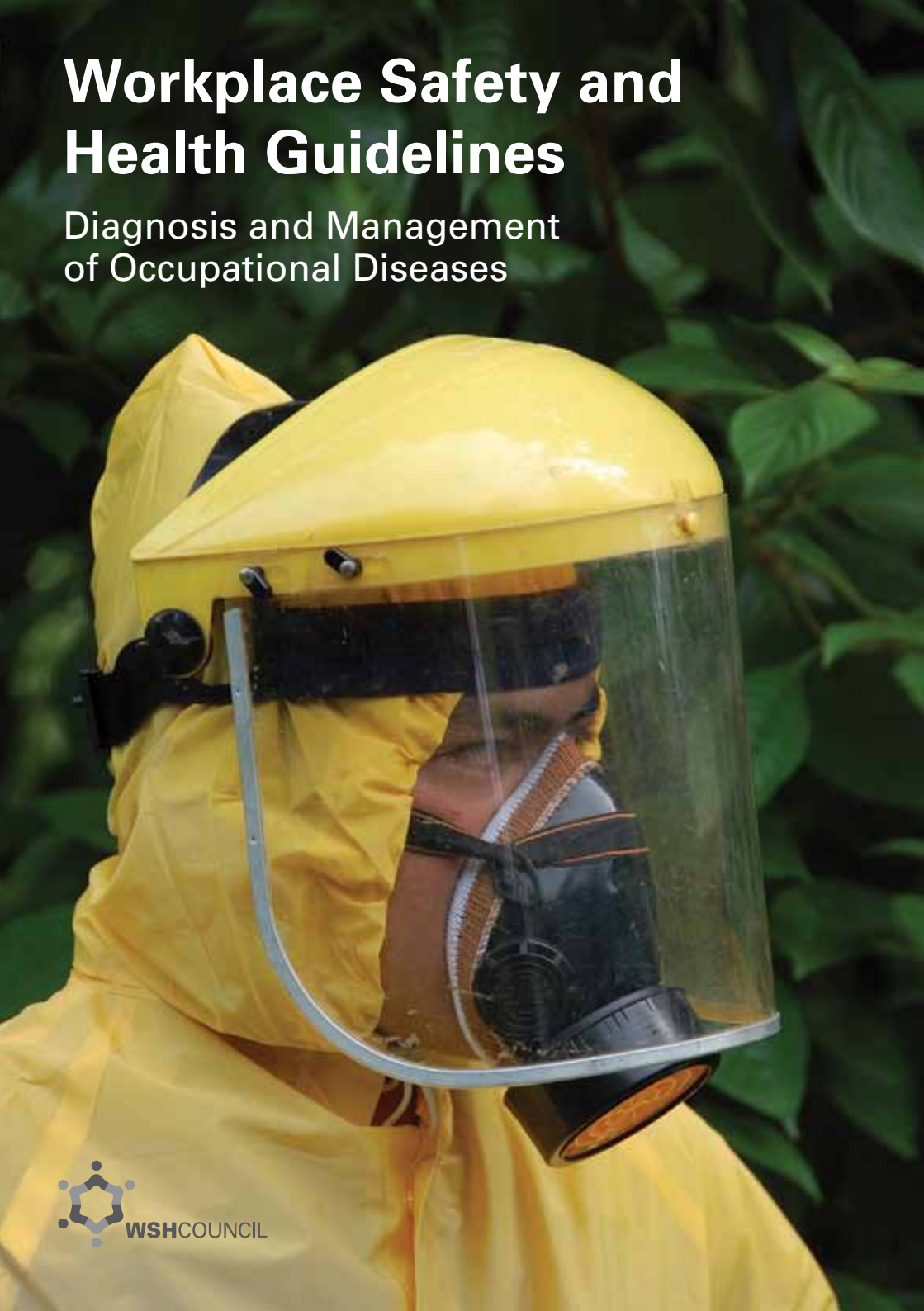
Workplace Safety and Health Guidelines

Diagnosis and Management of Occupational Diseases



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1. Foreword

Occupational disease (OD) is defined as any disease contracted as a result of an exposure to risk factors arising from work activity. Doctors have a legal responsibility to report ODs under the Workplace Safety and Health Act. However, it is often under-reported and goes unrecognised in view of the long latency period and changes in the types of industries, as well as the use of new technologies and materials.

It is important for doctors and the health professionals to recognise occupational and work-related diseases among their patients. Early detection and intervention can prevent or minimise morbidity and disability from these diseases. It can also prevent further deterioration or recurrence and result in the protection for other employees who may be exposed to similar risks. In addition, ODs are compensable under the Work Injury Compensation Act which covers all employees.

The objective of this guide is to provide doctors with a quick and easy reference for the diagnosis and management of work-related conditions. The photographs of common work processes in Appendix A will be useful when taking occupational history and identifiying possible exposures associated with certain specific diseases. The illustrations on personal protective equipment in Appendix B may be helpful for patient education. There is also a step-by-step guide on how to report OD to the Ministry of Manpower and a list of clinics where you can refer suspected cases for further investigation and management.

The Ministry of Manpower and Workplace Safety and Health Council would like to thank all the experts who have contributed to the development of the guide, practitioners who have given us their valuable feedback and all who have made this guide possible.

2. Diagnosis and Reporting of Occupational Diseases in Singapore

Occupational disease (OD) is defined as any disease contracted as a result of an exposure to risk factors arising from work activity. Risk factors include exposure to physical, chemical, biological, ergonomic or psychosocial hazards at the workplace. Doctors have a legal responsibility to report ODs under the Workplace Safety and Health (WSH) Act. In Singapore, there are 35 ODs that are reportable under the Second Schedule of the WSH Act (see Appendix C). The three most common ODs reported in Singapore are noise-induced hearing loss, occupational skin diseases and excessive absorption of chemicals.

It is important for doctors and health professionals to recognise occupational and work-related diseases among their patients to prevent them from being permanently disabled by the disease and to enable affected workers to exercise their rights to compensation. The reporting of ODs triggers investigations to be conducted to establish causality and identify other employees and workplaces that may be at risk, so that preventive measures can be put in place.

2.1 Diagnosis of Occupational Diseases

As ODs may have a long latency period, the diagnosis will need to entail:

- taking a detailed occupational and medical history;
- clinical examination for specific symptoms and signs of ODs; and
- conducting relevant investigations, including review of safety data sheets and workplace evaluation to document exposure and exclude other non-occupational causes.

1. A detailed occupational history includes:

- work process (e.g., work tasks, tools used);
- exposure to hazards (e.g., dust, fumes, radiation, chemicals, biological, physical hazards);
- route of exposure (e.g., inhalation, skin, ingestion);
- frequency, duration and intensity of exposure;
- use of personal protective equipment (e.g., gloves, respirators);
- presence of engineering control (e.g., process enclosure, local exhaust ventilation, general ventilation); and
- work organisation (e.g., work hours, breaks, overtime).

2. Correlate the occupational history with symptoms in relation to:

- the onset and duration of symptoms (temporal relationship between exposure and onset of symptoms);
- aggravating factors;
- effects of off-days and holidays; and
- other workers affected.

3. Ask for the worker's past work history and any relevant information for previous jobs held.

2.2 Reporting of Occupational Diseases

All registered medical practitioners are required to report any of the ODs listed in the Second Schedule of the WSH Act (see Appendix C) within 10 days from the diagnosis of the disease under the WSH (Incident Reporting) Regulations. All notifications should be made via the electronic notification system at www.mom.gov.sg/ireport or through Health Professionals Portal (HPP) at www.hpp.moh.gov.sg. See Appendix D for a step-by-step guide on how to report ODs.

A robust notification system provides important data for understanding the extent and depth of the occupational safety and health status in Singapore. It helps the authorities to identify persons and industries at risk, as well as to identify new and emerging ones.

Doctors may refer workers with suspected occupational or work-related disease to one of the occupational health clinics (see Appendix E) for further investigation to establish work-relatedness.

Doctors should also inform employers of the diagnosis to enable employers to comply with their statutory duty to notify ODs to Ministry of Manpower (MOM). It is also a good practice for doctors to inform workers suffering from ODs that they should keep their employers updated on their diagnosis and management and remind their employers of their obligations to report to MOM.

Note
Non-compliance with the reporting requirements may result in a fine of up to $5,000 for first offence, and up to $10,000 or/and an imprisonment for a second or subsequent offence.

2.3 Other Relevant WSH Legislation

Doctors should also be conversant with two other legislations relating to work injury compensation and mandatory medical examinations for workers exposed to certain hazards.

The Work Injury Compensation Act (WICA) is based on a "no fault" principle. Under WICA, an employee who sustains injury or contracts a disease is eligible for work injury compensation if it is shown that the accident/ disease arose out of and in the course of employment. It allows for compensation in terms of medical expenses and incapacity. Employers should be advised to notify MOM electronically at www.mom.gov.sg/ireport. Upon notification, MOM will assess the affected employee for compensation under WICA.

Workers employed in occupations with exposure to certain hazards are required to undergo specific medical examinations under the WSH (Medical Examinations) Regulations. The medical examinations and tests help to detect workers with OD or overexposure early, and ensure that workers remain fit for such work. These medical examinations are conducted by Designated Workplace Doctors (DWDs) registered with MOM.

3. Occupational Diseases

3.1 Compressed Air Illness and Barotrauma

Compressed air illness (CAI) and barotrauma can occur in workers exposed to compressed air environments. CAI can be classified as decompression illness (DCI) and dysbaric osteonecrosis. Barotrauma can affect air-filled spaces in the body, for example, sinuses, ears and lungs. Cases of CAI from tunnelling projects in Singapore are usually seen at company appointed doctors.

3.1.1 Clinical Presentation

CAI may present with joint pains, rashes, and symptoms relating to respiratory and nervous systems involvement. Severe cases may develop intravascular coagulation as the excessive gas triggers the coagulation cascade. DCI should be suspected if the presenting symptoms occur within 36 hours from the last exposure to compressed air environment. In cases of barotrauma, pain and bleeding can occur over the affected site. See Table 1 for details on presentations of CAI and barotraumas.

Condition		Presentation
Compressed Air Illness (CAI)	Type 1 Decompression Illness (DCI)	Joint • Acute pain around major joints Skin • Urticarial and bluish-red mottling • Itch
	Type 2 DCI	Neurological • Vertigo, pins and needles, parasthesia, hypoaesthesia, ataxic gait, hyperreflexia, Babinski's sign, paralysis and weakness of limbs, headache, seizures, vomiting, visual loss or visual field defect, incontinence, impaired speech, tremors and coma Respiratory • Chest tightness, substernal pain, severe coughing, dyspnea, pulmonary oedema and shallow respiration
	Dysbaric Osteonecrosis	• Usually asymptomatic unless there is joint involvement resulting in pain and limitation of movement. Condition may take months or years to develop.

Barotrauma	Sinus Barotrauma	• Acute pain over sinus area and/or nasal, post nasal bleeding
	Middle Ear Barotrauma	• Otalgia, haemorrhagic exudates or burst eardrum accompanied with hypoacusis, tinnitus, vertigo when cold water enters middle ear • Hearing loss
	Inner Ear Barotrauma	• Severe vertigo • Hearing loss in the affected side
	Pulmonary Barotrauma	• Chest pain, breathlessness, unconsciousness, subcutaneous emphysema

Table 1: **Clinical presentations of CAI and barotrauma.**

Risk factors for compressed air illness include:

- medical unfitness, for example, obese and older workers may be at higher risk;
- high pressures, for example, pressures more than 1 bar (greater risk with higher pressures);
- long working hours in compressed air, for example, those working more than 4 hours;
- failure to follow proper decompression procedure;
- multiple entries into compressed air environment, for example, supervisors and engineers;
- lack of acclimatisation, for example, new workers; and
- heavy manual work in free air between shifts/ dives.

Risk factors for barotrauma include:

- medical unfitness, for example, those with pre-existing medical conditions, those who are not able to clear their ears or who have chronic diseases of the ear, air passages or the lungs (see also risk factors for compressed air illness above);
- sudden changes of pressure;
- failure to follow proper compression procedures;
- smoking;
- coughing;
- breath-holding; and
- infections affecting the ear or upper respiratory tract.

3.1.2 Differential Diagnosis

Exclude non-occupational causes with similar symptoms, such as those due to:

- degenerative joint diseases;
- strains and sprains;
- infections;
- spinal cord compression (e.g., tumour);
- multiple sclerosis;
- Guillain–Barré syndrome; and
- myasthenia gravis.

3.1.3 Diagnostic Criteria of Work-relatedness

A good occupational history of exposure to hyperbaric or high pressure environment is critical. In addition, supporting documents of repeated dives or rapid ascents will aid in determining the diagnosis of CAI or barotrauma.

3.1.4 Investigation to Establish Work-relatedness

i. Take an occupational history to establish if there is exposure to a high pressure environment. These following processes may involve the use of or be exposed to compressed air:

- tunnelling or shaft sinking operations in water-bearing strata;
- caisson work on river beds;
- pressurisation checks, for example, in aircrafts;
- work in medical locks or recompression chambers; and
- diving.

ii. Correlate the exposure history with individual symptoms and investigation results, such as sinus, chest and long bone x-rays, audiograms (see Table 1). Ask for the logbook which will detail the record of the worker's work in compressed air or diving.

iii. Ask company for exposure records which will have information on pressures used, workers' registers and barographs.

3.1.5 Management

Treatment for CAI usually involved the administration of 100% oxygen and recompression in a hyperbaric chamber according to specific treatment protocols. Medications may be used to alleviate pain and swelling.

Treatment for barotrauma may involve the use of antihistamines, decongestants, analgesic drugs and antibiotics depending on the severity of the case. Sinus x-rays, audiometric tests and tympanograms may be useful for further evaluation of the condition.

All cases should preferably be referred to the Appointed Medical Practitioner or to a hyperbaric/diving physician. Contacts of the appointed medical practitioner can be found on the worker's identity disc or logbook.

You may contact the hyperbaric treatment centers at:

- Singapore General Hospital (contact no: 6321 3427)
- Tan Tock Seng Hospital (contact no: 6355 9021)

Advice to workers:

- Strictly follow suspension period to avoid further exposure.
- Upon return to compressed air work, follow advice on the contraindications of entry into compressed air environment, such as cold, sore throat, earache or chest infection.

Advice to companies:

- Review workplace risk assessment (RA) and put in place measures to follow proper compression and decompression procedures.
- Review the need for compressed air and if lower pressures can be used.
- Notify MOM (CAI and barotrauma are notifiable and compensable diseases).
- Find out more about requirements for medical examinations under the WSH (Medical Examinations) Regulations.

3.2 Diseases Caused by Excessive Heat

Diseases caused by excessive heat (heat disorders) can result from prolonged exposure to excessive heat causing the body's cooling mechanism to break down, especially in unacclimatised workers. A rise in the core body temperature may lead to temporary or permanent disturbances in bodily functions which may be further aggravated by strenuous physical activity.

3.2.1 Clinical Presentation

Heat disorders can be viewed as a continuum of illnesses ranging from mild presentation as heat rash, syncope and heat cramps to the more severe presentation of heat exhaustion and heat stroke (see Table 2).

Condition	Presentation
Heat rash	• Itchy red papules to prickly sensation to blistering, especially in hot and humid environment
Heat syncope	• Transient loss of consciousness, preceded by pallor, blurring of vision, dizziness and nausea
Heat cramps	• Painful muscle cramps (most often in the legs) • Weakness, nausea, vomiting
Heat exhaustion (if untreated, it has the potential to develop into life-threatening heat stroke)	• Core temperature usually in the range 37.7 to 40°C • Profuse sweating, cool clammy skin, tachycardia, hyperventilation • Nausea, vomiting, headache, dizziness, light-headedness • Intestinal cramps • Fatigue, weakness and inability to continue strenuous physical exertion • Normal mental state and stable neurological status

Heat stroke (fatal if not treated quickly)	• Core temperature usually above 40°C • Hot and dry skin • Central Nervous System (CNS) changes include dizziness, drowsiness, confusion, irritability, aggressiveness, apathy, disorientation, loss of bladder and bowel functions, seizures and even coma • Cardiovascular deterioration • Multi-organ failure

Table 2: Clinical presentations of heat disorders.

Predisposing factors include:

- lack of acclimatisation (e.g., workers coming from a colder country would need to get used to the hot environment);
- poor hydration;
- illness (e.g., diabetes) or on medication;
- older workers;
- obesity; and
- alcohol consumption.

3.2.2 Differential Diagnosis

Exclude non-occupational causes with similar symptoms such as those due to:

- other causes of unconsciousness or syncope such as stroke, hypoglycemia; or
- other causes of increased body temperature such as fever due to infections.

3.2.3 Diagnostic Criteria of Work-relatedness

A good occupational history of work in hot environment, especially in an unacclimatised worker. Reports on air temperature, humidity and air movement/ ventilation are useful measures of heat stress in the environment. One of the available composite indices is the Wet Bulb Globe Temperature.

3.2.4 Investigation to Establish Work-relatedness

i. Take an occupational history to establish if the worker is exposed to physical work in a hot environment. At-risk workers include those who are newly assigned to work in such an environment. These are:

- construction workers (especially those working under the hot sun);
- steel workers;
- oven and furnace operators;
- shipyard workers; and
- landscaping and agriculture workers.

Heat acclimatisation involves the gradual increase in duration of exposure to performing moderate work under hot weather and is usually optimised by 10 to 14 days. New workers would need at least one to two weeks to adjust to Singapore's weather conditions.

ii. Ask company for environmental records, such as air temperature, humidity and other measures of heat indices.

3.2.5 Management

Treatment will depend on the type of presentation. This may range from rest and the replacement of fluid and electrolytes in heat cramps to the immediate and aggressive cooling efforts to reduce core body temperature in heat exhaustion and heat stroke. Details on treatment can be found in *SAF-MOH Clinical Practice Guidelines 1/2010: Management of Heat Injuries.*

Advice to workers with mild forms of heat disorders:

- Drink enough water before returning to work.
- Seek treatment if condition deteriorates (progressing to heat exhaustion).

Workers presenting with heat exhaustion and heat stroke should be referred to hospitals for further evaluation and treatment.

Advice to companies:

- Notify MOM.
- The company should review workplace RA and put in place control measures to reduce exposure by adjusting work schedules. For example, strenuous work can be done in the cooler parts of the day and shaded areas can be provided for work and rest.
- Ensure that new workers are acclimatised to work in hot weather.
- Provide sufficient water intake and rest breaks.
- Ensure that workers are trained to recognise symptoms of heat stress and report illnesses early.

3.3 Occupational Cancers

Cancer is one of the leading causes of death in Singapore. Occupational cancer is cancer caused by exposure to carcinogens that fall under Group 1 of the International Agency for Research on Cancer (IARC) in the workplace.

IARC classifies the agents into five groups:

Group 1: Proven human carcinogens (based on epidemiological studies among workers with long exposure)

Group 2A: Probable human carcinogens (evidence from animal studies which are relevant to human exposure)

Group 2B: Possible human carcinogens (evidence of significant increase in cancer incidence in more than one animal species or strains)

Group 3: Agents are not classifiable as carcinogenic to humans; and
Group 4: Agents probably not carcinogenic to humans

Some well-established occupational cancers include mesothelioma caused by asbestos, and liver angiosarcoma caused by vinyl chloride monomers and arsenic. Under WICA, these cancers are compensable.

3.3.1 Clinical Presentation

The clinical features are specific for the type of cancers, irrespective of whether the cancer is work-related or not. There are no specific histopathological features to distinguish it from non-occupational causes.

As some cancers have a long latency period, it is a challenge to establish the exposure history for such cancers and therefore the causal relationship.

3.3.2 Differential Diagnosis

Exclude non-occupational causes, such as those due to:

- strong family history (genetic predisposition);
- lifestyle factors, for example, smoking, dietary factors, excessive exposure to the sun during outdoor activities; and
- use of certain drugs, such as estrogens (breast, ovarian and uterine cancer) and tamoxifen (uterine and endometrial cancer).

3.3.3 Diagnostic Criteria of Work-relatedness

While a good occupational history of exposure may be difficult to obtain in view of the long latency period of some cancers, it is nevertheless critical for diagnosis. Astute doctors should have a high index of suspicion that a workplace factor may be responsible if a rare cancer occurs in a young worker or in a cluster of workers. Supporting documents of personal or workplace exposure monitoring if available will aid in determining the diagnosis of work-relatedness.

3.3.4 Investigation to Establish Work-relatedness

i. Take a good occupational history to establish if there is exposure to the following carcinogens under IARC Group 1.

Cancer Involving	Type of Carcinogens	Exposure Situations/ At-risk Exposure
Bladder	4 Aminobiphenyl	• Rubber and tyre manufacturing
	Arsenic*	• Wood preservation • Use of pesticides • Manufacture of glass, semiconductors, alloys, pigment, anti-fouling paints
	Benzidine	• Manufacture of pigments and dyes
Blood (Leukemia)	Benzene*	• Petrochemical industry • Refinery • Laboratory and testing work involving the use of benzene • Work involving handling of fuels containing benzene (e.g., vehicle workshops, petrol stations) • Bulk storage of petrol and related products
	Ionising radiation	• Use of radioactive isotopics or irradiation apparatus, such as X-ray machines
Lung	Arsenic*	• Wood preservation • Use of pesticides • Manufacture of glass, semiconductors, alloys, pigment, anti-fouling paints
	Asbestos*	• Construction and demolition of buildings containing asbestos roofings, rubbish chutes • Ship breaking and repair where asbestos is used for insulation of boilers, pipes • Repair and replacement of asbestos brake linings by car and bus mechanics
	Beryllium	• Manufacture of nuclear devices, satellite and radar systems, aircraft brushings and bearings in the defence and aeronautical industry
	Cadmium*	• Manufacture of nickel-cadmium battery, jewellery, certain fungicides, pigments and dyes • Waste treatment • Smelting and refining of ores containing cadmium • Silver brazing using cadmium-containing fillers • Welding on cadmium-containing alloys • Plastic industry (during compounding of polyvinyl chloride) • Cadmium electroplating • Automobile and aircraft industries

	Chromium (hexavalent)	• Chromium metal plating • Manufacture of pigments and dyes
	Nickel	• Stainless steel production • Manufacture of batteries
	Bis (chloromethyl) ether	• Chemical industry
	Vinyl Chloride (VCM)*	• Rubber and plastic manufacturing • Storage of VCM • Sampling and analysis of VCM
Liver (Angiosarcoma)+	Arsenic*	• Wood preservation • Use of pesticides • Manufacture of glass, semiconductors, alloys, pigment, anti-fouling paints
	Vinyl Chloride (VCM)*	• Rubber and plastic manufacturing • Storage of VCM • Sampling and analysis of VCM
Pleural, Peritoneum (Mesothelioma)+	Asbestos*	• Construction and demolition of buildings containing asbestos roofings, rubbish chutes • Ship breaking and repair where asbestos is used for insulation of boilers, pipes • Repair and replacement of asbestos brake linings by car and bus mechanics
Nasal Cavities and Paranasal Sinuses	Chromium (hexavalent)	• Electroplating • Production and welding of stainless steel parts
	Nickel	• Stainless steel production • Manufacture of batteries
	Wood dust	• Woodworking

Skin+	Arsenic*	• Wood preservation • Use of pesticides • Manufacture of glass, semiconductors, alloys, pigment, anti-fouling paints
	Ultraviolet radiation	• Work involving excessive exposure to the sun (e.g., in the construction and shipbuilding industries)
	Polycyclic hydrocarbons, tar, pitch, bitumen, mineral oil (including paraffin), soot	• Petrochemical industry • Refinery

*Workers exposed to these chemicals are required to undergo mandatory medical examinations under the WSH (Medical Examinations) Regulations.
+ These cancers are compensable under WICA.

Table 3: **Carcinogens and associated exposures.**

ii. Ask company for results of exposure monitoring which will provide additional support for the diagnosis if the levels exceed the permissible exposure levels. The American Conference of Government Industrial Hygienists (ACGIH) has a list of exposure limits, some of which are specific for prevention of cancers, although most will argue that there is no "safe" level for cancer. However, the exposure limits provide some basis for a balanced view of the relative contributions of the exposure to the condition.

iii. Correlate the cancer to the latency period, the minimum duration of exposure and level of exposure. The latency period can range from 5 to 30 or 40 years, depending on the type of cancer.

iv. Exclude non-occupational causes.

3.3.5 Management

All cancers need to be referred to hospitals for further management. Company should be advised on the following:

- Review workplace risk assessment (RA) and put in place control measures to reduce exposure through engineering controls, limiting access and protecting workers by means of personal protective equipment (PPE).
- Substitute with non-carcinogenic substances whenever possible.
- Find out more about requirements for medical examinations under the WSH (Medical Examinations) Regulations and workplace monitoring.
- Keep a register of all workers exposed to carcinogens for at least 10 years.

3.4 Occupational Eye Disorders

Eye disorders resulting from work are largely under-reported and they can be easily prevented. The most common types of eye injuries result from small foreign objects ejected by tools or during activities such as grinding, welding and hammering. In the diagnosis and treatment of eye disorders, it is important to bear in mind the nature of the patient's occupation and the nature of work activity at time of injury. The attending doctor should maintain a high index of suspicion when the mechanism of injury may be suggestive of a penetrating eye injury. For example, high energy impact on the eye, injury involving sharp objects, high velocity projectiles, and lack of eye protective device. In addition, when treating a case of acute or chronic conjunctivitis, the attending physician should also consider possible irritation from exposure to chemicals at work.

3.4.1 Clinical Presentation

Symptoms may include pain, blurring or loss of vision, redness, increased tearing and bleeding. Examination should include assessment of the eyelids, eyeball and the face. A slit-lamp microscope will aid in making a diagnosis.

The common eye disorders in the occupational setting are foreign bodies in the eye and chemical irritation. Foreign bodies may cause little or no damage if confined to the conjunctiva, although subsequent rubbing of the eye may cause severe conjunctival laceration or corneal abrasions.

For chemical-related eye disorders, the attending doctor should look out for other signs and symptoms of poisoning or exposure to the specific chemical. For example, while trichloroethylene used as a degreasing agent can cause optic neuritis and retinitis, one should also look out for evidence of neurological symptoms and liver dysfunction.

3.4.2 Differential Diagnosis

Exclude non-occupational causes such as those due to:

- diabetes;
- hypertension;
- infections;
- age-related macular degeneration;
- sports-related injuries; and
- accidental contact from use of hair dye, superglue, shampoo.

3.4.3 Diagnostic Criteria of Work-relatedness

A good clinical examination should be accompanied by a detailed occupational history. This should include details of the accident, mechanism of injury and/or what chemicals were involved. A good understanding of the working conditions, mechanism, duration and intensity of exposure will raise the index of suspicion that the eye condition is work-related.

3.4.4 Investigation to Establish Work-relatedness

i. Take a good occupational history to establish if the following exposure situations are the cause of the eye disorders. The clinical presentation with the likely cause and its management are listed in Table 4.

Clinical Presentation	Likely Cause	Exposure Situations/ At-risk Exposure*	Management of Worker
Eye Irritation/ Burning Sensation	Foreign body in cornea or conjunctiva	• Construction, especially chiselling and hacking • Woodworking • Metalworking • Grit-blasting (in shipyards)	• Immediate irrigation with sterile water or isotonic saline solution • Removal of penetrating foreign bodies best carried out by the ophthalmologist. • Refer to an ophthalmologist if there is possible penetration of the orbit • Antibiotic eye ointment may be started if there is possibility of infection • Advise patient to come back for review within 24 hours or report to the emergency department if the symptoms worsen
	Chemicals (e.g., acids, alkalis, solvents+, flour, gases such as hydrogen sulphide+, ammonia+.)	• Chemical industry • Electronics • Dry-cleaning • Woodworking • Metal industries • Bakery	
	Non-ionising radiations (e.g., microwaves, infrared, ultraviolet light, laser radiation)	• Welding work, especially welders' assistants and nearby workers	• Advise rest and return for follow up if symptoms are not resolved within 24 hours • Follow up for scarring or cataract

Tired Eyes/ Blurring of Vision/ Tearing/ Dryness	Prolonged computer use	• Work environment with inadequate lighting, glare, rest period and low humidity	• Advise rest with adequate work-rest regime of at least 15 mins for every hour of continuous work • Adjust work station lighting to at least 500 lux and reposition light sources or computer screen to reduce glare
Hyphaema	Blunt trauma to the eye	• Construction, especially chiselling and hacking • Woodworking • Metalworking • Grit blasting (in shipyards)	• Refer to an ophthalmologist if there is possible penetration of the orbit
Cataracts	• Ionising radiation • Ultraviolet light	• Welding work, especially welders' assistants and nearby workers • Excessive exposure to the sun during outdoor work	• Use eye protection • Refer to an ophthalmologist for evaluation
Blindness	Methanol Poisoning[+]	• Making of biofuels	
Corneal Ulceration	Tar, pitch, bitumen, mineral oil (including paraffin), soot or any compound product, or residue of any of these substances	• Petrochemical industry • Refinery	

*See Appendix A for photographs of the various exposure situations.
[+]Exposure to these chemical may give rise to systemic effects.

You will need to inform the employer to notify MOM if the worker is given more than 3 consecutive days of medical leave or is hospitalised for at least 24 hours. This is required under the WSH (Incident Reporting) Regulations. The report should be submitted within 10 days of the accident.

Table 4: **Clinical presentations of eye disorders.**

3.4.5 Management

Occupational eye disorders can be prevented. When dealing with chemical injuries, the most important step is immediate extensive and copious eye irrigation. Cases should be referred to the emergency eye department for further review and treatment.

Advice to workers:

- Refer to Table 4. It is a good practice to refer the patient to an ophthalmologist if you suspect the condition requires specialist follow-up.
- Instruct them on the appropriate eye protectors and face shields to use.

Advice to companies:

- Identify high-risk work processes and put in place measures for eye protection, such as machine guarding, use of appropriate personal eye protection and provision of eye wash facilities.
- Extra eye protection should be taken for workers with good vision in only one eye. This is to reduce the worker's risk of total blindness should an accident happen.

3.5 Occupational Hearing Loss (Noise-induced Hearing Loss and Acoustic Trauma)

Hearing loss can be acute and it may result from accidents and injuries sustained at work, for example, following a blast injury, head injury and barotrauma. Hearing loss may also be chronic and occur gradually over a period of time as a result of prolonged exposure to excessive noise at work, resulting in noise-induced deafness (NID).

3.5.1 Clinical Presentation

Acute hearing loss is usually sudden and may be accompanied by pain, bleeding, tinnitus or giddiness. The hearing loss may be unilateral or bilateral which may or may not improve over time. The hearing loss may be conductive, affecting all frequencies with rupture of the eardrum or sensorineural if the cochlea is affected.

Chronic hearing loss or NID, which develops insidiously over a long period of time, is the irreversible sensorineural hearing loss caused by damage to the hair cells of the organ of Corti when they are exposed to excessive noise. NID in the early stages affects the high frequencies, and the person may not notice that he has NID until he is unable to hear high-pitched sound such as the electronic beep of a handphone. There may also be a gradual loss of clarity in perceived speech, resulting in difficulty in understanding what others say. Another presenting symptom is the presence of a high-pitched tinnitus, initially intermittent, which may become continuous in about 20% of cases. Usually, both ears are affected.

In the later stages of NID, the hearing loss extends over the lower frequencies and the workers may find difficulty in hearing normal conversation. As is the workers are unable to hear their own voices clearly, they will also tend to speak loudly.

3.5.2 Differential Diagnosis

Exclude other causes of hearing loss below:

- history of deafness since childhood (congenital deafness may be associated with maternal rubella, flu, or prenatal medication, birth trauma);
- familial deafness;
- childhood illnesses such as measles (which usually results in bilateral deafness) or mumps, (which usually results in unilateral deafness), encephalitis, meningitis, cerebral abscesses;
- use of ototoxic drugs, such as streptomycin, gentamycin, neomycin;
- history of head injury;
- history of deep x-ray therapy (DXT), especially at the head and neck regions;
- presbycusis (especially for those above 50 years old);
- infection of the ear, for example, otitis media; and
- excessive noise exposure from non-occupational sources, for example, discotheque, personal MP3 use.

3.5.3 Diagnostic Criteria of Work-relatedness

A good occupational history of exposure is critical. In addition, supporting documents of results of personal or workplace exposure monitoring will aid in determining the diagnosis of NID.

3.5.4 Investigation to Establish Work-relatedness

i. Take a good occupational history to establish if there is exposure to excessive noise or impact noise (e.g., from a blast). Noise exposure is expected to be high in the following workplaces:

- shipbuilding and ship repairing;
- iron and steel mills;
- metalworking industries;
- woodworking industry;
- textile industry;
- paper industry;
- air terminal work, for example, jet engine testing;
- industries with bottling processes; and
- landscaping, for example, using of leaf blowers, lawnmowers and trimmers.

ii. Audiometric test

An audiometric test should be performed on the worker. Worker should not be exposed to loud noises for at least 16 hours prior to the test to avoid temporary threshold shift. The classical NID pattern of hearing loss shows a dip in the 4 and/or 6 kHz frequencies. See Figure 1 on how a worker is evaluated for clinical or audiometric hearing loss.

It will be good if companies have serial audiograms for comparison as it can show the deterioration in the hearing status over the years.

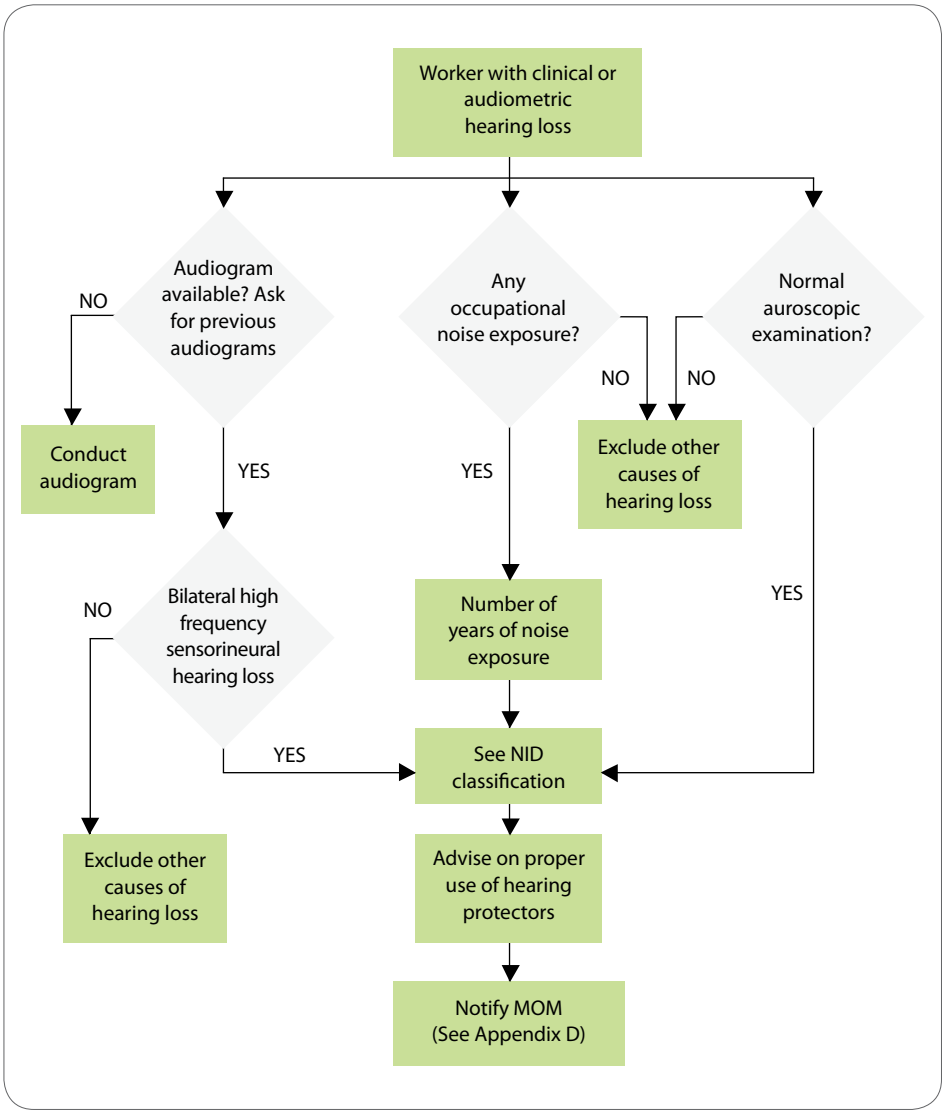


Figure 1: Evaluation for hearing loss.

Noise-induced deafness may be classified into:

Suspect
- occupational exposure to noise less than 5 years
- unilateral high frequency hearing loss

Early
- occupational exposure to noise 5 years or more
- audiogram shows average hearing loss (AHL) of 1, 2 and 3 kHz <50 dBA in the better ear

Advanced
- occupational exposure to noise 10 years or more
- audiogram shows AHL of 1,2 and 3 kHz >=50 dBA in the better ear

3.5.5 Management

The objective is to prevent further hearing loss in the worker and reduce noise exposure to other workers.

Advice to workers:

- Use hearing protectors correctly when working in noisy environments. See Appendix B for types of hearing protectors and their application.
- Go for annual audiometric examinations to monitor progression of the hearing loss.

Advice to companies:

- Review workplace RA and put in place control measures to reduce exposure to noise, for instance, reducing noise from machines via engineering control measures, or locating noisy machines away from workers.
- Provide workers exposed to excessive noise with ear protectors and ensure that they wear them.
- Ensure that workers exposed to excessive noise have annual audiometric examinations.
- Implement a hearing conservation programme.
- Notify MOM (NID is a notifiable and compensable disease).

3.6 Occupational Infections

Occupational infections are defined as infections caused by exposure to biological agents, such as bacteria, viruses, fungi and parasites at the workplace. These can occur following contact with infected persons and animals or their tissues, secretions, or excretions. Specific infections due to work are uncommon (e.g., Nipah virus infection in abattoirs) and some can easily be missed unless there is a high index of suspicion (e.g., SARS in healthcare workers).

3.6.1 Clinical Presentation

The clinical presentation is the same as for any specific infectious disease. Most will present at the clinic with flu-like symptoms, fever, malaise and headache. Sometimes, they may present as a complication of a specific infection (see *A Guide on Infectious Diseases of Public Health Importance in Singapore*, 7th ed., Ministry of Health).

Emerging infectious diseases often pose a challenge in diagnosis and management for the clinician. Hence, there is a need for continued vigilance and for careful history taking on occupational exposures when evaluating patients for illnesses that could possibly be occupationally acquired. It is beyond the scope of this chapter to go into details of each specific disease. The successful control of infections is dependent on early recognition and prompt diagnosis of the condition by attending doctors. The emphasis therefore, is on early recognition and prevention of those infections which are caused by specific work-related exposures. The clinician should always be on the alert for clustering of cases within similar occupational groups or in specific workplaces.

3.6.2 Differential Diagnosis

Exclude non-occupational sources of infection, such as:

- imported infections (ask for travel history); and
- endemic infections (contacts with infected susceptible household members and other close contacts in a non-occupational setting).

3.6.3 Diagnostic Criteria of Work-relatedness

A good occupational history of exposure/ contact with the infectious agents at the workplace is critical. Suspicion on work-related infections should be high when there is a history of a specific incident, such as an accident (e.g., spills, splashes), injury (e.g., sharps injuries), performing a high-risk procedure (e.g., bronchoscopy) or coming into close contact with an infectious source (e.g., when caring for infected patients or animals). The specific infection can sometimes be confirmed by isolating and identifying a biological agent in the patient and correlating this with evidence of such exposure or the presence of other workers with the same infection at the workplace.

3.6.4 Investigation to Establish Work-relatedness

i. Take a good occupational history to establish if there is exposure to the following biological agents at the workplace. The main exposure situations which should raise suspicion that the infection is work-related are listed in Table 5.

Classification of Agents	Disease	Exposure Situations/ At-risk Exposure
Virus	AIDS*	Healthcare workers, laboratory personnel, biological waste handlers
	Avian Influenza*	Poultry houses where there is close contact with infected birds
	Chicken pox	Healthcare workers, childcare workers, teachers
	Chikungunya*	Construction sites, agriculture/ farm
	Dengue Fever*	Construction sites, agriculture/ farm
	Hepatitis B/C*	Healthcare workers, laboratory personnel, biological waste handlers
	Herpes Simiae Virus	Primate laboratory workers
	Measles*	Healthcare workers, childcare workers, teachers
	Nipah Virus Infection*	Abattoir workers, pork vendor, veterinary and healthcare workers
	Rabies	Animal handlers, veterinary workers
	Rubella*	Healthcare workers
	SARS*	Healthcare workers and laboratory personnel
Bacteria	Anthrax+	Cleaning, preparation and treatment of untreated wool and hides
	Leptospirosis+	Drainage and sewerage workers, veterinarians, abattoir workers, waste and refuse collectors, road sweeping work, and military personnel
	Tetanus	Agriculture/ farm workers, especially with history of cuts/ wounds
	Tuberculosis*	Healthcare workers, morticians and laboratory personnel
	Melioidosis*	Construction sites, agriculture/ farm, military personnel
Parasite	Malaria*	Agriculture/ farm workers, military personnel working in endemic areas

*These diseases are legally notifiable under the Infectious Disease Act. All notifications should be made on MD131 form via the electronic notification system (CD-LENS) at http://www.cdlens.moh.gov.sg or by fax to either 6221 5528 or 6221 5538.
+These diseases are notifiable under the Second Schedule of the WSH Act. Doctors seeing clusters of infectious diseases or anthrax should contact the MOH Communicable Disease Surveillance Team at 1800 325 8451.
All work-related infections are compensable under the WICA, administered by MOM.

Table 5: Occupational infections and associated exposure situations

ii. Conduct the relevant laboratory test to establish diagnosis for the suspected infection and correlate this with the clinical presentation, the incubation period and the mode of transmission.

iii. Establish if two or more cases are linked by epidemiological features of time, place and person.

iv. Exclude non-occupational causes, such as imported infections from overseas travel and presence of similar infections among family members or close contacts.

3.6.5 Management

Treatment is supportive unless a specific infection has been established. In some cases, antibiotic administration at the earliest signs of the infection is essential.

Advice to workers:

- Practice good personal hygiene and, where appropriate, use PPE, such as surgical mask to reduce spread of infection.
- It is very important to attend follow-up appointments to monitor disease progression and evaluate if there is a need for hospitalisation.
- Let the worker know when he or she can return to work based on the infectious period of the specific infections.

Advice to companies:

- Depending on the type of infection, isolate the worker immediately to reduce the risk of transmitting the infection.
- Maintain a record of workers falling sick and look out for secondary cases among co-workers.
- Review workplace RA and put in place control measures to reduce exposure (e.g., prevention of needlestick injuries).
- Notify Ministry of Health (MOH) and MOM.
- Discuss the need for specific immunisation in high risk personnel/ workplaces.
- Advise putting in place a policy/ procedure for infection control (this includes work restriction of infected workers and/or allowing time away from work during periods of illness, promoting good hygiene practices, use of PPE and a system for reporting sick).

3.7 Occupational Lung Diseases

An occupational lung disease is a lung condition caused by or aggravated by work. In Singapore, the common occupational lung diseases reported are occupational asthma, silicosis and mesothelioma.

The emphasis here will be on the recognition and prevention of those lung disorders which are caused by specific work-related exposures. It is beyond the scope of this book to go into details of each specific disease and referral should be made to textbooks for details. For occupational lung cancers, please refer to the section on "Occupational Cancers".

3.7.1 Clinical Presentation

Acute reactions include rhinosinusitis, laryngitis, pneumonitis, bronchitis, pulmonary oedema and upper airway obstruction. Chronic reactions may include asthma, bronchitis, bronchiolitis, fibrosis and cancer. Workers may present with symptoms, such as coughing, wheezing, chest tightness and shortness of breath. Physical examination may reveal crepitations, rhonchi, hyper-resonance of the lungs and clubbing of the fingers.

3.7.2 Differential Diagnosis

Exclude non-occupational sources of exposures that may contribute to or cause the lung injury:

- fibrosis of the lung from past infections;
- domestic-related exposures such as dust, mites, pets;
- personal hobbies with exposure to epoxy, solvents;
- smoking history (note that smoking can aggravate an occupational lung disease); and
- history of atopy (this may be a predisposing factor in occupational asthma).

3.7.3 Diagnostic Criteria of Work-relatedness

A good occupational history of exposure is critical. Radiological examination may be useful in diagnosing pneumoconiosis and a lung function test will give an indication of the severity of the disease. Sometimes, isolation of the biological agent in the sputum is useful (e.g., tuberculosis). In addition, supporting documents of results of personal or workplace exposure monitoring will aid in determining the diagnosis of work-related lung diseases.

The clinician should always be on the alert for clustering of cases with similar occupational groups or in specific workplaces.

3.7.4 Investigation to Establish Work-relatedness

i. Take a good occupational history to establish if there is exposure to the toxic agents in Table 6.

Common Occupational Lung Disease	Common Agents	Exposure Situations
Occupational Asthma*	Animal and plant proteins	• Laboratories • Bakeries • Food-processing industry
	Antibiotics	• Pharmaceutical industry
	Acid anhydrides, isocyanates, polyurethane, plicatic acids	• Manufacture and use of epoxy plastics, paints, polyurethane foams, glues and adhesives
	Colophony	• Soldering process
	Welding fumes	• Welding operations
	Metals	• Metal-plating • Metal-grinding
Reactive Airway Dysfunction Syndrome (RADS)	Inhalation of smoke, acid fumes, irritant gases (e.g., chlorine, hydrogen sulphide, ammonia) where ventilation is poor and exposures can be very high.	• Spray-painting • Electroplating • Parquet-laying
Silicosis*	Respirable silicon dioxide or silica in crystalline form	• Mining, sandblasting, tunnel drilling, quarrying work • Foundry work • Stone carving work • Ceramic work • Construction work
Asbestosis*	Inhalation of asbestos fibres (all types of asbestos are capable of causing mesothelioma with crocidolite being the most potent carcinogen)	• Lagging and delagging of insulation materials in boilers for ships or buildings • Maintenance of friction materials (such as brake linings and clutch facings) • Demolition of buildings with asbestos containing materials in fixtures such as in roofs, walls and rubbish chutes • Manufacture of asbestos containing pipes
Byssinosis*	Cotton dust	• Yarn and fabric manufacturing

*These diseases are legally notifiable under the WSH Act. For cases of suspected occupational asthma, methacholine challenge test may be carried out to assess for airway hyper-responsiveness. In addition, a bronchial challenge test with the suspected causative agent can be carried out in a hospital setting.

Table 6: Occupational lung diseases and associated exposure to toxic agents.

ii. Correlate the exposure history with the individual symptoms and investigation results:

- Correlate symptoms with work periods, for example, occupational asthma is likely to worsen during work and improve when worker is off work or on leave. Serial peak expiratory flow monitoring is useful to determine a workplace association to asthma.
- For diseases with long latency periods (e.g., silicosis, asbestosis, malignant mesothelioma), emphasis has to be placed on past exposures many years ago, starting from the first job.
- Chest X-ray may show eggshell calcifications/ small round opacities in silicosis.
- Pulmonary function test may be normal or show restrictive pattern in silicosis and an obstructive pattern in occupational asthma.

iii. Ask company for Safety Data Sheet (SDS) and results of exposure monitoring. The SDS will give an indication of the chemicals the worker may be exposed to in the workplace. Exposure monitoring provides additional support for the diagnosis if the levels exceed the permissible exposure levels (for occupational lung diseases due to sensitising agents, there may be low level exposures).

iv. Exclude non-occupational causes, pre-existing and predisposing factors, such as:

- Past record of infections, atopy, domestic-related exposures causing asthma.

3.7.5 Management

Treatment may involve giving bronchodilators, steroids, to removal from the exposures in the workplace. In some cases, the workers may need a change from their current jobs to avoid the offending chemical, for example, in occupational asthma.

Advice to workers:

- Refer to the Occupational Lung Clinic at the Singapore General Hospital (Tel: 6321 4402) and Tan Tock Seng Hospital (Tel: 6357 7000) for further investigation and management. A bronchial challenge test may be needed to identify the causative agent.
- Workers should be removed from further exposure to the offending agent. Complete removal from exposure remains the most effective treatment of sensitiser-induced occupational asthma.
- Workers with silicosis should be followed up with chest x-ray for evidence of tuberculosis, especially those with symptoms of cough.

Advice to companies:

- Identify high-risk workers to reduce their chance of toxic exposure.
- Review workplace RA and put in place control measures to reduce exposure.
- Advise on requirements for medical examinations under the WSH (Medical Examinations) Regulations.
- Notify MOM if worker is suspected to have a work-related lung condition.

3.8 Occupational Skin Disorders

An occupational skin disorder is a skin condition caused by or aggravated by work. In Singapore, occupational skin disorders are the second most commonly reported OD. The most common causative agents locally are oils, solvents and cement.

3.8.1 Clinical Presentation

The clinical appearance of an occupational skin disorder is no different from any other skin disorder. We can suspect the skin rash to be work-related when these appear on the parts of the body which may be in contact with the offending agent, for example, on the hands and forearms. However, the face and other parts of the body may be affected where there are exposures to airborne agents, for example, oil mists and metal fumes.

The most common presentation of occupational skin disorder is contact dermatitis which may be caused by an irritant or allergen. Acute presentations may include redness, swelling, blisters and oozing. Chronic contact dermatitis may present with scaly, thickened, fissured appearance and pigmentary changes. Other presentations include contact urticaria, acneiform eruptions and secondary infections.

3.8.2 Differential Diagnosis

Exclude non-occupational sources of exposures that may cause or aggravate the skin rash. Ask for:

- domestic exposures (e.g., wetwork and use of detergents when doing housework);
- cosmetics and jewellery (e.g., sensitivity to fragrances and nickel compounds);
- history of atopy (e.g., possibility of endogenous eczema); and
- hobbies using epoxy glues, solvents.

3.8.3 Diagnostic Criteria of Work-relatedness

A good occupational history to determine the worker's work process, materials, practice and habits is essential in the diagnosis of an occupational skin disorder. The onset or worsening of the rash (primary location with or without secondary spread) should be correlated:

- duration of employment
- change in the work process or use of new chemicals
- time relationship of the rash with work periods (usually, there is some improvement when the patient is away from work)

Note that the use of PPE may itself be the cause of the rash (e.g., workers may be allergic to the latex gloves worn).

3.8.4 Investigation to Establish Work-relatedness

i. Take a good occupational history to establish if there is exposure to the toxic agents in Table 7.

Industry	Irritants	Allergens
Agriculture and Horticulture	Animal feeds, fertilisers, solvents, plants, oils, disinfectants, pesticides	Plants, gloves, animal feeds, pesticides, disinfectants
Chemical and Pharmaceutical	Chemicals, acids, alkalis, water, detergents	Chemicals, medicaments, latex gloves and rubber masks
Construction and Building	Cement, preservatives, fiberglass, solvents, oils	Cement, rubber or leather gloves and boots, epoxy resins, woods, paints
Electronics	Solvents, acids, alkalis, resins, fibreglass	Resins (epoxy, acrylates, isocyanates, formaldehyde), soldering fluxes, nickel, chromate, cobalt, gloves and finger cots
Food and Catering	Vegetable and food juices, water and detergents	Food, gloves, antioxidants, preservatives
Hairdressing	Shampoos, permanent wave solutions, water	Nickel, hair dyes, fragrances, latex or rubber gloves
Healthcare	Alcohol, disinfectants, antiseptics, water	Latex gloves, rubber masks, formaldehyde, preservatives, resins
Metal Fabrication	Cutting fluids, oils, coolants	Cutting fluids and oils
Shipbuilding and Repair	Cutting fluids, oils, coolants	Cutting fluids and oils, welding fumes, resins
Woodworking and Furniture-making	Wood dust, resins, soaps and detergents, solvents, oils, turpentine	Woods, rubbers or latex gloves, resins, wood preservatives

Table 7: Occupational skin disorders and associated exposure to toxic agents.

Contact with natural rubber latex can cause contact urticaria. This condition can occur in healthcare workers. Contact urticaria may also be caused by raw seafood (cooks).

Acneiform eruptions may result from exposure to oil and grease. Frictional dermatitis and callosities may occur in workers using mechanical tools. Warty growths may develop in workers who are continually exposed to tar, pitch, bitumen, mineral oil or paraffin. If untreated, the skin may develop into an epitheliomatous ulceration and cancer. Common sites involved are the eyelids, cheeks, chin, behind the ears, neck, arms, scrotum and thighs.

ii. Correlate the exposure history with the individual symptoms and investigation results.

- Correlate symptoms with work practices and work periods. For example, observing workers will be useful in establishing if there is personal contact with the offending agent. The relationship between onset/ aggravation of rash with work periods provides a clue as to its work-relatedness (e.g., the rash is likely to worsen during work and improve when worker is off work or on leave);
- Correlate the use of PPE and the onset/ worsening of rash;
- Patch testing may be useful to determine if the worker has allergic contact dermatitis; and
- Prick testing can be used to determine if a worker has contact urticaria, for example, to latex or seafood.

iii. Ask company for SDS which will provide additional information on the type and toxicity of materials and chemicals handled at work.

iv. Exclude non-occupational causes, pre-existing and predisposing factors.

3.8.5 Management

The management of occupational dermatosis depends on its morphological presentation and cause. The causative agent must be identified.

Advice to workers:

- Minimise contact with the causative agent. For example, workers can wear suitable PPE, such as impervious gloves and/or aprons in the case of irritant contact dermatitis. For workers with allergic contact dermatitis, you may consider recommending that they ask for a job scope with no exposure to the offending agent.
- Maintain good personal hygiene and work practices.
- If the rash does not improve or if an allergic contact dermatitis is suspected, the worker may need referral to the Joint Occupational Dermatosis Clinic at National Skin Center for further investigation (contact no: 6350 6666).

Advice to companies:

- Review SDSs and put in place control measures to minimise workers' exposure in high-risk work processes. This may include the substitution of harmful substances for less harmful ones, provision of local exhaust ventilation, and suitable PPE, such as impervious gloves, aprons and washing facilities.
- Consider reassigning worker with allergic contact dermatitis to other work that does not involve exposure to specific allergen.
- Notify MOM (occupational skin disorders are notifiable and compensable).

3.9 Poisoning: Aniline

Aniline belongs to the group of aromatic amines. It is a clear to slightly yellow liquid with a characteristic fishy or aromatic odour.

Absorption can occur through the skin or by inhalation. The main toxic effect is through the production of methaemoglobin. Aniline is a suspected bladder carcinogen.

3.9.1 Clinical Presentation

Exposure to aniline causes methemoglobinemia, a blood disorder, in which oxygen delivery to the tissues is impaired. This may have mild to severe consequences depending on the duration and amount of exposure and the symptoms vary depending on the level of methemoglobin. Following acute exposure, cyanosis, dizziness, headaches, irregular heartbeat, convulsions, coma, and death may occur. Direct contact with aniline can also produce skin and eye irritation.

Long-term exposure to lower levels of aniline may cause symptoms similar to those experienced in acute high-level exposure.

3.9.2 Differential Diagnosis

Exclude other causes of methaemoglobinaemia, such as:

- hereditary causes; and
- drug-induced, for example, nitrites and nitrates, phenacetin, sulfonamides.

3.9.3 Diagnostic Criteria of Work-relatedness

A good occupational history of exposure and its correlation to the clinical presentation is critical. In addition, supporting documents of personal or workplace exposure monitoring will aid in determining the diagnosis of work-related poisoning.

3.9.4 Investigation to Establish Work-relatedness

i. Establish the exposure history and correlate it with the signs and symptoms presented. The main exposure situations that would raise suspicion that the worker's clinical presentation is work-related are listed in Table 8.

Exposure Situations/ At-risk Exposures	Acute Presentation	Chronic Presentation
Manufacture of • synthetic dyestuff and marking inks • methylene diisocyanate • stabilises for rubber products • polyurethane foam • explosives and pesticides	General • headache, nausea, tinnitus, weakness, irritability, vomiting, dry throat Mucosal membranes • lips, tongue and mucus membrane turns grey, irritation to skin, eyes and respiratory tract Neurological • confusion, ataxia, disorientation, lethargy, drowsiness, seizures, coma Cardiovascular • heart blocks, arrhythmias, cardiogenic shock Respiratory • failure, paralysis, breathlessness Genitourinary • dysuria, haematuria, renal failure	General • loss of appetite, headache, dizziness, insomnia Haematological • anaemia, intravascular haemolysis Cardiac, renal and hepatic damage may occur due to secondary effects of hemolysis.

Table 8: Clinical presentations of aniline poisoning.

ii. Ask company for results of exposure monitoring and the Safety Data Sheet of chemicals used. Review if the chemicals handled contain aniline. If the exposure levels exceed the permissible exposure levels, a work-related condition should be suspected. Note that hand contamination and accidental ingestion are also possible sources of exposure.

Blood methaemoglobin levels should be obtained to substantiate the diagnosis and monitor the condition. Other investigations include full blood count (FBC), peripheral blood film, electrocardiogram (ECG), renal and liver function tests.

3.9.5 Management

Advice to workers:

- Stop further exposure or reassign him to another area without exposure to aniline till further review.
- Practise good personal hygiene to reduce absorption (e.g., avoid smoking and eating with hands at the workplace).
- Use appropriate PPE, such as respirators, impervious gloves, polyvinyl chloride (PVC) or rubber boots, face shields and overcoats/ aprons and maintain them properly.

- Workers with acute exposure or with signs and symptoms of aniline poisoning should be referred to the hospitals for further evaluation. This can be followed by referral to the Joint Environmental Occupational Toxicology Clinic (JEOTC) at Changi General Hospital for further investigation (contact no: 6850 3333).

Advice to companies:

- Identify high-risk workers and educate them on measures to reduce exposure.
- Review workplace RA and put in place control measures to reduce exposure.
- Notify MOM (aniline poisoning is a notifiable disease).

3.10 Poisoning: Gases

Toxic gases can be inhaled or absorbed through the mucosal surfaces. In an occupational setting, exposure to toxic gases is mostly due to accidents. Water-soluble gases (e.g., chlorine, ammonia, sulfur dioxide, hydrogen chloride) dissolve in the upper airway and cause mucous membrane irritation. Less soluble gases (e.g., nitrogen dioxide, phosgene, ozone) are more likely to cause severe bronchiolitis, with delayed pulmonary edema. Cardiovascular and neurological symptoms can also occur.

3.10.1 Clinical Presentation

Acute exposure to high levels can cause sudden onset of respiratory symptoms such as coughing, wheezing or breathlessness. Some gases can exert their effects on organs other than the lungs, for example, carbon monoxide is a non-irritating asphyxiant that affects mainly the central nervous system.

3.10.2 Differential Diagnosis

Exclude non-occupational causes of the presenting symptoms involving the respiratory and central nervous systems:

- respiratory tract infections;
- narcotics; and
- alcohol intoxication.

3.10.3 Diagnostic Criteria of Work-relatedness

A good occupational history of exposure and its correlation to the clinical presentation is critical. In addition, supporting documents of results of workplace exposure monitoring will aid in determining the diagnosis of work-related poisoning.

3.10.4 Investigation to Establish Work-relatedness

i. Establish the exposure history to the following toxic gases and correlate it with the signs and symptoms presented. The main exposure situations that would raise suspicion that the worker's clinical presentation is work-related are listed in Table 9.

Type of Gas	Exposure Conditions	Acute Presentation	Chronic Presentation
Carbon Dioxide (CO_2)	• Refrigerant use • Brewing and wine industries • Manufacture and use of dry ice • Greenhouses • Combustion of fuels and wood • Pharmaceutical processing • Arc welding • Work (e.g., cleaning) in confined spaces (manholes, ship tanks) • Accidental leakage from fire retardant equipment containing CO_2	• Neurological (drowsiness, headache, nausea, vertigo, weakness, irritability, unconsciousness) • Cardiovascular (chest pain, angina, ischaemia) • Panic attacks	• General (anorexia, lethargy) • Neurological (headache, dizziness, incoordination and ataxia)
Hydrogen cyanide (HCN)	• Metal-refining • Electroplating • Jewellery making • Film recovery • Insecticide fumigant • Laboratory work	• Neurological (general weakness, confusion, bizarre behavior, headache, sleepiness, seizures, coma) • Respiratory (dyspnoea)	• General (gradual onset of weakness) • Neurological (confusion, residual anoxic injury)
Hydrogen sulphide (H_2S)	• Work (e.g., cleaning) in confined spaces (manholes, ship tanks) • Work in sewerage tanks (where there is decaying matter) • Laying of underground cables	• Eyes (ocular irritation) • Respiratory (upper and lower airway irritation, delayed pulmonary oedema, hypoxia) • Neurological (loss of consciousness)	• Neurological (residual anoxic injury)
Carbon monoxide (CO)	• Work involving incomplete combustion of fossil fuels, for example, during operation of diesel engines in confined spaces and fire-fighting.	• General symptoms (headache, nausea, vomiting, dizziness, fatigue, weakness) • Neurological (confusion, disorientation, visual disturbance, syncope and seizures, cerebellar signs, coma) • Respiratory (breathlessness, pulmonary edema) • Cardiovascular (arrythmias)	• Neurological (Parkinsonism, personality disorders, memory loss, impaired mood and concentration, vegetative state, residual anoxic injury)

Phosgene	• Manufacture of isocyanates, polyurethane and polycarbonate resins • Pesticide use • Welding (when volatile chlorine compound or vapour contacts with flame or very hot metal)	• Respiratory (upper airway inflammation and pneumonitis)	• Respiratory (delayed pulmonary oedema in low doses)
Nitrogen dioxide (NO_2) and nitrous fumes	• Combustion of fossil fuels, for example, in internal combustion engines, thermal power stations, gas heaters and stoves	• Mucosal (irritation of eyes, nose and throat, cough) • Respiratory (dyspnea, acute bronchitis, pulmonary edema) • Cardiovascular (palpitations, tachycardia, chest pain, angina)	• Respiratory (decrease lung function, chronic bronchitis, allergic responses to inhaled pollutants)

Table 9: **Clinical presentations of poisoning by toxic gases.**

Air monitoring: levels of the gases in air can be monitored to see if permissible exposure levels are exceeded.

ii. Correlate the exposure history with the individual symptoms and investigation results. Severe acute poisoning does not usually present a diagnostic challenge that it is related to exposure to toxic gases as a high level of exposure can be ascertained and the clinical manifestations are present. However, it may be difficult to document the specific toxic gases and its source.

For some gases, specific biological samples may be obtained to substantiate the diagnosis and monitor progress of condition (see Table 10).

Type of Gas	Specific Biological Indicators
Carbon Dioxide	Blood gas: partial pressure CO_2
Carbon Monoxide	Blood carboxyhemoglobin concentration
Hydrogen Cyanide	Blood cyanide concentration
Hydrogen Sulphide	Urine and blood thiosulfate levels

Table 10: **Biological indicators for toxic gases.**

iii. Ask company for details of work task and exposure monitoring if available. This provides additional information to substantiate the exposure history from the worker.

3.10.5 Management

Advice to workers:

- Workers with signs and symptoms of poisoning should be referred directly to the hospitals for further evaluation. Cases can be followed up at the JEOTC at Changi General Hospital (contact no: 6850 3333).
- Correct use of PPE, such as respirators, impervious gloves, PVC or rubber boots, face shields and overcoats/ aprons.

Advice to companies:

- The company should review workplace RA and put in place control measures to reduce exposure. Suitable PPE should be provided and worn. This could include full face mask with gas canister and protective suits and gloves.
- Notify MOM.

3.11 Poisoning: Metals

Metals comprise up to 75% of the elements in the periodic table. They can be present as contaminants in air, water, food and soil. Some of these are essential elements needed for bodily functions.

Metals can exist as elemental metals, or in the ionic or organic forms with each form having its own specific toxicity. High-dose exposures are rare in the workplace but low level chronic exposures may occur, resulting in kidney disease or neurological deficits. This chapter covers the commonly used metals in occupational settings.

3.11.1 Clinical Presentation

Acute exposures usually occur through inhalation and may cause pneumonitis which can progress to acute respiratory distress syndrome. Skin contact may result in dermatitis and burns. Ingestion, usually accidental, may present with gastroenteritis.

The presentation for chronic exposure is usually insidious and non-specific. Some metals may cause multiple organs to be affected. Doctors should have a high degree of suspicion that the condition is work-related when there is a cluster of cases from the same occupational group or workplace.

3.11.2 Differential Diagnosis

Exclude non-occupational causes, such as those due to:

- sources from the environment, for example, diet/ food (especially seafood); and
- drugs (e.g., arsenicals in herbal remedies).

3.11.3 Diagnostic Criteria of Work-relatedness

A good occupational history of exposure is critical. In addition, supporting documents of results of personal or workplace exposure monitoring will aid in determining the diagnosis of work-related metal poisoning.

3.11.4 Investigation to Establish Work-relatedness

i. Establish the exposure history to the following metals and correlate with the signs and symptoms presented. The main exposure situations that would raise suspicion that the worker's clinical presentation is work-related are listed Table 11.

Common Metal	Exposure Situations/ At-risk Exposure	Acute Presentation	Chronic Presentation
*Arsenic (As)	• Manufacture and use of pesticides, wood preservatives containing arsenic • Sawing, sanding and burning of wood treated with arsenical preservatives • Manufacture of semiconductors (in particular wafer production and maintenance of ion implant machines) • Manufacture and use of lead alloys, anti-fouling paints and pigments • Smelting of arsenic containing ores • Additives in animal and poultry feeds	• Fever, loss of appetite • Gastrointestinal tract (GIT) (severe diarrhea, "rice water" stools, hepatomegaly) • Lung (cough, laryngitis, mild bronchitis, and dyspnea) • Cardiovascular (cardiac arrhythmia, cardiac failure) • Neurological (peripheral neuropathy, encephalopathy)	• Skin (increased pigmentation, desquamation, herpetic lesions about the mouth, hyperkeratoses, especially of palms and soles) • Liver (cirrhosis, hepatitis, angiosarcoma) • Lung (chronic bronchitis, basilar fibrosis) • Neurological (peripheral neuritis characterised by numbness of hands and feet, progressing to painful "pins and needles"; initially sensory, later motor) • Others (nasal septum perforation, aplastic anemia, Raynaud's syndrome)
Arsine (AsH_3)	• Accidental exposures during metal refining, waste treatment and cleaning of tanks containing acid sludge • Smelting of arsenic containing metals • Manufacture of semiconductors (in particular wafer production and maintenance of ion implant machines)	• Massive intravascular hemolysis • Triad of haemoglobinuria (port-wine urine), jaundice and abdominal pain • Associated shivering, severe thirst and ECG changes	

Beryllium (Be)	• Manufacture, fabrication or reclaiming of beryllium and its alloys in aircraft parts, automobiles, computers, sports equipment, dental bridges and mirrors	• Lung (acute chemical pneumonitis) • Skin and eye irritation (conjunctivitis, papular vesicular dermatitis)	• Lung (berylliosis- chronic lung inflammation characterised by granuloma formation; cancer of the lung has also been reported) • Skin (chronic granulomatous lesion)
*Cadmium (Cd)	• Waste treatment • Manufacture of cadmium-nickel batteries • Silver brazing, welding and soldering operations using cadmium-containing fillers • Plastics industry, especially with PVC compounding • Cadmium electroplating • Spray-painting or removal of paints/ coatings containing cadmium by scraping or blasting • Repair and finishing in the automobile and aerospace industry (especially of landing gears with cadmium coating) • Manufacture and use of fungicides and pigments • Jewellery manufacture • Smelting and refining of zinc (Zn), lead (Pb) or copper (Cu) ores and scrap processing	• Metal fume fever with flu- like symptoms of weakness, fever, headache, chills, sweating and muscular pain. • Acute renal failure • Lungs (acute pulmonary edema within 24 hours) • GIT (severe irritation with nausea, vomiting and abdominal pain following accidental ingestion)	• Renal (tubular and/or glomerular damage characterised by low molecular weight proteinuria, glucosuria, amino aciduria, albuminuria and reduced creatinine clearance) • Bone (osteomalacia, osteoporosis and fractures • Itai-itai disease • Lung (chronic pulmonary disease, Cancers of lung) • Others (anosmia, anemia, teeth discoloration)

*Lead (Pb) a) Inorganic Lead	• Manufacture of lead-acid storage batteries • Manufacture and use of stabilisers in PVC compounding • Manufacture of solder • Burning/ welding/ cutting of lead-coated structures among ship breakers and welders • Manufacture and use of lead-based paints • Manufacture and use of ammunition (e.g., firing range instructors) • Manufacture and use of glazes for porcelin, enamels, tiles, ceramics and pottery) • Printing industry	• GIT (nausea, vomiting, diarrhea or constipation and abdominal pain) • Renal (acute renal failure) • Neurological (encephalopathy, convulsions, coma, paresthesia, pain and muscle weakness)	• GIT (lead colic) • Neurological (lead palsy, wrist drop and foot drop) no sensory changes • Slow mental changes such as learning difficulty may occur • Blood (basophilic stippling, anemia) • Burton's line (a bluish-black pigmentation at margins of gums) • Renal (chronic nephritis and tubular degeneration) • Reproductive (spontaneous abortion, still births, subfertitlity and neurological damage to the fetus)
b) Organic lead (tetra ethyl and tetramethyl)	• Cleaning of tanks containing leaded gasoline or aviation fuel • Production and transportation of anti-knock agents containing organic lead compounds • Blending anti-knock agents and raw gasoline at refineries	• Mainly CNS (headache, tremor, nervousness, agitation, insomnia, troubled dreams, hallucinations, mental confusion, coma, death)	
*Manganese (Mn)	• Milling of manganese ore • Manufacture of dry cell batteries (manganese dioxide) • Iron and steel industry • Manufacture of paints, varnishes, inks and dyes, fertilisers, feed additives, disinfectants and bleaching agents, glass and ceramics	• Metal fume fever • Lung (irritation, cough, bronchitis, pneumonitis) • Minor irritation of the eyes and mucous membranes	• CNS (psychomotor, speech and gait disturbances followed by manic depressive psychosis and parkinsonism) • Lung (pneumonitis, bronchitis)

	• Manufacture of potassium permanganate ($KMnO_4$) • Welding operations with manganese coated rods • Manganese electroplating • Manufacture of matches and fireworks		
*Mercury (Hg) • Elemental and inorganic Hg	• Electrolytic production of sodium hydroxide, chlorine and acetic acid as fluid cathode • Manufacture of scientific instruments (e.g., barometers, thermometers), electrical control devices (batteries, meters, switches) • Manufacture of antifouling paints and pigments • Dentistry • Plating of gold, silver , bronze and tin in jewellery • Photography and photogravure • Laboratories (soil testing using mercury as a pressure medium, malt analysis for protein content in brewery)	• Irritation of the lungs, GIT • Circulatory collapse • Acute renal failure	• GIT (metallic taste, burning sensation in mouth, loose teeth, gingivostomatitis, excessive salivation and nausea) • CNS (tremor, fatigue, depression, headaches) • Emotions (easy blushing and intense shyness, anxiety, emotional lability, irritability, insomnia) • Renal (reversible proteinuria, nephrotic syndrome)
• Organic Hg (methyl, ethyl and phenyl Hg)	• Manufacture and use of certain pharmaceutical products (e.g., antiseptics, diuretics, contraceptives) • Manufacture and use of pesticides • Manufacture and use of paints and waxes (especially antifouling paints, paint preservatives) • Use as catalysts agents in chemical industry	• As above	• Neurological (parethaesia, concentric constrictions of visual fields, impairment of hearing, rigidity, tremor, seizures) • Others (fatigue, dyspnoea, chest and abdominal pain, vomiting)
Phosphorus (white phosphorus is the most toxic)	• Manufacture of special glass in sodium lamps • Manufacture of heads of strike matches, explosives, pyrotechnics, smoke bombs and screens	• Severe irritation of mucous membranes (throat, eyes and lungs)	• Liver damage (jaundice) • Renal failure with coma and fits

	• Manufacture of fertilisers containing phosphoric acid and phosphates • Manufacture of pesticides and rodenticides • Manufacture of food additives and toothpaste	• Abdominal pain, diarrhea, sweating and weakness • Skin (severe burns which are necrotic, fluorescent under UV light and have garlic-like odour) • Acute renal necrosis • Acute hepatic necrosis	• Bone damage (resulting in necrosis of the jaw bone – phossy jaw) with subsequent distortion of face • Anemia and leucopenia may be observed

*Workers exposed to these chemicals are required to undergo mandatory medical examinations under the WSH (Medical Examinations) Regulations.

Table 11: **Clinical presentations of poisoning by metals.**

ii. Ask company for results of exposure monitoring and the SDS of chemicals used. Review if the chemicals handled contain the above metals. If the exposure levels exceed the permissible exposure levels, a work-related condition should be suspected. Note that hand contamination and accidental ingestion are also possible sources of exposure.

iii. Specific investigations to document worker's absorption of metals and its effects on health can be carried out as listed in the Guidelines on Statutory Medical Examinations. Workers with biological indicators exceeding the threshold limits specified in the Guidelines should be suspended from further exposure and reviewed closely.

iv. Exclude non-occupational causes, such as diet or consumption of herbal products.

3.11.5 Management

Advice to workers:

- Suspend the workers from further exposure or reassign them to another area without exposure to the metal for a period of up to 3 months.
- Repeat the specific biological indicator at end of 3 months or earlier. If results improve, continue monitoring every 3 months or earlier till results returned to normal before returning to previous work. If not, refer to JEOTC at Changi General Hospital for further investigation (contact no: 6850 3333).
- Cases with symptoms should be referred to JEOTC as soon as possible.
- Practice good personal hygiene to reduce absorption (e.g., avoid smoking and eating with hands at the workplace).
- Instruct them on the proper use and maintenance of appropriate PPE, such as respirators and gloves.

Advice to companies:

- Identify high-risk workers and educate them on measures to reduce exposure.
- Review workplace RA and put in place control measures to reduce exposure.
- Notify MOM (poisoning by certain metals is a notifiable disease).
- Find out more about requirements for medical examinations under the WSH (Medical Examinations) Regulations.

3.12 Poisoning: Pesticide

Pesticides are chemical compounds used to eliminate pests and vectors of diseases and protect crops. They are classified as insecticides, herbicides, fungicides, rodenticides, and so on. Within each class, there are subclasses and they all have their unique mechanism of action, physical, chemical and toxicological properties.

Pesticides are commonly used in the industry as well as in many households. Occupational exposures to these chemicals are through dermal and inhalation, while non-occupational exposures usually occur by accidental ingestion. This chapter covers the more commonly used pesticides.

3.12.1 Clinical Presentation

The clinical presentations vary depending on the type of pesticide. The acute effects can range from cholinergic effects to weakness, confusion, coma and convulsions. Neurological symptoms, shortness of breath, nausea and vomiting can also occur. Chronic effects usually present as peripheral neuropathy and neurobehavioural effects.

For example, acute poisoning by organophosphorus (OP) and carbamate insecticides usually present with cholinergic effects (DUMBBELS). Chronic or delayed toxicity from OP poisoning may lead to neuropsychiatric effects.

3.12.2 Differential Diagnosis

Exclude non-occupational causes, such as those due to:

- other causes of neurological disorders, such as motor neuron disease, impending cerebrovascular accident (CVA), diabetic ketoacidosis;
- gastroenteritis (e.g., acute pesticide poisoning may present with diarrhea and vomiting); and
- non-occupational exposure to pesticides used in domestic settings, accidental ingestion of pesticides and exposure to nerve agents used in chemical warfare, especially in a mass casualty situation.

3.12.3 Diagnostic Criteria of Work-relatedness

A good occupational history of exposure and its correlation to the clinical presentation is critical. In addition, supporting documents of results of personal or workplace exposure monitoring will aid in determining the diagnosis of work-related poisoning.

3.12.4 Investigation to Establish Work-relatedness

i. Establish the exposure history to the pesticides used and correlate it with the signs and symptoms presented. The main exposure situations that would raise suspicion that the worker's clinical presentation is work-related are listed in Table 12.

Types of Pesticide	Exposure Situations/ At-risk Exposure	Acute Presentation	Chronic Presentation
Organophosphate (OP)* • Basudin 60 • Dichlorvos • Dimethoate • Dipterex • Diazinon • DDVP (2,2, Dichlorovinyl O, O-Dimethyl Phosphate) • Fenthion • Malathion • Parathion • Rogor • Tamaron	• Pest control • Farming and gardening use • Crop management • Manufacture of pesticide	Neurological • Cholinergic effects (DUMBBELS) • Diarrhea, diaphoresis • Urination • Miosis • Bradycardia • Bronchorrhea broncho-constriction • Emesis • Lacrimation • Salivation, sweating Others • Weakness • Fasciculation • Myoclonus • Confusion • Coma • Convulsion Intermediate syndrome • General weakness and respiratory failure (occurring 24–96 hours after exposure and last for 1–2 weeks)	Neurological • Distal sensory, motor neuropathy (occurs 1–5 weeks after exposure) Neurobehavioural • reduced fine motor coordination • slowed reaction time Neuropsychiatric • apathy • depressed memory function • irritability

Carbamate • Aldicarb • Carbaryl • Carbofuran • Propoxur	• Pest control • Farming and gardening use, • Crop management • Manufacture of pesticide	Similar to OP except that they are usually self-limiting and are resolved within a few hours of stopping exposure.	
Methyl Bromide (also known as bromomethane, monobromo methane)	• Fumigation of soil, crops • Fumigation in mills, warehouse, ships, freight cars • Manufacture of pesticide	Respiratory • Shortness of breath, acute pulmonary edema GIT • Nausea and vomiting Neurologic • Lethargy, headache, seizures, paresthesia, peripheral neuropathy, ataxia, coma, convulsion Skin • Irritation and burns	Neurological • Visual disturbance, ataxia, vertigo, tremor and seizures, peripheral neuropathy Neurobehavioural • Agitation
Pyrethrum and Synthetic Pyrethoid Insecticides • Deltamethrine • Permethrin • Cypermethrin	• Agricultural applications	Skin • Irritation, allergic contact dermatitis, vesicles, papules, itching Neurologic • Topical parathesia • Dizziness, headache, coma and convulsion (for those with high exposures, e.g., through ingestion) Respiratory • Asthma, allergic rhinitis, nasal congestion and sore throat	

Table 12: Clinical presentations of poisoning by pesticides.

Note
The highest exposure and incidences of poisoning occur with individuals involved in agricultural and horticultural pest control operations. Exposure can occur during the mixing of the compounds with water and spraying of the pesticides. Workers involved in the manufacture of pesticides may also be exposed to the hazard.

ii. Correlate the exposure history with the individual symptoms and investigation results. Acute poisoning does not usually present a diagnostic challenge as a history of excessive exposure is usually available and the clinical manifestations are present. However, mild cases of poisoning may not be apparent as the symptoms can be non-specific.

Biological samples may be obtained to substantiate the diagnosis and monitor progress of condition (see Table 13).

Pesticide	Biological Threshold Limit Value/ Specimen Type	Other Tests
Organophosphate*	Serum, urinary organophosphate and metabolites	Red blood count (RBC) cholinesterase and plasma cholinesterase levels**, ECG, EMG, CXR
Carbamates	Serum, urinary carbamate and metabolites	RBC cholinesterase and plasma cholinesterase levels** (need to be done early)

*Workers exposed to these chemicals are required to undergo mandatory medical examinations under the WSH (Medical Examinations) Regulations.
**Cholinesterase levels should be compared with baseline levels (if available) or with the laboratory's lower limit of normal (if baseline levels are not available) to determine if any decrease in levels is significant.

Table 13: Biological tests for pesticides' poisoning.

iii. Ask company for details of work activity and exposure monitoring if available. This will provide additional information to substantiate the history from the worker.

3.12.5 Management

Advice to workers:

- Strictly follow suspension period to avoid further exposure. For those with exposure to OP, monitor the cholinesterase levels as outlined in the *Guidelines on Statutory Medical Examinations*.
- Practice good personal hygiene.
- Instruct them on the proper use of PPE, such as respirators, impervious gloves, PVC or rubber boots, face shields and overcoats/ aprons
- Workers with signs and symptoms of pesticide poisoning should be referred for further evaluation at JEOTC at Changi General Hospital (contact no: 6850 3333).

Advice to companies:

- Suspend the workers from further exposure or reassign them to another area with no exposure to the pesticides for a period of time specified by the Designated Workplace Doctors (DWDs).
- Notify MOM (pesticide poisoning is a notifiable and compensable disease).
- The company should review workplace RA and put in place control measures to reduce exposure. Suitable PPE should be provided and worn. This could include full face mask with gas canister and protective suits and gloves.
- Advice on requirements for medical examinations under the WSH (Medical Examinations) Regulations. Look for evidence of poisoning in other workers.

3.13 Poisoning: Solvents

The term solvent means "material used to dissolve another material". They are broadly classified as aqueous (water-based) and non-aqueous solvents (organic solvents). Most industrial solvents are used for cleaning, degreasing, thinning and extraction.

Commonly used organic solvents are usually volatile. These include aromatics (such as benzene and toluene) and halogenated hydrocarbons (such as trichloroethylene, perchloroetheylene and carbon tetrachloride). Other commonly used solvents are the alcohols, xylene and ether.

3.13.1 Clinical Presentation

Solvents are easily absorbed through the skin and by inhalation in the workplace. Acute high exposures through inhalation may cause central nervous system depression, respiratory arrest, unconsciousness, and death.

Prolonged exposure may lead to neurological impairment such as peripheral neuropathy, irritability and memory loss. In severe cases, toxic encephalopathy, manifested by diminished concentration, memory, and learning ability may occur. Hepato-renal injuries are more common with halogenated hydrocarbon.

Dermal exposures can cause dermatitis. Carcinogenic risk is increased with certain solvents, such as benzene (known to cause leukemia).

When a worker is exposed to more than one solvent, their effects on target organs may be additive.

3.13.2 Differential Diagnosis

Exclude non-occupational causes due to:

- solvent abusers (e.g., glue sniffers);
- excessive alcohol intake;
- hobbies using glue; and
- drugs such as phenobarbital and chloral hydrate.

3.13.3 Diagnostic Criteria of Work-relatedness

A good occupational history of exposure is critical. In addition, supporting documents of results of personal or workplace exposure monitoring will aid in determining the diagnosis of work-related solvent poisoning.

3.13.4 Investigation to Establish Work-relatedness

i. Establish the exposure history to the following solvents and correlate it with the signs and symptoms presented. The main exposure situations that would raise suspicion that the worker's clinical presentation is work-related are listed in Table 14.

Common Solvents	Exposure Situations/ At-risk Exposure	Acute Presentation	Chronic Presentation
Benzene*	• Petrochemical industries • Petroleum refineries • Bulk storage terminals involved in loading and unloading of chemicals containing benzene • Manufacture of plastics, synthetic fibres, detergents, synthetic resins • Laboratories using benzene in analytical techniques • Work involved with handling of fuels containing benzene (e.g., service stations, airport terminals, vehicle workshop) • Work involving use of commercial solvents such as toluene and xylene (where benzene may be present as a contaminant)	• Neurological (dizzy, headache, nausea, vomiting, slurred speech, disorientation, loss of consciousness) • Cardiovascular (palpitations) • Respiratory (cough, sore throat, running nose) • Skin irritation	• Bone marrow depression (leucopenia, thrombocytopenia, aplastic anemia, pancytopenia) • Skin (dry, scaly dermatitis, erythema and/or blistering) • Neurological (motor and neural damage, impaired vision, fatigue, sleep disturbances) • Carcinogenic (leukaemia)

Carbon Bisulphide (also known as carbon disulphide)	• Manufacture of viscose rayon, resins, plywood adhesives, cellophane, varnishes • Refining of petroleum and paraffin • Extraction of oil and rubber • Dry-cleaning industries • Degreasing in semiconductors industry	• Neurological (central nervous system depression, delirium peripheral neuropathy, coma, seizures) • Mucosa (irritation to the skin, eyes and respiratory tract), blistering with secondary burns may occur with direct contact with the skin) • GIT (nausea, vomiting) • Renal (renal failure) • Cardiovascular collapse • Respiratory (pulmonary edema, respiratory failure)	• Neurological (diminished mental and motor ability with staggering gait and loss of coordination, impaired vision, fatigue, sleep disturbances and defective memory) • Psychological (irritability, suicidal tendencies, manic depressive psychosis) • Cardiovascular (atherosclerosis, heart disease) • Genitourinary (microhematurias, albuminuria, hypertensive, nephrosclerosis) • Others (chronic gastritis, anemia)
Perchloroethylene (PCE)* or tetrachloroethylene	• Dry-cleaning and textile processing • Degreasing of metal parts in metal fabricating, automotive, shipyards, aircraft and aerospace industries • Cleaning of lenses in the optical industry • Manufacture and use of printing ink, varnishes, adhesives, polishes, rubber coatings and silicones	• Mucosa membranes (irritation to eyes, nose, and respiratory tract) • Central nervous system (massive exposure can cause dizziness, headache, nausea, inco-ordination, coma and death)	• Central nervous system (non-specific complaints like headache, dizziness, fatigue and inco-ordination) • Skin (irritation and even burns) • Liver (cirrhosis has been observed in workers exposed to high levels)

Trichloroethylene (TCE)*	• Degreasing of metal parts in metal, electronics, automotive, shipyards, aircraft and aerospace industries • Spot removers in dry-cleaning • Cleaning of lenses in the optical industry, • Use as solvent for extraction of waxes, fats, resins and oils • Manufacture and use of printing inks, varnishes, adhesives, paints, lacquers, rug cleaners and disinfectants	• Mucosa membranes (irritation to eyes, nose, and respiratory tract) • Central nervous system (massive exposure can cause excitation, dizziness and euphoria initially. This is followed by a depressive phase of headache, nausea, sleepiness and coma). • Respiratory system (chemical pneumonitis and death from respiratory failure may occur) • Cardiovascular (high exposure can sensitise the myocardium leading to arrhythmia and cardiac arrest)	• Central nervous system (non-specific complaints like headache, irritability, fatigue and insomnia.) • Skin (irritation and dermatitis) • Liver (few cases of hepatitis-like syndromes and steatosis have been reported) • Renal (proteinuria and raised blood urea) • Others (severe potentially fatal systemic allergic reaction presenting as Stevens Johnson Syndrome or toxic epidermal necrolysis. This may occur even with minimal exposure and usually presents with fever, rash and jaundice within 2–3 weeks of exposure.)
Toluene	• Manufacture of rubber, dye, glue, printing inks, paints • Removal of paints from contaminated parts • Wood and furniture industry	• Mucosa membranes (irritation to eyes, nose, and respiratory tract) • Neurological (headaches, confusion, and memory loss, impaired judgment, unbalanced gait, blurred vision, loss of consciousness, coma, and death). • Respiratory (pneumonitis, respiratory arrest)	• Central nervous system (non-specific complaints like headache, irritability, fatigue and insomnia.) • Renal (renal tubular damage) • Skin (dermatitis) • GIT (liver dysfunction)

*Workers exposed to these chemicals are required to undergo mandatory medical examinations under the WSH (Medical Examinations) Regulations.

Table 14: Clinical presentations for solvent poisoning.

ii. Ask company for results of exposure monitoring and the SDS of the chemicals used. Review if the chemicals handled contain the above solvents. If the exposure levels exceed the permissible exposure levels, a work-related condition should be suspected. Note that solvents can also be easily absorbed through the skin even in the absence of high exposure monitoring results.

iii. Specific investigations to document worker's absorption of certain solvents and its effects on health can be carried out as listed in the Guidelines on Statutory Medical Examinations. Workers with biological indicators exceeding the threshold limits specified in the Guidelines should be suspended from further exposure and reviewed closely. For workers exposed to suspected toluene poisoning, you may wish to test the blood toluene levels.

Note
Liver function tests, urine analysis, nerve conduction and electromyographic studies may be performed in cases of suspected solvent poisoning, especially for workers with chronic exposure. Specialised neuropsychometric tests may be used to evaluate behavioural effects.

3.13.5 Management

Most workers improve once they are no longer exposed to the solvent (especially if the exposure is of short duration). For those with high and prolonged exposures, recovery may be incomplete.

Advice to workers:

- Suspend the workers from further exposure or reassign them to another area without exposure to the solvent for up to one month.
- Repeat the specific biological indicator at end of the suspension period. If results improve, continue monitoring every month or earlier till results returned to normal before returning to previous work. If not, refer worker to JEOTC at Changi General Hospital for further investigation (contact no: 6850 3333).
- Practice good personal hygiene to reduce absorption (e.g., avoid smoking and eating with hands at the workplace).
- Instruct them on the proper use and maintenance of appropriate PPE, such as goggles, respirators and gloves.
- Cases with symptoms should be referred to JEOTC as soon as possible.

Advice to companies:

- Identify high-risk workers (workers with liver diseases, solvent abuse or who are alcoholics) to educate them on taking measures to reduce exposure. They should not work in areas where there is significant exposure to solvents.
- Review workplace RA and put in place control measures to reduce exposure.
- Find out more on requirements for medical examinations under the WSH (Medical Examinations) Regulations.
- Notify MOM (poisoning by chemicals is a notifiable disease).

3.14 Toxic Anemia

Toxic anemia is a notifiable disease. Toxic anemia occurs when the erythrocytes are reduced in number or volume, or are deficient in hemoglobin as a result of damage caused by medication, chemicals and circulating metabolites. The anemia may be followed by leucopenia, thrombocytopenia and pancytopenia.

3.14.1 Clinical Presentation

Abnormal blood count and/or peripheral blood film is probably the first indication of a blood disorder. Mild forms of toxic anemia may not cause any noticeable symptoms. Regardless of the cause, all types of anemia have similar signs and symptoms from the blood's reduced capacity to carry oxygen. Physical examination may show the presence of anemia and mild jaundice. Common symptoms include anorexia, general weakness, dizziness and exercise intolerance.

Certain exposures may give rise to more specific clinical signs, which suggest the underlying cause. For example, blue line on the gingival margins (lead), peripheral neuropathy (arsenic, lead) plantar-palmar hyperkeratosis and transverse lines in the nail bed (arsenic). In addition, some chemicals can cause specific blood disorders (leukaemia from exposure to benzene; and ionising radiation and aplastic anaemia from exposure to trinitrotoluene). These are, however, rarely found in today's occupational setting.

In some cases, toxic anemia develops within hours or days of exposure to a toxin (arsine causing massive intravascular haemolysis), but in most cases, it takes months of exposure before symptoms of toxic anemia appear. Often, the symptoms of toxic anemia clear when exposure to the toxin stops. Prolonged exposure may result in chronic renal failure and/or neurologic impairment.

3.14.2 Differential Diagnosis

Exclude non-occupational causes such as those due to:

- hereditary conditions (e.g., G6PD deficiency, thalassemia, haemophilia);
- drugs (e.g., sulfonamides, NSAIDs, chloramphenicol); and
- nutritional deficiency (e.g., iron, folic acid and Vit B12 deficiency).

3.14.3 Diagnostic Criteria of Work-relatedness

A good occupational history of exposure is critical. In addition, supporting documents of results of personal or workplace exposure monitoring will aid in determining the diagnosis of work-related anemia.

3.14.4 Investigation to Establish Work-relatedness

i. Take a good occupational history to establish if there is exposure to the toxic agents in Table 15.

Classification of Agents	Type of Agent	Exposure Situations/ At-risk Exposure
Metals	Arsenic*	• Manufacture of glass, paint, enamels, weed killers, pesticides
	Inorganic lead*	• Manufacture of lead acid battery • Cutting of scrap metal containing lead • Production of PVC stabilisers • Manufacture of paint pigments
	Organic lead*	• Manufacture of anti-knock additive in petroleum
	Mercury*	• Petrochemical industry • Repair and maintenance of blood pressure sets containing mercury • Analytical laboratories
Solvents	Benzene*	• Petrochemical industry
Gases	Arsine*	• Semiconductor industry where galvanising, etching, soldering and lead plating are carried out • Smelting and refining industry • Cleaning of acid storage tanks • Waste treatment plants (arsine is released when acid comes in contact with metals containing arsenic)
Other chemicals	Aniline	• Manufacture of rubber, dyes
	Trinitrotoluene	• Manufacture of explosives
Physical	Ionising radiation	• Radio-isotopes imaging in medical and industrial setting (particularly to evaluate the quality of welded joints in ship and aircraft maintenance)

*Workers exposed to these chemicals are required to undergo mandatory medical examinations under the WSH (Medical Examinations) Regulations.

Table 15: Exposure to toxic agents of anemia.

ii. Correlate the exposure history with the individual biological result:

- Review the patient's serial haemoglobin results and correlate them with the blood/urine levels of the chemicals or metabolites. Refer to the WSH (Medical Examinations) Regulations.
- Review the peripheral blood film. Basophilic stippling of the red cells can be evidence of lead exposure, although the degree of stippling does not correlate with the body burden of lead. Heinz bodies are seen in haemolytic states associate with exposure to aniline, naphthalene, benzene.

iii. Ask company for results of exposure monitoring which will provide additional support for the diagnosis if the levels exceed the permissible exposure levels.

iv. Exclude non-occupational causes, pre-existing and predisposing factors, for example, nutritional deficiencies, thalassemia and other blood disorders.

3.14.5 Management

Workers with abnormal blood test results should be investigated. Depending on the cause and severity of the anemia, treatment may involve advice on adequate nutrition, hematinics, and removal from exposure to toxic chemicals. For toxic anemia, no specific treatment exists, except for chelation therapy in specific poisoning, such as lead. Some patients improve quickly once they are no longer exposed to the toxin, especially if the disease is detected early. For others, recovery may take months.

Advice to workers:

- Suspend the workers from further exposure or reassign them to another area without exposure to the toxic agent for a period of 3 months (especially if the worker is a susceptible worker with pre-existing or predisposing condition).
- Repeat the blood tests at end of 3 months. If results improve, continue monitoring every 3 months till results returned to normal before returning to previous work. If not, refer worker to JEOTC at Changi General Hospital for further investigation and management (contact no: 6850 3333).
- Instruct them on what constitutes a healthy diet and the importance of good personal hygiene to reduce absorption (e.g., avoid smoking and eating with hands at the workplace).
- Instruct them on the proper use and maintenance of appropriate PPE, such as respirators and gloves when going to workplaces with exposure.

Advice to companies:

- Identify high-risk workers to reduce their chance of toxic exposure.
- Review workplace RA and put in place control measures to reduce exposure.
- Notify MOM (toxic anemia is a notifiable disease).
- Find out more about requirements for medical examinations under the WSH (Medical Examinations) Regulations.

3.15 Toxic Hepatitis

Toxic hepatitis is a notifiable and compensable disease. Toxic hepatitis is an inflammation of the liver which occurs when the liver is damaged by drugs, chemicals and circulating metabolites. With the exception of a few chemicals that cause specific lesions (e.g., liver angiosarcoma is strongly associated with exposure to vinyl chloride monomer), liver damage due to occupational exposure does not differ clinically or morphologically from non-occupational causes, such as from certain drugs and excessive alcohol intake. Under WICA, toxic hepatitis can be compensated if a worker is involved in any process involving exposure to tetrachloroethane, nitro-derivatives or amino-derivatives of benzene or vinyl chloride monomer.

3.15.1 Clinical Presentation

An abnormal liver function test result is probably the first indication of liver damage. Mild forms of toxic hepatitis may not cause any noticeable symptoms. The clinical features are the same irrespective of their underlying cause. Common symptoms include anorexia and general weakness. Clinical presentations of anemia, jaundice, palmar erythema, liver/ spleen enlargement are rare in an occupational setting.

In some cases, toxic hepatitis develops within hours or days of exposure to a hepatoxic agent, but in most cases, it takes months of exposure before symptoms of toxic hepatitis appear. Often, the symptoms of toxic hepatitis clear when exposure to the hepatoxic agent stops. Prolonged exposure however, can permanently damage the liver, leading to cirrhosis and liver failure.

3.15.2 Differential Diagnosis

Exclude non-occupational causes such as those due to:

- infections;
- drugs (e.g., contraceptives, statins, aspirin, tetracycline, methotrexate);
- alcohol; and
- glue sniffing.

3.15.3 Diagnostic Criteria of Work-relatedness

A good occupational history of exposure is critical. In addition, supporting documents of results of personal or workplace exposure monitoring will aid in determining the diagnosis of work-related hepatitis.

3.15.4 Investigation to Establish Work-relatedness

i. Take a good occupational history to establish if there is exposure to the hepatotoxic agents in Table 16.

Classification of Hepatotoxic Agents	Type of Agent	Exposure Situations/ At-risk Exposure
Metals	Arsenic*	Manufacture/ Use of pesticides
	Beryllium	Manufacture of nuclear devices, satellite and radar systems, aircraft bushings and bearings in the defence and aeronautical industry
Solvents	Carbon tetrachloride	Dry-cleaning
	Chloroform	Laboratories, especially in pathology labs
	Dimethylformamide	Solvent manufacturing
	2-nitropropane	Painting
	Perchloroethylene*	Degreasing/ cleaning with solvents
	Trichloroethylene*	Degreasing/ cleaning with solvents
	Tetrachloroethane	Manufacture of paints and varnishes
Anesthetic Gases	Halothane	Operating rooms
Other Chemicals (including nitro-derivatives or amino-derivatives of benzene)	Trinitrotoluene	Manufacture of explosives
	Vinyl Chloride Monomer*	Rubber, plastic manufacturing
Biological	Dengue hemorrhagic fever	Construction sites, agriculture/ farm
	Hepatitis A, B, C, D+	Sewerage workers, healthcare workers
	Leptospirosis+	Sewerage and drainage workers, waste collectors, abattoir workers, tunneling workers
	Malaria	Agriculture/ farm workers, military personnel
	Meliodosis	Construction sites, agriculture/ farm, military personnel

*Workers exposed to these chemicals are required to undergo mandatory medical examinations under the WSH (Medical Examinations) Regulations.
+These diseases are notifiable under the Second Schedule of the WSH Act.

Table 16: Exposure situations for hepatotoxic agents.

ii. Ask company for results of exposure monitoring which will provide additional support for the diagnosis if the levels exceed the permissible exposure levels. It also provides the basis for a balance view on the relative contributions of the exposure to the clinical findings.

iii. Exclude non-occupational causes, pre-existing and predisposing factors, for example, past history of liver disease such as alcoholic liver cirrhosis, infections related hepatitis.

3.15.4 Management

The cause of abnormal liver function test results should be investigated. For toxic hepatitis, no specific treatment exists. Therefore, treatment is usually supportive and includes removal from toxic chemicals. If indicated, antiviral drugs may be used. Some patients improve quickly once they are no longer exposed to the hepatotoxic agent, especially if the disease is detected in the early stage. For others, recovery may take months.

Advice to workers:

- Strictly follow suspension period to avoid further exposure to the hepatotoxic agent.
- Repeat the liver function test at end of 3 months. If results improve, continue monitoring every 3 months till results returned to normal before advising on return to previous work. If there is no improvement, refer worker to JEOTC at Changi General Hospital for further investigation (contact no: 6850 3333).
- Reduce alcohol intake and practice good personal hygiene to reduce absorption.
- Instruct them on the proper use and maintenance of appropriate PPE, such as respirators and gloves when going to workplaces with exposure.

Advice to companies:

- Suspend the workers from further exposure or reassign them to another area with no exposure to the hepatotoxic agent for a period of three months (especially if two or more parameters are abnormal and/or there is a predisposing factor which makes the workers more susceptible to liver damage from exposure to hepatotoxic agents).
- Review workplace RA and put in place control measures to reduce exposure.
- Notify MOM (toxic hepatitis is a notifiable and compensable disease).
- Find out more about requirements for medical examinations under the WSH (Medical Examinations) Regulations.

3.16 Work-related Musculoskeletal Disorders Involving the Upper Limbs and Spine

Musculoskeletal disorders (MSDs) are common in the general population. The presentation ranges from aches and pains to numbness and limitation of movement involving different parts of the musculoskeletal system. For work-related MSDs, terms such as repetitive strain injury, occupational overuse syndrome and cumulative trauma disorders have been used.

3.16.1 Clinical Presentation

The most common symptoms may be that of aches and pain in the neck, shoulders or arms. If there is nerve compression, numbness and weakness of the affected regions can occur. Details of some common work-related musculoskeletal disorders with their presenting signs and symptoms are listed in Table 17.

3.16.2 Differential Diagnosis

Exclude non-occupational sources of exposures that may cause or aggravate the musculoskeletal problem:

- domestic exposures (e.g., the washing and wringing of clothes while doing laundry can lead to wrist pain [i.e., de Quervain's tenosynovitis]);
- looking after children or elderly at home;
- sports, hobbies and leisure activities;
- past or pre-existing medical conditions, (e.g., rheumatoid arthritis, degenerative bone conditions, cancer, ankylosing spondylosis);
- previous history of injuries; and
- psychosocial and sociocultural make-up of the workers.

3.16.3 Diagnostic Criteria of Work-relatedness

A good occupational history to determine the worker's work process, materials, practice and habits is essential. The onset or worsening of work-related MSD should be correlated to the following:

- duration of employment;
- change in the work process or practice (an increase in the workload may precipitate or aggravate the symptoms);
- time relationship of the aches and pains with work periods (usually, there is some improvement when the patient is away from work); and

The risk factors present in work-related MSDs include awkward/ static postures, repetitive motion, handling of excessive loads and forceful movements.

3.16.4 Investigation to Establish Work-relatedness

i. In addition to eliciting the signs and symptoms of MSD, a good occupational history is important to establish if there is exposure to the types of job activities in the workplace (see Table 17) for the specific presentation. Note that older, untrained or new workers on the job may be more prone to developing these disorders.

Musculoskeletal Disorders	Subjective Symptoms	Objective Signs	Typical Job Activities
Carpal Tunnel Syndrome (CTS)	• Pain, paresthesia, numbness, tingling, reduced touch sensitivity in median nerve distribution of hand (first three fingers and base of thumb) • Weakness and clumsiness of hand • Aggravated by prolonged full active flexion of wrist • Worse in early hours of morning, (waking patient from sleep and causing her to shake hand)	• Positive* phalen's test (complete flexion of wrist for 1 minute) • Positive* tinel's sign (percuss at the CT for 0.5 minute) • Wasting of thenar eminence • Nerve conduction tests (but can be normal in early CTS) * Reproduce symptoms in median nerve distribution	Buffing, grinding, polishing, sanding, assembly work, typing, keying, cashiering, hammering
Ulnar Nerve Neuropathy at the Elbow (Cubital Tunnel Syndrome)	• Numbness, tingling in the little and ring fingers • Weakness of hand grasp and thumb pinch • Symptoms may worsen with prolonged elbow flexion • Pain, if present, may be referred to the elbow	• Parasthesia in the distribution of ulnar verve • Wasting of intrinsic muscles and weakness in pinch and grasp • Wasting of hypothenar muscles and clawing of ring and little fingers • Tinel's sign positive over ulnar groove • Positive Wartenberg's sign (i.e., weakness in adduction of the little finger)	Resting forearm near elbow on a hard surface, excessive flexion/ extension of elbow
Tennis Elbow (Lateral epicondylitis)	• Pain in lateral epicondyle during rest/ active motion of wrist and fingers • Pain and/or weakness in gripping (e.g., shaking hands or holding heavy objects) • Pain may radiate to dorsum of wrist	• Tenderness over lateral epicondyle • Pain on lateral aspect of elbow on resisted extension of wrist and fingers with elbow fully extended • Pain/ weakness on gripping	Turning screws, small parts assembly, hammering, meat-cutting

Rotator Cuff Tendinitis	• Pain in the shoulder exacerbated by abduction or elevation of the arm • Pain at night and at rest if more severe	• Pain on active or resisted abduction or internal/ external rotation • Local tenderness on the supraspinatus tendon or rotator cuff • Possible limited abduction • Impingement test	Overhead assembly, overhead welding, overhead auto repair, reaching, lifting, carrying load on shoulder
De Quervain's Tenosynovitis	• Pain on dorsal radial aspect of wrist which may radiate down thumb or forearm • Pain on thumb movement • Grip/ pinch is weak	• Finkelstein's test (passive ulnar deviation of wrist with thumb held adducted); if tested positive, there will be sharp pain in tendons • Pain on resisted extension and abduction of thumb • Local tenderness on palpation at radial styloid	Buffing, grinding, polishing, sanding, pushing, pressing, sawing, cutting, butchering, use of pliers, inserting screws in holes, forceful hand wringing
Trigger Finger/ Stenosing Tenosynovitis	• Stiffness/ triggering/ clicking/ catching of finger on extension • Finger locked in flexion or extension	• Palpable nodule at base of digit just proximal to the metacarpo-phalangeal joint	• Trigger finger: Using tools with sharp edges pressing into tissue or with handles too far apart for the users' hands • Tenosynovitis: Buffing, grinding, polishing, sanding, pushing, pressing, sawing, cutting, butchering, use of pliers, inserting screws in holes, forceful hand wringing
Tension neck	• Tightness and pain in the neck, shoulders and interscapular region. • Numbness radiating to the arms and fingers	• Stiffness on movement • Localised tenderness	Data entry with prolonged flexion, extension, twisting of the neck

Low back pain	• Onset of back pain may be sudden or gradual • Leg pain may occur with radiculopathy • Sciatica can occur with prolapsed intervertebral disc	• Localised tenderness • Limitation in straight leg raising	Heavy lifting, carrying or pushing, sudden overload, repetitive loading

Table 17: MSDs and associated job activities.

Note
Some cases may require an ergonomic assessment which involves assessing the level or intensity of force, repetitiveness, task duration, posture, rate of movement, vibration, psychosocial and organisational factors. This may require the expertise of a professional trained in ergonomics.

ii. Correlate the exposure history with the individual symptoms and investigation results:

- Correlate symptoms with work periods, for instance, a work-related MSD is likely to worsen during work and improve when the worker stops working or goes on leave. There may be a period of increased workload or a change in work process which triggers the onset of symptoms.
- The clinician should always be on the alert for clustering of cases with similar occupational groups or in specific workplaces (ask if there are other workers in the workplace doing the same task who have similar complaints).

iii. Ask company for details of work carried out to determine if the work exposures are sufficient to cause the work-related MSD. Work involving prolonged static postures, heavy lifting, forceful or repetitive movements of a specific joint provides additional support for the diagnosis of work-related MSD.

iv. Exclude non-occupational causes, pre-existing and predisposing factors such as domestic-related exposures and hobbies (listed in 3.16.2).

3.16.5 Management

The objective of management is relieving pain and inflammation, restoring the patient's range of movement, and modifying the work environment and/or work task so as to prevent a recurrence of the condition. It is important to identify the factors leading to the MSD so that the appropriate advice may be given.

Advice to workers:

- Adopt proper postures when handling loads (e.g., when lifting, keep the trunk straight and knees bent, avoid twisting and jerky movements, carry loads close to the body).
- Ask for assistance if heavy loads need to be carried.
- Take the required rest breaks.
- Refer to the Work-related Musculoskeletal Disorders Clinic at Tan Tock Seng Hospital for further investigation and management (contact no: 6357 7000).

Advice to companies:

- Reorganise the workplace and work process to decrease weight of loads, reduce frequency of lifting, keeping heavy objects at knuckle height.
- Eliminate need for manual material handling, if possible, by providing mechanical lifting aids (e.g., lift tables, hoists, cranes).
- Automating some of the repetitive tasks.
- Rescheduling of work processes to incorporate rest periods.
- Job rotation to different tasks so that the muscle groups can recover.
- Transfer of worker to area where there is less or no exposure to risk factor.
- Train workers in manual handling techniques and ensure that they adopt safe techniques in manual handling.

3.17 Work-related Post-traumatic Stress Disorders

Work-related Post-Traumatic Stress Disorders (PTSDs) can be defined as a psychosocial disorder resulting from exposure to an extreme traumatic stressor in the workplace.

Examples of traumatic stressor at the workplace may include witnessing the death of a colleague crushed by a collapsed crane; serious injury from a fall at height; amputation/ degloving injuries of limbs; a life-threatening accident involving chemical explosion or fire; and violence at work. These are distinct from the painful stressors of life such as divorce, failure, rejection, serious illness and financial difficulties.

3.17.1 Clinical Presentation

Symptoms and signs of PTSD include:

- intrusive recollections or flashbacks or relieving the traumatic event for minutes or even days at a time;
- acting as if the traumatic event is happening all over again with upsetting dreams or nightmares about the traumatic event;
- trying to avoid thinking or talking about the traumatic event or avoiding the scene where the traumatic event took place;
- feeling emotionally numb;
- irritability or anger;
- trouble sleeping;

- trouble concentrating; and
- being easily startled or frightened by loud noises.

3.17.2 Differential Diagnosis

Exclude non-occupational causes of PTSDs, such as:

- personal stressors such as divorce, failure, rejection, serious illness and financial reverses;
- domestic violence; and
- natural disasters as earthquakes, tsunamis, and so on.

Vulnerable workers with pre-existing psychosocial disorders, such as, primary depression, anxiety disorders, personality disorders.

3.17.3 Diagnostic Criteria of Work-related PTSD

A history of exposure to a traumatic stressor is critical to the diagnosis. The worker must be exposed to a traumatic event in which both of the following elements are present:

- experienced, witnessed, or been confronted with an event or events that involve actual or threatened death or serious injury, or a threat to the physical integrity of oneself or others; and
- responding with intense fear, helplessness, or horror.

In addition, the worker must have the following symptoms:

- Intrusive recollections, such as recurrent distressing dreams and recollections of the images, thoughts, or perceptions of the event.
- Avoidant/ numbing, such as persistent avoidance of stimuli associated with the trauma and numbing of general responsiveness of at least *three* of the following:
  - efforts to avoid thoughts, feelings, or conversations associated with the trauma;
  - efforts to avoid activities, places, or people that arouse recollections of the trauma;
  - inability to recall an important aspect of the trauma;
  - markedly diminished interest or participation in significant activities;
  - feeling of detachment or estrangement from others;
  - restricted range of affect (e.g., unable to have loving feelings); and
  - sense of foreshortened future (e.g., does not expect to have a career, marriage, children, or a normal life span).
- Hyper-arousal, indicated by at least *two* of the following:
  - difficulty falling or staying asleep;
  - irritability or outbursts of anger;
  - difficulty concentrating;
  - hyper-vigilance; and
  - exaggerated startle response.

The duration of symptoms should be more than one month and causing functional disturbances in social, occupational, or other activities of daily living.

3.17.4 Management

The symptoms of PTSD respond well to treatment. Early intervention post event will help to mitigate symptoms of post-traumatic stress, and early identification and treatment will reduce complications and improve outcome greatly. It is also important that the workplace has a "return to work" plan which includes counselling and education. Doctors should closely work with the management to help the worker gradually return to work.

Advice to workers:

- Encourage them to share their traumatic experience and how they feel with someone they trust.
- Advice to join a support group to share similar traumatic stress experience.
- Follow up regularly to monitor progress of treatment and to identify any complications
- Refer to a psychiatrist for further management if needed.

Advice to companies:

- Put in place a crisis response plan, comprising the following:
  - capability to identify affected workers for early management;
  - communication of crisis-related information to control fears and rumors; and
  - build confidence that the crisis is under control and demonstrate concern for workers' welfare.
- Refer workers and managers at risk to a health professional or counsellor with training and experience in trauma-related conditions early.
- Look out for workers with signs of delayed or continued trauma-related stress in the weeks and months after the traumatic event.
- Put in place a "return to work" plan for affected workers.

4. Appendix

Appendix A – Common Work Processes

Confined space work

Entry into confined space

Work in confined space

Storage tank

Manhole work

Tunnelling

Confined space work includes work in underground vaults, tanks, storage bins, manholes, pits, silos, process vessels, pipelines and tunnels where there is the potential to contain or trap hazardous atmospheres.

Possible health hazards in confined spaces include:

- toxic gases and vapours, for example, hydrogen sulphide, methane, CO, CO_2, solvents;

- low oxygen environment (O_2 deficiency); and
- constrained or awkward postures

Workers may succumb to asphyxiation, poisoning by toxic gases and vapours and develop musculoskeletal disorders.

Construction

Cutting of tiles

Pneumatic drilling

Plastering

Work in excavation site

Demolition

Manual handling of loads

Construction activities may expose the worker to:

- noise and vibration (e.g., from cutting and drilling processes);
- cement and wet work in plastering;
- ergonomic risks (e.g., from manual handling);

- wet work;
- asbestos dust and fibres; and
- silica dust.

Workers may develop hearing loss from exposure to excessive noise, hand-arm vibration syndrome from the exposure to vibration, contact dermatitis from wet work and exposure to cement, pneumoconosis from inhaling silica dust and lower back pain from manual handling activities.

Laundry and Dry-cleaning

Steam pressing

Hot pressing

Manual ironing

Loading of laundry

Workers in the laundry and dry-cleaning industry can be exposed to:

- solvents such as perchloroethylene and tricholoroethylene;
- ergonomic hazards from handling of heavy laundry loads; and
- excessive heat.

This can lead to excessive absorption/ poisoning to solvents especially during maintenance or when ventilation is ineffective. Exposure also occurs when workers remove the clothes from the laundry machines. Workers may also develop musculoskeletal disorders and heat rash from exposure to excessive heat and high humidity.

Horticulture and Landscaping

Preparation of pesticides

Application of pesticides

Horticulture work—transplanting

Horticultural work—weeding

Tree pruning

Workers in the horticulture and landscaping industry may be exposed to:

- pesticides (e.g., carbamates and OPs) from the preparation and application of pesticides;
- biological agents (from contact with soil borne organisms);
- wet work;
- ergonomic risks; and
- excessive heat.

Workers may succumb to excessive absorption/ poisoning from pesticides, infections such as meliodosis , musculoskeletal disorders and dermatitis from wet work.

Shipbuilding and Repair

Welding

Grit blasting

Non-destructive testing using radioactive isotopes

Solvent degreasing by dipping parts into basin containing solvent

Confined space work

Lagging/ delagging

Workers in this industry share similar hazards to those found in confined space work and the metal working industry.

Workers in the shipbuilding and ship-repair industry maybe exposed to hazards such as:

- heat and UV radiation from cutting and welding;
- ionising radiation from non-destructive testing;
- solvent exposure from degreasing;
- awkward postures and manual handling ; and
- asbestos (from lagging and delagging of insulated pipes).

Worker may develop cataract and arc eye from exposure to heat and UV radiation, leukemia from exposure to ionising radiation, noise-induced deafness from exposure

to excessive noise, musculoskeletal disorders from awkward postures and manual handling and excessive exposure/ poisoning from solvent use. Mesothelioma can develop in workers with past exposure to asbestos during lagging and delagging activities of insulated pipes.

Metalworking

Hammering

Grinding

Vapour degreasing

Solvent degreasing

Workers in the metalworking industry maybe exposed to hazards such as:

- heat and UV radiation from cutting and welding;
- noise from hammering, stamping, grinding and use of air gun;
- solvent exposure from degreasing and spray painting; and
- foreign objects in eye, resulting in corneal ulcers, eye irritation.

Worker may develop cataract and arc eye from exposure to heat and UV radiation, noise-induced deafness from exposure to excessive noise and excessive exposure/ poisoning from solvent use.

Woodworking

Sawing using machine saw

Sanding

Lamination with Acrylate glue

Varnishing parquet flooring

Workers in the woodworking industry may be exposed to hazards such as:

- noise and vibration from sawing and sanding;
- ergonomic hazards from repetitive flexion and extension of the upper limbs;
- wood dust; and
- chemicals such as solvents, epoxy glue, formaldehyde, isocyanates.

Workers may develop noise-induced deafness from exposure to excessive noise, hand-arm vibration syndrome from the use of tools and musculoskeletal disorders from repetitive flexion/ extension of the upper limbs. They may also be sensitised to wood dust, epoxy glue, formaldehyde and isocyanates.

Hotel and Catering

Housekeeping—making of beds

Housekeeping—vacuuming

Cleaning

Cutting

Handling seafood

Manual lifting

Carrying goods

Chef exposed to hot environment

Carrying chairs

Carrying food trays

Workers in the hotels and catering industry may be exposed to:

- wet work;
- contact with food proteins which may predispose to allergies;
- ergonomic hazards (awkward postures and repetitive flexion/ extension of wrist and elbows); and
- hot work and hot environment.

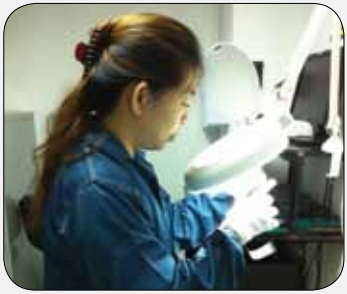
Workers may develop contact dermatitis from wet work and contact urticaria from sensitisation to raw food such as seafood. Adoption of awkward postures and repetitive work can lead to musculoskeletal disorders.

Electronics

Work in cold room

Silkscreen printing

Inspection of printed circuit board assembly



Inspection of printed circuit board assembly

Wave soldering system

Spot soldering

Workers in the electronics industry may be exposed to:

- ergonomic risk from prolonged awkward postures;
- respiratory allergens and irritants from soldering fluxes;
- lead from soldering and silkcreen prinitng; and
- eye strain from intense near/ microscpic work.

Workers may develop musculoskeletal disorders from prolonged awkward postures, occupational asthma from sensitisation to soldering fluxes and excessive absorption/

poisoning from lead used in silkscreen printing. Workers can also be exposed to hazards during maintenance of these machines.

Healthcare

Handling patients
(photo for illustration only)

Patient transfer
(photo for illustration only)

Handling sharps

Disposal of used linen

Dental work

Workers in the healthcare sector may be exposed to:

- ergonomic risk from lifting, carrying and other manual handling tasks;
- respiratory allergens and irritants from sterilisation; and
- biological hazards from infected body fluids.

Workers may develop musculoskeletal disorders, occupational asthma from sensitisation to latex gloves and glutaldehyde and infections from contact with infected body fluids.

Logistics

Lifting loads

Reaching for objects on high shelves

Bending back when handling loads

Overstretching or twisting back when retrieving items from shelves

Workers in the logistics sector may be exposed to ergonomic risks from awkward postures, lifting, carrying and handling of loads, and may develop musculoskeletal disorders from such work.

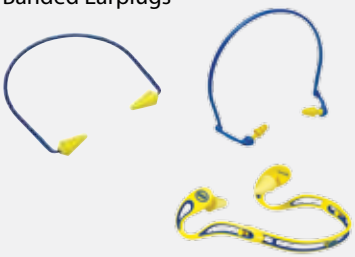
Appendix B – Personal Protective Equipment

Hearing Protectors

In general, earplugs or earmuffs are used when the noise exposure level is between 85 to 100 dBA. For exposure exceeding 100 dBA, earmuffs over earplugs are used together.

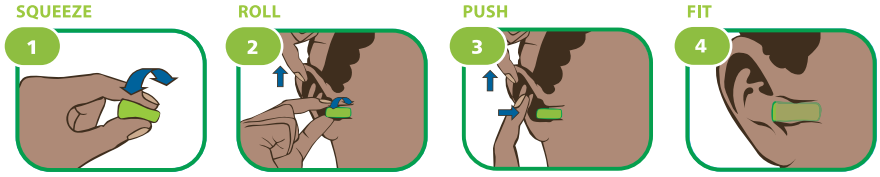
Hearing protectors should be properly maintained and cleaned. Workers who are required to use hearing protectors should receive adequate training on its proper use, care and maintenance. Selecting the right type of hearing protectors and the correct usage over the period of exposure to excessive noise are critical to effective hearing protection.

Type of Hearing Protectors	Application
Disposable Foam Earplugs 	• Usually made from compressible materials that the wearer rolls down before inserting into the ear canals. After insertion, these earplugs will expand to form a seal within the ear canals. • Good hand hygiene should be practiced before rolling down. • Discard earplugs after each use.
Pre-moulded Earplugs 	• Pre-moulded earplugs are usually made of soft forms of glass wool, silicone, rubber or plastics. • Readily inserted into the ear canal without need for prior shaping. • They can be available in different sizes. • Reusable but should be discarded when they become damaged, hardened or deformed.

Banded Earplugs 	• Easy to wear or remove. • The flexible band can be used to loop around the neck when not in use. • They are most commonly used for intermittent noise exposures. • *Note: Some noise can be transmitted from the band itself.*
Over-the-head Earmuffs  Helmet-mounted Earmuffs 	• Earmuffs are usually used when earplugs cannot be fitted properly or when dual protection is required for noise levels exceeding 100 dBA. • They are easily worn or taken off and generally give better acoustic seal than earplugs thus providing better hearing protection. • Available in different sizes. • If the cushions have become hardened or worn out, they should be replaced before use.

Correct method of wearing earplugs: Pull earlobes backwards and upwards with the opposite hand to ensure proper fit.

Proper usage of earmuffs: Hair should be brushed away and earmuff should cover the entire ear with the cushion making a proper seal; this can be done by adjusting the respirator straps and handles of the eyewear where appropriate.



At least 75% of the plug should be inserted into the ear canal when using pre-moulded or disposable earplugs to be effective.

Gloves

Gloves should be used when there is a possibility of contact with hazardous chemicals such as solvents, and corrosives such as acids and alkalis.

Type of Gloves	Application
Cotton Gloves 	• Breathable gloves, suitable for light duty work, general assembly and as liners for coated gloves.
Latex Gloves 	• Latex gloves are usually used as protection against wet work, plastering, contact with mild chemicals, such as detergents and cement.
Nitrile Gloves  Neoprene Gloves 	• Nitrile and neoprene gloves are used as protection against chemical hazards such as acids, alkalis, solvents, fats, oils and organic acids.

Leather Gloves 	• Leather gloves may be used as protection against heat, cold and mechanical hazards such as abrasions, cuts and punctures.
Heat-resistant Gloves 	• Used in work where there is high temperature, such as hot mechanical work, forging, vulcanising applications, plastic extruding, handling hot castings and smelting works.

Respirators

Respirators are used to protect the user from the inhalation of harmful dusts, fumes, vapours, gases and against oxygen-deficient atmospheres. They can be broadly classified into air-purifying (non-powered and powered) and supplied-air respirators (airline and self-contained breathing apparatus).

Respirators should be selected based on the type of hazards in the workplace and be properly maintained and cleaned. Fit-testing should be conducted to ensure adequate protection when in use.

Types of Respirators	Application
Air-purifying Respirators 1. Non-powered a. Disposable Respirator 	• Air-purifying respirators may be powered and non-powered. They may be disposable or equipped with a filter or cartridge and are designed for specific contaminants. They are not suitable for use in oxygen-deficient environments. • A common disposable respirator is the N95 respirator which is used to protect against respirable dust of less than 10 microns, such as mists, welding fumes and some biological agents.
b. Respirator with Filter or Cartridge • Full Face piece Respirator  • Half Face piece Respirator 	• Respirators fitted with the appropriate filters or cartridges can be used to remove mist, particulates, and certain gases and vapours. Exposure to such hazard or combination of hazards can be found in some common application such as welding, degreasing or spray painting works. • A full face-piece respirator gives a higher assigned protection factor than a half face-piece. A full face-piece also provide eye and face protection.

2. Powered Air-purifying Respirators

- In the powered air-purifying respirators (PAPR), the contaminated air is drawn through a filter or cartridge by a fan and delivered to user. PAPRs are used when a higher level of protection is needed.

Supplied-air Respirators

1. Airline Respirators

- They are used in situations with unknown air contaminants, high contamination levels and in oxygen-deficient environment, such as in confined spaces.
- In airline respirators, the breathing air is supplied through a hose from a compressor drawing air from an uncontaminated source or compressed air cylinder. User movement may be restricted by the length of the hose.

2. Self-contained Breathing Apparatus

- In self-contained breathing apparatus (SCBA), a full face piece is commonly used and the air source is carried by the user. This allows the user to move without being restricted by the airline.

Appendix C – List of Reportable Occupational Diseases in Singapore under Workplace Safety and Health Act

1. Aniline poisoning
2. Anthrax
3. Arsenical poisoning
4. Asbestosis
5. Barotrauma
6. Beryllium poisoning
7. Byssinosis
8. Cadmium poisoning
9. Carbamate poisoning
10. Compressed air illness or its sequelae, including dysbaric osteonecrosis
11. Cyanide poisoning
12. Diseases caused by ionising radiation
13. Diseases caused by excessive heat
14. Hydrogen Sulphide poisoning
15. Lead poisoning
16. Leptospirosis
17. Liver angiosarcoma
18. Manganese poisoning
19. Mercurial poisoning
20. Mesothelioma
21. Noise-induced deafness
22. Occupational asthma
23. Occupational skin cancer
24. Occupational skin diseases
25. Organophosphate poisoning
26. Phosphorous poisoning
27. Poisoning by benzene or a homologue of benzene
28. Poisoning by carbon monoxide gas
29. Poisoning by carbon disulphide
30. Poisoning by oxides of nitrogen
31. Poisoning from halogen derivatives of hydrocarbon compounds
32. Musculoskeletal disorders of the upper limb
33. Silicosis
34. Toxic anaemia
35. Toxic hepatitis

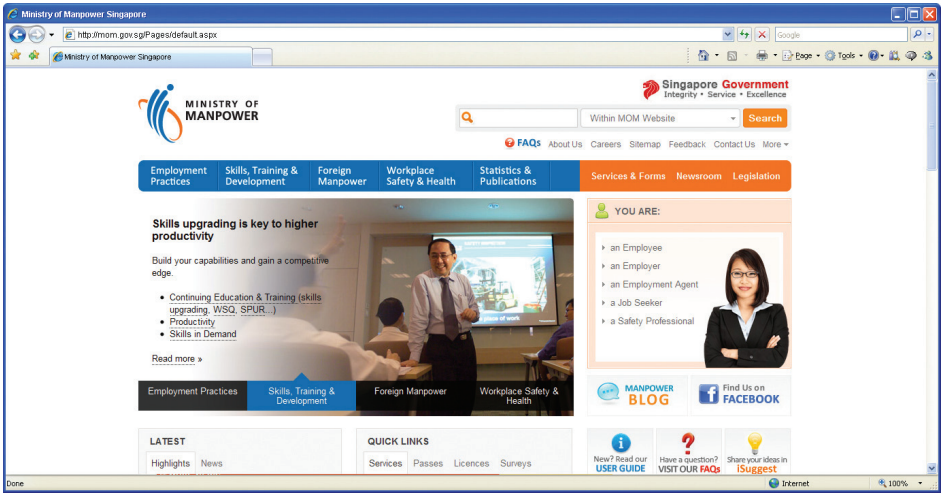
Appendix D – Step-by-Step Guide on the Reporting of Occupational Diseases*

You may access iReport at www.mom.gov.sg (see steps 1-8) or the Health Professionals Portal website at www.hpp.moh.gov.sg (see steps A-E).

The following is a step-by-step guide to the reporting of ODs:

iReport through MOM Website

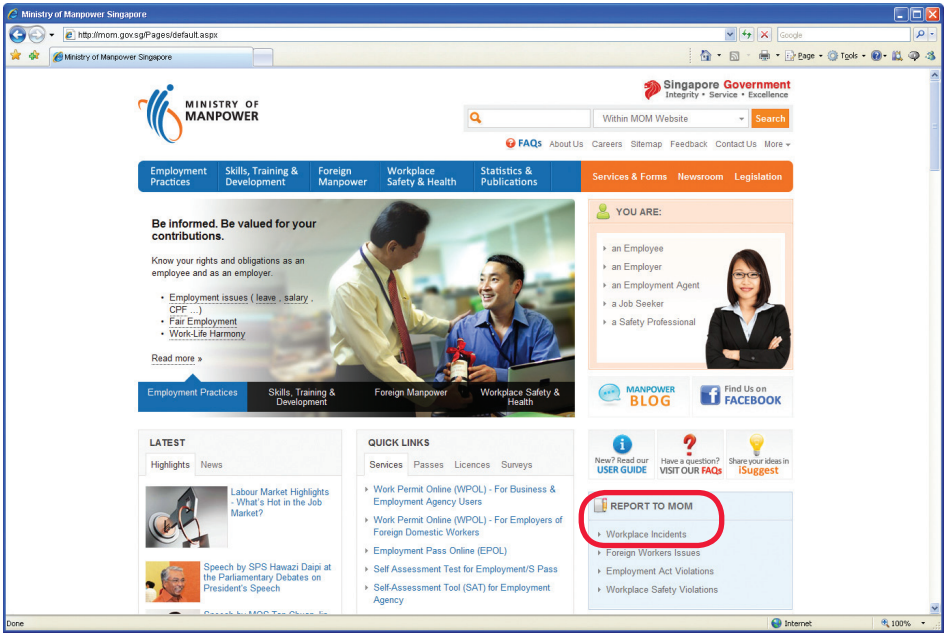
Step 1: Go to MOM at www.mom.gov.sg**



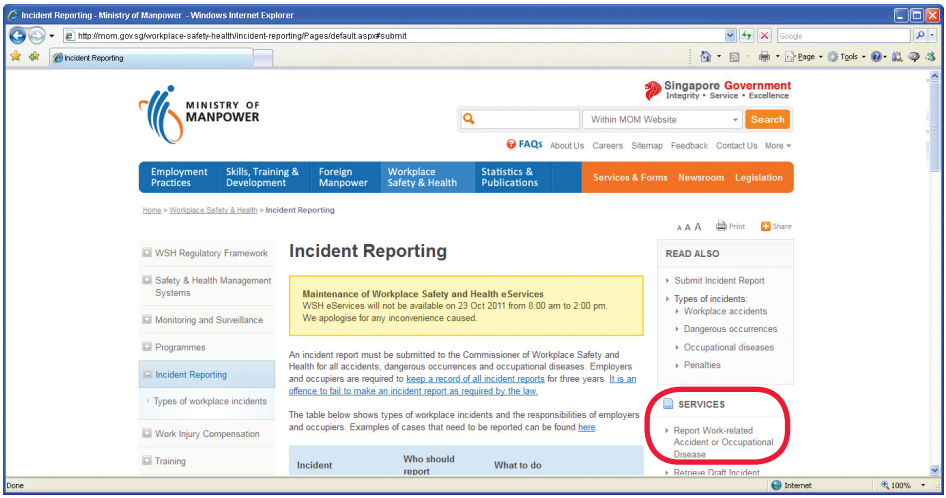
* Screenshots here are accurate as of November 2011.

** iReport can also be accessed via www.mom.gov.sg/iReport

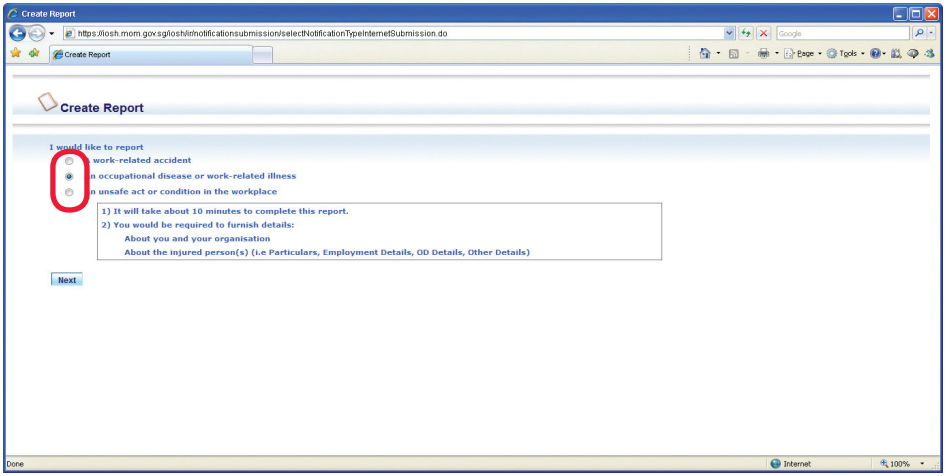
Step 2: Go to "Report to MOM" and click on "Workplace Incidents".



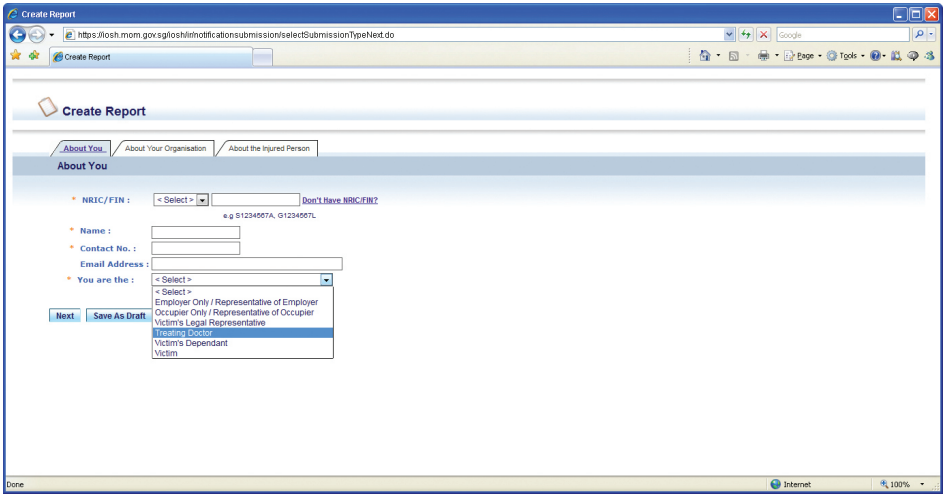
Step 3: Click "Report Work-related Accident or Occupational Disease" under "SERVICES".



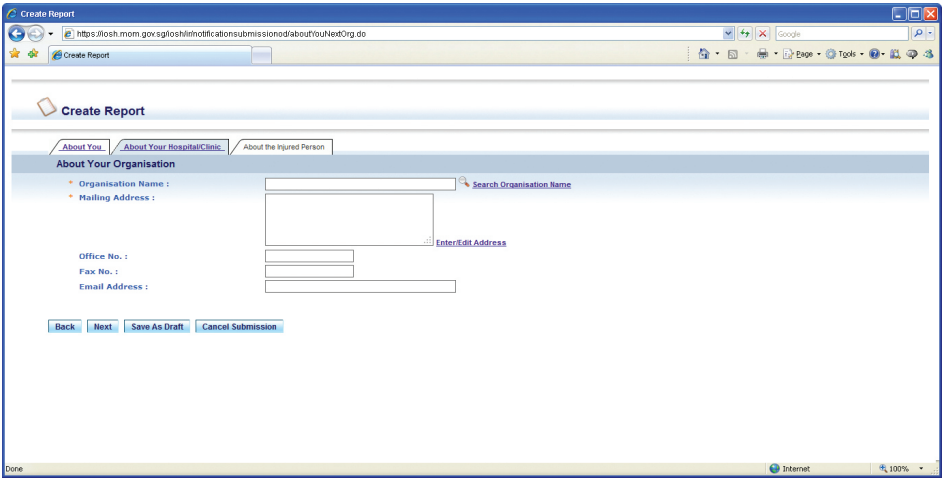
Step 4: Click "An occupational disease or work-related disease". Then click "Next".



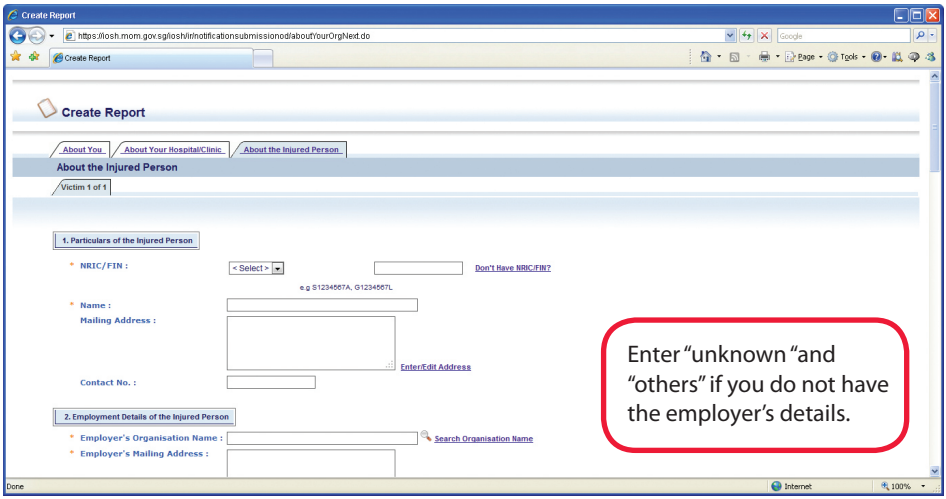
Step 5: Fill in your particulars and select "Treating Doctor" and click "Next".



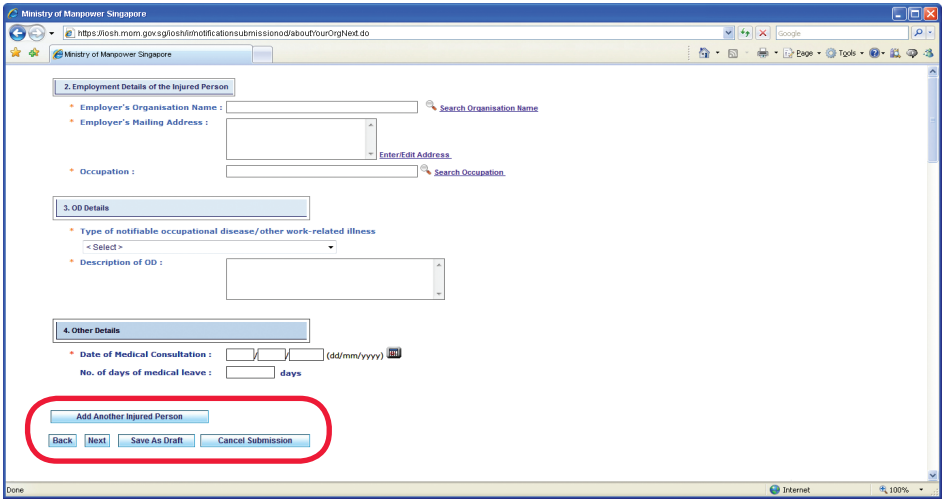
Step 6: Fill in the details of your clinic/ hospital and click "Next".



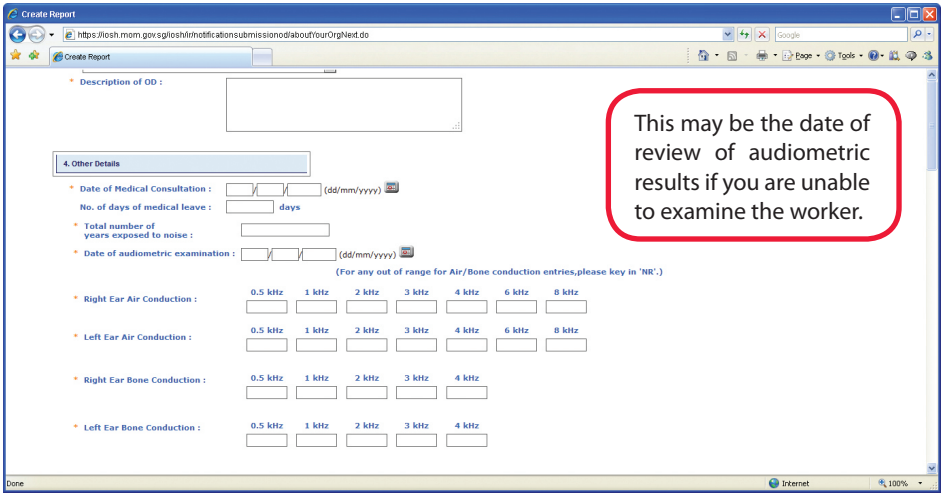
Step 7: Fill in details of the injured person, details of the OD (e.g., Occupational Skin Diseases or Noise-induced Deafness). Enter "unknown" and "others" if you do not have the employer's details.



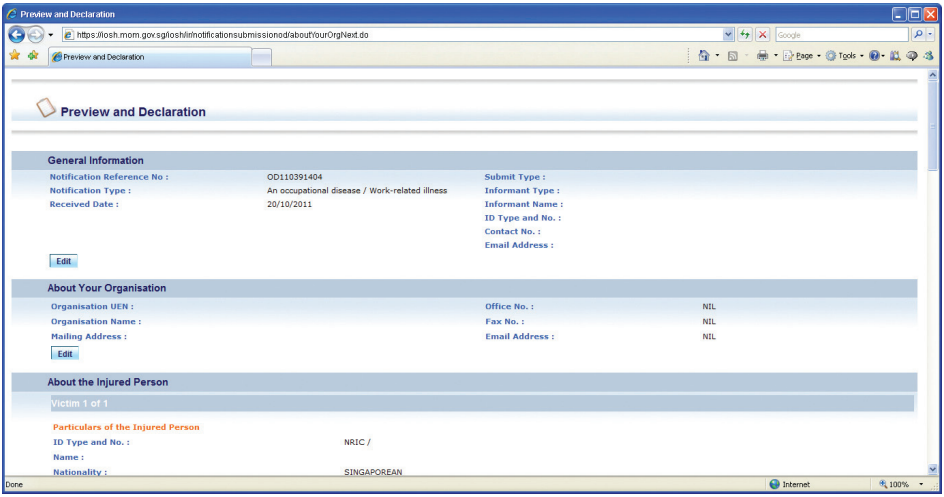
Then click "Next" or "Add Another Injured Person".

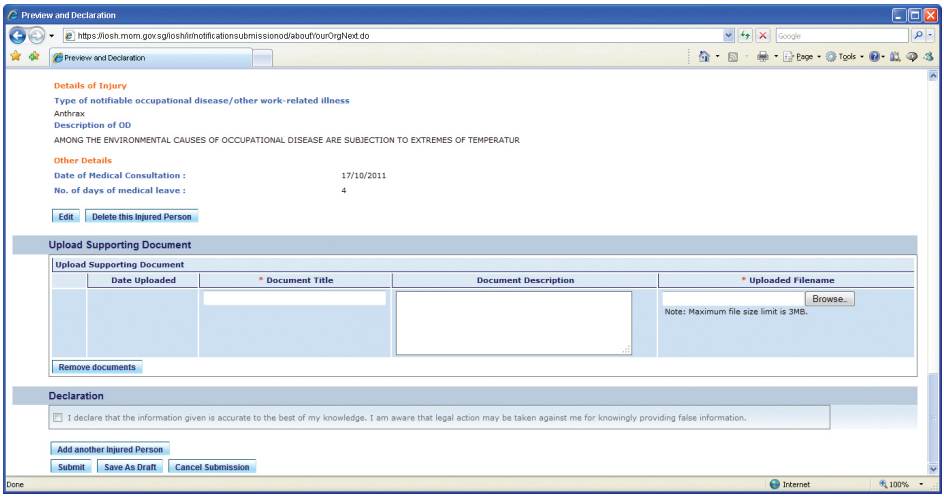


For Noise-induced Deafness, fill in the audiogram results.



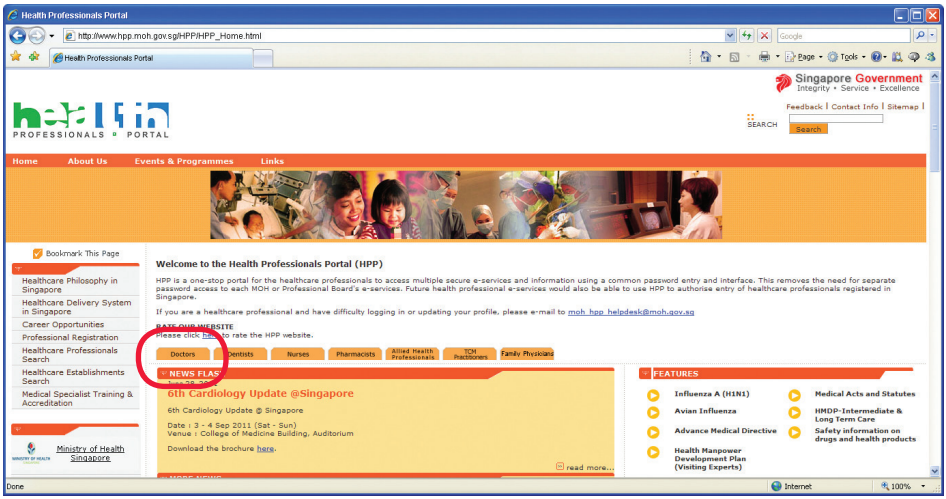
Step 8: Check the details, make your declaration and submit.





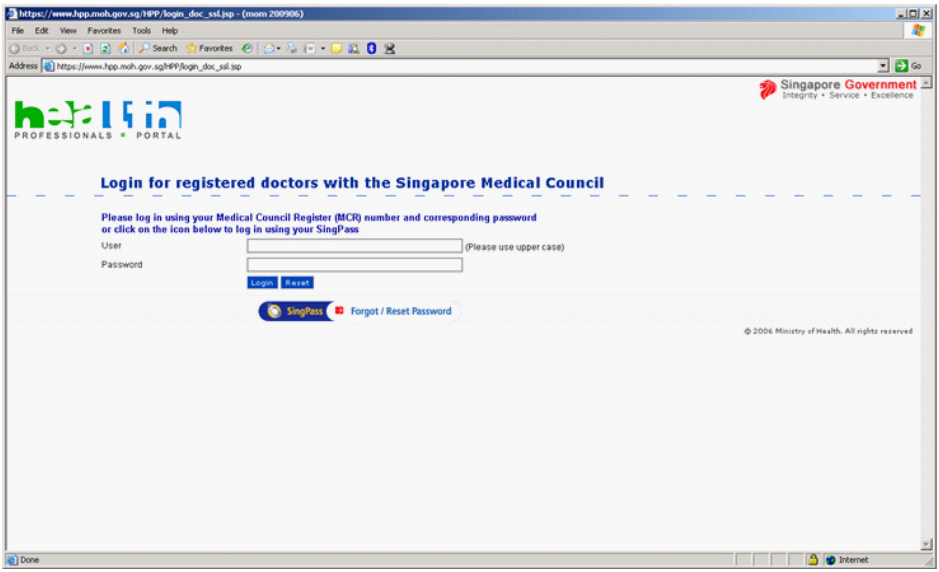
Through the Health Professionals Portal

Step A: Go to www.hpp.moh.gov.sg and click on "Doctors".

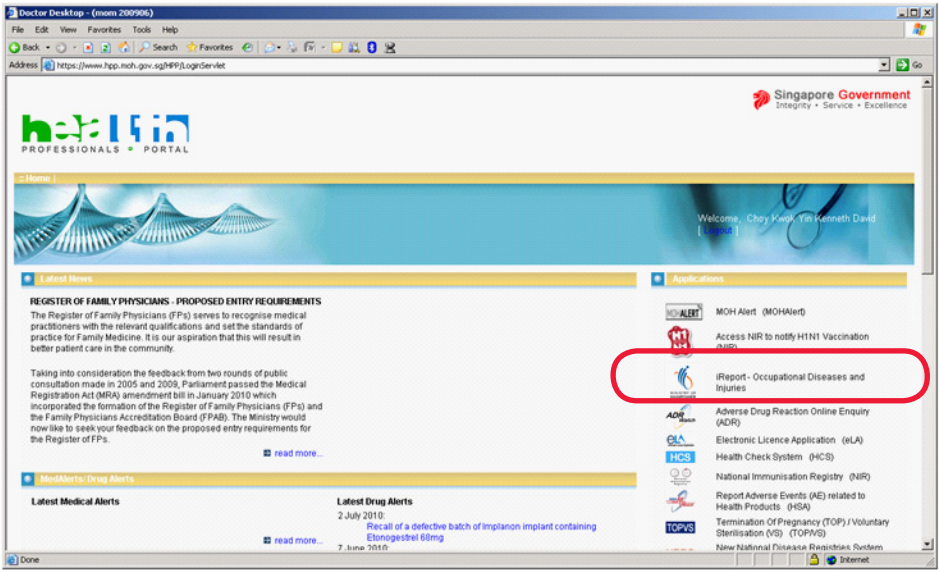


Step B: Click "Login here".

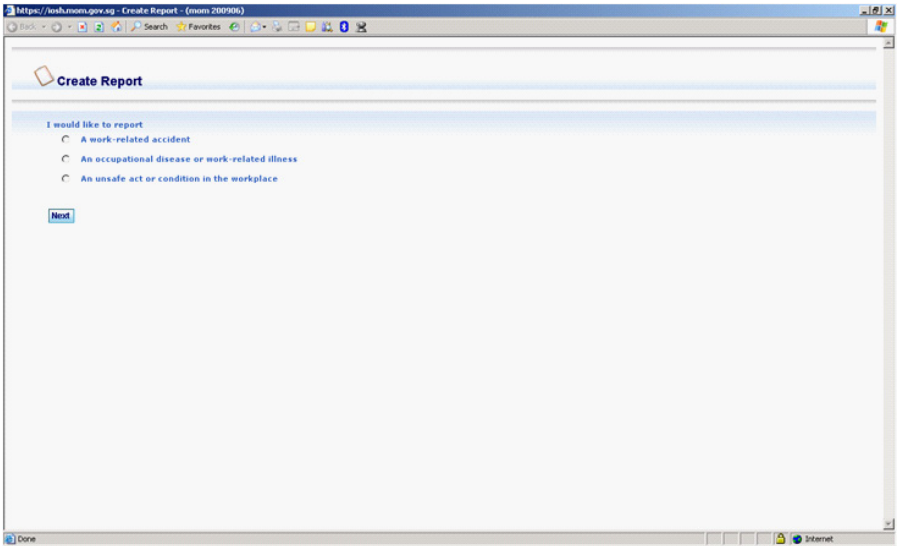
Step C: Use your MCR no and password or via SingPass.



Step D: Click on "iReport – Occupational Diseases and Injuries".



Step E: Step D will bring you to the "Create Report" page as in Step 4 of the MOM website.



Appendix E – List of Occupational Health Clinics

Occupational Health Clinic	Suspected Medical Condition	Contact No.
Occupational Health Clinic, Geylang Polyclinic	Any work-related illness	6842 2440
Occupational Health Clinic, Hougang Polyclinic	Any work-related illness	6355 3000
Occupational Medicine Specialist Clinic, Jurong Polyclinic	Any work-related illness	6355 3000
Occupational Dermatoses Clinic, National Skin Centre	Occupational skin disease	6350 6666
Occupational Lung Disease Clinic, Singapore General Hospital	Occupational lung disease	6321 4402
Occupational Lung Disease Clinic, Tan Tock Seng Hospital	Occupational lung disease	6357 7000
Joint Occupational Deafness Clinic, Tan Tock Seng Hospital	Occupational hearing loss	6357 7000
Work-related Musculoskeletal Disorder (WRMSD) Clinic, Tan Tock Seng Hospital	Work-related musculoskeletal disorders	6357 7000
Joint Environmental Occupational Toxicology Clinic (JEOTC), Changi General Hospital	Occupational chemical exposure or poisoning	6850 3333

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