

# Occupational Health and Safety

## Chapter 54

### LEARNING OBJECTIVES

1. Define occupational health
2. Explain workers' role in occupational health safety and hygiene
3. Discuss the scope of occupational health and safety.
4. Discuss the common occupationally acquired diseases.
5. Explain how work affect health and health affects work.
6. Give examples of some ergonomic hazards

### Definition of Occupational Health

**Occupational Health** is the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations by preventing departures from health, controlling risks and the adaptation of work to people, and people to their jobs.

### Industrial Hygiene

In general terms, activities directed to identifying, assessing, preventing and managing hazards to the worker in the working environment, falls in the domain of Occupational Safety and Health (OSH).

It predominantly involves identifying systematically and scientifically activities which can prevent various untoward effects on the health and welfare of a worker. The approach is interdisciplinary to safeguard physical, social, psychological, economic and ergonomic needs of the workers.

The ILO/WHO committee on Occupational health, in 1950, defined it as:

- Actions aimed at promotion and maintenance of a higher degree of physical, mental and social well-being of workers
- Prevention among workers, the departures from health, caused by any of their working conditions
- Protection in their employment from risks resulting from factors adverse to health and

- Placing and maintenance of the workers in an occupational environment adapted to the physiological and psychological capacity and satisfaction

The fast progressing industries, job needs, work place mechanics, unemployment, global economy recession, developing countries getting industrialized, population explosions and many other factors are contributing to occupational stresses and hazards.

The activities undertaken are being proactive and anticipatory instituting facilities to manage hazards, on-going assessment of problems encountered and long term programs of hazard control.

- Anticipation and being Proactive: This requires careful study of occupational environment, worker variables, instituting Occupational Safety and Health (OSH) guidelines and standards, material safety data sheets, literature search and data help.
- Managing Hazard: This requires recognizing hazard and likely implications of the hazard to the workers and the steps to minimize the adverse effects.
- On-going Assessment: The machine status is changing over time, the skill gap and changing skill demands of improved technology and the resulting additional measures have to be instituted continuously.
- Long Term Program of Hazard Control: This would require staying cognizant of the worker's welfare, safety, compensation and development needs.

### Ergonomics

It is a closely related subject of occupations and workers. Conceptually it is concerned with stress evaluation occurring in a work environment and the ability of people to cope with these stresses. It involves designing suitably, the facilities, furniture, equipment, tools and job demands to make them compatible with work-force capabilities and limitations. It is arbitrarily subdivided into four major areas:

- **Engineering Psychology (or Cognitive Ergonomics):** This deals with designing working and safety tools with a minimum margin of error.

**Steps for Adjusting Your Workstation:**

- 1 Adjust the chair height so your elbows are at about desktop level.
- 2 Adjust seat back for good support of the lower back, using a lumbar pillow if needed.
- 3 If your seat has a tilt feature set this so you are comfortably supported.
- 4 If you feel don't comfortably reach the floor or there is pressure on the backs of your legs, use a footrest or lower the keyboard.
- 5 Locate your monitor so the top of the viewing area is at or below eye level.
- 6 With elbows at desk level, your wrists should be straight. Use a wrist rest if desired, and if you have armrests try to adjust them so they support your arms without being too high or too low. Use small pads on armrests if needed.
- 7 Locate the mouse next to the keyboard, so both elbows are by the sides while working. Use your mouse pad or another soft surface to pad edge of desk. Avoid pressing your hands or forearms against any sharp edges on desk.
- 8 Adjust screen brightness and contrast for clear comfortable viewing, and clean the screen frequently.

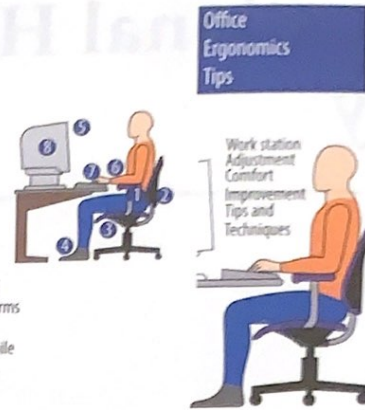


Fig. 54.1 Office Ergonomics

- **Anthropometry:** This concerns human measurement and their statistical analysis. This helps in designing suitable working needs.
- **Work Physiology:** This studies the effect of work functions to vital systems of the body, like exhaustion, fatigue, pain, cardio-respiratory functions etc.
- **Biomechanics:** Most of the work activities may lead to physical injuries which need to be recognized and controlled through safety engineering (Fig. 54.1 and 54.2).

**Toxic Contaminants**

These can be sub-typed on the basis of the physical, chemical and biological nature of hazards. These contaminants can affect by injury, inhalation, ingestion, surface absorption or punctures. Some of the physical hazards can be inflammable, explosives, glare or sound affecting. Vibrations and repetitive movements in work can lead to a variety of bad effects. Chemical fumes, dust, gases mainly affect by inhalation. Some of them are highly toxic to lungs, liver, kidneys, stomach, eyes and may even be carcinogenic. Biological contaminants may lead to almost all types of diseases.

**Types of Hazards**

The hazards have been classified into the following types:

- **Physical:** Which include temperature extremes, poor or excessive light, noise, high frequency vibrations, ionizing and non-ionizing radiations.
- **Chemical:** A wide range of chemicals can be sub-typed by their mode of action and severity of complications caused. Thus the chemicals may affect skin, eyes, nasopharyngeal mucosa, inhalants affecting lungs and chemicals ingested, like metals.
- **Biological:** These include parasitic, microbial, zoonotic, fungal and opportunistic infections.

- **Mechanical:** The injuries caused by machines and work place.
- **Psycho-social and Behavioural:** They include a long list of effects from fatigue, pain, moods to serious chronic diseases.
- **Temperature and Humidity:** Temperature levels in the working environment play an important role in the quality and quantity of output as well as minor to serious effects on the worker.

The ambient comfort temperature for human beings is 69-80° F (20°-27°) with a relative humidity level of around 70%.

Three factors cause discomfort in a closed working zone, i.e. high temperature, high humidity and lack of air movement. An air-conditioner provides the comfort zone by controlling these factors. High temperature also leads to exhaustion, cramps, heat stroke, and increased accident rates. Industries requiring furnaces, ovens, boilers steam have to consider controlling heat and humidity.

Very low temperature can lead to frost bite, hypothermia, chilblains and respiratory distress.

- **Light:** Poor light (less than 15 foot candles: A **foot-candle** is a non-SI unit of illuminance or **light** intensity widely used) can lead to visual strains, headache, visual fatigue, nystagmus, lacrymation, etc. Excessive brightness leads to glare which can damage the retina and visual acuity. Welders are therefore exposed to glare if they do not use protective goggles.
- **Noise:** Long term exposure to high frequency noise can lead to serious damage to hearing, and general symptoms of irritability, speech problems and fatigue.
- **Vibrations:** Drilling, pneumatic tools and heavy hammers can lead to injuries to joints and muscles. Blood supply may also be affected leading to spasms, and tremors.
- **Radiation:** Ultraviolet radiation affects eyes and skin,

while ionizing radiation affects bone marrow, gonads, genes and may lead to various cancers.

The human work force in their prime years of economic development spends about 40 hours per week on the job. During these approximately forty hours they confront a variety of effects and hazards. The prime objective of this complex exposure should be, aiming at ensuring and maintaining good physical, social, mental safety, security and health aspects of the work force. It thus richly avails the knowledge and skills of the fields of occupational medicine, industrial hygiene, toxicology, education, engineering-safety, ergonomics, sociology, behavioural psychology, information technology, etc.

**AIMS: The aims of occupational health and safety are:**

- Ensuring the highest degree of physical, mental and social well-being of workers in their occupations
- Preventing adverse effects on health due to work place hazards
- Protecting and controlling hazards of occupations
- Matching health and safety needs with suitable occupational environment
- Continued adaptation of workers to work and vice-versa

### Impact of Occupational Hazards

- At least 250 million occupation related accidents occur globally every year with 33,500 deaths in them
- The number of accidents and deaths are much higher in the developing countries than in the developed world, primarily because of better health and safety arrangements
- There is a heavy cost involved to both employee and employer in case of occupational injury or illness
- To the employee it is suffering of health, income, possibly loss of job and health-care costs
- The employer may have to pay the medical and compensation cost, deal with damaged machinery and equipment, reduced production, poor quality of work and negative morale on other workers
- The employer may have to replace the injured worker, train a new worker, and suffer loss to quantity in product
- The responsibility of ensuring safety and good health is shared by the individual worker, the employer, the management, the unions and the government
- Monitoring accurate documentation, record keeping, data analysis and interpretations are vital for learning and meeting legal proceedings

### OCCUPATIONAL DISEASES

While occupational injuries can be acute and sudden, occupational diseases are usually chronic and debilitating.

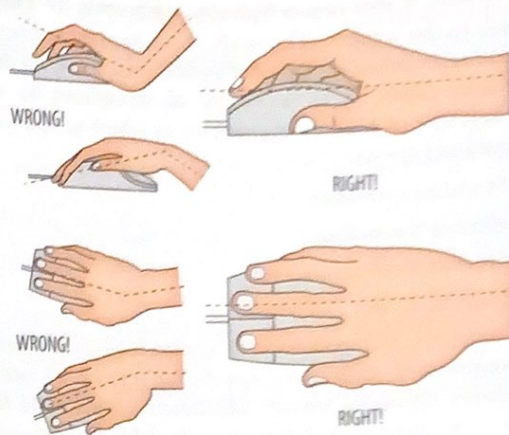


Fig. 54.2 Hand Fatigue

Many diseases have stayed historically in association with occupations, such as pneumoconiosis, asbestosis, lead poisoning, allergies, stress related problems, musculoskeletal disorders, reproductive and heart diseases.

Due to their long duration and cumulative insidious effects of their causative factors, quite often these diseases are either not recorded or not reported.

In developing countries even an unsophisticated industry can have very ordinary unsafe working conditions, like unguarded machinery, an unsafe building, slippery floors, inadequate fire precautions, unsuitable temperatures, noise, dust and fumes.

### Zoonosis

It consists of viral, bacterial, rickettsial, fungal, protozoal, and helminthic disease. Among the most important throughout the world are: anthrax, brucellosis, tetanus, encephalitis, leptospirosis, rabies, and salmonellosis. The infection could enter the body through inhalation, ingestion, or through the skin or mucus membrane.

### Health Hazards Associated with Tannery

1. Hook worm and Ascaris infection
2. Salmonellosis
3. Malaria and onchocerciasis
4. Schistosoma and anthrax
5. Hydrated cysts
6. Tetanus and infections of gangrene

### Ergonomic Hazards

The term ergonomics began to be used by a group of physical, biological, and psychological scientists and engineers to describe interdisciplinary activities that were designed to solve problems created by wartime technology. The term is derived from the Greek roots ERGON, which is related to work and strength, the NOMOS, indicating

law or rule. It also means Human engineering or 'Fitting the job to the worker.' The study of human characteristics for the appropriate design of scientific principles, method and data drawn from a variety of disciplines to the development of engineering systems in which people play a significant role are:

- Human capabilities,
- Human limitations,
- Human motivations, and
- Human desires

Ergonomics is the application of human biological science in conjunction with the engineering science in order to achieve optimum mutual adjustment of man and his work. It includes considerations of the total physiological demands of the job upon the worker even beyond productivity, health and safety. In general, ergonomics deals with the interaction between humans and such additional environmental elements such as heat, light, sound, atmospheric contaminants and all tools and equipment pertaining to the work place.

Ergonomics or the proper designing of work systems based on man factors has the following advantages:

- There will be more efficient operations
- There will be fewer accidents
- There will be reduced training time
- There will be fewer costs of operations
- There will be more effective use of workers or personnel.

The goal of 'ERGONOMICS' or human factors ranges from making work safe to humans, and increasing human efficiency and well-being. To ensure a continuous high level performance work system must be tailored to human capacities and limitations measured by anthropometry and biomechanics.

## PNEUMOCONIOSIS

### Definition

**Fibrosis and scarring of the lungs secondary to repeated inhalation of dust associated with any occupation.**

Any working environment having very fine dust, (less than 4 microns) carries a serious risk of causing a pulmonary fibrotic disease called pneumoconiosis. This disease is a serious outcome which leads to crippling pulmonary functions.

### Factors Affecting Pneumoconiosis

The nature and progress of this disease depends on some of the following factors:

- Health status of the subject:** Healthy people with healthy lifestyles withstand the noxious effects of dust better than those with poor health conditions.

Good nutrition, doing exercise, being a non-smoker and having good health are protective against serious effects of pneumoconiosis.

- Types of dust:** Certain dusts have chemical toxicity and lead to damage of the pulmonary tissue, ending in fibrotic effects.
- Size of the dust:** The finer the dust, the more hazardous it becomes. Dust particles of a large size (over 5 microns) do not enter the pulmonary alveolar epithelium and are expelled out by the respiratory functions. The small sized particles enter in the alveolar mucosa and lead to a foreign body reaction process. The particles may lead to a physical blockage in pulmonary blood circulation, or initiate pathological reactions like nodular changes which gradually become fibrotic. The net outcome is narrowing of the pulmonary function surface and inviting superadded infections like tuberculosis.
- Quantity and concentration of dust in relation to time and space:** The heavier the dose, the more serious effects can occur. This also relates to the area of space in which the exposure occurs. Heavy concentration in a narrow space is thus more hazardous.
- Duration of exposure:** It has been observed that small doses of dust spread over longer period of time are more hazardous than a large dose in lesser time. This suggests the cumulative synergistic effect of dust over a long period of time.
- Opportunistic infections:** The weakened lung tissue invites secondary bacterial and viral infections like T.B, H.I.V. etc.
- Progression of effects:** Some dust is more rapid in progression of side effects than others, such as silica.

### Pathophysiology

The pulmonary alveolar tissue shows a foreign body reaction leading to nodular and fibrotic effects. The alveolar tissue gets damaged and is replaced by fibrotic tissue. This shrinks the alveolar space capacity and reduces oxygenation functions. The initial reaction leads to irritant cough. The damage may progress and become irreversible.

Although much has been studied for Pneumoconiosis, the real basis of the hazardous effect of various kinds of dust is still not clearly understood.

### Classification

Pneumoconiosis is classified into various types based on the type of dust involved.

Examples of Pneumoconiosis:

- Silicosis
- Anthracoconiosis
- Asbestosis
- Byssinosis
- Bagassosis
- Farmer's Lung (Table 54.1)

## SILICOSIS

Any industrial process which generates free silica or silicon dioxide ( $\text{SiO}_2$ ) leads to silicosis among those exposed to it. Silica is more common than other dust as it is encountered in many industries like mines, construction work, sand blasting, mica, ceramic etc. When silica is combined with other super added dust of chemical or heavy metals it becomes more hazardous. The induction phase of silica leading to symptoms of silicosis may vary from a few months to about 5 years.

In silicosis, subjects usually present with cough with sputum symptoms, breathlessness, asthma, anxiety, and fever if some secondary infection has occurred. Their vital capacity is reduced, affecting their work performing capacities. A chest X-ray shows multiple fluffy spots spread over the lung surface, making it look like miliary tuberculosis. Some of the silicotic patients may even be labelled as suffering from tuberculosis because of the close resemblance of symptoms, signs and radiological appearances. Lung fields appear shrunken due to fibrosis which is combined with compensatory emphysema, reducing further the pulmonary function.

There is no treatment of an established case of silicosis. It is therefore important to identify the case at an early stage, or manage dust at the work place, or to shift the worker to a different work place.

## ANTHRACOSIS

Workers in the coal mining industry are exposed to coal dust. Coal dust has certain distinctive features. The induction period (time of exposure to the first appearance of symptoms) is longer than silicosis. Initial symptoms are milder deficiencies of ventilation functions. At this stage if the exposure to coal is continued, the progress becomes faster, and leads to progressive massive fibrosis. However, if the exposure is minimized or stopped, even then the anthracosis process progresses slowly.

Anthracosis requires more than a decade of exposure to raise the morbidity and mortality outcomes. Chest X-rays of coal miners confirms the diagnosis. The risks of secondary infections are also lower than in silicosis, and for this reason anthracosis was considered as an inert disease.

## BYSSINOSIS

It is derived from Greek meaning 'fine linen'. It was called 'Brown lung disease'. It is caused by exposure to raw cotton dust. The cotton industry is a major economic contributor in southeast Asian countries. Employees of yarn and fabric manufacture industries are at risk. It is believed that endotoxins excreted from walls of gram negative bacteria which grow on the cotton, lead to byssinosis. Like anthracosis, cotton dust exposure also takes two stages. An early stage of sensitivity, leading to dry cough and sneezing. Historically, workers after a week-end rest used to get exposed on Mondays and developed such symptoms. Thus it was also called 'Monday Morning Fever'.

Table 54.1 Occupational Lung Diseases

Occupational Lung Diseases	
• Hypersensitivity pneumonitis	• Pneumococcosis
• farmer's lung	• asbestosis
• bagassosis	• berylliosis
• humidifier/air conditioner lung	• silicosis
• bird breeder's lung	• coal worker's lung
• cheese worker's lung	• byssinosis
• malt worker's lung	• baritosis
• paprika splitter's lung	• chalcosis
• mollusk shell hypersensitivity	
• chemical worker's lung	
• wheat weevil	

During the later stages the patient looks chronically ill, poorly nourished, with difficulty in breathing, chest wall is barrel shaped and extra respiratory muscles are overactive.

The symptoms include difficulty in breathing, chest tightness, wheezing, cough and chronic bronchitis. X-ray findings are indistinguishable from advanced pulmonary tuberculosis.

Avoidance of exposure and early detection are major modes of managing.

## BAGASSOSIS

It is a diffused parenchymal lung disease caused by inhaled dust from processing sugar cane; usually in the manufacture of wall board. Inhalation of sugar cane dust particles in an occupational industry can lead to many lung symptoms. It has been suggested that some thermophilic actinomycete is responsible for the body reaction.

## ASBESTOSIS

It is a chronic inflammatory and fibrotic condition of pulmonary parenchyma caused by inhalation of asbestos fibers. Workers, who are involved in the products using asbestos mining and are exposed over a long time, are at risk. Asbestos mining and asbestos developing procedures also carry the risk.

Asbestos fibers are of two types; Amphibole (thin and straight) and Serpentine (curved). Asbestos fibers are 20–500  $\mu$  length and 0.5–50  $\mu$  diameter. Asbestos is used in asbestos cement, textile, break lining, gasket and thermal insulating sheets.

The straight form of fibers reach the alveoli, they cause activation of local lung's immune system and initiate an inflammatory reaction. Macrophages ingest the fibers and stimulate fibroblasts to lead to fibrosis. The symptoms do not appear before 5–10 years of exposure.

Table 54.2 Occupational Diseases

Disease	Source of Exposure	Major Antigen
farmer's lung	Moldy hay	Saccharopolyspora
Bagassosis	Moldy sugar cane fiber	Thermoactinomyces sacchari
Grain handler's lung	Moldy grain	S. rectivirgula, T. vulgaris
Humi difier/air-conditioner lung	Contaminated forced-air systems, heated water reservoirs	S. rectivirgula, T. vulgaris
Bird breeder's lung	Pigeons, parakeets, fowl, rodents	Avian or animal proteins
Cheese worker's lung	Cheese mold	Penicillium casei
Malt worker's lung	Moldy malt	Aspergillus clavatus
Paprika splitter's lung	Paprika dust	Mucor stolonifer
Wheat weevil	Infested wheat	Sitophilus granarius
Mollusk shell hypersensitivity	Shell dust	Sea snail shells

Patients develop dyspnoea and there is an increased risk of developing certain malignancies like mesothelioma and lung cancer.

There is no treatment for asbestosis except for symptomatic management of the chronic obstructive disease through nebulizers.

### FARMER'S LUNG

It is a type of hypersensitivity pneumonitis associated with intense or repeated exposure of inhaled biological dust. Such a situation usually occurs when moldy hay is disturbed and inhaled. The thermophilic actinomyces species flourish when the temperature around hay becomes 40-60°C along with high humidity. Similarly such molds are found in abundance in decaying compost, hay, sugar cane etc. Farmer's lung is often a disease of dairy farmers. Grain farmers are not at risk.

Farmer's lung is a universal problem and ranks as number 3 among occupational hazards. The prevalence of this condition among farmers is said to be 0.4-7% in the US. Major factors contributing to the prevalence and severity of this disease include humidity, temperatures and types of farming.

### Pathogenesis

This depends on the intensity, frequency and duration of exposure and to host response. Acute macrophilic infiltration is seen initially, followed by lymphocytosis of the airways. Levels of interleukins 1 and 8 and tumour necrosis factor-alpha are increased. Initially such reactions increase vascular permeability and decreased lung compliance. After prolonged exposure, type III hypersensitivity leads to farmer's lung.

### Clinically

Acute, sub-acute and chronic stages are recognized.

In the acute stage symptoms resolve within 12 hours to a few days period if the exposure is eliminated.

The sub-acute stage presents as chronic cough, dyspnea, anorexia and weight loss.

The chronic stage will have irreversible lung damage and symptoms will be severe, even in a resting stage.

No single diagnostic test is specific. The diagnosis largely depends on a detailed environment history. Bronchoscopy is useful to exclude other diseases (Table 54.2).

### Signs and Symptoms could be:

**Pulmonary Symptoms**  
 Dyspnoea  
 Cough with expectoration  
 Chest Discomfort  
 Haemoptosis  
**General Symptoms**  
 Ill health  
 Restless sleep  
 Loss of appetite  
 Loss of weight  
 Anorexia  
 Pallor  
 Cyanosis  
 Lymphadenopathy  
 Oedema

### Complications:

Lung Fibrosis  
 Lung Cancer  
 Pleurisy  
 Congestive Cardiac failure  
 Cor Pulmonale

### LEAD POISONING

It is also called plumbism, in which the lead level in the body becomes toxic. Lead in the body affects the heart, bones, intestines, kidneys and the nervous system. Children are particularly more vulnerable as it can cause

behavioural and learning disorders. It leads to abdominal pain, headache, confusion, irritability, anaemia and may cause seizures or coma. One of largest threat to children is through older paints which may be ingested.

Lead has been used for centuries because of its useful properties. It makes easy alloys with other metals, is easily oxidized and has a low melting point (327°C). Man has gradually recognized its effects which are quite serious. Its effects on joints and the brain were identified in the Roman era. Tetra ethyl and tetra methyl lead have been used in petrol for improving combustion. Lead is in paints, food cans for soldering, ceramic glazes, pipes, automobile batteries, scrap metals, welding, grinding and sand blasting.

### Modes of Poisoning

Lead attains access to the human body through the air, soil, food, paints, and occupations dealing with products involving lead as a manufacturing component. It is absorbed by the inhalation of fumes and dust, by ingestion from G.I.T through food and hand contamination and through the skin. Body stores lead, in various tissues like erythrocytes, the liver, kidneys, bones, and body enzymes.

Raised lead level is detectable by blood testing, dense lines in the bones of children through X-rays or even urine testing. A blood level of 10 µg/dl in adults and 5 µg/dl in children are considered hazardous.

**Occupational lead exposure:** Lead is used in a long list of products: Radiation shields, ammunition, some surgical equipment, fetal monitors, plumbing items, circuit boards, ceramic glazes, and lead mines, to name a few. Therefore, plumbers, auto mechanics, glass manufactures, welders, rubber manufacturers, printing press operators, zinc and copper smelting workers, and those involved in the combustion of solid waste and production of paints are at high risk.

Residual lead in soil contributes in urban areas, which is the outcome of leaded gasoline; broken down lead paints, used engine oils, pesticides and surrounding foundries.

Water may get contaminated through soil, lead pipes, or storage tanks. Many household products like utensils, toys, herbal remedies, fishing lures, glazed ceramic and food cans may be added threats causing plumbism.

### Signs and Symptoms

There may be no symptoms in some persons. Lead needs a long period of sustained exposure, although acute exposure may also be toxic.

**CNS:** Organic lead mainly involves the central nervous system to cause tremors, insomnia, delirium and convulsions.

**G.I.T:** In adults, gastro-intestinal symptoms are more common. These include nausea, abdominal pain, constipation, colicky pains, an unusual taste in the mouth

and personality changes. The gums may show a blue line, while serious effects include encephalopathy, wrist drop, and even death.

A pregnant lady with raised lead levels can also cause toxic effects to the fetus, especially in the last trimester. This leads to prematurity and low birth weight.

### Pathophysiology

The Tetraethyl lead is a gasoline additive that passes through the skin and is deposited in the bones and teeth; from where it passes into the blood even after a long time. Lead interferes in the functions of many enzymes (delta-aminolevulinic acid dehydrates) required for vitamin-D synthesis, D.N.A transcription and cell membranes.

R.B.C.s become more fragile, permeability of blood vessels is altered, the immune system may be disturbed, leading to excessive inflammatory proteins. This may become a factor of causing asthma in children.

Proximal tubules of the nephrons are damaged raising the risks of hypertension or diabetes mellitus. Urate excretion is inhibited leading to predisposition for gout.

The reproductive system has shown many effects like low count, motility and disturbed morphology of sperms.

### Diagnosis

- Blood lead levels crossing 10 µg/dl in adults and 5 µg/dl in children are considered unsafe.
- Red blood cells show basophilic stripping, and erythrocyte protoporphyrin (EP) in the blood is elevated.
- An X-ray may show foreign material containing lead in the G.I.T.

### Prevention and Treatment

The following actions can prevent or minimize the effects of lead poisoning:

- Avoidance of exposure to lead: This can be on an individual or family level. Individual steps include hand washing and intake of calcium and iron. Family action includes regular vacuuming and eliminating lead containing objects like batteries, jewelry, blinds, and left over paints. Periodic checks on lead content of piped and stored water. Hot water is more likely to contain lead than cold water.
- Periodic screening of children and those exposed to lead and occupations using lead should be undertaken.
- Regulation to curtail and control lead use in various industries, stopping lead use in gasoline, reducing lead content of household furniture.
- Chelation therapy of those showing symptoms of poisoning includes treatment with iron, calcium and zinc.

## OCCUPATIONAL CANCERS

### Introduction

Cancers are one of the top three leading causes of mortality all over the world. In 2008, a total of 12.7 million new cases and 7.6 million deaths occurred due to cancers. Among these 19% were attributed to environment, including occupational settings. It is estimated that 1.3 million deaths per year are attributable to occupational factors.

The occupational factors leading to cancer, include air pollution, ultraviolet-radiation, indoor radon, asbestos and many chemicals. Lung cancer, mesothelioma and bladder cancer are leading types of cancers. Currently 63% of cancer deaths are reported from low and middle-income countries. More than 100,000 persons die each year in the world due to asbestos related lung cancer, mesothelioma and asbestosis.

Other agents related to cancer and available in the environment are benzene, arsenic in water, cadmium, ethylene oxide, benzopyrene, silica, ionizing radiation, ultraviolet radiation, tanning devices, aluminum and coke production, iron and steel founding and in the rubber manufacturing industry.

Air pollution caused 165,000 lung cancer deaths globally in 2004, of which 65.4% were caused by outdoor air pollution, 21.5% by solid fuels used for cooking and heating and 13.1% due to second hand smoke.

Ultraviolet radiation caused 60,000 deaths in 2002, of which 80% were melanomas and 20% basal and squamous cell skin carcinomas.

### Tools for Prevention of Occupational and Environmental Cancers

WHO has developed the following actions:

- WHO framework convention on Tobacco control
- Policy on elimination of asbestos-related disease
- Guidelines for air quality and drinking water quality
- Policy option for prevention and mitigation of radon
- Practical advice and information on health effects of UV exposure
- Safety standards for clinical and food including cancer-causing contaminants like dioxins and aflatoxins
- The international program on chemical safety, including ten chemicals of major public health concern
- WHO's global plan of action on worker's health

Ever since carcinogens have been known to be associated with specific cancers, there has been constant research to provide a chain of pathogenesis and to quantify the lowest feasible concentration (L.F.C) based on analytic limits of detection or technological feasibility. Carcinogens have been categorized as follows on the basis of current evidence:

Category 1: Probable or confirmed occupational carcinogens

Category 2: Suspect occupation carcinogen

Category 3: Carcinogenic evidence inconclusive

In a recent 12<sup>th</sup> Report on Carcinogens (RoC) issued by the US Department of Health and Human services on June 10, 2011, more than 200 substances have been listed as carcinogens.

The International Labour Organization (ILO) has an even larger number of substances with risk and safety phrases.

The Cancer Council of Australia in the year 2008, suggested the following occupational health and safety legislation to include:

- Eliminating work place exposure to tobacco smoke
- Using sun protection methods to minimize U.V. radiation
- Widespread adherence to asbestos removal procedures
- Minimizing the number of people exposed to known carcinogens through safe work environments
- Training employees about exposure reduction
- Workplace monitoring of carcinogens where applicable
- Development of appropriate new regulations and updating old regulations and existing occupational exposure limits
- Active enforcement of existing regulations in occupational health
- Having reasonable access to nutritional food and an opportunity for physical activities

### Steps for Primary Prevention

- Elimination of cancer causing agents
- Substituting the cancer causing agents with non-carcinogenic or less hazardous materials
- Introducing engineering controls like ventilation and enclosures
- Creating a distance between carcinogens and workers
- Using robotics in high exposures areas
- Dust minimizing actions
- Educating workers about hazardous substances
- Personal protective equipment (PPE)

## OCCUPATIONAL HEALTH HAZARDS IN AGRICULTURE SECTOR

The agricultural sector is considered one of the most hazardous occupations to health by the I.L.O. Agriculture involves several risky activities and exposure which can adversely affect health. These include close contact with animals, plants, chemicals, and biological products, difficult working conditions, use of hazardous agricultural tools and machinery and irregularly long working hours.



Pakistan and many other South Asian countries have their main economy in agriculture and a large proportion of their populations are occupied in the agricultural field.

The table below summarizes the health hazards in agricultural work as observed in developing countries (Table 54.3).

Many of the agricultural related health hazards go unreported. Farmers affected by acute poisoning are quite large in numbers, with higher mortality rates. Agricultural functions in poor countries are usually managed by traditional manual labour and lead to fatigue, musculoskeletal complication and infections. When motorized equipment is used it leads to higher complications like injuries and mortalities due to inadequate training and missing personal protection equipment.

Zoonotic diseases are not rare and insect borne diseases are quite common. Under-utilization of the impoverished public sector health units cause the diseases to become chronic, leading to disabilities and death.

### Management

Dealing with agricultural occupational health hazards is not easy, since farmers are mostly illiterate, poor, unskilled and unaware of the health implications. The health coverage by the public sector is neither comprehensive nor of good quality. Farmers resort to disregarding the health hazards or utilize sub-optimal services.

It is very difficult to educate the farmers from a primary prevention point of view. Major actions required are; to provide them with personal protection equipment (PPE).

Table 54.3 Health Hazards

Exposure	Health effect	Specificity to agriculture
Weather, climate	Dehydration, heat cramps, heat exhaustion, heat stroke, skin cancer, pneumonias	Most agricultural operations are performed outdoors in extremely hot or cold weather
Snakes, insects	Fatal or injurious bites and stings	Close proximity results in high incidence, no protective dress used
Sharp tools, farm equipment	Injuries ranging from cuts to fatalities; hearing impairment (from loud machinery)	Most farm situations require a wide variety of skill levels for which workers have little formal training, and there are a few hazard controls on tools and equipment with poor maintenance of equipment
Physical labor, carrying loads	Numerous types of (largely unreported) musculoskeletal disorders, particularly soft-tissue disorders, e.g. back pain	Agricultural work involves awkward and uncomfortable conditions and sustained carrying of excessive loads
Pesticides	Acute poisoning, chronic effects such as neurotoxicity, reproductive effects and cancer	More hazardous products are used in developing countries without personal protective equipment (PPE)
Dust, fumes, gases, particulates	Irritation of the eyes and respiratory tract, allergic reactions, respiratory diseases such as asthma, chronic obstructive pulmonary disease, and hyper sensitivity pneumonitis	Agricultural workers are exposed to a wide range of dust and gases from decomposition of organic material in an environment with few exposure controls and limited use of PPE in hot climates
Biological agents and vectors of diseases	Skin such as fungal infections, allergic reactions, and dermatoses	Workers are in direct contact with environmental pathogens, fungi, infected animals, and allergic plants
	Parasitic diseases such as schistosomiasis, malaria, sleeping sickness, leishmaniasis, dengue, ascariasis, and hookworm	Workers have intimate contact with parasites in soil, wastewater/sewage, dirty tools, and rudimentary housing
	Animal-related diseases or zoonoses such as anthrax, bovine tuberculosis, and rabies (at least 40 to 250 zoonoses are occupational diseases in agriculture)	Workers have ongoing, close contact with animals through raising, shelter and slaughtering
	Cancers, such as bladder cancer caused by urinary bilharzias contracted through working in flooded areas in North and Sub-Saharan Africa	Agricultural workers are exposed to a mix of biological agents, pesticides, and diesel fumes, all linked with cancer
Poverty, illiteracy and poor healthcare	Tuberculosis, socio-psychological problems, nutritional diseases	Agricultural workers lack basic human healthcare facilities

Adopted from Focus 13 by Donald Cole May 2006

safe equipment and tools, anti-venom sera, and injury care services, and guiding them for early toxicity symptoms of chemicals and arranging services to care for them.

Long range actions of improving literacy, socio-economic conditions and skill training may also be required.

### Absenteeism

A habitual pattern of absence from duty or obligation is called absenteeism. It is considered as an act of poor performance, deliberate avoidance and breach of contract between employee and employer. If it becomes a regular and more frequent practice, it becomes a threat for the administration which might like to consider punitive action.

Absenteeism may cause economic losses, a break in flow of functions and even handicap the organisation. From the operational research point of view, it might be an indicator of psychological problems, social adjustment at work or health related activity. It becomes essential to discriminate between absence due to genuine reasons and absence for improper reasons.

Some employees may feel threatened by their absence and job insecurity. In this consideration, some sick employees may attend their jobs in illness, risking their own health and transmission of their disease to others.

One of the issues in absenteeism is obtaining a doctor's note for supporting their illness. The time of communicating the absence to the concerned work place is important, so that the manager can make alternate arrangements to minimize a breakdown of the work system.

Some of the absenteeism may be the outcome of job related factors. These could be postural issues like backache, exhaustion, fatigue etc., or related to skill deficiencies, psychological or administrative adjustments. Stress is both a factor leading to absenteeism and an outcome of chronic absenteeism.

In contrast to absenteeism, attending work while sick (presenteeism) is also a phenomenon requiring research. Some of these workers are called workaholics. It has been observed that absenteeism is more frequent when the worker becomes a permanent employee.

Some of the actions desired may be shifting from the type of job, providing incentives, recognition of employee's performance or treating their health issues if involved. Some organisations keep a doctor, social worker or a psychiatrist to help investigate and rehabilitate workers showing chronic absenteeism.

## OCCUPATIONAL INFECTIONS

Workers can be prone to microbial agents when they are exposed to occupations dealing with biologically active organisms.

The infections can be transmitted from co-workers, infected animals, laboratory workers, soil etc. Bioterrorism is a recent threat as an occupational hazard.

The clinical presentation, modes of diagnosis and treatment of infections would be the same as these infections might develop through non occupational modes. Traditionally parasitic disease, skin infections, tuberculosis and many zoonotic diseases have been common ailments.

Recently some newly emerging pandemics have caused great harm. Severe Acute Respiratory Syndrome (SARS) initially recorded as atypical pneumonia from China in 2002; soon it spread to thousands of adults in different countries by 2004, involving many healthcare workers. SARS has high mortality (about 10%).

Avian Influenza (H<sub>5</sub>N<sub>1</sub> Serotype) spread across many Asian countries in 2005. This virus mainly infects birds but can involve workers dealing with birds.

Hepatitis A, B, C have shown serious threat in developing countries. Health care workers are especially vulnerable to such infections. HIV can be transmitted through transfusion, organ transplant and laboratory sources.

Workers in veterinary services, dairy farming, slaughterhouses, sewers, zoos, laboratories, and pet dealers are at a higher risk of getting zoonotic diseases like brucellosis, tetanus, rabies etc.

In most of such infectious diseases primary immunization activities are available. This may be supplemented by special protection dresses and avoidance of exposures.

### Occupational Skin Diseases

Skin is the most commonly injured part of the body in most of the common industries. Contact with toxic and infected materials can lead to a variety of diseases.

Irritant contact dermatitis results from substances which are irritants to skin due to their pH, physical concentration, or solubility. These substances cause redness and chapping of the skin. If the exposure is prolonged it may lead to irritant dermatitis.

Some substances are phototoxic like juices of plants. If these are simultaneously exposed to natural artificial light they can lead to skin reactions. Coal tar, amino benz dyes, sulfonamides, thiazides are some of the examples.

Many microbes can infect skin to cause skin diseases. Staphylococci and streptococci settle in abrasions in the skin.

Brucellosis is a common skin infection in veterinarians and livestock workers.

Fungal infections of the skin and nails are quite common in occupations with excessive sweating and repetitive nail trauma.

Mechanical trauma, tears and frost bite are common in occupations which carry these hazards.

Ionization radiation and skin cancers are possible in occupations dealing with ultraviolet light, polycyclic aromatic hydrocarbons, arsenic, ionizing radiation and trauma.

## STRATEGIES FOR ACHIEVING OCCUPATIONAL SAFETY AND HEALTH

A safe and healthy worker is an asset to the organisation.

### History

Governments in various countries had been inspecting and advising private sectors in industries to improve safety measures for their workers. Some insurance companies tried to provide compensations for occupational injuries by undertaking group insurance and charging premiums from companies. The guiding principles were agreeing on standards based on consensus. Occupational diseases were often not clearly correlated to exposures to work practices. Many years may elapse between exposure and initial symptoms.

In USA and many other developed countries, safety and health concerns lead to the development of an Occupational Safety and Health Administration (OSHA) in the early 70's. This was also supplemented by a Mining Safety and Health Act (MSHA) to cover initial symptoms.

The International Labour Organization (ILO) of the United Nations was established in 1919, to ensure improved labour conditions and laying down minimum standards related to health, welfare, living and working conditions of workers.

### Ecology

The triad of working conditions includes man, machine and environment. The host is the worker and the machine and the environment have to be made safe for the host.

Machines are becoming more complex and not necessarily safe. Poor machine installation, insufficient safety measures, poor maintenance and unsafe parts can result in injuries.

The working environment includes a physical, chemical, social, biological and psychological atmosphere which influences worker health and safety.

Job related factors such as service conditions, duty timings, administrative regulations, opportunities for development, incentives, unions etc. affect job satisfaction, health and the security of workers.

Social security and welfare measures are important elements in illness, retirement, accidents and security of the workers. This also includes legal support in the event of ensuring the worker's right.

## Strategies of Occupational Hazards Prevention

### At the time of Recruitment

It is important to have a well-defined job specification and the workers suitability to match the selection process. The principles of organisational behaviour are important to understand the factors responsible for the worker to seek a job, physical suitability, matching skill, expected level of commitment to the job and competencies.

A record of this exercise should be kept in the personal file to decide on the needs of induction, training, building on organisational policy awareness and recording the worker's potentials.

### Pre-placement Examination

Once the worker has been selected, a very careful benchmark record of his/her personal information should be maintained.

This Should Include the Following:

- Family and personal history of the past, regarding views and values of work and health related issues.
- A socio-demographic profile to record the age, habits, family composition, previous jobs, life style, educational achievement etc.
- Complete physical examination, to exclude or record any clinically judged observations. This would also include a basic anthropometric record of height, weight etc.
- This should be supplemented by basic laboratory tests like routine blood picture, urine analysis, and X-ray chest. These results should become part of the personal file.
- It might also be important to enquire about and record allergies, blood lipids level, blood sugar, asthma, alcoholism, drug dependence or addictions etc.

### Periodic Examination

The concept in periodic examination is to identify any occupational problem at the earliest time and undertake early treatment. It may also help in deciding to shift the worker from one job location to a less hazardous position and take actions in the work environment.

The frequency and steps of a periodical check-up will differ depending on the types of occupational exposure and expected outcome.

### Provision of Safe Basic Human Needs

It will be useful to the employer and the employee if the work place has access to safe water, basic sanitation, recreation and socialization enclosures.

A subsidized cafeteria with safe food will keep the workers healthy and happy.

### Basic Health Facilities

A health unit to cater for essential healthcare needs should be available with necessary medical and diagnostic support facilities. Drugs for routine healthcare problems should also be available at subsidized rates.

The centre may provide services to the employee's family for prevention and cure of diseases.

### Work Place Safety and Sanitation

This is of prime importance to care for safety and health of workers. Physical needs like space, air, humidity, temperature and avoidance of dust, need to be provided by engineering design, regular maintenance and supervision.

### Periodic Training and Job Growth

Job satisfaction, job recognition actualization and growth opportunities keep the workers energized and synergized.

### Record Keeping

A Management Information System (MIS) maintains a good record and guides the management to take actions proactively in view of worker's safety.

The data can be a source of assessing progress and undertaking research.

### Operational Research

Good organisations ensure an ongoing research activity to suitably modify the procedures, products, opportunities and feedback for the sake of the worker's safety and health.

### Legislation

Every government keeps monitoring and laying rules and regulations to achieve worker's safety, health and rights.

The following is a summary of steps by the Government of Pakistan to lay certain rules.

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Table 54.4 Types of occupational hazards

Chemical	Physical	Biological	Mechanical	Psychosocial Stress
Organic Solvents (benzene, carbon tetra chloride)	Noise (can lead to hearing loss)	Exposure to bacteria, viruses, fungi, protozoa, rickettsia	Repetitive use injuries, excessive force, awkward postures, poorly designed physical environment	Due to work overload, fear of job loss, geographical isolation.
Heavy metals (cadmium, mercury, Lead)	Temperature Air pressure Radiation	Blood can have infectious agents, lead or arsenic	(may cause tenosynovitis, bursitis, carpal tunnel syndrome)	Can lead to a high cost as it may lead to absenteeism, poor productivity, mental illness (Post traumatic stress disorder).
Gases (sulphur dioxide, Carbon mono oxide, silo filler's disease)	Non Ionizing; UV, infrared Ionizing: X-rays, gamma rays.	Pneumoconiosis Skin Diseases Neurological diseases		
Second Hand Smoke				

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