper hand hygiene after contact with each patient.</li> <li>• Keep nails short and discourage use of artificial nails.</li> <li>• When nursing a patient on contact precautions, put on PPE on entry to the room.</li> <li>• Adhere to the proper sequence of PPE removal.</li> <li>• When removing PPE, gloves should be removed last.</li> <li>• Hand hygiene should be performed after removing the gloves.</li> <li>• Segregate used disposable and non-disposable PPE.</li> <li>• Label bags of used PPE properly.</li> <li>• Contain and dispose contaminated waste and PPE properly.</li> <li>• Wash laboratory coats separately from other clothes and ideally they should not be brought home.</li> <li>• Clean and disinfect biomedical equipment such as endoscopes, surgical instruments, patient care equipment like thermometers and glucose monitoring devices properly.</li> <li>• Clean and disinfect shared toys between patient use (in paediatrics) properly.</li> <li>• Maintain a distance of at least one metre between symptomatic and non-symptomatic patients in the waiting room.</li> </ul>

Hierarchical approach	Examples of control measures to reduce exposure
<b>Administrative Controls</b>	<ul style="list-style-type: none"> <li>Educate and train staff on hazards and effects as well as safe work practices.</li> </ul>
<b>Personal Protective Equipment</b>	<ul style="list-style-type: none"> <li>Use appropriate eye protection such as safety goggles or face shields.</li> <li>Use impervious aprons.</li> <li>Wear appropriate gloves.</li> <li>Wear rubber boots or plastic overshoes where the flooring/ground is likely to be contaminated.</li> </ul>

## 6.2.6 Biological Matter

Exposure to certain animal proteins and vegetable matter can cause allergies, dermatitis and occupational asthma.

### Vegetable Matter

Workers exposed to vegetable matter such as wheat, soybean, buckwheat and other cereal flours, raw cotton fibres and other vegetable proteins can develop asthma or dermatitis. In the healthcare setting, this might occur in the kitchens and animal research facilities. The organisation should assess the exposure risk and implement control measures such as improved ventilation, local exhaust ventilation, safe work practices and use of appropriate PPE.

### Control Measures

Hierarchical approach	Examples of control measures to reduce exposure
<b>Engineering Controls</b>	<ul style="list-style-type: none"> <li>Consider enclosing the weighing and sifting process.</li> <li>Automate the sifting process.</li> <li>Use local exhaust ventilation together with enclosure for sifting process.</li> </ul>
<b>Safe Work Practices</b>	<ul style="list-style-type: none"> <li>Transfer flour or animal feed in such a way to minimise generation of dust.</li> <li>Wet cleaning of dusty areas.</li> <li>Implement a Respiratory Protection Programme if respirators are used.</li> </ul>
<b>Personal Protective Equipment</b>	<ul style="list-style-type: none"> <li>Use appropriate respirators, fit-tested if necessary.</li> <li>Wear apron.</li> <li>Wear non-slip shoes.</li> <li>Wear gloves.</li> </ul>

### Mode of Exposure

Workers are exposed to vegetable matter through direct contact or by inhalation.

### Exposure Situations/Procedures

- Use cereal flours in food preparation such as sifting or addition of flour.
- Transfer animal feed to smaller containers.

### Workers at Risk

- Kitchen aides and cooks; and
- Animal husbandry workers.

## Animal Proteins

Researchers and veterinary workers who handle animals may develop occupational asthma or dermatitis due to inhalation of or direct contact with animal proteins found in fur, dried secretions and excreta of animal. In the kitchens, employees can be exposed to animal proteins as they handle fish and meat in food preparation.

### Exposure Situations/Procedures

- Handle animals in animal research facilities;
- Use cell lines in research laboratories;

- Use animal tissues/parts in research laboratories;
- Handle various meats in food preparation; and
- Work in biomedical research facilities.

### Workers at Risk

- Animal husbandry workers;
- Animal researchers;
- Biomedical researchers; and
- Kitchen workers.

## Control Measures

Hierarchical approach	Examples of control measures to reduce exposure
<b>Engineering Controls</b>	<ul style="list-style-type: none"> <li>• Ensure proper ventilation, air flow and sufficient air exchange.</li> <li>• Provide Local Exhaust Ventilation (LEV) and well-designed ventilation in animal housing areas.</li> <li>• Use biological safety cabinets where appropriate.</li> </ul>
<b>Safe Work Practices</b>	<ul style="list-style-type: none"> <li>• Practise standard precautions.</li> <li>• Cover all open wounds with waterproof plaster.</li> <li>• PPE such as laboratory coats should not be worn outside the working areas.</li> <li>• Implement a Respiratory Protection Programme if respirators are used.</li> </ul>
<b>Administrative Controls</b>	<ul style="list-style-type: none"> <li>• Educate and raise awareness amongst staff.</li> </ul>

## Hierarchical approach

### Personal Protective Equipment

- Use respirators where appropriate (fit-tested).
- Wear eye protection.
- Wear gloves.
- Use impervious aprons.
- Wear appropriate shoes.

### Further information can be obtained from:

- HSE, UK: Biological agents: Managing the risks in laboratories and healthcare premises
- World Health Organisation (WHO): Laboratory Biosafety Manual 3rd edition
- MOH: Guidelines for Preventing Transmission of Bloodborne Infections in a Healthcare Setting
- CDC, USA: Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings
- CDC, USA: Guidelines for Infection Control in Dental Healthcare Settings

## 6.3 Physical Hazards

### 6.3.1 Falls from Heights

Falling from height is one of the major causes of fatalities and injuries in the workplace, including the healthcare industry. Especially for smaller establishments such as private general practitioner (GP) clinics and optical retail shops where space is a constraint, storage cupboards are usually built right up to the ceiling. These workplaces should be equipped with ladders so that employees can access heights safely. The safe use of ladders is important to ensure that employees are protected from the risk of falling from heights.

#### Good work practices when working with ladders are:

- Use the right ladder for the job;
- Place the ladder on stable and level ground;
- Wear proper footwear e.g. non-slip flat shoes;
- Maintain three points of contact with the ladder at all times; and
- Do not work on the top rung of the ladder.

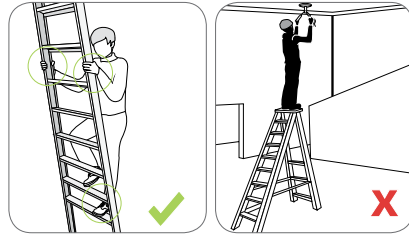


Figure 10 (a): Always maintain three-point contact with the ladder at all times.

Figure 10 (b): Do not work on the top rung of the ladder.

### 6.3.2 Slips, Trips and Falls

Slippery or uneven surfaces are commonly observed workplace hazards in healthcare facilities. Other conditions that can also contribute to slips, trips and falls include insufficient lighting, poor housekeeping, spills, wet and slippery flooring, lack of proper handholds and/or carelessness of individuals.

Some preventive measures for slips and trips are:

- Clean up spills immediately;
- Erect signs to warn passer-bys about slippery floors during and after cleaning;
- Provide and ensure the usage of proper footwear such as anti-slip shoes;
- Practise good housekeeping;
- Keep floors and stairs dry and clean;
- Use anti-slip mats in areas that are often wet or slippery e.g. shower facilities; and
- Keep walkways free of obstruction.

### 6.3.3 Ergonomics

Ergonomics is the science of fitting the job to the worker, the design of equipment and work tasks to conform to the capability of the worker. Musculoskeletal disorders can result from a mismatch between the capabilities of the workers, the equipment and the work task. Adjusting the work environment and work practices can prevent injuries before they occur.

Healthcare employees are at risk when handling, lifting or transferring patients and residents.

Increased ergonomic risk can occur from patient handling tasks such as:

- Repetitive e.g., repeatedly cranking manual adjustments for beds;
- Done in awkward postures e.g., reaching across beds to lift patients/residents;
- Done using a great deal of force e.g. pushing chairs or gurneys across elevation changes or up ramps; and
- Lift heavy objects e.g., manually lifting immobile patients/residents alone.

Other hazards include:

- Overexertion e.g. trying to stop a patient/resident from falling or picking patient/resident up from floor or bed;
- Multiple lifts per shift;
- Lifting alone with no available staff to help;

- Lifting patients who cannot support their own weight or who are overweight;
- Working beyond one's physical capabilities;
- Distance to be moved, and the distance the patient/resident is from the employee, (it is more stressful to reach away from the body to lift or pull a patient/resident);
- Awkward postures:
  - Twisting of the back or neck;
  - Bending – lateral or side bending, bending over;
  - Reaching above shoulder height, kneeling, squatting, or leaning over a bed;
  - Fixed awkward postures can contribute to development of musculoskeletal disorders. The use of inappropriately designed equipment or tools can contribute to the development of musculoskeletal disorders as it would require the worker to adopt awkward postures when using it; and
- Employee exposure to ergonomic stressors in healthcare workplaces occurs not only during patient-handling tasks but also while performing other tasks as well in the kitchen, laundry, engineering, pharmacy and housekeeping areas of facilities, for example during the transportation of equipment, moving food carts or other heavy carts, preparing medications in biological safety cabinets, pouring liquids out of

heavy pots or containers, reaching into deep sinks or containers, using hand tools, and during housekeeping tasks.

## Control Measures

### Handling, Lifting or Transferring Patients

Mechanical lifting equipment such as the following can help lift patients who cannot support their own weight.

- Overhead track mounted patient lifters built into the ceiling can be used to move patients from room to room without manual lifting;
- Lateral transfer devices used to laterally transfer the patient/resident for example from bed to gurney. They usually involve multiple staff members to help do the lifting. This is often done with the help of a draw sheet, or similar device. Some new lateral transfer systems do not require any lifting by staff, and are totally mechanical. This type of device helps prevent back injuries in staff; and
- Avoid awkward postures while lifting or moving patients. The worker should adopt proper lifting techniques and use assist devices and other equipment to reduce excessive lifting hazards. Two or more persons may be deployed to lift heavy loads.

Boards and sheets can be used to help move patients and these include:

- Sliding boards/patient slides: A slick board used under patients/resident to help reduce the need for lifting during

the transfer of patient/resident from bed to chair, or chair to car. Patients/residents are slid rather than lifted;

- Slip sheets/roller sheets: Help to reduce friction while laterally transferring patients/residents or repositioning patients/residents in bed and to help reduce the force workers need to exert to move the patient/resident;
- Height adjustable electric beds that have height controls to allow for easy transfers from bed height to wheelchair height. These beds can be kept low to the ground for patient/resident safety and then raised up for interaction with staff. Avoid hand cranked beds, which can lead to wrist/shoulder musculoskeletal disorders such as strain or repetitive motion injuries; and
- Wheelchairs with removable arms to allow for easier lateral transfers, especially useful with height adjustable beds.

When lifting patients or loads:

- Never transfer patients when off balance;
- Lift loads close to the body;
- Never lift alone, particularly fallen patients/resident, use team lifts or use mechanical assistance;
- Limit the number of allowed lifts per employee per day;
- Avoid heavy lifting especially with spine rotated; and
- Training on when and how to use mechanical assistance.

Transferring or moving items or objects:

- Place equipment on a rolling device if possible to allow for easier transport, or have wheels attached to the equipment;
- Push rather than pull equipment when possible. Keep arms close to your body and push with your whole body not just your arms;
- Get help when moving heavy or bulky equipment or equipment that you cannot see over;
- Do not transport multiple items alone;
- Ensure that passageways are unobstructed; and
- Attach handles to equipment to help with the transfer process.

### Reaching and Lifting Tasks

Limit excessive reaching and back flexion when reaching into deep sinks or containers by:

- Placing an object such as a plastic basin in the bottom of the sink to raise the surface up while washing items in the sink; or
- Removing objects to be washed into a smaller container on the counter for scrubbing or soaking and replacing back in the sink for final rinse.

Limit reaching or lifting hazards when lifting trash, laundry or other kinds of bags by:

- Using handling bags for laundry, garbage and housekeeping when possible that have side openings to allow for easy disposal without

reaching into and pulling bags up and out. The bags should be able to slide off the cart without lifting;

- Limiting the size and weight of these bags and provide handles to further decrease lifting hazards;
- Placing receptacles in unobstructed and easy to reach places;
- Installing chutes and dumpsters at or below grade level; and
- Using spring-loaded platforms to help lift items such as laundry, keeping work at a comfortable uniform level.

Limit reaching and pushing hazards from moving heavy laundry, carts and housekeeping by:

- Keeping carts, hampers or gurneys well maintained to minimise the amount of force exerted while using these items;
- Using carts with large, low rolling resistance wheels. These can usually roll easily over mixed flooring as well as gaps between elevators and hallways;
- Keeping handles of devices to be pushed at waist to chest height;
- Using handles to move carts rather than the side of the cart to prevent the accidental smashing of hands and fingers;
- Pushing rather than pulling whenever possible;
- Getting help to move heavy or bulky items; and
- Keeping floors clean and well maintained.



### Housekeeping Tasks

Employees can reduce ergonomic risks during housekeeping by:

- Using carts to transport supplies rather than carrying;
- Avoiding awkward postures while cleaning (e.g. twisting and bending);
- Alternating tasks or rotate employees through stressful tasks; and
- Avoiding tight and static grip and using padded non-slip handles.

### Hand Tools

Limit strains and sprains of the wrists, arms, and shoulders, of maintenance workers by choosing hand tools carefully. Hand tools should:

- Be properly designed, and fit to the user;
- Have padded non-slip handles;
- Allow the wrist to remain straight while doing finger intensive tasks. Select ergonomic tools such as ergonomic knives or bent-handled pliers;
- Have minimal tool weight; and
- Have minimal vibration or use vibration dampening devices and vibration-dampening gloves.

### Ergonomics Programme

An ergonomics programme provides a systematic approach for the organisation to manage ergonomic risks and issues at the workplace. The establishment of the programme allows the organisation to

make better informed choices and help create a safety culture that promotes good ergonomics at work.

The key elements in an ergonomics programme include:

- Management commitment and policy;
- Employee involvement;
- Training and education;
- Hazard identification;
- Workplace monitoring, reporting and medical management;
- Implementation of control measures; and
- Evaluation and review.

To understand more about implementing an ergonomics programme, reference can be made to the WSH Guidelines on Improving Ergonomics in the Workplace.

### 6.3.4 Noise

In a healthcare facility, excessive noise levels can be encountered in compressor rooms, workshops, laundry areas, orthotics, plaster rooms and dental centres/clinics.

Noise exposure limits are expressed in decibels (dB(A)). A decibel is the sound pressure level reading obtained on the A scale of a sound level meter at slow response. The A scale contains the frequency range of the human ear.

Prolonged exposure to excessive noise can cause noise-induced hearing loss

(NIHL), other detrimental effects of excessive noise exposure include tinnitus, acoustic trauma, interference with speech communication and with perception of warning signs, disruption of job performance, annoyance and extra-auditory effects.

Healthcare personnel at risk include workshop technicians, laundry staff, facilities management staff, nurses and doctors/dentists working in orthotics, plaster rooms and dental centres/clinics. Employees should not be exposed to excessive noise beyond the stipulated limits in the WSH (Noise) Regulations 2011.

### Control Measures

Hierarchical approach	Examples of control measures to reduce exposure
<b>Elimination/Substitution</b>	<ul style="list-style-type: none"> <li>• Replace metal-to-metal contact with synthetic material-to-metal contact.</li> </ul>
<b>Engineering Controls</b>	<ul style="list-style-type: none"> <li>• Provide enclosures with acoustical foam lining for noisy compressors and equipment.</li> <li>• Acoustical treatment of walls to reduce noise reflection.</li> <li>• Apply vibration damping to noisy machines using springs or elastomers.</li> </ul>
<b>Administrative Controls</b>	<ul style="list-style-type: none"> <li>• Limit persons' exposure time to excessive noise through job rotation.</li> </ul>
<b>Personal Protective Equipment</b>	<ul style="list-style-type: none"> <li>• Provide suitable personal hearing protectors to all persons exposed to excessive noise and ensuring their usage.</li> </ul>

The control of excessive noise can be supported by establishing an effective hearing conservation programme (HCP) whenever employee noise exposures equal or exceed eight hour time weighted average (TWA) sound level of 85 dB(A).

The hearing conservation programme should include:

- Monitoring of noise exposure levels for identification of noise hazard and evaluation of the risks involved;
- Implementation of reasonably practicable noise control measures, such as engineering and administrative controls to minimise the risk from noise;
- Provision of suitable personal hearing protectors to all persons exposed to excessive noise and ensuring their usage;
- Training and educating all persons involved in HCP, including management, HCP team members and all employees who are exposed to excessive noise, to increase their awareness of noise hazards and their prevention;
- Conducting annual audiometric examinations for employees exposed to excessive noise by a Designated Workplace Doctor for detection of early hearing impairment. The results must be submitted to MOM;
- Keeping records and documenting the measures taken to protect employees from noise; and

- Evaluating HCP to determine its effectiveness and areas for improvements.

Employees diagnosed with noise-induced deafness (NID) have to be notified to MOM at [www.mom.gov.sg/ireport](http://www.mom.gov.sg/ireport). NID is a notifiable and compensable occupational disease.

#### Further information can be obtained from:

- WSH (Noise) Regulations 2011
- WSH (Medical Examinations) Regulations, 2011
- WSH (Incident Reporting) Regulations, 2006
- Work Injury Compensation Act, 2008
- Singapore Standard CP 99: 2003 Code of Practice for Industrial noise control
- MOM: Guidelines for Noise Control and Vibration
- WSH Council: WSH Guidelines on Hearing Conservation Programme

### 6.3.5 Vibration

Noisy processes are often associated with vibration. Intense vibration may be transmitted to persons who operate certain vehicles, equipment (e.g. grinders and cutters in prosthesis workshop) and hand held tools (e.g. dental ultrasonic scalers and vibrators, bone drills/saws in operating theatres).

Where persons are exposed to whole body or hand-arm vibration, the exposure must be controlled and maintained within limits to protect them from adverse health effects.

Healthcare personnel at risk include workshop technicians, dentists, doctors and nurses working in orthotics, plaster rooms, operating theatres and dental centres/clinics and cleaners.

#### Control Measures

Hierarchical approach	Examples of control measures to reduce exposure
<b>Elimination/Substitution</b>	• Procure low vibration equipment and tools in replacement of high-vibration ones.
<b>Safe Work Practices</b>	• Ensure all equipment and hand tools are maintained in good condition.
<b>Administrative Controls</b>	• Design work breaks to avoid long periods of vibration exposure. • Provide information and training to affected personnel on the hazard, signs of injury and ways to minimise risk and report any symptoms.

#### Further information can be obtained from:

- MOM: Guidelines for Noise Control and Vibration

### 6.3.6 Ionising Radiation

The Radiation Protection Act and its Subsidiary Legislation on Ionising Radiation covers radioactive materials and ionising radiation generating apparatus used in the healthcare industry. The radioactive wastes generated are also governed by these legislations.

To own and use the radioactive materials and apparatus, healthcare establishments need to apply for the appropriate licences from the Radiation Protection & Nuclear Science Department (RPNSD), National Environment Agency (NEA).

#### Radiation Exposure in Healthcare

Healthcare employees may be exposed to ionising radiation from portable and fixed X-ray machines, radioactive materials used in nuclear medicine and other ionising radiation generating devices. The effects of radiation exposure include the following.

- **Deterministic effects**
  - Erythema and dermatitis;
  - Cataract;
  - Bone marrow suppression; and
  - Temporary or permanent sterilisation.
- **Large whole-body exposures cause:**
  - Nausea;
  - Vomiting;
  - Diarrhoea;
  - Weakness; and
  - Death.

- **Stochastic effects**

Cancer: Genetic effects may lead to congenital defects in the employee's offspring (i.e. hereditary effects).

Exposure to radiation can occur in the following situations.

- Unprotected employees, bystanders and members of the public who are near an irradiating machine in operation or radionuclide sources. The amount of exposure depends on the amount of radiation, duration of exposure, distance from the source and type of shielding in place.
- Employees can be exposed to radioactive isotopes or specimens and excreta of humans and animals who have received radioisotopes.
- Exposure may come from patients undergoing nuclear medicine procedures.
- Exposure may also result from handling of radioactive spills.
- Poorly maintained machinery and improperly designed facility/room.
- Spent sources of radioactive materials or contaminated materials which are not properly stored or handled.

#### Exposure Monitoring

- Thermoluminescent dosimetry badges or their equivalent should be used for long-term monitoring of personnel;
- Radiation monitoring equipment should be used to monitor the working environment;

- Appropriate personnel monitoring equipment such as film badges, pocket chambers, pocket dosimeters or film rings should be used to monitor healthcare workers who may be exposed to radiation hazards; and
- Records of the radiation exposure of the employees should be kept and the employee should be advised of his individual exposures as according to licensing conditions.

#### Control Measures

Hierarchical approach	Examples of control measures to reduce exposure
<b>Elimination/Substitution</b>	<ul style="list-style-type: none"> <li>• Consider X-ray machines that can operate with a smaller electric current when buying new X-ray machines.</li> <li>• Use advanced (digital) screen/material so that X-ray operating at a smaller electric current can still give the same picture quality.</li> </ul>
<b>Engineering Controls</b>	<ul style="list-style-type: none"> <li>• Operate the X-ray and other (portable) irradiation devices with adequate shielding in accordance to the Radiation Protection Act and Regulations.</li> <li>• Run procedures remotely from control panel in adjacent room, where practicable. e.g. remote fluoroscopy.</li> <li>• Use lead glass as a barrier to protect against radiation exposure when procedures must be done close to the patient.</li> <li>• Use lead strips during fluoroscopic procedures.</li> <li>• Provide lead shields for syringes or vials containing radioisotopes.</li> </ul>
<b>Safe Work Practices</b>	<ul style="list-style-type: none"> <li>• Give adequate warning to surrounding staff or members of the public before operating X-ray machines.</li> <li>• Establish a preventive and corrective maintenance programme for X-ray machines with specific personnel responsible for assuring proper maintenance of the X-ray machines.</li> <li>• Establish a contamination monitoring plan for all work areas where radioactive materials are used, handled or stored.</li> <li>• Implement SWPs for cleaning up of contaminated work areas.</li> </ul>

Hierarchical approach	Examples of control measures to reduce exposure
	<ul style="list-style-type: none"> <li>• Provide a separate storage area for radioactive sources. This area should be adequately shielded. Only authorised personnel should have access to such a storage area.</li> <li>• Provide proper cleaning agents for cleaning of work areas and hands.</li> </ul>
<b>Administrative Controls</b>	<ul style="list-style-type: none"> <li>• Obtain appropriate licenses to own irradiating apparatus and radioactive materials.</li> <li>• To operate an irradiation apparatus, appropriate licences need to be obtained from the regulatory authority. These licences are only issued to qualified medical practitioners who have the necessary knowledge on the safe use of these apparatus.</li> <li>• To use radioactive materials (for medical purposes), appropriate licences need to be obtained from the regulatory authority. These licences are only issued to qualified/relevant medical practitioners who have the necessary knowledge on the safe use of these materials.</li> <li>• Establish guidelines to manage patients who are undergoing nuclear medicine procedures.</li> <li>• Document and retain inventories of radioactive materials.</li> </ul>
<b>Personal Protective Equipment</b>	<ul style="list-style-type: none"> <li>• Provision of proper PPE e.g. leads aprons, lead gloves, thyroid shields and lead goggles.</li> </ul>

## Radioactive Waste Management

Unusable radioactive materials and articles/things contaminated by radioactive materials are generally considered radioactive waste. Radiation protection legislations do not allow such waste to be disposed off or accumulated without the approval of the Director-General for Environment Protection.

Two main types of radioactive waste can be found in the healthcare establishments:

- Low level radioactive waste (solid and liquid); and
- Spent sealed sources (solid).

## Control Measures

Hierarchical approach	Examples of control measures to reduce exposure
<b>Safe Work Practices</b>	<ul style="list-style-type: none"> <li>• Prepare a separate storage area for radioactive waste and the area should be adequately shielded.</li> </ul>
<b>Administrative Controls</b>	<ul style="list-style-type: none"> <li>• Healthcare establishments should establish a safety committee or a radiation safety officer to be responsible for the disposal of radioactive waste.</li> <li>• Authorised personnel should have access to such storage areas.</li> </ul>

Disposal of radioactive waste from any healthcare establishment requires approval from the establishment's internal committee or officer responsible for radiation safety. In addition, written consent from RPNSD is needed before the disposal can be carried out.

Healthcare establishments are advised to consult RPNSD on matters relating to the disposal of such waste.

### Further information can be obtained from:

- Radiation Protection Act 2007
- Radiation Protection (Ionising Radiation) Regulations
- National Environment Agency, Singapore Radiation Protection <http://app2.nea.gov.sg/anti-pollution-radiation-protection/radiation-protection>
- European Commission Nuclear energy – Radiation protection [http://ec.europa.eu/energy/nuclear/radiation\\_protection/radiation\\_protection\\_en.htm](http://ec.europa.eu/energy/nuclear/radiation_protection/radiation_protection_en.htm)
- Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) Radiation Health Series <http://www.arpansa.gov.au/publications/codes/rhs.cfm>

- US Department of Energy (DOE), Office of Environment Health, Safety & Security, Nuclear safety, policy, guidance & reports <http://energy.gov/ehss/policy-guidance-reports/nuclear-safety-policy-guidance-reports>
- International Commission on Radiological Protection (ICRP) <http://www.icrp.org>
- International Atomic Energy Agency <http://www.iaea.org/>
- National Council on Radiation Protection & Measurements (NCRP) <http://www.ncrponline.org/>
- United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) <http://www.unscear.org/>

All URLs on this page were current as of 11 August 2014.

## 6.3.7 Non-ionising Radiation

The Radiation Protection Act and Subsidiary Legislation on Non-ionising Radiation apply to the following types of medical irradiating devices:

- High power lasers;
- Medical ultrasound apparatus;
- Magnetic Resonance Imaging (MRI) apparatus; and
- Ultraviolet sunlamps.

Healthcare establishments need to obtain the appropriate licences to own and/or to operate irradiating apparatus.

### Laser

A laser is a device that emits intense coherent light through a special mechanism called stimulated emission. As a light source, a laser can have various properties, depending on the purpose for which it is designed and calibrated.

The four classes of lasers are:

**Class I** – Least-hazardous class, it is considered incapable of providing damaging levels of laser emissions. Used in laser printers and compact disc players.

**Class II** – Applies only to visible laser emissions and may be viewed directly for time periods of less than or equal to 0.25 seconds, which is the aversion response time. Some laser pointers and laser barcode scanners belong to this class. Continuous lasers in this class operate at a power of less than 0.001 W.

**Class IIIa** – Dangerous under direct or reflected vision, this class includes lasers that emit both invisible and visible electromagnetic spectrum.

Many laser pointers belong to this class. Continuous lasers in this class operate at a power in the range 0.001 – 0.005 W.

**Class IIIb** – Considered as a high power laser, this class may extend across the whole electromagnetic spectrum and are hazardous when viewed intrabeam. Lasers in this class are used in physiotherapy treatments and for research purposes. Continuous lasers in this class operate at a power of less than 0.5 W.

**Class IV** – This class of laser has the highest energy. It also extends across the whole electromagnetic spectrum. It presents significant fire, skin, and eye hazards. Class 4 lasers are used for laser displays, laser surgery and cutting metals.

### Exposure to Lasers in Healthcare

Exposure of healthcare workers to lasers can occur in the operating rooms during excision and cauterisation of tissues, where Class IIIb and Class IV lasers are most often used. Exposure usually occurs from unintentional operation and/or when proper controls are not in effect. Direct beam exposure can cause burns to the skin and eyes, resulting in possibly blindness. The electric current used to generate the beam is a potential shock hazard. Fire is another major concern when using lasers.



Laser beam should be kept away from any flammable liquid, gases or

any flammable object that can emit flammable vapour.

## Control Measures

Hierarchical approach	Examples of control measures to reduce exposure
<b>Engineering Controls</b>	<ul style="list-style-type: none"> <li>• Use portable smoke evacuators and room suction systems.</li> <li>• Insulate/ground laser systems adequately, especially those with high voltage capacitance.</li> <li>• Attach bleeders and proper grounding to the system.</li> <li>• All doors to operating rooms that house lasers should contain safety interlocks which shutdown the laser system if anyone enters the room.</li> <li>• Cover or black out all windows in laser surgical areas to protect employees outside the surgical area.</li> </ul>
<b>Safe Work Practices</b>	<ul style="list-style-type: none"> <li>• Establish a preventive and corrective maintenance programme for laser machines with specific personnel responsible for assuring proper maintenance of this equipment. Only qualified personnel (with the appropriate licences) should maintain the system. Maintenance may only be done according to written standard operating procedures.</li> <li>• Laser operators should check the laser system before each procedure and during extended procedures. Classifications of lasers should coincide with actual power output. Generally, power measurement is required when the manufacturer's information is not available, if the laser system has not been classified, or if alterations have been made to the laser system that may have changed its classification. Only personnel trained in laser technology should make measurements.</li> </ul>
<b>Administrative Controls</b>	<ul style="list-style-type: none"> <li>• Ensure all personnel using such equipment are trained in the proper usage. Only personnel with the appropriate licence are allowed to use Class IIIb and Class IV laser devices.</li> <li>• Provide warning signs in areas where exposure to lasers is likely.</li> </ul>

## Hierarchical approach

## Examples of control measures to reduce exposure

- Provide proper PPE, e.g. protective clothing (laboratory jacket or coat can provide protection for the arms. For Class IV lasers, consideration should be given to flame resistant materials), gloves (tightly woven fabrics and opaque gloves provide the best protection) and laser protective eyewear (wavelength of the laser is the most important factor in determining the type of eye protection to be used).

## Personal Protective Equipment

- Provide skin covers and/or "sun screen" creams is recommended for ultraviolet lasers (200-400nm).

## Further information can be obtained from:

- Radiation Protection Act 2007
- Radiation Protection (Non-Ionising Radiation) Regulations

## Exposure to Laser Plume in Healthcare

During surgical procedures that use a laser or electro-surgical unit, the thermal destruction of tissue creates smoke as a by-product. Consequently, healthcare workers may be exposed to laser or electro-surgical smoke.

### Potential Hazards

Research has shown that the laser smoke plume can contain toxic gases and vapours such as benzene, hydrogen cyanide, and formaldehyde, bio-aerosols, dead and live cellular material (including blood fragments), and viruses.

At high concentrations, the smoke causes ocular and upper respiratory tract irritation in healthcare workers, and creates visual problems for the surgeon. The smoke has unpleasant odours and has been shown to have mutagenic potential. Although there has been no documented transmission of infectious disease through surgical smoke, the potential to generate infectious viral fragments, particularly following treatment of venereal warts, may exist. The smoke may act as a vector for cancerous cells which may be inhaled by the surgical team and other exposed individuals. Note that the laser beam may ignite the plume or biological vapours.

## Control Measures

Hierarchical approach	Examples of control measures to reduce exposure
<b>Engineering Controls</b>	<ul style="list-style-type: none"> <li>Use portable smoke evacuators and room suction systems.</li> </ul>
<b>Safe Work Practices</b>	<ul style="list-style-type: none"> <li>Keep the smoke evacuator or room suction hose nozzle inlet as close as possible (within one diameter of the suction hose) to the surgical site to effectively capture airborne contaminants.</li> <li>Keep smoke evacuator switched on (activated) at all times when airborne particles are produced during all surgical or other procedures.</li> <li>Consider all tubing, filter and absorbers as infectious waste and dispose of them appropriately.</li> <li>Install new filters and tubing before each procedure.</li> </ul>

### Hierarchical approach

### Examples of control measures to reduce exposure

- Inspect smoke evacuator systems regularly to prevent possible leaks.
- Practise Standard Precautions<sup>4</sup>.

### Personal Protective Equipment

- Provide proper PPE e.g. gloves and laser protective eyewear.

### Further information can be obtained from:

- CDC, NIOSH: Hazard Controls - Control of Smoke from Laser/Electric Surgical Procedures

<sup>4</sup>Standard Precautions are based on the principle that all blood, body fluids, secretions, excretions except sweat, nonintact skin, and mucus membranes may contain transmissible infectious agents. Standard Precautions include a group of infection prevention practices that apply to all patients, regardless of suspected or confirmed infection status, in any setting in which healthcare is delivered.\*

For more details on Standard Precautions, refer to the "Guidelines for Preventing Transmission of Bloodborne Infections in a Healthcare Setting", published by the Ministry of Health (MOH) Singapore.

\* Excerpt from CDC: Guideline for Isolation Precautions 2007. [http://www.cdc.gov/hicpac/2007ip/2007ip\\_part3.html](http://www.cdc.gov/hicpac/2007ip/2007ip_part3.html)

## Medical Ultrasound

Medical ultrasound apparatus are used for diagnostic, therapeutic and surgical purposes. They emit ultrasound at acoustic frequencies above 16 kHz.

Since these apparatus are electrical devices, care must also be taken to avoid any possible electrical incidents.

### Control Measures

Hierarchical approach	Examples of control measures to reduce exposure
<b>Safe Work Practices</b>	<ul style="list-style-type: none"> <li>• Implement an inspection plan to detect possible wear and tear, which can expose current conducting parts on the apparatus.</li> <li>• Put in place quality control procedures and testing programme to ensure apparatus performance specifications are met.</li> </ul>
<b>Administrative Controls</b>	<ul style="list-style-type: none"> <li>• Only qualified personnel are allowed to operate the apparatus.</li> <li>• A licence is needed to possess/own such apparatus.</li> </ul>

#### Further information can be obtained from:

- Radiation Protection Act 2007
- Radiation Protection (Non-Ionising Radiation) Regulations
- Academy of Medicine, Singapore: Guidelines on the Use of Ultrasound in Medicine

## Magnetic Resonance Imaging

Magnetic resonance imaging (MRI) apparatus emit strong magnetic fields and radiofrequency radiation for the purpose of imaging or spectroscopy of the human body.

Strong magnetic fields may have harmful effect on the human body. In addition, strong magnetic fields may propel small objects and lead to physical injury if there is no proper shielding. Since these apparatus are electrical devices, care must also be taken to avoid any possible electrical incidents.

### Control Measures

Hierarchical approach	Examples of control measures to reduce exposure
<b>Safe Work Practices</b>	<ul style="list-style-type: none"> <li>• Implement an inspection plan to detect possible wear and tear, which can expose current conducting parts on the apparatus.</li> </ul>
<b>Administrative Controls</b>	<ul style="list-style-type: none"> <li>• Only qualified personnel are allowed to operate the apparatus.</li> <li>• A license is needed to possess/own such apparatus.</li> <li>• Install proper warning signs to alert people of the high magnetic field in the vicinity and its dangers.</li> <li>• Install proper warning signs to alert people of the generation of radiofrequency radiation.</li> </ul>

#### Further information can be obtained from:

- Radiation Protection Act 2007
- Radiation Protection (Non-Ionising Radiation) Regulations

## Ultraviolet Sunlamps

These are apparatus that emit ultraviolet radiation ( $\lambda = 180 - 400 \text{ nm}$ ) to induce skin tanning or other cosmetic effects.

Since these apparatus are electrical devices, care must also be taken to avoid any possible electrical incidents.

## Control Measures

Hierarchical approach	Examples of control measures to reduce exposure
<b>Engineering Controls</b>	<ul style="list-style-type: none"> <li>Ensure that the appropriate safety features are built into the apparatus.</li> </ul>
<b>Safe Work Practices</b>	<ul style="list-style-type: none"> <li>Implement an inspection plan to detect possible wear and tear, which can expose current conducting parts on the apparatus.</li> <li>Put in place quality control procedures and testing programmes to ensure apparatus performance specifications are met.</li> </ul>
<b>Administrative Controls</b>	<ul style="list-style-type: none"> <li>Only qualified personnel are allowed to operate this apparatus.</li> <li>A license is needed to possess/own such apparatus.</li> </ul>
<b>Personal Protective Equipment</b>	<ul style="list-style-type: none"> <li>Provision of proper PPE e.g. protective eyewear.</li> </ul>

### Further information can be obtained from:

- Radiation Protection Act 2007
- Radiation Protection (Non-Ionising Radiation) Regulations

## 6.3.8 Sharps

'Sharps' are objects with a thin cutting edge or point that are able to cause injuries such as cuts, lacerations or puncture wounds. These include scalpels and blades, suture and injection needles, knives, machinery and cutting devices, and broken glass and porcelain.

### Management System

An effective sharps management programme should have the following elements.

### Management Policy and Strategy

Management support with the provision of clear goals, responsibilities and resources is vital for a successful programme. Involvement of employees is important as they are most familiar with the hazards at the workplace.

### Identification of Hazards

Areas and processes where there are risks of sharps injuries should be systematically identified from information from injury and illness data, workers' compensation claims, near miss investigation reports, insurance company reports, employee interviews, employee surveys and workplace observations.

### Risk Assessment and Risk Control

The risks should be controlled at source where possible first, and risk control measures implemented to mitigate the risks based on the hierarchy of control.

### Post-Exposure Programme

In the event that a sharps injury does occur, a post exposure programme should be in place to cope with injured employees who have been exposed to occupational infections, biological matter and chemicals. Treatment given would depend on what the exposure was and address fitness to work.

### Health Surveillance

There should be a health surveillance system in place to monitor work-related ill health in sharps exposed employees.

### Prevention

- Vaccinations
  - Where certain occupational infections due to sharps injuries can be prevented by vaccinations, a vaccination programme should be implemented such as for Hepatitis B.
- Case finding, incident reporting and investigation
  - A system should be set up to report and investigate all cases of sharps injuries and near-misses. This system should also ensure that legislative requirements for reporting are met. Results of such investigations and the controls implemented should also be documented.
- Record keeping
  - Records of sharps exposures, interventions and any worker follow-up should be properly kept and maintained. Reporting of any occupational disease that occurs as

a result of sharps exposure is required under the current WSH Act. The report should be kept for at least five years or longer where appropriate.

- Education and training
  - All employees working in areas where there is potential for sharps exposure should be trained in the proper use of sharps, usage of PPE where appropriate, infection control policies, vaccinations, post-exposure prophylaxis and reporting procedures for occupational accidents and diseases. The training programme should also ensure that SWP are known and understood by all staff.
- Monitoring and review
  - Information on sharps injuries, mechanism, location, health effects should be analysed by management to ensure that the safety and health policy and procedures remain effective and relevant.

### Exposure Situations/Procedures

- Use of scalpels, blades, suture and injection needles, cutting devices and machinery in:
  - Operating theatres;
  - Wards;
  - Clinics;
  - Pharmacy and drug preparation areas;
  - Radiologic and radiotherapy facilities;
  - Clinical and research laboratories and facilities;

- Mortuaries; and
- Waste storage and treatment areas.
- Use of knives, cutting devices and equipment, and machinery in:
  - Kitchens; and
  - Engineering workshops.
- Handling sharps in:
  - Waste storage and treatment areas; and
  - Laundries.
- Handling of broken glass and porcelain by:
  - Nursing staff;
  - Laboratory staff;
  - Housekeeping staff;
  - Kitchen staff;
  - Laboratory staff; and
  - Waste disposal staff.

If the sharp objects are contaminated by either human or animal blood, bodily fluids, secretions and excrement, infections such as hepatitis B, hepatitis C, HIV and other infections could occur.

The sharps could also be contaminated by chemicals such as solvents, disinfectants, cytotoxic and other hazardous drugs, and radioactive material, resulting in adverse health effects.

### Workers at Risk

- Doctors;
- Dentists;
- Nurses;
- Patient care staff;
- Laboratory staff;
- Radiologic and radiotherapy staff;
- Pharmacy and related staff;
- Kitchen staff;
- Housekeeping staff;
- Waste disposal staff; and
- TCM practitioners.

### Control Measures

Hierarchical approach	Examples of control measures to reduce exposure
<b>Elimination/Substitution</b>	<ul style="list-style-type: none"> <li>• Reduce and/or eliminate use of sharps where possible.</li> <li>• Consider alternative methods of medication delivery, e.g. oral, topical etc.</li> <li>• Consider use of blunt-tip suture needles where applicable, e.g. muscle, soft tissue etc.</li> <li>• Consider needleless intravenous delivery systems.</li> <li>• Use an alternative method of food preparation if available.</li> </ul>
<b>Engineering Controls</b>	<ul style="list-style-type: none"> <li>• Use guarding for kitchen equipment such as mincers, food mixers, meat slicers and vegetable slicers.</li> <li>• Use sharps with safety features.</li> </ul>
<b>Safe Work Practices</b>	<ul style="list-style-type: none"> <li>• In clinical areas:               <ul style="list-style-type: none"> <li>- Avoid recapping of syringes;</li> <li>- If recapping cannot be avoided, use one handed recapping techniques with assistive devices;</li> <li>- Set up instrument trays with uniform orientation of all sharps;</li> <li>- Separate sharp from non-sharp equipment using instruments such as forceps;</li> <li>- Separate used from un-used sharps;</li> <li>- Use forceps to sort and dispose of sharp contaminated devices;</li> </ul> </li> </ul>



Hierarchical approach	Examples of control measures to reduce exposure
	<ul style="list-style-type: none"> <li>- Use labelled puncture proof containers for disposal;</li> <li>- Locate disposal containers close to immediate work area;</li> <li>- Never over fill sharps containers; and</li> <li>- Use containers designed to exclude hands/fingers.</li> </ul> <ul style="list-style-type: none"> <li>• In the operating theatre, in addition to the above:               <ul style="list-style-type: none"> <li>- Use verbal cues before passing sharp instruments;</li> <li>- Use instruments such as receptacle/tray/ container/forceps or other devices to pass sharps;</li> <li>- Use forceps/instruments for suturing and not hands; and</li> <li>- Use instruments for retraction of tissues.</li> </ul> </li> <li>• In the kitchen and other areas where there are machines:               <ul style="list-style-type: none"> <li>- Ensure safety guards are in place before using the machine;</li> <li>- Do not remove safety guarding or interlocks installed on machines;</li> <li>- Do not reach into moving parts of machines with fingers;</li> <li>- Follow manufacturer's or supplier's instructions when operating the machine;</li> <li>- Clean or maintain the machine only when power has been shut down;</li> <li>- Wash and clean sharp tools separately from other instruments or utensils;</li> <li>- Refrain from wearing loose or frayed clothing;</li> <li>- Kitchens – Knives:                   <ul style="list-style-type: none"> <li>- Use the right knife for the task at hand;</li> <li>- Use a flat surface or cutting board;</li> <li>- Ensure that the knife is sharp;</li> <li>- Store knives properly in a proper rack in a visible place;</li> <li>- Cut away from the body when trimming, deboning or cutting; and</li> <li>- Curl the fingers of the other hand over the object that is being cut.</li> </ul> </li> </ul> </li> </ul>

Hierarchical approach	Examples of control measures to reduce exposure
<b>Administrative Measures</b>	<ul style="list-style-type: none"> <li>• Establish a vaccination policy for all healthcare staff against vaccine preventable bloodborne infections.</li> <li>• Implement a prompt post exposure programme for injured healthcare workers.</li> <li>• Training and education in safe work practices (standard precautions) at induction for new workers and periodically for all healthcare workers.</li> <li>• Establish an improved reporting system for sharps injuries and their follow-up.</li> </ul>
<b>Personal Protective Equipment</b>	<ul style="list-style-type: none"> <li>• Wear mesh gloves when using knives when appropriate.</li> <li>• Use armoured gloves in operating theatres when working with sharp objects.</li> </ul>

**Further information can be obtained from:**

- WSH Council: WSH Guidelines for the Hospitality and Entertainment Industries
- CDC: Workbook for Designing, Implementing, and Evaluating a Sharps Injury Prevention Program

## 6.4 Psychosocial Hazards

Healthcare workers work in an environment that constantly change due to rapid advances in medicine, science and technology as well as having to meet international standards in patient care and clinical quality. Due to the complex nature of their work, involvement in direct patient care and time pressures make them more vulnerable to psychosocial threats to their well-being.

A simple definition of psychosocial hazards could be 'those aspects of the

design and management of work, and its social and organisational contexts, that have the potential for causing psychological or physical harm'. Some of the common psychosocial hazards at the workplace include issues relating to shift work, overtime work, stress and burnout, workplace aggression and violence and increased patient acuity. Should the need arise, access to counselling or emotional support for work related incidents should be made available to your employees.

The table below summarises the types of psychosocial risk factors and gives some examples.

### Psychosocial Risk Factors and Examples<sup>5</sup>

<b>Job Content</b>	Lack of variety or short work cycles, fragmented or meaningless work, under use of skills, higher uncertainty, continuous exposure to people through work.
<b>Workload and Work Pace</b>	Work overload or under load, machine pacing, high levels of time pressure, continually subject to deadlines.
<b>Work Schedule</b>	Shift working, night shifts, inflexible work schedules, unpredictable hours, long or unsociable hours.
<b>Control</b>	Low participation in decision making, lack of control over workload, pacing, shift work, etc.
<b>Environment and Equipment</b>	Inadequate equipment availability, suitability or maintenance; poor environmental conditions such as lack of space, poor lighting, excessive noise.
<b>Organisational culture and Function</b>	Poor communication, low levels of support for problem solving and personal development, lack of definition of, or agreement on, organisational objectives.
<b>Interpersonal Relationships at Work</b>	Social or physical isolation, poor relationships with superiors, interpersonal conflict, lack of social support.

<sup>5</sup>Stavroula Leka, *Towards the Development of a Psychosocial Risk Management Toolkit (PRIMAT)* The Global Occupational Health Network Newsletter, Issue No. 10 -2006.

### 6.4.1 Shift Work, Overtime, Stress and Burnout

#### Occurrence

Shift work, overtime and extended work times are an inherent part of the healthcare system. Stress and burnout could be a long term result of shift work and extended work times. The development of work-related stress is often a result of the complex interplay of multiple psychosocial hazards.

#### Effects of Exposure

##### Shift work

- Disturbance of circadian rhythm (biological clock);
- Sleep deprivation;
- Physical and mental health effects;
- Disruption of family and social life;
- Fatigue and burnout; and
- Increased risk of injuries/accidents.

#### Control Measures

There are two levels at which changes can be made to mitigate the effects of shift work.

##### Organisational changes

- Shift design and schedules can be adjusted so that staff have sufficient rest days;

##### Facilities:

- A work environment with adequate lighting and ventilation is important for all shifts;
- Provide rest facilities for all staff;
- Provision of adequate meal breaks; and
- Training and education on health and safety effects of shift work and techniques for recognition and reduction of stress.

##### Staff Stress Management

- As far as possible, adhere to regular eating patterns and good nutrition;
- Consider sleeping on a set schedule and obtaining sufficient sleep;
- Allow time for relaxation; and
- A regular exercise regime is recommended.

Management of shift work can be dealt with holistically in the programme for work-related stress.

#### Psychosocial Hazard Management System

The organisation should develop a policy to reduce workers' exposures to work-related stress. Buy-in from senior management is important for the success of the programme.

Programme for managing psychosocial exposures:

- Identify the hazards. The key areas of work that should be assessed include:
  - Demands;
  - Control;
  - Support;
  - Relationships;
  - Roles; and
  - Organisational change.
- Identify at risk employees:
  - This can be done through a survey questionnaire. In addition, existing records such as sickness absence, employee turnover and productivity records could also be reviewed. Regular debriefing sessions after severe and emotionally taxing events are also helpful in monitoring the psychosocial environment.
- Evaluation of risk:
  - The risk level can be evaluated based on the information in the previous two steps. Focus groups can be set up to explore possible solutions and the results communicated to the all employees.
- Record findings:
  - An action plan should be developed by both management and employees to address psychosocial hazards identified.

- Monitor and review:
  - The milestones in the action plan should be monitored. The effectiveness of the solutions could be evaluated by follow-up surveys.

**Further information can be obtained from:**

- Hans-Martin Hasselhorn, Allan Toomingas, Monica Lagerström: Occupational Health for Healthcare Workers: A Practical Guide, 1999
- CDC, NIOSH: Stress at Work
- HSE, UK: Stress - Management Standards

## 6.4.2 Workplace Harassment and Violence

Workplace aggression and violence is a recognised hazard, but the true extent may not be known as it is likely to be under-reported.

### Occurrence and Risk Factors

Workplace aggression and violence can range from verbal abuse, use of profanities and physical assaults. Aggression and violence can occur between staff, patient to staff and public to staff.

### Effects of Exposure

- Psychological trauma; and
- Physical injuries.

### Hazard Management System

A system should be put in place to reduce exposure of healthcare workers to violence and abuse.

The components should include:

- A clear policy known and understood to management and employees, it should be clearly communicated to both patients and accompanying persons;
- Clearly defined protocols for dealing with at-risk situations where staff is subject to either physical abuse, verbal intimidation or threats;
- Management commitment and employee participation in a violence prevention programme;

- Analysis of worksites:
  - A risk assessment of the workplace should be carried out to identify the hazards and assess the severity of the risk. A review of the injury and illness records, compensation claims and screening surveys for workplace violence would also form part of the risk assessment;
- Safety and health training of healthcare workers should include:
  - Conflict resolution;
  - Recognising and managing assaults; and
  - Awareness of workplace violence;
- Record keeping:
  - All healthcare workers should be encouraged to report incidents of workplace aggression and violence and the report should also include action plans to prevent recurrence; and
- Evaluation of the programme:
  - The programme should be evaluated regularly to ensure a safe and secure workplace for all staff.

## Control Measures

Hierarchical approach	Examples of control measures to reduce exposure
<b>Engineering Controls</b>	<ul style="list-style-type: none"> <li>Design of the working environment could be improved such as providing physical security measures.</li> </ul>
<b>Administrative Controls</b>	<ul style="list-style-type: none"> <li>Staffing schedules can be adjusted to ensure that staff do not work alone and to minimise patient waiting time.</li> <li>Movement of the public in hospitals should be controlled.</li> </ul>

### Further information can be obtained from:

- US OSHA: Guidelines for Preventing Workplace Violence for Health Care and Social Service Workers
- CDC, NIOSH: Violence - Occupational Hazards in Hospitals
- HSE, UK: Preventing Workplace Harassment and Violence

## 7 Hazardous Drug Handling

Hazardous drugs are drugs or chemicals that demonstrate one or more of the following characteristics in either humans or animals: carcinogenicity, teratogenicity or other developmental toxicity, reproductive toxicity, organ toxicity at low doses, genotoxicity or where the structure and toxicity profiles of new drugs mimic existing drugs determined hazardous by the above criteria.

Commonly, this would include cytotoxic and anti-neoplastic drugs, anti-virals as well as new bio-engineered drugs. Although the drugs kill or damage cancer cells, they can also damage normal cells. This coupled with the increasing use and complexity of chemotherapy as well as the unknown effects of new drugs such as nanotechnology has led to concern over the risks to healthcare workers involved in the preparation, handling, administration and disposal of these drugs. Such drugs administered to patients may also be excreted unmetabolised in their urine, resulting in exposure to nurses, attendants, housekeeping and waste disposal staff.

### Effects

Some studies have shown that exposure to these drugs can cause acute health effects such as skin and eye irritation, and chronic health effects including adverse reproductive outcomes such as infertility, miscarriage, birth defects and possibly leukaemia and other cancers.

### Exposure Situations/Procedures

Hazardous drugs are commonly administered by injection as single doses or as a continuous infusion. Some drugs can also be given orally as tablets, capsules or as liquids.

The potential for exposure exists during various tasks such as drug reconstitution and mixing, connecting and disconnecting intravenous tubing, and disposing of waste equipment or patient waste.

Drugs can be found in the air, on work surfaces, clothes, medical equipment and in patient urine and faeces.

The common routes of exposure are through skin and mucous membrane contact (in spills and splashes) and inhalation (e.g. overpressurising vials), but ingestion (eating or drinking in contaminated areas) or injection (needlestick injuries) can also occur.

Some of the areas where exposure could occur include:

- Hospitals;
- Hospices;
- Oncology units;
- Pharmacies;
- Wards;
- Reception and delivery areas;
- Infusion centres; and
- Laundry areas.

Activities where exposure could occur include:

- Drug reconstitution and mixing;
- Connecting and disconnecting intravenous tubing;
- Housekeeping;
- Maintenance of equipment;
- Disposal of waste equipment;
- Disposal of patient waste; and
- Laundering of contaminated bed linen and patient clothing.

### Workers at Risk

- Pharmacists and pharmacy technicians;
- Nurses and nursing assistants;
- Operating room staff;
- Doctors;
- Hospital attendants and transport staff;
- Facility staff receiving and transporting stock;
- Biological waste handlers/cleaners/environmental services staff; and
- Laundry staff handling contaminated linen, bed clothes, bedding, etc.

### Health and Safety Management System for Use of Hazardous Drugs

Due to the potent nature of these drugs and their potential for harm, a management system should be in place to protect the health and safety of healthcare and other workers coming into contact with these drugs. The system should include management

of the movement of the drugs from entry into the facility through preparation and administration, waste disposal, equipment maintenance and housekeeping, spill control to medical surveillance. There should be periodic review of the health and safety management system.

### Management Policy

The policy is a written statement of the organisation's intent to provide a safe and healthy environment. It should enlist the support of employees in achieving its aims. The policy should outline the health and safety responsibilities within the organisation, and put in place systems and procedures to ensure the health and safety of its employees. It should cover all areas where there is potential exposure to hazardous drugs such as wards, clinics, operating theatres, pharmacies, logistics, cleaning, laundry and portering. The policy should be communicated to all employees.

### Risk Assessment

Management should ensure that proper RAs are conducted for all activities where there is handling of or exposure to hazardous drugs. A risk assessment is a means of determining the risk associated with exposure to a particular hazard or work. The steps in conducting a RA include:

- Hazard identification; all institutions should develop and maintain their own list of hazardous drugs in use;
- Determine workers at risk and how harm could arise;

- Likelihood of harm arising, assessment of adequacy of existing precautions;
- Documentation of findings and control measures selected as well as any other steps necessary to reduce exposure risk; and
- Reviewing the RA if the nature of work changes or if there is a change in the process.

The coverage of the RA should include:

- Routine work;
- Non-routine work;
- Emergency situations;
- Activities of personnel with access to the facility such as visitors, volunteers, subcontractors and workers;
- Vulnerable persons such as new and expectant mothers and those with impaired immune systems, young and trainee workers; and
- All facilities at your workplace.

Risks should be controlled at source and control measures should follow the hierarchy of controls such as elimination or substitution, engineering control measures, safe work practices, administrative measures and PPE. Documentation of risk assessments and controls should be kept up to date.

### Exposure Control

Measures to control exposure should be applied in the following order.

- Use totally enclosed systems as the first choice for controlling exposure to carcinogens, unless this is not reasonably practicable;
- Control exposure at source, including use of adequate ventilation systems and appropriate organisational measures; and
- Issue PPE where adequate control of exposure cannot be achieved by other measures alone.

The broad measures described above will include more specific controls such as:

- Organising work to reduce the quantities of drugs used, the number of employees potentially exposed and their duration of exposure to the minimum;
- Arranging for the safe handling, storage and transport of cytotoxic drugs;
- Using good hygiene practices and providing suitable welfare facilities e.g. prohibiting eating, drinking and smoking in areas where drugs are handled and providing washing facilities; and
- Training all staff who may be involved in handling cytotoxic drugs or cleaning areas likely to be contaminated on the risks and the precautions to be taken.

## Safe Work Procedures

There should be written procedures on any work where there is exposure to hazardous drugs. This should include patient care areas, operating theatres, pharmacies, laundry, mortuary, waste disposal and biomedical maintenance. The SWPs should include the use of appropriate safety equipment, PPE and techniques on safe handling of such drugs as well as the safety and health precautions to be taken in the course of work.

In addition, a safe drug handling programme should be established and incorporate the following.

- Policies and procedures defining:
  - Presence of hazardous drugs;
  - Labelling of drugs;
  - Storage of drugs;
  - Personnel issues (vulnerable workers such as expectant workers, young workers, trainees etc.);
  - Spill control; and
  - Detailed procedures for preparing, administering, and disposing of hazardous drugs;
- Procedures and training for handling hazardous drugs safely, cleaning up spills, and using all equipment and PPE; and
- Safe work practices relating to both drug manipulation techniques and to general hygiene practices such as not permitting eating or drinking in areas where drugs are handled e.g. the pharmacy or clinic.

## Personal Protective Equipment

- PPE includes respirators, safety glasses, face shields, overalls, aprons, gloves and boots;
- Selection of PPE should be based on routes of potential exposure to hazardous drugs and other concomitant hazards and the nature of work;
- Employers need to ensure that employees are trained in the use of PPE and that the equipment is adequately maintained;
- To ensure that employees are effectively protected, PPE should be properly selected, correctly used, comfortably fitted and regularly maintained;
- Effective protection can only be achieved if the PPE chosen is:
  - Suitable for the task;
  - Suited to the wearer and environment;
  - Compatible with other PPE in use;
  - In good condition; and
  - worn correctly.
- Gloves:
  - Where contact with cytotoxic drugs is possible, and methods of control other than protective gloves are not reasonably practicable, protective gloves must be provided for employees; and
  - Glove material will not offer unlimited protection from cytotoxic drugs. Gloves should be changed regularly or when integrity is breached, torn, damaged, etc.;

- Eye and face protection:
  - Eye and face protection is relevant, particularly where cytotoxic drugs are being handled outside an enclosed system and there is a risk of splashing. A number of options are available including a face shield or visor, goggles and safety spectacles;
- Respiratory protection:
  - Preparation of cytotoxic drugs should be carried out in a suitable safety cabinet or pharmaceutical isolator. However, if it is not reasonably practicable to control exposure using total enclosure/ local exhaust ventilation, respiratory protective equipment (RPE) should be considered if exposure to powders or aerosols is possible. Surgical masks will not protect against the inhalation of fine dust or aerosols;
  - Manipulation of oral or topical medicines containing cytotoxic drugs should be avoided if possible. If this is unavoidable, tasks such as dividing or crushing tablets should be restricted to a controlled environment, ideally within a pharmacy department. Carrying out these procedures in wards or clinics should be actively discouraged;
  - A suitable PPE programme should be implemented taking the above elements into consideration; and
  - If respirators are used, a respiratory protection programme should also be in place to manage the use such equipment.

## Disposal

Operations where hazardous drugs are generated including contaminated patient waste should be governed by a waste management system that includes proper labelling according to national or international codes, proper storage, treatment, transport and disposal of such wastes.

## Emergency Planning

Policies, plans and procedures are required for incidents such as spills and splashes, particularly if a spill occurs outside the biological safety cabinets. The plan should describe what needs to be done that includes emergency procedures, first aid procedures, use of safety equipment and appropriate PPE, decontamination and cleaning, and proper waste disposal.

Proper spill kits and clean up kits should be placed within easy reach where possible exposures might occur and staff should be trained in their use. Appropriate PPE should also be used when cleaning up spills. Any drugs that come into direct contact with the skin should be washed off with soap and water and medical advice should be obtained. If drugs come into direct contact with the eye, they should be washed out with water or an eye wash bottle containing water or normal saline. Medical advice should be obtained.



## Education and Training

All employees should be given suitable and sufficient information about the hazardous drugs they could be exposed to and the risks created by this exposure. They should also be informed of the results of the risk assessment, the precautions they should take, usage of PPE, emergency and first aid procedures, post-exposure monitoring and reporting procedures for occupational accidents and diseases. A health and safety training programme should be implemented to ensure that SWPs are known and understood by all staff.

## Surveillance

### Monitoring Exposure at the Workplace

Monitoring exposure can include any periodic test or measurement which helps to confirm the ongoing effectiveness of controls. Where there is exposure to cancer-causing drugs, it is a good practice to monitor the workplace for exposure. However, there is currently no recognised standard against which test data can be compared against.

Performing serial measurements and observing trends in the data can be useful to help demonstrate that control measures are still adequate or the need to review them. These monitoring techniques can also help confirm restoration of adequate control if there is a failure of the measures put in place.

## Health Surveillance

A medical surveillance programme should be in place to monitor the health of workers exposed to hazardous drugs. The elements of a medical surveillance programme would include:

- Questionnaires on reproductive and general health at the time of employment and periodically;
- Laboratory tests including complete blood counts, urinalysis and any other relevant tests such as liver function and renal function done at employment and periodically during employment;
- Physical examination of healthcare staff at time of employment and periodically where indicated by either the questionnaire or laboratory tests;
- Workers who have significant exposure to spills and splashes should also be on the monitoring programme;
- Workers with significant change in health status detected should also be on a follow-up programme;
- Results of questionnaires and tests should be monitored for trends that may be a sign of health effects due to exposure. If there are significant health changes, the employer should:
  - Evaluate current preventive measures; engineering control measures (biological safety cabinets, containment, ventilation, closed system transfer devices and IV infusion systems);
  - Compare performance with recommended standards;
  - Perform environmental sampling where possible;

- Work practices;
- PPE policies and employee compliance and use;
- Availability of appropriate PPE such as double gloves, non-permeable gowns, respiratory protection;
- Develop or refine a plan to prevent further worker exposure;
- Offer alternative duty or reassignment to affected worker; and
- Continue ongoing medical surveillance of all workers at risk.

## Record Keeping and Reporting

A facility should keep exposure records of its employees who work with hazardous drugs.

Information in the records should include type of work, location of work done and any specific incidents or exposures that occurred. These records should be properly kept and maintained.

Reporting of occupational diseases is required under the current legislation. Documentation should be kept for at least five years.

## Hazards and Controls on Selected Work Activities and Areas

### Receiving and Storage of Areas

The main hazard is spills from damaged containers or when handling intact containers.

Hierarchical approach	Examples of control measures to reduce exposure
<b>Engineering Controls</b>	<ul style="list-style-type: none"> <li>• Provide sufficient general exhaust ventilation.</li> <li>• Consider dedicated emergency exhaust fan powerful enough to quickly purge airborne contaminants in the event of a spill.</li> </ul>
<b>Safe Work Practices</b>	<ul style="list-style-type: none"> <li>• Store and transport in closed containers.</li> <li>• Ensure proper labelling.</li> <li>• Observe for potential cracks/damaged containers/leakage.</li> <li>• Cover all cuts/lacerations with plasters.</li> </ul>
<b>Administrative Controls</b>	<ul style="list-style-type: none"> <li>• Educate and train staff on hazards, effects, safe work practices and use of PPE.</li> </ul>
<b>Personal Protective Equipment</b>	<ul style="list-style-type: none"> <li>• Use appropriate PPE such as:               <ul style="list-style-type: none"> <li>- Chemotherapy gloves when receiving, handling, unpacking and transporting vials to work areas;</li> <li>- Protective clothing; and</li> <li>- Eye and face protection.</li> </ul> </li> </ul>

### Drug Preparation and Administration

The hazard analysis should include a review of the whole process. Access to the preparation areas should be limited.

The job tasks should be coordinated for effective control of exposures to workers. In addition, a spill control programme should be in place in the event of spills and splashes.

### Preparing Hazardous Drugs

Hierarchical approach	Examples of control measures to reduce exposure
<b>Engineering Controls</b>	<ul style="list-style-type: none"> <li>• Prepare drugs in ventilated cabinets. Ideally use a totally enclosed cabinet.</li> <li>• Consider using closed system transfer devices, glovebags and needleless systems for transfer of drugs from primary packaging to dosing systems (to be done inside a ventilated cabinet).</li> </ul>
<b>Safe Work Procedures</b>	<ul style="list-style-type: none"> <li>• Wash hands before putting on gloves.</li> <li>• Seal the finished product in a container before removing from ventilated cabinet.</li> <li>• Seal and wipe all waste containers inside a ventilated cabinet before removal for disposal.</li> <li>• Remove all outer gloves and sleeve covers and bag for disposal while still inside a ventilated cabinet.</li> <li>• Follow the proper sequence of removing PPE.</li> <li>• Dispose all PPE immediately after use.</li> <li>• Compounding of drugs and counting of tablets should also be done in a biological safety cabinet if this is likely to produce dust such as non-coated tablets.</li> </ul>
<b>Administrative Controls</b>	<ul style="list-style-type: none"> <li>• Prepare hazardous drugs in a centralised area where possible.</li> <li>• Train all staff in safe work practices and use of proper equipment.</li> <li>• Ensure the availability of SDS.</li> </ul>

Hierarchical approach	Examples of control measures to reduce exposure
<b>Personal Protective Equipment</b>	<ul style="list-style-type: none"> <li>• Use proper PPE.</li> <li>• Use chemotherapy gloves or double gloving when opening drug packaging, handling vials/finished products, labelling or disposing of hazardous waste.</li> <li>• Ensure latex free gloves are available for those with latex allergy.</li> <li>• Change gloves regularly according to recommendations on SDS and/or when integrity is breached, torn damaged etc.</li> <li>• Use proper disposable gowns made of polyethylene-coated polypropylene with closed fronts, long sleeves, elastic or knit cuffs.</li> <li>• Consider using disposable sleeve covers to protect wrist area.</li> <li>• Use appropriate respirators if ventilated cabinets are not available.</li> <li>• Use eye and face protection if aerosols is anticipated.</li> <li>• Dispose PPE immediately after use according to national regulations.</li> </ul>

## Administration of Hazardous Drugs

Hierarchical approach	Examples of control measures to reduce exposure
<b>Engineering Controls</b>	<ul style="list-style-type: none"> <li>• Administer drugs by using needleless and closed systems.</li> <li>• Use Luer-lock fittings.</li> </ul>
<b>Safe Work Procedures</b>	<ul style="list-style-type: none"> <li>• Carry an emergency spill kit when transporting hazardous drugs from preparation to administration areas.</li> <li>• Put the emergency spill kit at hand or nearby while administering the drugs.</li> <li>• Place plastic backed absorbent pads under IV line to catch leakages.</li> <li>• Place sterile gauze under push sites.</li> <li>• Tape IV tubing connection sites.</li> <li>• Observe standard precautions.</li> <li>• Wipe all syringes, IV bags, lines and pumps clean of hazardous drugs.</li> <li>• Do not remove IV tubing from bag containing hazardous drugs beside patient's bed.</li> <li>• Flush tubing at end of infusion before removing IV bag and tubing.</li> <li>• Dispose IV bag and line intact in accordance with pharmacy instructions or legislative regulations.</li> <li>• Place disposable items in a purple chemotherapy waste container and close lid.</li> <li>• Remove protective clothing in the proper sequence;</li> <li>• Double-bag all chemotherapy waste bags.</li> <li>• Dispose PPE immediately after use according to national regulations.</li> </ul>

Hierarchical approach	Examples of control measures to reduce exposure
<b>Administrative Controls</b>	<ul style="list-style-type: none"> <li>• Train staff on the proper safe work procedures and proper use of PPE.</li> <li>• Restrict the number of staff who are allowed to administer hazardous drugs.</li> <li>• Check Luer-lock fittings for leaks.</li> <li>• Prime IV line inside ventilated cabinet if using hazardous drugs if not primed with non-drug solution.</li> </ul>
<b>Personal Protective Equipment</b>	<ul style="list-style-type: none"> <li>• Use chemotherapy/latex gloves when handling and administering hazardous drugs.</li> <li>• Double glove if using latex gloves.</li> <li>• Change gloves regularly and when integrity is breached, torn, damaged, etc.</li> <li>• Ensure latex free gloves are available for those with latex allergy.</li> <li>• Use proper disposable gowns made of polyethylene-coated polypropylene with closed fronts, long sleeves, elastic or knit cuffs.</li> <li>• Wear chemical splash goggles or equivalent safety glasses.</li> <li>• Use appropriate respirators when handling aerosolised drugs or if aerosols is expected.</li> <li>• Dispose PPE immediately after use according to national regulations.</li> </ul>

### Ventilated Cabinets/Biological Safety Cabinets

- Preparation of hazardous drugs should be done in a dedicated cabinet.
- Selection should be based on needs such as aseptic drug preparation and worker's safety and health considerations.
- Selection criteria should include the design of airflow and exhaust so there is sufficient flowrate, laminar flow, use of non-recycled air, etc.
- There should be real time monitoring of cabinet performance.

### Maintenance of Ventilated/Biological Safety Cabinets

#### Routine maintenance

- A workplan should be in place for regular testing of HEPA filters, leak tests and other performance characteristics.
- Safety protocols and procedures should be developed for safe work practices when conducting routine maintenance, including lockout/tagout procedures, signages, proper disposal and PPE use.
- Maintenance staff should be trained in hazards, proper work procedures and work practices.
- Appropriate PPE should be provided including gowns, eye and face protection, gloves and shoes.
- Ensure proper disposal of used filtration media according to national regulations.

### Non-routine maintenance (e.g.servicing and upgrades)

- The same precautions for routine maintenance should also apply.

### Spill Control

There should be policies and procedures to manage spills which include:

- A respiratory protection programme; and
- Standard operating procedure in the event that personnel are also contaminated.

Hierarchical approach	Examples of control measures to reduce exposure
<b>Safe Work Procedures</b>	<ul style="list-style-type: none"> <li>• Correct selection and use of materials in spill kit.</li> <li>• Proper handling of spills.</li> <li>• Use of appropriate PPE.</li> <li>• Locate spill kits in immediate vicinity of potential spill areas.</li> <li>• Dispose contaminated materials/equipment properly according to NEA regulations on hazardous waste,</li> </ul>
<b>Administrative Controls</b>	<ul style="list-style-type: none"> <li>• Education and training on safe work practices.</li> <li>• Educate and train staff in safe work practices.</li> <li>• Proper warning signs.</li> <li>• Allow access only to authorised and trained personnel.</li> <li>• Spill handling drills.</li> <li>• Establish standard operational procedures (SOPs) in the event of personnel contamination.</li> </ul>
<b>Personal Protective Equipment</b>	<ul style="list-style-type: none"> <li>• Use appropriate PPE such as gloves, respirators and face protection, gowns and footwear.</li> <li>• Include respiratory protection programme.</li> <li>• Dispose PPE immediately after use according to national regulations.</li> </ul>

## Medical Waste Disposal

Identify all possible types of waste generated by preparation and administration of hazardous medications such as partially filled vials, undispensed products, unused IV medications, needles and syringes, gloves, gowns, underpads, bed linen and contaminated materials from spill cleanups.

Do not place needles and sharps contaminated with cytotoxic wastes into infectious disease containers.

Put needles, empty vials and sharps (preferably as one unit) in puncture proof plastic waste containers. When full, the container should be placed in purple cytotoxics bag. Put syringes, gloves, gowns, and tubing into purple cytotoxic waste bags.

Radioactive waste should be placed in red bags for disposal by licensed NEA contractors. Incinerate at regulated medical waste facility – use licensed NEA disposal contractors for biohazardous waste (refer to NEA for further information).

## Routine Cleaning, Decontaminating and Housekeeping

### Cleaning and Decontaminating

Hierarchical approach	Examples of control measures to reduce exposure
<b>Engineering Controls</b>	<ul style="list-style-type: none"> <li>• Ensure sufficient ventilation to prevent build up of hazardous airborne drug concentrations.</li> </ul>
<b>Safe Work Procedures</b>	<ul style="list-style-type: none"> <li>• Clean work surfaces with an appropriate deactivating agent before and at the end of each activity and at the end of each work shift.</li> </ul>
<b>Administrative Controls</b>	<ul style="list-style-type: none"> <li>• Implement protocols for proper storage of hazardous drugs according to NEA and other international guidelines.</li> <li>• Do not store and use hazardous drugs in unventilated areas such as unventilated storage closets or rooms.</li> <li>• Plan a schedule of regular cleaning activities for work surfaces and equipment that might become contaminated e.g. trolleys and carts etc should be in place.</li> </ul>
<b>Personal Protective Equipment</b>	<ul style="list-style-type: none"> <li>• Put on appropriate eye protection such as safety glasses with side shields or face shields when there is risk of liquid splash.</li> </ul>

Hierarchical approach	Examples of control measures to reduce exposure
	<ul style="list-style-type: none"> <li>• Use appropriate gloves according to SDS and glove selection guidelines.</li> <li>• Use gloves that are chemically resistant to decontaminating or cleaning agent.</li> <li>• Use double gloves.</li> <li>• Ensure availability of latex-free gloves for those with latex allergy.</li> <li>• Use disposable fluid resistant gowns if necessary.</li> <li>• Dispose PPE immediately after use according to national regulations.</li> </ul>

### Housekeeping

Hierarchical approach	Examples of control measures to reduce exposure
<b>Safe Work Procedures</b>	<ul style="list-style-type: none"> <li>• Use appropriate PPE such as gowns, gloves, eye and face protection, footwear etc.</li> <li>• Place linen contaminated with hazardous drugs or excreta from patients who have received hazardous drugs in the last 48 hours in specially marked and labelled laundry bags which are then placed in another impervious bag (double bagging).</li> <li>• Pre-washed contents of laundry bag before adding to the other laundry for a second wash.</li> <li>• Follow standard precautions when handling excreta contaminated with blood.</li> <li>• Wash reuseable items such as glassware or other contaminated items twice with detergent by a trained employee wearing double latex gloves and a gown.</li> <li>• Wash hands with soap and water after removal of gloves.</li> <li>• Procedure for removal of gloves: <ul style="list-style-type: none"> <li>- Remove outer gloves and gown by turning them inside out and placing them in a purple bag; and</li> <li>- Repeat the procedure with the inner glove.</li> </ul> </li> </ul>

Hierarchical approach	Examples of control measures to reduce exposure
<b>Administrative Controls</b>	<ul style="list-style-type: none"> <li>• Educate and train all nursing, housekeeping and biological waste disposal staff on effects of exposure to hazardous drugs and the precautions to take.</li> </ul>
<b>Personal Protective Equipment</b>	<ul style="list-style-type: none"> <li>• Use face shields where splashing may occur.</li> <li>• Use fluid resistant disposable gowns which should be changed whenever contaminated.</li> <li>• Use appropriate gloves; double glove if handling linens, faeces or urine from patients who had received hazardous drugs within the last 48 hours up to the last seven days.</li> <li>• Linen personnel should wear latex gloves and gowns when handling prewashed material.</li> <li>• Suitable latex free gloves should be made available for those with latex allergies.</li> <li>• Dispose PPE immediately after use according to national regulations.</li> </ul>

### Further information can be obtained from:

- US OSHA: Technical Manual. Section VI Chapter 2: Controlling Occupational Exposure to Hazardous Drugs
- CDC, NIOSH: Preventing Occupational Exposures to Antineoplastic and Other Hazardous Drugs in Healthcare Settings
- CDC, NIOSH: Medical Surveillance for Healthcare Workers Exposed to Hazardous Drugs
- HSE, UK: Safe handling of cytotoxic drugs in the workplace
- NEA: Hazardous Substances
- NEA: Toxic Waste Control



## 8 Hazardous Waste Management

Healthcare facilities generate diverse wastes that require proper disposal. These wastes are often hazardous, and must therefore be packaged, transferred and disposed off properly to protect the person handling it and the environment at large.

### Types of Hazardous Waste Generated

Wastes from healthcare facilities include infectious waste, pathological waste, contaminated sharps, routine clinical waste, cytotoxic waste, radioactive waste, pharmaceutical waste, chemical waste and general waste.

Infectious waste is defined as waste that is capable of causing an infectious disease. Infectious waste includes sharps, microbiological cultures, pathological organs and other waste from patients with Biosafety Level III (e.g. Hepatitis B) and IV (e.g. Lassa fever) infections. Waste that is heavily soiled with the patient's blood or body fluid should also be treated as potentially infectious.

Infectious waste, pathological waste, contaminated sharps and other contaminated waste from treatment areas are considered as biohazardous wastes which need special handling and disposal by licensed biohazardous waste contractors. Infectious waste, in addition, may need pre-treatment before it is disposed of as biohazardous waste. Beside biohazardous waste, expired

cytotoxic drugs and waste materials which are contaminated with cytotoxic drugs during the preparation and administration of cytotoxic therapy are also required to be properly handled and incinerated by approved biohazardous waste incinerators.

Pharmaceutical wastes are also commonly found in healthcare facilities. Depending on the nature of the pharmaceutical waste, they could be either disposed off through special waste incinerators or as general waste.

Chemical wastes include discarded solid, liquid and gaseous chemicals from diagnostic and experimental work, and from cleaning, housekeeping disinfecting and engineering services such as used lubricating oil, spent photographic developing solutions and spent solvents. These wastes should be segregated as biohazardous and non-hazardous waste for special disposal by licensed toxic waste contractors.

General wastes generated in healthcare facilities may include office waste, food waste, packing materials, waste water from laundries and floor washing and other substances that do not pose any significant contamination risk in handling. Such wastes could be disposed off as general household waste by general waste contractors at public waste disposal facilities if they are not contaminated with biohazardous or toxic waste.

### Hazardous Waste Management Programme

The management of all healthcare facilities should develop a hazardous waste management programme suitable for the size of the facility and types of wastes generated. The hazardous waste management programme should form part of the safety and health management system. The management should also appoint person/s within the facility with the responsibility for maintenance and management of waste transfer and disposal documentation, such as the generation, collection, treatment and safe disposal of hazardous waste.

The hazardous waste management programme should include the following elements.

#### Identification of Hazardous Waste

This includes designation of the waste that should be managed as biohazardous and segregation of biohazardous waste from non-biohazardous waste.

#### Safe Work Procedures

Written procedures on treatment of all types of wastes generated by the healthcare facility should be established and documented. A transport and disposal flowchart from the generation site to the disposal site can be drawn up to provide clarity on the sources of wastes. The responsibilities of personnel should be described in these procedures.

### Packaging of Waste

Colour-coded disposal bags must be used to segregate wastes that need special handling and disposal.

Type of waste	Sharps or breakable objects present?	Puncture resistant container required?	Colour code	Examples
<b>Biohazardous only</b>	No	No	Yellow	<ul style="list-style-type: none"> <li>Gauzes soiled with bodily fluids</li> </ul>
	Yes	Yes	Yellow	<ul style="list-style-type: none"> <li>Used syringes and tubings contaminated with bodily fluids</li> <li>Partially filled glass vials of hazardous drugs</li> </ul>
<b>Cytotoxics</b>	No	No	Purple	<ul style="list-style-type: none"> <li>Expired cytotoxic drugs</li> <li>Disposable gloves, bench wipes and gowns used during chemotherapeutic drugs preparation</li> </ul>
<b>Biohazardous contaminated with cytotoxics</b>	Yes	Yes	Purple	<ul style="list-style-type: none"> <li>Used syringes and tubings for administering chemotherapeutic drugs</li> <li>Glass vials with cytotoxic drug residue</li> </ul>
<b>Radioactive</b>	No	No	Red	<ul style="list-style-type: none"> <li>Disposable gloves and bench wipes used in the preparation of radioactive materials</li> </ul>
<b>Biohazardous and contaminated with radioactive materials</b>	Yes	Yes	Red followed by yellow (after the radioactive material has decayed to the safe level)	<ul style="list-style-type: none"> <li>Used syringes for administering radioactive isotopes to patients</li> </ul>
<b>General waste</b>	Yes/No	If practicable	Black	<ul style="list-style-type: none"> <li>Empty antibiotics and vaccines vials</li> <li>General pharmaceuticals (vitamin tablets, creams and ointments)</li> </ul>

## Storage

All hazardous wastes stored should be quantified and tracked. A register of all the wastes that are being generated and stored should be kept. The register should include:

- type and quantity;
- source of waste e.g. department or unit;
- date ready for disposal; and
- appointed licensed collector.

All containers used for storing hazardous wastes should be clearly labelled with the type of wastes, and where possible, the associated safety and health hazards and recommended PPE during handling.

## Disposal

The management should identify off-site hazardous waste collectors licensed by NEA to collect and dispose off the various types of hazardous wastes. All waste generated by healthcare institutions must be disposed off in accordance to legal requirements. Waste must be segregated into hazardous and non-hazardous waste so that it can be safely disposed off by the respective licensed waste contractors. The management should develop a licensed hazardous waste collector assessment programme to verify the capability and competency of potential off-site hazardous waste contractors in handling their wastes.

## Contingency Measures for Emergency Situations

The management should establish emergency response plans and procedures to deal with on-site incidents involving hazardous wastes and provide adequate hazardous material response equipment.

## Staff Training

All personnel involved in the generation, packaging, handling, storage and disposal of hazardous wastes, especially infectious waste should be properly trained to ensure that they are equipped with the appropriate knowledge (potential health hazards and precautions to take, safe handling techniques and disposal procedure).

## Further information can be obtained from:

- Singapore Standard CP 100: 2004 Code of Practice for Hazardous Waste Management

## 9 Emergency Preparedness and Response

Planning and preparing for emergencies is an essential part of hazard prevention and control. It is the responsibility of the management to establish and maintain plans and procedures to identify the potential for and responses to incidents and emergency situations. These plans and procedures should also be frequently reviewed and updated.

The emergency response plan should form part of the safety and health management system. It should include procedures for all possible emergencies that the healthcare facility may encounter and should be placed under the charge of an emergency response team.

### 9.1 Emergency Response Plan

An effective emergency response plan should include the following characteristics.

#### Corporate Policy

This policy should emphasise the importance of emergency response planning and affirms management support for the emergency response initiative.

#### Emergency Planning and Response Committee

An emergency planning and response committee should be set up to create, implement and execute contingency plans in times of emergencies and to prevent accidents and loss of life and property.

#### Incident Command System

A command and control system to coordinate actions during an emergency should be established. It should detail the chains of command or responsibility, roles and responsibilities of designated employees, the communication network and “alerting” procedures, for both during and after office hours, to be used during an emergency. Communication with external emergency agencies (e.g. Singapore Civil Defence Force (SCDF) and NEA), regulatory agencies (e.g. MOH and MOM), and the community should be established.

#### Emergency Evacuation Procedures

The evacuation procedures for in-patients, out patients, employees and on-site contractors should be elaborated. It should detail the various evacuation routes and assembly areas for partial or full evacuation.

#### Protection of Vital Records and Equipment

Designated employees should be trained in emergency shut-down or lock-out procedures for critical equipment prior to evacuation. Procedures for protection of records vital to the facility should be established.

#### Training

Training for all levels of employees within the organisation should include evacuation procedures and routes, shut-down procedures, and usage of emergency equipment (e.g. self-contained breathing apparatus)

#### Regular Review and Updating

The emergency response plan should be regularly reviewed and updated. Practice drills should be carried out according to a pre-determined schedule. Results and findings from practice drills should be recorded and reviewed by the management.

### 9.2 Fire

Each healthcare facility should have an appointed Fire Safety Manager to ensure and enhance the fire safety standard within the facility, as required by the SCDF.

The healthcare facility should have a written fire emergency plan, including an

evacuation plan that is accessible and available to employees. The plan should include the following.

- Employees must be trained to recognise fire alarms;
- Responding and reporting on fire emergencies;
- Process of reporting fires and smoke;
- Identity of person to contact, including designation and contact number;
- Emergency escape procedures and escape routes;
- Procedures for employees who must remain to operate critical equipment before they evacuate;
- Procedures that account for all employees after evacuation;
- Rescue and medical duties for employees performing the duties;
- Fire protection equipment and systems available to control ignition sources; and
- Procedures and schedules for equipment maintenance.

All employees must be aware of the workplace emergency and fire evacuation plan. Fire drills should be conducted periodically and documented. The employees should be aware of their role in the event of any emergency situation and fire evacuation.

### 9.3 Chemical Spill or Leak

Each healthcare facility should have an appointed chemical spill response team. The team should prepare a Chemical Spill Response Plan which should include the appropriate specific procedures and response equipment for dealing with a chemical spill. It is the responsibility of each healthcare employee using chemicals and chemical products to be familiar with this plan.

The plan should include:

- Process of reporting chemical spill;
- Identity and contact number of appointed chemical emergency response team leader and its members;
- Procedures for initial containment of the spill and possible fire if the chemical is flammable;
- Procedures for the evacuation of non-essential personnel;
- Procedures for those employees who must remain to operate critical equipment before they evacuate;
- Provision of chemical spill response kit and PPE for chemical emergency response team;
- Procedures for administering first aid treatment to personnel exposed to chemical; and
- Procedures for packaging and disposal of contaminated chemicals and spill response equipment.

All employees must be aware of the chemical spill response plan. Practice drills should be conducted periodically and documented. The employees working in areas where hazardous chemicals are used or handled (e.g. laboratories, CSSU, TSSU) should be aware of their role in the event of an emergency situation.

Use of suitable materials, for example sand, earth or sodium bicarbonate to contain/absorb the spillage should be considered. Paper towels and sponges may be used as absorbent type cleanup aids but this should be done cautiously. Paper used to clean up oxidisers can later ignite and appropriate gloves should be worn when cleaning toxic materials with towels. Sponges should be chemical resistant. Contaminated residues should be collected in a suitable, clearly labelled container prior to disposal as "contaminated" or "special waste".

Commercial spill kits are equipped with instructions, absorbents, neutralisers and protective equipment. These cleanup supplies should be consistent with the hazards and quantities of substances used. These kits should be located strategically around the department area.

All personnel working with hazardous chemical including "response teams" must be trained in the appropriate spillage procedures. The training should also include familiarisation with areas covered by the teams. The training should include the use of any special equipment and PPE. The training must be recorded and personnel should be retrained at appropriate intervals.

### 9.4 Pandemic Flu, SARS and Emerging Infectious Diseases

In 2003, the emergence of severe acute respiratory syndrome (SARS) due to a novel SARS coronavirus resulted in a global outbreak of this disease. In Singapore, 42% of the probable cases were healthcare workers, whom over half were nurses. This highlighted the need for adequate protection of healthcare workers and the development of contingency plans to deal with future outbreaks and emerging infectious diseases.

It is anticipated that a pandemic flu may result in the next infectious disease outbreak. As part of emergency response planning, the organisation should have measures in the event that an outbreak of infectious disease occurs.

### 9.5 First Aid

Accidents can occur to anyone and in the healthcare industry, slips, trips and falls, needle stick injuries, contact with hazardous chemicals and burns can occur. The appropriate first aid given to the injured person is important in saving lives and preventing further injury and pain. Provisions should be made to enable first aid delivery to any person who is injured or becomes ill while at work and emergency procedures developed and practised regularly. Those giving first aid should be aware

of the associated hazards as they may come into contact with bloodborne pathogens such as hepatitis and human immunodeficiency virus (HIV) and other potentially infectious materials. They should practise Standard Precautions and be aware of the ways to protect themselves when administering assistance or first aid to the injured persons. The appropriate PPE such as impervious gloves, gowns and face masks can be used if there is a risk of exposure to the bloodborne pathogens and other infectious materials. In addition, they should also be aware of safe clean-up procedures of body fluids and soiled surfaces.

Some workplaces may use hazardous or toxic substances. If there is exposure to these substances, suitable facilities for emergency treatment such as emergency showers for quick drenching and eye wash for flushing of eyes should be available. These facilities for emergency use should be readily accessible and be properly maintained.

For more information, refer to the WSH (First- Aid) Regulations





# Facilities Management

## 10 Facilities Management

### 10.1 Safety in Construction and Renovation

#### General

- Prior to commencement of works, RA should be carried out for all construction and renovation works.
- All staff should be briefed on the intended construction works to be carried out, emergency plans and safety procedures to be followed.
- Site-specific protocols related to construction safety and health should be established for specialised areas within the facility.

#### Material Handling and Storage

- Proper housekeeping should be maintained within the construction site and its surroundings. All materials should be properly stored and all waste materials properly disposed.
- SDS for construction materials should be made easily accessible to all workers and the hospital's employees affected by the construction and renovation works.

#### Welding and Cutting

- Compressed gas cylinders should be properly secured and kept in an upright position at all times.
- Fire extinguishers should be adequately provided at work areas where welding and cutting works are being carried out.
- A Hot Work Permit System should be implemented and hot work permits should be completed and posted at the work location.
- Fire alarm systems within the facility should be properly set to allow hot work to be carried out without accidental activation.

#### Fire Safety

- An adequate number of fire extinguishers should be provided. They should be properly tagged and inspected.
- Training of workers on the use of fire fighting equipment should be conducted.
- Temporary construction partitions should be smoke tight and made of non-combustible materials.

#### Electrical Safety

- Temporary lightings should be in place for access areas and locations where works are being carried out.
- Junction boxes and panels should be properly covered.

## Miscellaneous

- Ladders and scaffolds should be of sound construction.
- All floor openings should be properly covered. Security measures should be put in place to prevent unauthorised entry into the construction site.
- Proper identification tags should be provided for all construction workers.
- Notification policy for deactivating life safety devices (smoke detectors, fire alarm systems etc.) should be periodically reviewed.
- Contingency plans should be developed for emergency responses to power failures, water supply disruptions and fires.

### Further information can be obtained from:

- WSH (Construction) Regulations 2007

## 10.2 Indoor Air Quality and Ventilation

Indoor Air Quality (IAQ) refers to the quality of indoor air as it relates to pollutants that may be airborne in the building. The pollutants may be brought into the building from outside or may come from the building itself.

Building pollutants may include but are not limited to:

- Pollen, dust, fungal spores, vehicle or building exhaust returning into the building by re-entrainment, soil gas (found in the soil as a result of decaying matter), leakage or spills, radon, leakage from underground storage tanks, standing water on roofs and in ducts that encourages microbial and fungal growth, ozone from copy machines, volatile organic compounds (VOC) from various solvents, monomers, toners, cements, markers, glues, tobacco smoke, cooking, cooling tower that encourages microbial growth, building vermin, wet and damp areas in ductwork where ideal conditions cause pathogens to grow, off-gassing of various building materials.

Good IAQ improves productivity at the workplace. On the other hand, poor IAQ could lead to losses in productivity as a result of comfort problems, ill health and sickness-absenteeism. All workplaces within your healthcare facility should be ventilated by natural or mechanical means e.g. air-conditioning mechanical

ventilation (ACMV) to provide a constant and sufficient supply of fresh air for all employees.

Employees should also be protected from inhalation of any contaminants in the workplace. All dust, fumes, steam or other airborne contaminants which arise as a result of any process or in the course of work should be removed at the source. This can be achieved through elimination or isolation of people from the contamination and implementation of control measures such as dilution ventilation, filtration, mechanical extraction systems or a combination of these.

### Indoor Air Quality and Ventilation Management Programme

The management, together with the facilities management team, should implement a management plan to ensure that good IAQ is achieved in all workplaces within your healthcare facility. The programme should include but should not be limited to the following components. Individual components can be delegated to responsible persons.

#### • Written Policy on Indoor Air Quality and Ventilation

The policy statement should state explicitly the responsibility and commitment of management to achieve good IAQ for all occupants in the healthcare facility.



- **Documentation of Ventilation Systems in Place**

Documents showing the layout and location of the ACMV system and other forms of extraction systems (e.g. downdraft tables and biological hoods) of your facility should be kept. This documentation should aid the facilities management team to locate major building system equipment and the areas they serve. Where changes are made to any system, the main design plan should be updated.

- **Regular Inspections and Air Monitoring**

Regular walk-through inspections of the premises and the ventilation systems including ACMV, should be conducted by a competent person. A checklist listing the major systems and equipment needed to be inspected can be used during inspection. Checks on ductwork, humidifiers and other ACMV and building system components should be conducted to detect any microbial growth or contamination. Feedback from occupants on the conditions in the building and the operation of the ACMV system can be obtained during inspection to identify possible irregularities. Indoor air monitoring and any environmental or biological sampling should be conducted by the competent persons if deemed necessary for the investigation so that adjustments or alterations can be made.

- **Preventive Maintenance Regime**

There should be established, a written maintenance plan and scheduling of maintenance for the various

components of the air-conditioning and exhaust systems. The maintenance plan should include reasonable and appropriate measures to avoid degradation of the air quality during renovation and construction works.

- **Training and Information**

The employees who are involved in building system operation and maintenance must be provided with training on:

- Types of ventilation systems that are used and how they operate;
- Use of PPE; and
- Control measures to ensure proper ventilation during building cleaning, maintenance and when handling chemicals and other harmful agents.

- **Records**

The following records should be maintained for reference and audit checks:

- IAQ and ventilation systems inspection records;
- Incidents investigation reports;
- Employee complaints detailing signs or symptoms that may be caused by building related illness; and
- Action plans to rectify any problem areas identified through investigation of complaint or incident.

**Further information can be obtained from:**

- MOM: Guidelines on Design, Operation and Maintenance of Local Exhaust Ventilation Systems.
- NEA: Guidelines for Good Indoor Air Quality in Office Premises.
- Singapore Standard SS554: 2009 Code of Practice for Indoor air quality for air-conditioned buildings

## 10.3 Safe Means of Access and Egress

- Safe means of access should be provided to and from:
  - Workplace; and
  - All work-related areas at a workplace.
- All means of access and egress should be free from obstructions.
- Handrails should be provided at access and egress areas where appropriate to prevent slipping.
- Exit signs should be posted and properly lit.
- All means of access or egress should be properly maintained.

### Further information can be obtained from:

- WSH (Construction) Regulations 2007

## 10.4 Maintenance of Facilities

### Control of Hazardous Energy: Lockout/Tagout

Maintenance and repair work on hazardous machinery or electrical installations have led to serious or fatal accidents in the past when such machinery or installations were not properly deactivated or de-energised. A few accidents had also occurred when such machinery or installation were inadvertently activated when workers were still carrying out the servicing or repair.

Employers of the servicing/repair workers should establish and implement lock-out procedures for the inspection, cleaning, repair or maintenance of any machinery, equipment or electrical installation that, if inadvertently activated or energised, could cause bodily injury. Such lock-out arrangements are often supplemented with a tag-out system to ensure a clear warning system is in place against inadvertent activation while work is still being carried out on the machinery or installation.

Every person carrying out the inspection, cleaning, repair or maintenance of such machinery, equipment or electrical installation must be fully instructed on the lock-out and tag-out (LOTO) procedures for that work before commencing the work.

It is important that any cleaning, servicing, maintenance or repair of hazardous machinery and electrical installation be carried out by competent personnel who are well instructed and familiar with the proper procedures, including the necessary LOTO procedures. Hence, these works should always be carried out by agents or suppliers of the machinery or electrical installation.

### Further information can be obtained from:

- Singapore Standard (SS) 571: 2011 Code of Practice for Energy lockout and tagout

### Electrical Safety

Electricity is a common source of energy widely used to power and run many types of equipment and appliances. When work is carried out with an electric powered tool or on an electrical circuit, the worker is exposed to the risks of electrical hazards. An accident involving electricity can cause a range of injuries such as electric shock, electrical burns, loss of muscle control and thermal burns.

In an electric shock, voltage as low as 50 volts applied between two parts of the human body can cause a current to flow that can block natural electrical signals between the brain and the muscles. This may result in stopping the heart from beating properly, preventing the person from breathing and causing muscle spasms. At high voltage or when the current flows through the body for

more than a few fractions of a second, the current can result in deep electrical burns that are permanently disabling. People who receive an electric shock often get painful muscle spasms that can be strong enough to break bones or dislocate joints. People can also receive thermal burns when they get too near hot surfaces from overloaded, faulty or shorted electrical equipment or if they are involved in an electrical explosion.

Electrical appliances and equipment are generally safe for use if they are designed and manufactured to acceptable electrical standards and codes, and that have been maintained in such a condition. Most electrical appliances are built with safeguards to prevent any overcurrent or earth leakage from reaching a dangerous level to injure a person. It is important that such safeguards are maintained to be in good working condition to provide the protection.

Before operating any electrical equipment or appliances, a visual inspection should be carried out to detect any defects or deterioration to the equipment such as inadequate wiring, exposed electrical parts or wires, bad insulation, overloading of the circuit from plugging too many appliances into the same source (main socket), wetness and spilled chemicals. Any necessary repair, maintenance or servicing of the equipment work should always be carried out by competent persons such as the agents or suppliers of the equipment.

Another common source of electrical hazards is the electrical installation. Electrical installations must be installed in accordance with Singapore Standard CP 5: 1998 Code of Practice for Electrical installations. Installations, repairs, maintenance and inspections should always be carried out by the electrical workers licensed by the Energy Market Authority.

### Pressure Vessel Safety

Autoclaves, jacketed steam sterilizers, air receivers and steam boilers are pressure vessels which can potentially explode and result in serious or fatal accidents and cause major property damage if they fail while in operation. These pressure vessels are used in hospitals and other healthcare facilities.

Owners of these pressure vessels should ensure the integrity of these pressure vessels to prevent any mishap by using pressure vessels that are designed and fabricated in accordance to internationally acceptable codes and standards such as the American Society of Mechanical Engineer's (ASME) Code and the British Standards. These pressure vessels must be examined and certified fit for service by Authorised Examiners before they are first being put into use.

Jacketed steam sterilisers, steam receivers and air receivers are required to have mandatory periodic inspections by Authorised Examiner once every 24 months. Steam boilers must be re-inspected by Authorised Examiner once every 12 months interval.

Organisations are to refer to the MOM's website for the list of Authorised Examiners, as well as related guidance materials such as the Guidelines for the Registration of Pressure Vessel in Workplaces by Authorised Examiner and the Guide to Local Fabricators of Pressure Vessels.

All operators of the pressure vessels must be trained on its safe operating procedures and be provided with all the necessary protective equipment. Operators of steam boilers must be trained and competent before they can operate them.

Besides the statutory inspections, pressure vessels should also be regularly serviced and maintained to ensure the equipment is functioning properly. Owners should always consult an Authorised Examiner and engage a competent boiler contractor for any repair carried out on a pressure vessel.

### Confined Spaces

A confined space is any space that is large enough for an employee to enter and perform assigned work; contains or has the potential to contain hazardous atmospheric hazards capable of causing death or serious physical injury; has restricted means for entry or exit and is not designed for continuous employee occupancy.

Employers requiring their staff to work in confined spaces are required to implement a programme for controlling, and where appropriate, protecting

employees from confined space hazards and for regulating employees' entry into confined spaces.

SWPs and protective equipment shall be ensured and provided for employees:

- Implement measures necessary to prevent unauthorised entry;
- Identify and evaluate the hazards before employee enters the confined space;
- Policies and procedures to specify acceptable entry conditions, isolating the confined space, purging, inerting, flushing, or ventilating the confined space, providing pedestrian and vehicular barriers, and verifying that conditions in the confined space are acceptable;
- Provide testing and monitoring equipment;
- Provide ventilation equipment;
- Provide communication equipment;
- Provide PPE where necessary;
- Provide lighting equipment needed to enable to employees to see well enough to do their work and to exit the space quickly in an emergency;
- Provide barriers and shields;
- Provide equipment for safe ingress and egress by authorised entrants; and
- Provide rescue equipment and any other equipment necessary for safe entry and rescue.

The employer should provide training to those employees working in such areas so that they can perform the work safely. The employer should certify that the training has been accomplished before assigning the employee to work in this area. The duties of all authorised entrants, attendants, and entry supervisor should be clearly defined and documented.

**Further information can be obtained from:**

- Singapore Standard SS 568: 2011 Code of Practice for Confined spaces
- WSH Council Technical Advisory on Working Safely in Confined Spaces

## 10.5 Lighting

The level of lighting provided and its distribution within workplaces have a major impact on how quickly, safely and comfortably employees are able to carry out their tasks. Adequate and uniform lighting help to reduce visual fatigue and provide for the health and safety of all employees in the workplace. The management should ensure that suitable lighting, depending on the type of task being carried out is provided for all work areas within the healthcare facility.

Measurement of lighting level should be carried out as part of the facilities maintenance programme to ensure adequate lighting is provided and a smooth transition between work areas with different lighting requirements.

Lighting values and recommendations can follow those set out in

- Singapore Standard SS 531: 2006 Code of Practice for lighting of work places Part 1: Indoor; and
- Singapore Standard SS 531: 2006 Code of Practice for lighting of work places Part 2: Outdoor.

### Illuminance values adopted from SS 531

Type of healthcare premises/activity	Maintained Illuminance (lux)
Operating theatre	1000
Pre-op and recovery room	500
Intensive care (simple examination)	300
Endoscopy room	300
Sterilisation / disinfection rooms	300
Autopsy rooms and mortuaries	500
Dental surgical rooms (general lighting)	500
Dialysis rooms	500
Wards (general lighting)	100

All exits, both normal and emergency, should be lit and provided with additional emergency lighting where necessary.

Outdoor areas such as walkways should be satisfactorily lit for work and access during hours of darkness to provide safety and security to both visitors and employees.

## 10.6 Signs, Colour Coding and Marking

Suitable safety signs are to be provided whenever there is a risk that has not been avoided or controlled by other means e.g. by engineering controls and safe systems of work. The areas that require putting up of safety signs can include those where chemical, noise, machinery, radiation, respiratory, flammable, radioactive, explosive and biological hazards exist. Safety signs of appropriate size (25 cm x 25 cm) should be displayed in such positions which can be clearly seen by persons working or entering into an area.

Safety signs which encapsulate appropriate colour and various

geometric shapes with a graphical symbol symbolises a general safety message. It is therefore, important for healthcare workers, nurses, doctors, therapist, cleaners, etc, to be conversant in identifying the safety signs and know what they need to do when they see a safety sign.

Safety signs can be classified into the following five main categories according to its functions.

- Prohibition signs;
- Mandatory action signs;
- Warning signs;
- Fire safety signs; and
- Means of escape and emergency equipment signs (safe condition signs).

The following are examples of common safety signs used in workplaces.

### Prohibition Signs



**P002**  
No smoking



**P003**  
No open flame; Fire open ignition source and smoking prohibited



**P009**  
Do not operate

### Mandatory Action Signs



**M002**  
Wear eye protection



**M004**  
Wear hearing protection



**M006**  
Wear hand protection



**M007**  
Wear foot protection

### Warning Signs



**W009**  
Warning:  
Biological hazard



**W012**  
Warning:  
Flammable material



**W013**  
Warning:  
Toxic hazard



**W015**  
Warning:  
Electrical hazard

### Fire Safety Signs



**F001**  
Fire extinguisher



**F002**  
Fire hose reel



**F006**  
Fire emergency telephone

### Safe Condition Signs



**E002**  
Emergency exit  
(right hand)



**E003**  
First aid



**E004**  
Emergency telephone

**Further information can be obtained from:**

- Singapore Standard SS 508: 2013  
Graphical symbols – Safety colours and safety signs  
Part 3: Design principles for graphical symbols for use in safety signs
- British Standard BS 5499: 2002  
Graphical symbols and signs - Safety signs, including fire safety signs -  
Part 5: Signs with specific safety meanings

## 11 Personal Protective Equipment

All healthcare employees who are engaged in any process or activity that involves a risk of bodily injury or danger to health should be provided with suitable and appropriate protective clothing and/or equipment. This is to provide them with reasonable protection against workplace risks that may be encountered.

Protective clothing and equipment should be considered as the last option where engineering or administrative controls cannot completely eliminate or isolate the hazard at source. If protective clothing or equipment needs to be used, the healthcare facility should implement a PPE programme.

Where there are authorised visitors, including contractors, to places of work where conditions require the use of particular protective clothing or equipment, employers should ensure that proper clothing and equipment are available to visitors.

### 11.1 Personal Protective Equipment Programme

This programme should address:

#### Hazards in the Healthcare Facility

The management should conduct a thorough RA of the workplace hazards and risks present.

Appropriate PPE should then be selected based upon the hazard(s) identified.

#### Selection of PPE

The PPE selected should be appropriate for the type of hazard and the conditions under which it is used; while taking into consideration the ergonomic requirements and state of health of the person wearing it; it should fit the wearer correctly and adjustments can be made.

Different sizes of clothing and appropriate types of equipment e.g. spectacles for employees with prescriptive eyewear should be provided to ensure effective protection.

#### Maintenance and Use of PPE

There should be provisions for issuing these PPE to new employees, replacing them when they are defective and proper storage areas to ensure hygiene and accessibility. PPE of a personal nature such as anti-splash goggles or safety shoes should be provided on an individual basis.



## Training of Employees

All employees should be trained in the proper use and maintenance of any PPE they use. This training must include:

- When PPE is to be worn;
- What PPE is necessary;
- How to properly don, take off, adjust, and wear PPE (The proper sequence and methods of donning and removing the various combinations of protective clothing and equipment should be included as part of the training);
- Limitations of PPE; and
- Proper care, maintenance, useful life, and disposal of PPE.

## Regular monitoring

The effectiveness of PPE provided should be assessed through monitoring employees' health and safety in relation to the hazard.

## Recordkeeping

Records of RAs, PPE assignments to individual employees and training on usage of PPE and training materials should be properly documented and kept.

## 11.2 Respiratory Protection Programme

The selection of respiratory protection in healthcare is important as respiratory devices are used to protect healthcare workers' from hazardous or infectious aerosols such as *Mycobacterium tuberculosis*.

Types of respiratory devices used in healthcare includes:

- Particulate respirators (N95, N99 & N100);
- Half- or full-face elastomeric respirators; and
- Powered air purifying respirators (PAPR).

Like other PPE, the selection of a respirator type must consider the nature of the exposure and risk involved. The elements of an effective respiratory protection programme should also include the following.

### Medical Evaluation

Before using a respirator, employees should have been medically evaluated to determine that if it is safe for them to wear it.

### Fit Testing

Fit testing is a means to check if there is a tight seal between the face and the facepiece. It should be performed on an annual basis following approved procedures.

This will ensure that the respirator chosen for the user provides the maximum level of protection.

### Training

All employees should be trained to conduct fit checking (both positive and negative pressure mode) before each use.

### Further information can be obtained from:

- Singapore Standard SS 548: 2009 Code of Practice for Selection, use and maintenance of respiratory protective devices
- Singapore Standard SS 549: 2009 Code of Practice for Selection, use, care and maintenance of hearing protectors
- Singapore Standard SS 98: 2005 Specification for Industrial safety helmets
- Singapore Standard SS 473: Specification for Personal eye-protectors Part 2: 2011 Selection, use and maintenance
- Singapore Standard SS 513: Specification for Personal protective equipment – Footwear Part 1: 2013 Safety footwear

## 12 Appendix A – List of Notifiable Occupational Diseases in Singapore under the Workplace Safety and Health Act

- Aniline poisoning
- Anthrax
- Arsenical poisoning
- Asbestosis
- Barotrauma
- Beryllium poisoning
- Byssinosis
- Cadmium poisoning
- Carbamate poisoning
- Compressed air illness or its sequelae, including dysbaric osteonecrosis
- Cyanide poisoning
- Diseases caused by ionizing radiation
- Diseases caused by excessive heat
- Hydrogen Sulphide poisoning
- Occupational skin diseases
- Lead poisoning
- Leptospirosis
- Liver angiosarcoma
- Manganese poisoning
- Mercurial poisoning
- Mesothelioma
- Noise-induced deafness
- Occupational asthma
- Occupational skin cancers
- Organophosphate poisoning
- Phosphorous poisoning
- Poisoning by benzene or a homologue of benzene
- Poisoning by carbon monoxide gas
- Poisoning by carbon disulphide
- Poisoning by oxides of nitrogen
- Poisoning from halogen derivatives of hydrocarbon compounds
- musculoskeletal disorders of the upper limb
- Silicosis
- Toxic anaemia
- Toxic hepatitis



Appendices

## Appendix B – Examples of Infections and Routes of Transmission\*

Route of Infection	Type of disease	Organisms
<b>Contact:</b> Either direct via hands of employees, or indirect via equipment and other contaminated articles	Gastrointestinal disease	<i>E. coli O157</i> <i>Salmonella typhi</i> <i>Clostridium difficile</i> <i>Campylobacter jejuni</i> Hepatitis A
	Skin and soft tissue infections	<i>Staphylococcus aureus</i> (including MRSA) Ringworm Orf
	Viral respiratory tract infections	Respiratory syncytial virus
<b>Droplet:</b> Large particles that do not remain airborne for very long and do not travel far from source	Respiratory tract infections	<i>Bordetella pertussis</i> Mumps
	Infectious rashes	<i>Varicella zoster</i>
	Meningitis	<i>Neisseria meningitidis</i>
<b>Airborne:</b> Small particles that can remain airborne and travel considerable distances	Respiratory tract infections	<i>Mycobacterium tuberculosis</i> <i>Mycobacterium bovis</i> Avian flu <i>Chlamydia psittaci</i>
	Infectious rashes	Rubella
	<b>Bloodborne:</b> Either direct contact with blood or body fluids (or via skin-penetrating injury) or indirect via contaminated articles, e.g. dressings	Hepatitis
Immune system disease		HIV HTLV

\* Adapted from HSE's *Biological agents: Managing the risks in laboratories and healthcare premises*.

## Appendix C – Summary of Hazards in Healthcare by Location

Location	Hazard	
<b>Central supply (CSSU)</b>	<ul style="list-style-type: none"> <li>Sterilising gases (if ethylene oxide is used)</li> <li>Sterilising/disinfecting agents (e.g. glutaraldehyde, peracetic acid, hydrogen peroxide and ortho-phthalaldehyde)</li> <li>Flammable gases</li> <li>Hazardous wastes (chemical and bio-hazardous)</li> </ul>	<ul style="list-style-type: none"> <li>Bloodborne pathogens</li> <li>Heat from steam/hot water</li> <li>Sharps</li> <li>Manual handling</li> <li>Standing for long hours</li> <li>Noise</li> <li>Splashes during washing of equipment</li> </ul>
	<b>Dialysis units</b>	<ul style="list-style-type: none"> <li>Formaldehyde</li> <li>Bloodborne pathogens</li> <li>Infectious diseases</li> <li>Hazardous wastes (chemical and bio-hazardous)</li> </ul>
<b>Dental surgery</b>	<ul style="list-style-type: none"> <li>Waste anaesthetic gases (WAGs)</li> <li>Mercury</li> <li>Methyl methacrylate</li> <li>Bloodborne pathogens</li> <li>Infectious diseases</li> <li>Hazardous wastes (chemical and bio-hazardous)</li> </ul>	<ul style="list-style-type: none"> <li>Awkward postures</li> <li>Noise</li> <li>Ionizing radiation</li> <li>Sharps</li> <li>Aerolisation during dental treatment</li> <li>Chemical allergy during cold sterilisation of equipment</li> </ul>

Location	Hazard	
<b>Kitchen service</b>	<ul style="list-style-type: none"> <li>Disinfectants and cleaning agents (e.g. soaps, caustic cleaners, detergents, chlorine based products, solvents, etc.)</li> <li>Manual Handling</li> <li>Noise</li> </ul>	<ul style="list-style-type: none"> <li>Sharps</li> <li>Heat</li> <li>Slips and trips</li> <li>Electrical hazards</li> </ul>
<b>Housekeeping</b>	<ul style="list-style-type: none"> <li>Disinfectants and cleaning agents (e.g. soaps, caustic cleaners, detergents, chlorine based products, solvents, etc.)</li> <li>Bloodborne pathogens (from soiled linen, misplaced used needles or waste disposal)</li> </ul>	<ul style="list-style-type: none"> <li>Manual handling</li> <li>Sharps</li> <li>Hazardous wastes (chemical, radioactive, infectious)</li> <li>Electrical hazards</li> <li>Slips, falls</li> </ul>
<b>Laboratory</b>	<ul style="list-style-type: none"> <li>Toxic chemicals</li> <li>Solvents</li> <li>Flammable and explosive agents</li> <li>Carcinogens (e.g. benzene and formaldehyde)</li> <li>Teratogens (e.g. ethylene oxide)</li> <li>Mutagens</li> <li>Cryogenic hazards</li> <li>Bloodborne pathogens</li> </ul>	<ul style="list-style-type: none"> <li>Infectious specimens</li> <li>Infectious/chemical aerosols (during processing)</li> <li>Allergy to PPE (latex allergy)</li> <li>Skin chaffing due to prolonged use of occlusive PPE and repeat handwashing</li> <li>Hazardous wastes (chemical, radioactive, infectious)</li> <li>Radiation</li> <li>Sharps</li> </ul>
<b>Laundry</b>	<ul style="list-style-type: none"> <li>Bloodborne pathogens</li> <li>Sharps (e.g. needle punctures)</li> <li>Hazardous wastes (chemical, bio-hazardous and radioactive)</li> </ul>	<ul style="list-style-type: none"> <li>Manual handling</li> <li>Noise</li> <li>Sharps</li> <li>Slips and trips</li> </ul>

Location	Hazard	
<b>Maintenance and engineering</b>	<ul style="list-style-type: none"> <li>Electrical hazards</li> <li>Tools, machinery</li> <li>Noise</li> <li>Welding fumes</li> <li>Asbestos</li> <li>Flammable liquids</li> <li>Solvents</li> <li>Mercury</li> <li>Pesticides</li> <li>Cleaners</li> <li>Ammonia</li> <li>Carbon monoxide</li> </ul>	<ul style="list-style-type: none"> <li>Ethylene oxide</li> <li>Freons</li> <li>Paints, adhesives</li> <li>Water treatment chemicals</li> <li>Sewage</li> <li>Heat stress</li> <li>Cold stress (refrigeration units)</li> <li>Work at heights</li> <li>Confined spaces</li> <li>Manual handling</li> <li>Strains and sprains</li> </ul>
<b>Nuclear medicine</b>	<ul style="list-style-type: none"> <li>Bloodborne pathogens</li> <li>Radionuclides (e.g. technetium)</li> </ul>	<ul style="list-style-type: none"> <li>X-irradiation</li> <li>Lifting</li> </ul>
<b>Office areas and data processing</b>	<ul style="list-style-type: none"> <li>Video display terminals</li> <li>Indoor air quality</li> </ul>	<ul style="list-style-type: none"> <li>Ozone</li> </ul>
<b>Operating rooms</b>	<ul style="list-style-type: none"> <li>Waste anaesthetic gases (WAGs)</li> <li>Antiseptics</li> <li>Methyl methacrylate</li> <li>Compressed gases</li> <li>Sterilising gases (e.g. ethylene oxide)</li> </ul>	<ul style="list-style-type: none"> <li>Sterilising/disinfecting agents (e.g. glutaraldehyde, peracetic acid, hydrogen peroxide and <i>ortho</i>-phthaldehyde)</li> <li>Bloodborne pathogens</li> <li>Infection diseases</li> <li>Manual handling</li> </ul>

Location	Hazard	
	<ul style="list-style-type: none"> <li>Awkward/static postures</li> <li>Sharps</li> </ul>	<ul style="list-style-type: none"> <li>Hazardous wastes (chemical and bio-hazardous)</li> <li>Electrical hazards</li> </ul>
<b>Pathology</b>	<ul style="list-style-type: none"> <li>Sterilising/disinfecting agents (e.g. glutaraldehyde, peracetic acid, hydrogen peroxide and ortho-phthalaldehyde)</li> <li>Fixative agents (e.g. formaldehyde)</li> <li>Solvents</li> <li>Phenols</li> </ul>	<ul style="list-style-type: none"> <li>Flammable substances</li> <li>Freons</li> <li>Bloodborne pathogens</li> <li>Infectious diseases</li> <li>Sharps</li> <li>Hazardous wastes (chemical and bio-hazardous)</li> </ul>
<b>Patient care</b>	<ul style="list-style-type: none"> <li>Waste anaesthetic gases (WAGs) (delivery rooms and recovery rooms)</li> <li>Bloodborne pathogens</li> <li>Infectious diseases</li> <li>Manual handling</li> <li>Standing for long periods</li> <li>Radiation</li> <li>Sharps (e.g. needle punctures)</li> </ul>	<ul style="list-style-type: none"> <li>Hazardous medication handling (e.g. cytotoxics and chemotherapeutic agents)</li> <li>Hazardous wastes (chemical and bio-hazardous)</li> <li>Psychosocial</li> <li>Electrical hazards</li> <li>Slips, falls</li> <li>Abuse from patient and relatives</li> </ul>
<b>Pharmacy</b>	<ul style="list-style-type: none"> <li>Mercury</li> <li>Hazardous medication handling (e.g. cytotoxics and chemotherapeutic agents)</li> </ul>	<ul style="list-style-type: none"> <li>Hazardous wastes (e.g. cytotoxics and chemotherapeutic agents)</li> <li>Slips, falls</li> </ul>
<b>Radiology</b>	<ul style="list-style-type: none"> <li>Radiation</li> <li>Lifting</li> </ul>	<ul style="list-style-type: none"> <li>Pushing, pulling</li> </ul>

## Appendix D – Useful Links

**Workplace Safety and Health Council**  
www.wshc.sg

**Ministry of Manpower**  
www.mom.gov.sg

**Ministry of Health**  
www.moh.gov.sg

**National Environment Agency**  
www.nea.gov.sg

**Health Sciences Authority**  
www.hsa.gov.sg

**Singapore Medical Council**  
www.smc.gov.sg

**Singapore Dental Council**  
www.sdc.gov.sg

**Singapore Nursing Board**  
www.snb.gov.sg

**Singapore Pharmacy Council**  
www.spc.gov.sg

**Singapore Standards eShop**  
www.singaporestandardseshop.sg

**National University of Singapore**  
www.nus.edu.sg

**OSHA Hospital e-Tool**  
<http://www.osha.gov/SLTC/etools/hospital/>

**World Health Organisation**  
www.who.int

**International Labour Organisation**  
www.ilo.org

**Occupational Safety and Health Administration (USA)**  
www.osha.gov

**The National Institute for Occupational Safety and Health (USA)**  
www.cdc.gov/niosh

**Centers for Disease Control and Prevention (USA)**  
www.cdc.gov

**Victorian Workcover Authority**  
www.vwa.vic.gov.au

**Health and Safety Laboratory – United Kingdom**  
www.hsl.gov.uk

**Joint Commission Resources**  
www.jcrinc.com

**Health and Safety Executive (UK)**  
www.hse.gov.uk





## Acknowledgements

### 13 Acknowledgements

The Workplace Safety and Health Council would like to acknowledge contributions from the following agencies.

- Ministry of Health (MOH)
- National Environment Agency (NEA)
- Health Sciences Authority (HSA)
- Singapore Health Services (SingHealth)
- ParkwayHealth
- Singapore Dental Association
- Singapore Medical Association
- SPRING Singapore
- Occupational Safety and Health Administration (OSHA), USA
- Centers for Disease Control and Prevention (CDC), USA
- The National Institute for Occupational Safety and Health (NIOSH), USA
- Health and Safety Executive (HSE), UK
- International Social Security Association (ISSA)
- Swedish Work Environment Authority
- Society of Gastroenterology Nurses & Associates (SGNA), Inc.
- World Health Organisation (WHO)
- British Standard Institute (BSI)
- Singapore General Hospital (SGH)



## 14 Amendments

This set of guidelines replaces the Workplace Safety and Health Guidelines – Healthcare published by the Workplace Safety and Health Council in April 2008.

The key amendments in this second edition published in September 2015 are:

Section	Amendment
<b>2</b>	Commitment from Top Management – new chapter to emphasize the importance of top management commitment in ensuring a safe and healthy workplace.
<b>4</b>	Incident Reporting and Investigation – new chapter to highlight reportable workplace incidents under the WSH (Incident Reporting) Regulations, and the procedures of incident investigation.
<b>5</b>	Risk Management – new chapter on the risk management process and the steps involved.
<b>6.1.1</b>	Management of Hazardous Chemicals Programme (MHCP) – revised to align guidance with WSH Guidelines on MHCP.
<b>6.3.1</b>	Falls from Heights – new section on working safely at heights.
<b>6.3.2</b>	Slips, Trips and Falls (STF) – new section on prevention of STF at the workplace.
<b>Appendix A</b>	Revised list of notifiable occupational diseases in Singapore under the WSH Act.

Published in April 2008 by the Workplace Safety and Health Council in collaboration with the Ministry of Manpower. These guidelines are co-developed by the Workplace Safety and Health (WSH) Council and the Ministry of Manpower.

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