COURSE GUIDE

PHS 817
OCCUPATIONAL HEALTH

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INTRODUCTION

Occupational Health (OH) is generally defined as the science of the anticipation, recognition, evaluation and control of hazards arising in or from the workplace that could impair the health and well-being of workers, taking into account the possible impact on the surrounding communities and the general environment. This domain is necessarily vast, encompassing a large number of disciplines and numerous workplace and environmental hazards. A wide range of structures, skills, knowledge and analytical capacities are needed to coordinate and implement all of the "building blocks" that make up national Occupational Safety and Health (OSH) systems so that protection is extended to both workers and the environment.

The scope of occupational health has evolved gradually and continuously in response to social, political, technological and economic changes. In recent years, globalization of the world's economies and its repercussions have been perceived as the greatest force for change in the world of work, and consequently in the scope of occupational safety and health, in both positive and negative ways. Liberalization of world trade, rapid technological progress, significant developments in transport and communication, shifting patterns of employment, changes in work organization practices, the different employment patterns of men and women, and the size, structure and life cycles of enterprises and of new technologies can all generate new types and patterns of hazards, exposures and risks. Demographic changes and population movements, and the consequent pressures on the global environment, can also affect safety and health in the world of work.

It is no coincidence that the protection of workers against sickness, disease and injury related to the working environment, as embodied in the Preamble to the Constitution of the ILO, has been a central issue for the Organization since its creation in 1919, and continues to be so today. Occupational safety and health is a key element in achieving sustained decent working conditions and strong preventive safety cultures. Close to 80 per cent of all ILO standards and instruments are either wholly or partly concerned with issues related to occupational safety and health. A large number of areas of ILO activity include an OSH or OSH-related component, among them employment, child labour, the informal economy, gender mainstreaming, labour statistics, labour inspection and maritime safety, HIV/AIDS and the world of work, and international migration. This breadth of penetration gives a clear indication of the continued importance of occupational safety and health as a core element of ILO activity and of the Decent Work Agenda in particular. In November 2000 the Governing Body of the ILO decided to apply on an

experimental basis an integrated approach to ILO standards-related activities in order to increase their coherence, relevance, impact and currency. OSH was selected as the first area to benefit from this approach, and at its 91st Session (2003) the International Labour Conference (ILC) held a general discussion to this end (ILO, 2003a). The ILC adopted conclusions defining the main elements of a global strategy to bring about measurable improvements in safety and health in the world of work and recommending the development of a new instrument aimed at establishing a promotional framework for occupational safety and health.

This course guide tells you what to expect from reading this course material.

WHAT YOU WOULD LEARN IN THIS COURSE

Occupational Health (PHS 817) is designed to introduce students to occupational health and safety principles and methods as they prepare to enter the workplace. Students learn the required skills, knowledge and attitudes in problem-solving and decision making regarding their occupational health and safety and that of others. The Occupational health course emphasizes occupational skills development across the lifespan with multiple opportunities for students to experience/ appreciate the impact of contextual factors on adaptive processes and role transition. Students are expected to acquire the tools to not only assist clients with adaptive processes across the lifespan but also to enable client participation in valued occupations. Through the course of their education, students are expected to develop the knowledge, skills and adaptive capacity needed to address occupational challenges inherent to the role of occupational therapist and the reflective skills needed to sustain life-long learning.

COURSE AIMS

The programme aims of this course are to:

- Provide a coherent body of theoretical and applied professional knowledge relevant to the area of occupational safety, health and environment.
- Develop a holistic, multi-disciplinary understanding of the scientific, legislative, policy, technical and managerial skills on which to base professional competence in relation to occupational safety, health and environment.
- Provide students with a critical awareness of the inter-relationship between organisational psychology and culture; the

workplace environment; health and the natural environment based on risk management principles and methods.

- Facilitate the development of competence through professional practice through alignment with competency requirements for occupational safety, health and environment, specifically those from the Institute of Occupational Safety & Health and their requirements for Initial Professional Development.
- Respond positively and effectively to the challenges of occupational safety, health and environment with a minimum of supervision.
- Develop an informed, critical and imaginative attitude towards professional practice of occupational health.
- Enhance abilities to critically appraise risk in a variety of complex situations and design and implement management solutions to reduce risk.
- Provide skills in design and conduct of occupational health research.

COURSE OBJECTIVES

After going through this course, student should be able to have knowledge and understanding of:

1. Detailed legislative, technical and scientific knowledge to effect decision making and problem solving for OHSE interventions in a wide range of complex situations.
2. A wide range of management strategies, methods and techniques to create, implement, review, use and control safe systems of work.
3. Risk management including hazard analysis, risk assessment, risk modelling and risk acceptability.
4. Organisational Culture and Psychology including the relationship to management functions; and influence on health, safety and environmental performance.
5. The chemical, physical and biological hazards in the workplace, together with their potential to act synergistically to impact detrimentally on health and the natural environment.
6. Individual and group behavioural issues in improving safety, health and environmental practice.
7. Comprehensive application of occupational health, safety and environmental management personally and within practice.
8. The application of research approaches, techniques and methodology in the work place.

WORKING THROUGH THIS COURSE

This course has been carefully put together bearing in mind that you might be new to the course. However, efforts have been made to ensure that adequate explanation and illustrations were made to enhance better understanding of the course. You are therefore advised to spend quality time to study this course and ensure that you attend tutorial sessions where you can ask questions and compare your knowledge with that of your course mates.

COURSE MATERIALS

This course comprises of seven modules broken down into 23 units. They are as listed below:

i. A course guide
ii. Study units

STUDY UNITS

This course comprises of six modules broken down into 21 units. They are as listed below:

Module 1 Introduction to Occupational Health

Unit 1 Concept of Occupational health
Unit 2 Definition of terms in Occupational Health
Unit 3 Classification of Workplace Environment

Module 2 Industrial Hygiene and Safety

Unit 1 Industry: Concept, Classification and Type
Unit 2 Industrial Hygiene
Unit 3 Workplace Safety
Unit 4 Types and Application of Safety Equipment

Module 3 Hazard Recognition, Evaluation and Control

Unit 1 Sources of Hazards
Unit 2 Types of Hazards
Unit 3 Control of Hazards

Module 4 Risk Management Framework

Unit 1 Exposure Routes and Assessment

Unit 2 Risk Assessment and Communication
Unit3 Healthy-Worker Effect

Module 5 Clinical Occupational Health and Safety

Unit 1 Occupational and Other Work-Related Diseases
Unit 2 Surveillance of Workers' Health (Pre-employment &Periodic Medical Examinations)
Unit 3 Occupational Accidents and Injuries in the Workplace
Unit 4 Workman Compensation

Module 6 Legislation and Policies of Occupational Health Practice

Unit 1 Workplace Health Audit
Unit 2 Occupational Health Policy
Unit 3 Occupational Health Code of Conduct
Unit 4 Guide to Occupational Health Practice

Module 1

In Unit 1, you will be taken through the meaning and concept of Occupation health. The unit also tells you why the need for occupational health and importance of occupational health in our work environment. In Unit 2, you will be taken through the various definitions of terms or terminologies used in the field of occupational health. In Unit 3, you will be exposed to the various types of working environment and a classification system to categorize the entire domain of workplace factors impacting performance and health.

Module 2

In Unit 1, you will be introduced to the concept and classification of industry; industrial revolution; and the importance of industry to the modern society. In Unit 2, you will learn about the concept and history of occupational/industrial hygiene; and the job duties of an Industrial Hygienists in an occupational setting. In Unit 3, you will learn about the definition of workplace safety; measures to ensure occupational safety and health of workers and the importance of appropriate workplace safety measures. In Unit 4, you will be taken through a broad overview of PPEs; types and maintenance of PPE.

Module 3

In Unit 1, you will be taken through the definition, concept and sources of hazards in an occupational setting. In Unit 2, you will be exposed to

the ranges of workplace hazards that workers are daily exposed to. In Unit 3, you will be introduced to the various control measures against workplace hazards.

Module 4

In Unit 1, you will be taken through the principal routes by which a substance can enter the body; quantification of the contaminants; and relevant statistics about the activities that can lead to an exposure. In Unit 2, will provide you a general background on the topic of risk analysis, and how it can be used in the problem solving process. In Unit 3, you will learn about the concept of healthy worker effect and the sources, components, magnitude, effect modifiers and strategies for reducing the HWE.

Module 5

In Unit 1, you will learn about occupational diseases and work-related diseases with their clinical manifestations and prevention strategies. In Unit 2, you will be taken through the workers' health surveillance; ethics and legal issues surrounding it. In Unit 3, you will be introduced to occupational accidents and injuries; their causative factors and preventions. You will also be acquainted with first aid techniques on several occupational injuries. In Unit 4, you will be taken through the concept of workman compensation and its laws. You will also be taken through the various forms of workers' compensation fraud by workers and employers, with a review of the Nigeria's Employee Compensation Act.

Module 6

In Unit 1, you will be taken through the general framework of workplace health audit; purpose, objectives and strategies of workplace surveillance. In Unit 2, you will be made to understand the key features and objectives of a national OSH policy; and the strategies areas focus of such policy. In Unit 3, you will be introduced to the principle of ethics, values and obligations of the occupational health professionals. In Unit 4, you will be exposed to occupational health practice guide and its components.

TEXT BOOKS AND REFERENCES

The following are list of textbooks, journals and website addresses that can be consulted for further reading:

Benjamin O. Alli (2008). Fundamental principles of occupational health and safety.

International Labour Office – Geneva: ILO 2008. Page 1 – 221. ISBN 978-92-2- 120454-1

Fedotov, I.A.; Saux, M.; Rantanen, J. (Eds). 1998. "Occupational health services", in Encyclopaedia of occupational health and safety, 4th ed., Vol. I (Geneva, ILO), pp. 161–62.

Harrington JM et al., (1998). Occupational Health, 4th ed. Oxford, Blackwell Science.

ILO (2003a). Standards-related activities in the area of occupational safety and health, Report VI, International Labour Conference, 91st Session. Available at: http://www.ilo.org/public/english/protection/safework/integrap/survindex.htm.

ILO/WHO. 2005. Joint ILO/WHO guidelines on health services and HIV/AIDS (Geneva). Available at: http://www.ilo.org/public/english/dialogue/sector/ techmeet/tmehs05/guidelines.pdf.

World Health Organization (2001). Occupational Health. A manual for Primary Healthcare Workers. WHO/OCH/85/E/L. World Health Organization Regional Office for the Eastern Mediterranean Cairo. Page 1 – 168.

ASSESSMENT

There are two components of assessment for this course. They are the tutor-marked assignment and the final examination.

TUTOR-MARKED ASSIGNMENT

The Tutor-Marked Assignment **(**TMA) is the continuous assessment component of your course. It accounts for 30 per cent of the total score. The TMAs will be given to you by your facilitator and you will return it after you have done the assignment.

FINAL EXAMINATION AND GRADING

The examination concludes the assessment for the course. It constitutes 70 per cent of the whole course. You will be informed of the time for the examination.

SUMMARY

This course intends to provide you with the knowledge of occupational health framework and its implication on the workplace environment as they affect man's productive capacity, health and ability to manage the working environment for sustainable development. We wish you success in this course and hope that you will apply the knowledge gained in the recognition, evaluation and control of workplace hazards arising that could impair the health and well-being of workers; and ensure safety in the work environment. It is also our expectation that you will be equipped with the skills to prevent and control workplace accidents and injuries, carried out risk analysis and communication.

MAIN COURSE

MAIN COURSE

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MODULE 1 INTRODUCTION TO OCCUPATIONAL HEALTH

UNIT 1 CONCEPT OF OCCUPATIONAL HEALTH

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1.0 INTRODUCTION

The word occupational health is a household even among the illiterate artisan in the rural setting to professionals in the urban industries. However, many a people take the application of this discipline less than a pinch of salt. The importance of occupational health in national development and economy progression cannot be over emphasised. Over the years, with the advancement of knowledge, occupational health has gradually developed from a mono-disciplinary risk-oriented activity to a multi-disciplinary and comprehensive approach that considers an individual's well-being, general health, personal and economy development. At the end of this unit, you will probably become fully aware of what occupational health is and how it applies to the health of the working populations and sustainable development.

2.0 OBJECTIVES

At the end of this Unit, you will be able to:

- define occupational health
- explain the interaction between work and environment
- explain the positive health effects of work and the negative impact of poor working condition on worker health
- explain why occupational health is importance
- explain how occupational health lies at the pivot of sustainable development.

3.0 MAIN CONTENT

3.1 What is Occupational Health?

Occupational health is a discipline that deals with all aspects of health and safety in the workplace. It has a strong focus on primary prevention of hazards. It has broad scope involving many specialised fields. It is concerned with:

- the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations;
- the prevention among workers of adverse effects on health caused by their working conditions;
- the protection of workers in their employment from risks resulting from factors adverse to health;
- the placing and maintenance of workers in an occupational environment adapted to physical and mental needs;
- the adaptation of work to humans.

In other words, occupational health and safety encompasses the “whole person”, that is the social, mental and physical well-being of workers.

Successful occupational health and safety practice requires the collaboration and participation of both employers and workers in health and safety programmes, and involves the consideration of issues relating to occupational medicine, industrial hygiene, toxicology, education, engineering safety, ergonomics, psychology, etc.

Occupational health issues are often given less attention than occupational safety issues because the former are generally more difficult to confront. However, when health is addressed, so is safety, because a healthy workplace is by definition also a safe workplace. The converse, though, may not be true - a so-called safe workplace is not necessarily also a healthy workplace. The important point is that issues

of both health and safety must be addressed in every workplace. By and large, the definition of occupational health and safety given above encompasses both health and safety in their broadest contexts.

3.2 Interaction between Work and Health

The social and economic importance of work receives considerable attention because a primary function of work in any society is to produce goods and services. Far less attention is paid to the importance of work to the individual, yet it is clear from recent research that work plays a crucial and perhaps unparalleled psychological role in the formation of self-esteem and a sense of order. Work is a powerful force in shaping a person's of identity. It can lend vitality to existence and establishes the cyclical patterns of day, week, month and year. It is believed that work for which no economic gain, such as child care, care for the aged and voluntary work, also has its rewards and contributes to personal gratification.

3.2.1 Positive Health Effects of Work

Two-way interaction

There is a continuous two-way interaction between a person and the physical and psychological working environment: the working environment may influence the person's health either positively and negatively and productivity is, in turn, influenced by the worker's state of physical and mental well-being. Work, when it is well-adjusted and productive, can be important factor in health promotion, e.g. partially disabled workers may be rehabilitated by undertaking tasks suited to their physical and mental limitations and, in this way, may substantially increased their working capacity. However, the fact that work can have positive influence on health has not yet been fully exploited; knowledge of work physiology and ergonomics needs to be further developed and applied to benefit worker's health.

3.2.2Negative Working Conditions Effects on Worker Health

Poor working conditions of any type have the potential to affect a worker's health.Unhealthy or unsafe working conditions are not limited to factories — they can be found anywhere, whether the workplace is indoors or outdoors. For many workers, such as agricultural workers or miners, the workplace is "outdoors" and can pose many health and safety hazards.Poor working conditions can also affect the environment workers' live in, since the working and living environments are the same for many workers. This means that occupational hazards can have

harmful effects on workers, their families, and other people in the community, as well as on the physical environment around the workplace. A classic example is the use of pesticides in agricultural work. Workers can be exposed to toxic chemicals in a number of ways when spraying pesticides: they can inhale the chemicals during and after spraying, the chemicals can be absorbed through the skin, and the workers can ingest the chemicals if they eat, drink, or smoke without first washing their hands, or if drinking water has become contaminated with the chemicals. The workers' families can also be exposed in a number of ways: they can inhale the pesticides which may linger in the air, they can drink contaminated water, or they can be exposed to residues which may be on the worker's clothes. Other people in the community can all be exposed in the same ways as well. When the chemicals get absorbed into the soil or reach groundwater supplies, the adverse effects on the natural environment can be permanent.

Overall, efforts in occupational health and safety must aim to prevent industrial accidents and diseases, and at the same time recognise the connection between worker health and safety, the workplace, and the environment outside the workplace.

3.3 Why is Occupational Health Important?

Work plays a central role in people's lives, since most workers spend at least eight hours a day in the workplace, whether it is on a plantation, in an office, factory, etc. Therefore, work environments should be safe and healthy. Yet this is not the case for many workers. Every day workers all over the world are faced with a multitude of health hazards, such as:

- dusts;
- gases;
- noise;
- vibration;
- extreme temperatures;
- chemicals and fumes;
- biological agents viz virus, bacteria, fungi, nematodes, protozoa etc.

Unfortunately some employers assume little responsibility for the protection of workers' health and safety. In fact, some employers do not even know that they have the moral and often legal responsibility to protect workers. As a result of the hazards and a lack of attention given to health and safety, work-related accidents and diseases are common in all parts of the world.

3.4 Occupational Health and SustainableDevelopment

The most successful economies have demonstrated that workplaces designed according to good principles of occupational health, safety and ergonomics are also the most suitable and productive. In addition,a healthy economy, high quality of products or services, and long-term productivity are difficult to achieve in poor working conditions where workers are exposed to health and safety hazards.

Principle 1 of the Rio Declaration on Environment and Development (United Nations Conference on Environment and Development, Rio de Janeiro, 1992) states:" Human beings are the centre of concern for sustainable development. They are entitled toa healthy and productive life in harmony in nature". Sustainable Development is defined as a strategy "to meet needs of the present world population without causing adverse effect on health and the environment, and without depleting or endangering the global resource base, hence without compromising the ability of future generations to meet their needs".

In terms of occupational health, the above principle means satisfaction of material needs through work and other production processes without causing danger to human health, the ecosystem, resource base or the health of the community,either in the short term or long term. Occupation health is a basic element and constitutes a social and health dimension of the principle of sustainable development.

Occupational healthis at the centre of sustainable development in the following ways:

- The prevention of occupational accidents, injuries and diseases and the protection of workers against physical and psychological overload, imply appropriate use of resources, minimizing unnecessary loss of human and material resources.

- The objective of healthy and safe work environments calls for the use of safe, low-energy, low-toxic emission, low-waste (green) technology and in many countries occupational health legislation requires the use of the best available production technology.

- The occupational health approach may facilitate undisturbed production that increase the quality of products, productivity and process management and helps to avoid unnecessary loss of energy and materials and to prevent unwanted impact on the environment.

- Most environmental health hazards that have later been found to affect the health of the general population were first detected in the work environment. The occupational environment provides an early warning system for certain environmental health hazards just as it also provides effective models for preventive action.

- For many adults, the work environment is the most demanding environment in terms of physical, psychological, ergonomic or psychological stresses and physical workload. The principle of Rio Declaration with regard to a healthy and productive life is particular relevant to the work environment and calls for occupational health action.

- The state of the general environment and the ecosystem has an impact on the health of the workers either directly or indirectly in several occupations, e.g. agriculture, mining, fishery and manufacturing. There is a two-way relationship between occupational health and safety on the other hand, and occupational health and sound environmental development on the other.

- Equally important for personal well-being and for socio-economic development of communities and countries is an employment policy that ensures access to work for everyone and enables individuals sustain themselves and their families. Highest possible employment is also a key factor in the safe, stable and sustainable social development of countries, while high unemploymentrate and other associated problems endanger such development.

- In developing countries, the health and well-being of the family is critically dependent on the health and productivity of its working members, thus making several members of the community dependent on the health of the worker. In a situation where organised social protection is lacking, the loss of health, life and working capacity of such a key member of the family often means severe crisis for the rest of the family, affecting indirectly the well-being, health and economy of the communitiesat large and of future generations.

Occupational health is a basic element and constitutes a social and health dimension of the principle of overall development. Occupational health practices constitute a set of key activities for such development.

4.0 CONCLUSION

In this unit, we have learnt that occupational health is a multidisciplinary activity aimed at the protection and promotion of the health of workers by preventing and controlling occupational accidents and diseases and by eliminating occupational factors and conditions hazardous to health and safety at work. Work and health are intertwined; a safe and sound working condition promotes good health; while the sound health of workers enhances productivity and economy of any nation.

Hence we can say occupational health lies at the centre of sustainable development; as it facilitate uninterrupted production that increases the quality of products, productivity and process management and helps to avoid unnecessary loss of human resource and materials. It also helps to mitigate negative impact on the environment.As we can see from our discussion so far, that rapid economic growth and technological development await the developing nations, if they can improve on their occupational health practice.

5.0 SUMMARY

In this unit we have learnt that:

- Occupational health is concern with the well-being and safety of the working populations.It involves the consideration of issues relating to occupational medicine, industrial hygiene, toxicology, education, engineering safety, ergonomics, psychology, etc.

- There is a continuous two-way interaction between a person's health and the working environment: occupational setting may influence the person's health either positively and negatively and productivity is, in turn, influenced by the worker's state of physical, social and mental well-being. Work, when it is well-adjusted and productive, can be important factor in health promotion.

- Apathy towards occupational health practices are responsible for a lot of occupational-related accidents, injuries and diseases.. As a result of the hazards and a lack of attention given to health and safety, work-related accidents and diseases are common in all parts of the world.

- Occupational health is a basic element and constitutes the social and health dimensions of the principle of overall development.

Occupational health practices constitute a set of key activities for such development.

- Developing nations can improve on their economy and technological development, if they can re-engineer their occupational health practices in line with sustainable development.

6.0 TUTOR-MARKED ASSIGNMENT

1. Give a concise definition of occupational health.
2. Explain succinctly the interaction between work and health.
3. Why is occupation health important in the workplace environment?
4. Explain in detail the statement "Occupational health is at the centre of sustainable development."
5. How can developing nations attain full economic productivity and technological development using sound occupational health practices?

7.0 REFERENCES/FURTHER READING

Benjamin O. Alli (2008). Fundamental principles of occupational health and safety.

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UNIT 2 DEFINITION OF TERMS IN OCCUPATIONAL HEALTH

CONTENTS

1.0 INTRODUCTION

This unit will expose students to the various terminologies used in the field of occupational health. This is a dictionary of terms for "personnel involved in the broad scope of activities that are carried out in the field of occupational health". This would be a useful addition to a standard reference textbook on occupational health. At the end of this chapter, students would understand the abbreviations, terms and definitions of words used in the occupational health to enhance their professional knowledge and skills in the working environment.

2.0 OBJECTIVES

At the end of this Unit, you will be able to:

- define the various terms used in occupational health
- understand the applications of various terms in occupational setting.

3.0 MAIN CONTENT

3.1 Glossary of Terms in Occupational Health.

The following are the terms used in an occupational setting to enhance professional communication among students/young occupational health practitioners and promote safety among workers. These include:

- Accident
- Core Competencies

- Damage
- Danger
- Harm
- Hazards
- Health and Safety Representative
- Health Care Provider
- Hierarchy of Controls
- Infection Prevention and Control
- Internal Responsibility System
- Joint Health and Safety Committee(JHSC)
- Occupational Accident
- Occupational Health
- Occupational Illness
- Occupational Injury
- Occupational Safety
- Provincial Infectious Diseases Advisory Committee
- Risk
- Routine Practices
- Safe Behaviour
- Safety
- Safety Professional
- Staff

3.2 Definition of Terms

Term	Definition
Accident	a sudden event that results in an undesired outcome such as property damage, bodily injury or death.
Core Competencies	Basic(core) knowledge elements or competencies related to infection prevention and control that are required by all Health Care Workers.

Damage	The loss of inherent quality suffered by an entity (physical or biological).
Danger	The degree of exposure to a hazard.
Harm	The loss to a person (or people) as a consequence of damage.
Hazards	Any existing or potential condition in the workplace which, by itself or by interacting with other variables, can result in death, injury, property damage or loss. Simply, hazard is a potential source of harm. An occupational hazard is a thing or situation with the potential to harm a Worker. A safety hazard causes accidents that physically injure Workers. A health hazard results in the development of disease.
Health and Safety Representative	A non-management individual chosen by Workers in a workplace that has less than 20 but greater than 5 employees, who is responsible for inspecting the workplace at least once per month to identify situations that may be a source of danger or hazard to Workers.
Health Care Provider	Any person delivering care to a client/patient/resident. This includes, but is not limited to, the following: emergency service workers, physicians, dentists, nurses, respiratory therapists and other health professionals, personal support workers, clinical instructors, students and home health care workers. In some non-acute settings, volunteers might provide care settings, volunteers might provide care and would be included as health care providers.
Hierarchy of Controls	The hierarchy of controls is a 'model' for hazard control. The hierarchy of controls describes control measures for any hazard as being directed either at the source of the hazard, along the path to the workers, or at the workers themselves. The use of the hierarchy of controls for any hazard is considered a best practice when dealing with the hazards of infectious agents.
Infection Prevention	Practices and procedures that help prevent or

and Control	reduce the risk of transmission of microorganisms to staff, clients/patients/residents or visitors.
Injury	Physical damage to body tissues caused by an accident or by exposure to environmental stressors. This injury may lead to death and is then called a "fatal accident" or may cause partial disability or lead to sick leave for a period of time.
Internal Responsibility System	A system in which every individual is responsible and accountable for health and safety, including Employers, Supervisors and Workers
Joint Health and Safety Committee(JHSC)	A committee composed of Workers and management required at any workplace that employs 20 or more Workers, to identify situations that may be a hazard and to make recommendations for improvements in health and safety.
Occupational Accident	Accident occurring at the workplace which may cause damage to machinery, tools or people.
Occupational Health	Health services for employees in the workplace provided by trained occupational health nurses and physicians.
Occupational Illness	A condition that results from exposure to a physical, chemical or biological agent to the extent that the health of the Worker is impaired, including occupational disease recognised under the Workplace Safety and Insurance Act.
Occupational Injury	An injury that arises out of, and in the course of, employment.
Occupational Safety	Risk identification at the workplace and preventive measures taken to reduce or eliminate the hazard which may lead to accidents.
Provincial Infectious	A multidisciplinary, scientific advisory body that provides evidence-based advice regarding

Diseases Advisory Committee	multiple aspects of infectious disease identification, prevention and control.
Risk	The likelihood of harm (in defined circumstances).
Routine Practices	The infection prevention and control practices that must be used routinely during all activities to reduce the infection risks to you and to clients/patients/residents and to control the transmission of microorganisms in all health care settings.
Safe Behaviour	Acting in such a way that no risk of injury is caused by one's behavior.
Safety	The absence of danger.
Safety Professional	A person whose basic job function and responsibility is to prevent accidents and other harmful exposures and the personal injury, disease or property damage that may ensue.
Staff	Anyone conducting activities in settings where health care is provided, including but not limited to, health care providers. See also, Health Care Providers.
Workplace health surveillance	The removal of the causative factors of disease.

4.0 CONCLUSION

In this unit, we have learnt the various terms used in occupational health and their definitions. Proper understanding of this glossary of terms and its relevance are important for efficient occupational health practices. Without knowledge of these terminologies it becomes impossible for you as young practitioners to apply theoretical knowledge of occupational health in real life situation.

5.0 SUMMARY

In this unit we have learnt that:

- Occupational health like other multidisciplinary courses make use of different terminologies that must fully understood by any person who wants to make a successful career in the field.
- The definitions of the various terms used in occupational health.

6.0 TUTOR-MARKED ASSIGNMENT

1. Give a concise definition of the following occupational health terminologies:

    a. Hazard
    b. Harm
    c. Core Competencies
    d. Hierarchy of Controls
    e. Infection Prevention and Control

    f. Occupational illness
    g. Danger
    h. Occupational Safety
    i. Occupational diseases
    j. Near miss
    k. Accident
    l. Injury

7.0 REFERENCES/FURTHER READING

Confer RG and Confer TR. (1994). Occupational Health and Safety Terms, Definitions and Abbreviations. Pp213. Boca Raton: Lewis and CRC. ISBN 1-56670-077-9.

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UNIT 3 CLASSIFICATION OF WORKPLACE ENVIRONMENT

CONTENTS

1.0 INTRODUCTION

In today's working environment, worker performance is affected by a large number of work factors that span across the job, process, and organisational levels. The identification and evaluation of the entire domain of work factors are, thus, crucial to developing integrated and long-term solutions to employee performance problems. A classification system is, therefore, warranted to characterise and assess this complex system. Workplace environment can be classified into physical and non-physical environment. In summary, there is an urgent need to develop a classification system for the characterisation of the synergistic effects of work place environment upon the worker. This unit deals with the various types of working environment and a classification system to categorise the entire domain of workplace factors impacting performance.

2.0 OBJECTIVES

At the end of this Unit, you will be able to:

- explain the concept of workplace environment
- list the types of Workplace environment
- classify the various workplace environment factors
- explain the various physical environment factors
- explain the various non-physical environment factors

3.0 MAIN CONTENT

3.1 Concept of Workplace Environment

A workplace environment is a location where someone works for his or her employer, a place of employment. Such a place can range from a home office to a large office building or factory. For industrialised societies, the workplace is one of the most important social spaces other than the home, constituting "a central concept for several entities: the worker and his/her family, the employing organisation, the customers of the organisation, and the society as a whole". The development of new communication technologies have led to the development of the virtual workplace, a workplace that is not located in any one physical space.

The design, arrangement and orientation of the work environment should reflect the full range of personnel. This requires an awareness of potential differences in physical dimensions such as stature and forward functional reach (anthropometric) and strength capabilities and limitations (biomechanical). If these factors are not considered, the workplace design may increase the likelihood for human error. Additional training, operations and maintenance manuals, along with more detailed written procedures, cannot adequately compensate for human errors caused by poor design.

Elements of Habitability Influenced by the Design Process

To produce suitable living and working conditions within design and budget constraints, habitability should be incorporated during design. When it is not possible to strictly adhere to habitability criteria, design alternatives are used to improve environmental conditions. Examples of alternatives are dampening noise transmission with acoustic insulation and alleviating vibration by applying resilience techniques.

Workplace ergonomics is a major aspect of designing for habitability. Ergonomics is the design, placement and arrangement of the components and spaces on board where crewmembers live and work. Design and ergonomics can be improved if addressed early in the planning stages. For example, the decision to locate crew berthing away (or suitably protected) from spaces containing noisy or vibrating equipment is easier before construction starts.

The ambient environmental conditions that impact habitability are:

- Noise levels
- Vibration
- Thermal comfort (temperature, humidity and ventilation)
- Illumination

3.2 Types of Workplace Environment

There are many different types of workplace environment. Several attempts have been made to quantify the different types in an organised way, as seen with the Holland Codes proposed by John Holland, a psychologist with an interest in matching people with work environments that suit their personalities. They can be broken down by the type of work done, the physical environment, or the social and situational factors that can play a role in shaping the workplace. Matching employees with the right environment can result in better performance and more satisfaction.

Holland's approach to the types of work environment looked at the nature of the work done. He identified six different environments:

1. realistic,
2. social,
3. enterprising,
4. artistic,
5. investigative, and
6. conventional.

Some workplaces use this model to assess prospective employees to determine if they would be a good fit and to find the best department for their skills and interests.

In **realistic environments**, work is more hands on, while **investigative environments** place a high priority on thinking and theoretical discussions. **Enterprising environments** involve more self initiative to start and innovate projects. **Conventional work** environments use set protocols and routines, such as data basing customer information, while **artistic environments** promote creativity and the production of works of art. **Social work environments** involve a high degree of interaction, as seen in customer service and teaching.

3.3 Workplace Environment Factor Classification System

A workplace environment factor is defined as aload acting upon the worker in the business environment to produce an output required by the organisation. A load may be classified according to its effect into either "energy expenditure" or "energy replenishment." An energy expenditure load results in energy depletion; an energy replenishment load works as a stimulus that increases human energy reserves.

Workplace environment factor can be classified into two (2) broad categories namely:

1. The Physical Environment Factor

2. The Non-Physical Environment Factor

These two interacts together to determine the efficiency of workers at a given occupational setting.

The physical environment factors are physical conditions in the workplace (e.g., noise, heat stress) that expend the three resources of human energy (i.e., physical, mental, and emotional). Also, the chemical (e.g., dust, fumes), biological (e.g., bacteria, viruses), and radiological (e.g., X-rays) factors are part of the physical environment conditions that drain all three resources of energy.

The non-physical or social environment loads are demands imposed upon the worker due to work situations and conditions that require interaction with others in the organisation (e.g., social conflict with the supervisor or co-workers). The organisational loads are demands in the work environment defined by how work is organised and structured (e.g., working night shift or long hours). The technical workplace environment conditions deal with the adequacy of equipment, tools, skills, knowledge, and supervision required to alter materials or information in some specified or anticipated way to achieve a desired end result. The social, organisational, and technical environment conditions primarily influence the emotional energy exertion.

3.3.1Physical Environment Factors

Physical environment conditions are classified according to sources, such as:

1. Physical,
2. Chemical,
3. Radiological or
4. Biological.

Physical factors include noise (exposure to constant or intermittent sounds of a pitch or level); vibration (exposure to a shaking object or surface that causes strain on the whole body or extremities); illumination (amount of light at work surfaces, objects, general area); thermal stress (exposure to heat, cold, wind, humidity); changes in barometric pressure (effects of pressure due to altitude effects); kinetic hazards (due to falling or accelerating objects); mechanical hazards (e.g., hazards due to contact with sharp edges, contact with shearing devices, body part caught between two surfaces); fall hazards (e.g., trip and fall such as when a worker encounters an unseen foreign object, stump and fall such as when a worker's foot suddenly meets a sticky surface or a defect in the walking surface); immediately dangerous to life and health

environments (e.g., electrical hazards, pressure hazards, fire arms): awkward or confining work space (i.e., conditions in which the body is cramped or uncomfortable); and hindrance of freedom of motion due to protective equipment, safety guard use, and awkward clothing.

Chemical factors refer to the presence of metals, metal fumes, solvents, pesticides, plastics, gases, and dusts (i.e., particulate matter) in the physical work environment. They include non-toxic chemicals (e.g., dust and fumes) and toxic chemicals (e.g., solvents, carcinogens, carbon monoxide or other gases, metal fumes, heavy metals such as lead, arsenic).

Radiological factors include ionizing and non-ionizing radiation. Examples of ionizing radiation are X-rays, alpha, beta, gamma particles. Non-ionizing radiation includes such things as ultraviolet light, infrared, and lasers.

Biological factors are classified into infectious agents (e.g., bacteria, viruses, parasites), blood borne agents (e.g., medical worker exposed to needle-sticks), exposure to plant sap (e.g., poison ivy), exposure to insect bites (e.g., bees, wasps), and animal bites or stings (e.g., dog bites, snakes).

3.3.2 Non-Physical Environment Factors

The non-physical environment factors can be grouped into three (3) categories namely:

1. Socialenvironmentconditions
2. Organisational environment conditions
3. Technical environment conditions

Social environment conditions

The social factors are subdivided into social conflict (with individuals inside or outside the organisation), interpersonal closedness (i.e., the way members of the organisation do not relate to one another their ideas and feelings); freedom from prejudice (i.e., acceptance of the worker for work-related traits, skills, abilities, and potential without regard to race, creed, and national origin, or to life styles and physical appearance); mobility (i.e., existence or non-existence of upward mobility as reflected, e.g., by the percentage of employees at any level who qualify for higher levels); and fairness of complaints and disciplinary actions.

The social environment contributes to energy replenishment via social support (from members inside the organisation), sense of community, interpersonal openness, social rewards, and knowledge of results (Figure 10). Social rewards include praise (i.e., opportunities to receive recognition for successful completion of work, aside from financial

incentives); nurturing (i.e., opportunities to receive guidance for successful completion of work); and participation in decision-making (i.e., opportunities to get involved in important organisational decisions). Knowledge of results is centered around feedback information provided by managers and co-workers.

Organisational environment conditions

Organisational environment classification that impacts energy expenditureconsists of eight sub-categories: time organisation (e.g., working night shifts), work responsibility (e.g., responsibility for lives and safety of others), compensation and income security (e.g., fairness and adequacy of base salary), logical sequence of work activities (for efficiency and effectiveness purposes), resource factors at the job, organisation, and process levels (e.g., time availability for job performance), interface factors (i.e., collaboration between various functions), organisational design factors (e.g., organisational structure), process design factors (e.g., flow of information between jobs).

The organisational environment factors that impact energy replenishment are subdivided into autonomy, task organisation, individual growth, reward, and knowledge of results. Those factors are distinct and different from those influencing energy expenditure.

Technical environment conditions

Factors in the technical environment determine whether the technology employed in the business enterprise is adequate with respect to the achievement of work goals (described in terms of work productivity, quality, and safety). Inadequate technical equipment, procedures, and expertise may severely compromise job performance because they contribute to added physical and mental task demands. The technical environment conditions are classified into resource and skill and knowledge factors. Resource factors include the availability of right tools, equipment, machinery, and the quality of information received for job performance. Skill and knowledge factors assess the degree to which the necessary items are provided: (a) skills and knowledge (i.e., technical expertise required for job performance); (b) technical procedures (provision of technical procedures required to transform work inputs to outputs); and (c) technical supervision (presence of technically competent supervisor).

4.0 CONCLUSION

The work system (i.e., company or organisation) is considered a complex system because it consists of a large number of work factors. An evaluation of factors is an important task for optimizing human

performance in the workplace. A workplace environment refer to the working space where an employee or labour works for his employer. This work environment is influenced by a lot of factors. In this unit, a methodology was described to manage the complexity of the entire domain of work factors by developing the architecture for a work-factor classification system. In this system, work factors are defined as loads acting upon the worker in the business environment. According to its effect, a load is classified into either energy expenditure or energy replenishment load. An energy expenditure load results in energy depletion; an energy replenishment load works as a stimulus that increases human energy reserves

The workplace environment which comprises physical and non-physical conditions works synergistically to affect either positively or negatively the productivity and well-being of workers. It is therefore important that all these conditions should be put in place when designing a workplace environment.

5.0 SUMMARY

In this unit we have learnt that:

i. A workplace environment is a location where a person/worker is employed and works for his or her employer. Such a place can range from a home office to a large office building or factory or industry.

ii. According to Holland there are six different workplace environments namely: realistic, social, enterprising, artistic, investigative, and conventional. Some workplaces use this model to assess prospective employees to determine if they would be a good fit and to find the best department for their skills and interests.

iii. A workplace environment factor is defined as aload acting upon the worker in the business environment to produce an output required by the organisation. A load may be classified according to its effect into either "energy expenditure" or "energy replenishment." An energy expenditure load results in energy depletion; an energy replenishment load works as a stimulus that increases human energy reserves.

iv. Workplace environment factors can be classified into two (2) broad categories namely: the Physical Environment factors (physical, chemical, biological and Radiological factors); and the

Non-Physical Environment factors which include (Social environment conditions, Organisational environment conditions and Technical environment conditions).

6.0 TUTOR-MARKED ASSIGNMENT

1. What do you understand by a “Workplace Environment”?
2. Explain the different types of Workplace Environment using the Holland’s Model Or Codes
3. How can a work load acts as “energy expenditure “or” energy replenishment.
4. Explain in detail all the components of a physical environment factors.
5. Explain in detail all the components of a non-physical environment factors.
6. How do the physical and non-physical workplace environment factors interact to affect worker’s health?

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MODULE 2 INDUSTRIAL HYGIENE AND SAFETY

UNIT 1 INDUSTRY: CONCEPT, CLASSIFICATION AND TYPE

CONTENTS

1.0 INTRODUCTION

In an industrial society, a major part of the population is employed by industries. This occurs typically in the manufacturing sector. Manufacturing industry became a key sector of production and labour in European and North American countries during the Industrial Revolution, upsetting previous mercantile and feudal economies. This came through many successive rapid advances in technology, such as the production of steel and coal. A labour union is an organisation of workers who have banded together to achieve common goals in key areas such as wages, hours, and other working conditions. The trade union, through its leadership, bargains with the employer on behalf of union members (rank and file members) and negotiates labour contracts with employers. This movement first rose among industrial workers.

In this unit, you will be introduced to the concept of industry in terms of conversion or production of goods and services; and its business activity. Also, you will be taken through a brief history of the industrial revolution and how it translates to economic growth across Europe.

Finally, the unit gave a broad insight into the various types of industries and their relevance in the society.

2.0 OBJECTIVES

By the end of this unit, you will be able to:

- explain the concept of industry
- give a brief history of the Industrial Revolution and its relevance to economic growth in Europe
- classify industry based on various factors
- explain the various types of industry
- explain the Colin Clark's sector model.

3.0 MAIN CONTENT

3.1 What Is Industry? Meaning

Industry refers to the production of goods and services by converting the inputs into outputs and or creation of utilities to customers. Goods produced by an industry are used either by consumers to satisfy their wants and needs or by other industries for further production. An industry may refer to an extraction, generation, conversion or production of goods and services or construction of building products for a certain price. Industry is the production of goods or related services within an economy. The major source of revenue of a group or company is the indicator of its relevant industry. When a large group has multiple sources of revenue generation, it is considered to be working in different industries.

The production side of business activity is referred as industry. It is a business activity, which is related to the raising, producing, processing or manufacturing of products. The products are consumer's goods as well as producer's goods. Consumer goods are goods, which are used finally by consumers. E.g. Food grains, textiles, cosmetics, VCR, etc. Producer's goods are the goods used by manufacturers for producing some other goods. e.g. Machinery, tools, equipment, etc. Expansion of trade and commerce depends on industrial growth. It represents the supply side of market.

3.2 Industrial Revolution

The Industrial Revolution led to the development of factories for large-scale production, with consequent changes in society. Originally the factories were steam-powered, but later transitioned to electricity once an electrical grid was developed. The mechanized assembly line was

introduced to assemble parts in a repeatable fashion, with individual workers performing specific steps during the process. This led to significant increases in efficiency, lowering the cost of the end process. Later automation was increasingly used to replace human operators. This process was accelerated with the development of the computer and the robot.

The main features involved in the Industrial Revolution were technological, socioeconomic, and cultural. The technological changes included the following: (1) the use of new basic materials, chiefly iron and steel, (2) the use of new energy sources, including both fuels and motive power, such as coal, the steam engine, electricity, petroleum, and the internal-combustion engine, (3) the invention of new machines, such as the spinning jenny and the power loom that permitted increased production with a smaller expenditure of human energy, (4) a new organisation of work known as the factory system, which entailed increased division of labour and specialisation of function, (5) important developments in transportation and communication, including the steam locomotive, steamship, automobile, airplane, telegraph, and radio, and (6) the increasing application of science to industry. These technological changes made possible a tremendously increased use of natural resources and the mass production of manufactured goods.

Following the Industrial Revolution, possibly a third of the world's economic output are derived that is from manufacturing industries. Many developed countries and many developing/semi-developed countries (People's Republic of China, India etc.) depend significantly on manufacturing industry. Industries, the countries they reside in, and the economies of those countries are interlinked in a complex web of interdependence.

3.3 Classification of Industry

Industries can be classified in a variety of ways. At the top level, industry is often classified according to the three-sector theory into sectors: primary (extractive), secondary (manufacturing), and tertiary (services). Some authors add quaternary(knowledge) or even quinary (culture and research) sectors. Over time, the fraction of a society's industry within each sector changes.

Below the economic sectors there are many other more detailed industry classifications. These classification systems commonly divide industries according to similar functions and markets and identify businesses producing related products.

Industries can also be identified by product, such as: construction industry, chemical industry, petroleum industry, automotive industry, electronic industry, power engineering and power manufacturing (such as gas or wind turbines), meatpacking industry, hospitality industry, food industry, fish industry, software industry, paper industry, entertainment industry, semiconductor industry, cultural industry, and poverty industry.

Market-based classification systems such as the Global Industry Classification Standard and the Industry Classification Benchmark are used in finance and market research. The International Standard Industrial Classification (ISIC) of all economic activities is the most complete and systematic industrial classification made by the United Nations Statistics Division. ISIC is a standard classification of economic activities arranged so that entities can be classified according to the activity they carry out. The categories of ISIC at the most detailed level (classes) are delineated according to what is, in most countries, the customary combination of activities described in statistical units, considering the relative importance of the activities included in these classes.

3.4 Types/Categories of Industry

According to the process of production and the nature of the products, an industry can be divided into the following categories

PRIMARY INDUSTRY

Primary industries refer to the creation of utilities by extracting materials form natural resources or the growth and development of vegetation and animals by means of reproduction process, Primary industries are further classified as extractive and genetic industries.

- **Extractive industry:** Extractive industry is concerned with extraction or drawing out goods from the soil, air or water. Generally, products of extractive industries come in raw form and they are used by manufacturing and construction industries for producing finished products. E.g. mining industry, coal mineral, oil industry, iron ore, extraction of timber and rubber from forests, etc.

- **Genetic industry:** Genetic industries are engaged in re-production and multiplication of certain spices of plants and animals with the object of sale. The main aim is to earn profit from such sale. It is related to the growth and development of flora and fauna by multiplying a certain species of plants and

breeding of animals. Plant nurseries, forestry, farming, animal husbandry, poultry etc. are the examples of genetic industry.

In developed countries primary industry has become more technologically advanced, for instance the mechanisation of farming as opposed to hand picking and planting. In more developed economies additional capital is invested in primary means of production. As an example, in the United States corn belt, combine harvesters pick the corn, and spray systems distribute large amounts of insecticides, herbicides and fungicides, producing a higher yield than is possible using less capital-intensive techniques. These technological advances and investment allow the primary sector to require fewer workforces and, this way, developed countries tend to have a smaller percentage of their workforce involved in primary activities, instead having a higher percentage involved in the secondary and tertiary sectors.

Developed countries are allowed to maintain and develop their primary industries even further due to the excess wealth. For instance, European Union agricultural subsidies provide buffers for the fluctuating inflation rates and prices of agricultural produce. This allows developed countries to be able to export their agricultural products at extraordinarily low prices. This makes them extremely competitive against those of poor or underdeveloped countries that maintain free market policies and low or non-existent tariffs to counter them. Such differences also come about due to more efficient production in developed economies, given farm machinery, better information available to farmers, and often larger scale.

SECONDARY INDUSTRY

The industries, which produce finished goods by the use of materials and supplies taken from the primary industries are known as secondary industries. Such industries convert raw materials and semi raw materials into finished products by way of processing the materials, assembling components, constructing building products etc.

According to the process applied and the nature of the product, these industries are divided into the following two types.

- **Manufacturing industry**

  Generally, the term industry refers to the manufacturing industry. It is concerned with the production of goods by using raw materials or semi raw materials as input and also creates from utility in them. Production of sugar from sugarcane, petroleum products from the crude oil, manufacturing vehicles by

assembling various components, etc. are some of the examples of this sort of industry. It is again divided into four types.

- **Analytical industry**: This industry relates to the analyzing and separating different components from a single material. For example, crude oil processed and separated into petrol, diesel, kerosene etc.
- **Synthetic industry**: This industry relates to the putting of various raw materials together to make a final product. For examples, cement is produced by mixing concrete, gypsum, coal etc. together.
- **Processing industry**: An industry, which produces the final products by using raw materials and semi raw materials through different stages of production is known as processing industry. Textile industry, paper and sugar mills, etc. are some of the examples of this sort of industry.
- **Assembling industry**: It refers to that industry which assembles various component parts that are already manufactured to make a new product. Manufacturing vehicles, electric equipment etc. are some of the examples of this type of industry.

- **Construction industry**

The industries, which are concerned with the engineering, erecting and construction of building products are known as construction industries. They use materials produced by other industries like cement, iron rods, concrete, bricks etc. Their distinctive characteristic is that the products of such industries are not generally sold in the ordinary market but built at a certain place and transferred its ownership or it is constructed as the order of the customer at particular site/place. Constructions of bridges, roads, dams, canals, building, etc. are the examples of construction industry.

TERTIARY/SERVICE INDUSTRY

Service industries are those industries, which do not produce physical goods but create utility services and sell them for a price. In modern times service sector plays an important role in the development of the nation and therefore it is named as service industry. The tertiary sector of industry involves the provision of services to other businesses as well as final consumers. Services may involve the transport, distribution and sale of goods from producer to a consumer, as may happen in wholesaling and retailing, or may involve the provision of a service, such as in pest control or entertainment. The goods may be transformed

in the process of providing the service, as happens in the restaurant industry. However, the focus is on people interacting with people and serving the customer rather than transforming physical goods.

Examples of tertiary industries may include the following:

- Entertainment
- Government
- Telecommunication
- Hospitality industry/tourism
- Mass media
- Healthcare/hospitals
- Public health
- Information technology
- Waste disposal
- Consulting
- Gambling
- Retail sales
    - Fast-moving consumer goods (FMCG)
- Franchising
- Real estate
- Education
- Financial services
    - Banking
    - Insurance
    - Investment management
- Professional services
    - Accounting
    - Legal services
    - Management consulting

QUATERNARY INDUSTRY

The **quaternary sector of the economy** is a way to describe a knowledge-based component of the economy, which typically includes services such as information technology, information-generation and -sharing, media, and research and development, as well as knowledge-based services like consultation, education, financial planning, blogging, and designing.

The quaternary sector is based on knowledge and skill. It consists of intellectual industries providing information services, such as computing and ICT (information and communication technologies), consultancy (offering advice to businesses) and R&D (research, particularly in scientific fields). According to some definitions, the quaternary sector

includes other pure services, such as the entertainment industry, and the term has been used to describe media, culture, and government.

"Quaternary sector" is a further delineation of the three-sector hypothesis of industry in the sense that the quaternary sector refers to a part of the third or tertiary sector along with the quinary economic sector. It has been argued that intellectual services are distinct enough to warrant a separate sector and not be considered merely as a part of the tertiary sector. This sector evolves in well-developed countries and requires a highly educated workforce.

QUINARY INDUSTRY

A fifth or quinary sector is sometimes identified as the human services sector, providing services otherwise provided at home. This includes the hospitality industry.

3.5 Deindustrialisation

Historically certain manufacturing industries have gone into a decline due to various economic factors, including the development of replacement technology or the loss of competitive advantage. An example of the former is the decline in carriage manufacturing when the automobile was mass-produced.

A recent trend has been the migration of prosperous, industrialised nations towards a post-industrial society as explained in Figure 1. This is manifested by an increase in the service sector at the expense of manufacturing, and the development of an information-based economy, the so-called informational revolution. In a post-industrial society, manufacturers relocate to more profitable locations through a process of off-shoring.

Measurements of manufacturing industries outputs and economic effect are not historically stable. Traditionally, success has been measured in the number of jobs created. The reduced number of employees in the manufacturing sector has been assumed to result from a decline in the competitiveness of the sector, or the introduction of the lean manufacturing process. Related to this change is the upgrading of the quality of the product being manufactured. While it is possible to produce a low-technology product with low-skill labour, the ability to manufacture high-technology products well is dependent on a highly skilled staff.

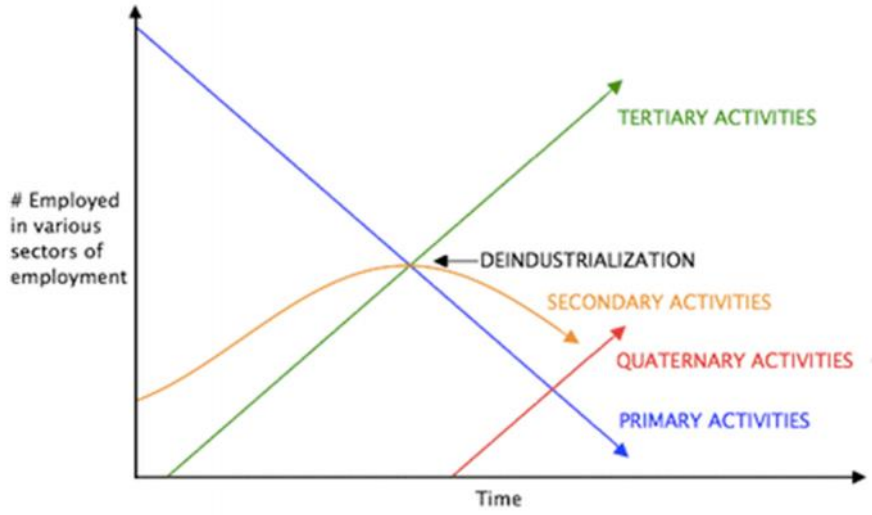

Figure 1: Colin Clark's sector model of an economy undergoing technological change. In later stages, the quaternary sector of the economy grows – shown in red

4.0 CONCLUSION

Since the advent of the industrial revolution in Europe, there has been a lot of social, economic and technological advancement across the globe. This revolution led to the process of change from an agrarian and handicraft economy to one dominated by industry and machine manufacturing. Industrialisation has led to efficient utilisation of raw materials or products (primary sector) to finished goods and services (tertiary sector) for economic development. The industries play a key role in the wealth generation of any countries by engaging the productive minds of the teeming population.

Some economists contrast wealth-producing sectors in an economy such as manufacturing with the service sector which tends to be wealth-consuming. Examples of services may include retail, insurance, and government. These economists contend that an economy begins to decline as its wealth-producing sector shrinks. Manufacturing is an important activity to promote economic growth and development. Nations that export manufactured products tend to generate higher marginal GDP growth which supports higher incomes and marginal tax revenue needed to fund the quality of life initiatives such as health care and infrastructure in the economy. The field is an important source for engineering job opportunities. Among developed countries, it is an important source of well paying jobs for the middle class to facilitate greater social mobility for successive generations on the economy.

5.0 SUMMARY

In this unit we have learnt that:

- An industry may refer to an extraction, generation, conversion or production of goods and services or construction of building products for a certain price. Industry is the production of goods or related services within an economy. In an industrial society, industry employs a major part of the population. This occurs typically in the manufacturing sector.

- The Industrial Revolution led to the development of factories for large-scale production, with consequent changes in society. The main features involved in the Industrial Revolution were technological, socioeconomic, and cultural. These technological changes made possible a tremendously increased use of natural resources and the mass production of manufactured goods.

- Industries can be classified in a variety of ways. At the top level, industry is often classified according to the three-sector theory into sectors: primary (extractive), secondary (manufacturing), and tertiary (services). Some authors add quaternary (knowledge) or even quinary (culture and research) sectors.

- Primary industries refer to the creation of utilities by extracting materials form natural resources or the growth and development of vegetation and animals by means of reproduction process, Primary industries are further classified as extractive and genetic industries.

- Secondary industries convert raw materials and semi raw materials into finished products by way of processing the materials, assembling components, constructing building products etc.

- The tertiary sector of industry involves the provision of services to other businesses as well as final consumers. Services may involve the transport, distribution and sale of goods from producer to a consumer, as may happen in wholesaling and retailing, or may involve the provision of a service, such as in pest control or entertainment.

6.0 TUTOR-MARKED ASSIGNMENT

1. Explain the concept “Industry”.
2. Give a brief history of the Industrial Revolution in Europe and how it led to economy transformation and technological advancement of the continent.
3. Write a concise note on the International Standard Industrial Classification (ISIC).
4. With the aid of an example, explain the relationship between the various types of industry.
5. Use the Colin Clark’s Model to explain how economy and technological growth can occur in any society.

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UNIT 2 INDUSTRIAL HYGIENE

CONTENTS

1.0 INTRODUCTION

Industrial hygienists (IH) are at the forefront of health and safety in today's industrial workplaces. Their focus runs deeper than the everyday safety issues that involve hard hats, safety glasses, fall protection, and lockout/tagout scenarios. Their emphasis is toward the promotion of health and general well-being of all workers. They spend considerable effort ensuring workers in their environment are protected from hazards that may represent immediate and long-term effects on their general health and well-being. They study and work to control worker exposure to hazards such as noise, dust, and, of course, gas and vapors. As part of being responsible for controlling the hazards themselves, the IH becomes responsible for managing the programs and tools used to monitor the hazards. In this unit, you will learn the definition of occupational/industrial hygiene, who is an industrial hygienist, history of the practice of occupational hygiene and the job responsibilities/duties of an Industrial Hygienists in an occupational setting.

2.0 OBJECTIVES

By the end of this unit, you will be able to:

- define Occupational/Industrial hygiene
- discuss who an Industrial Hygienists is
- give a brief history of the Industrial hygiene
- classified industry based on various factors
- explain the roles of an Industrial Hygienists.

3.0 MAIN CONTENT

3.1 What Is Industrial Hygiene?

Industrial hygiene has been defined as “that science and art devoted to the anticipation, recognition, evaluation, and control of those environmental factors or stresses arising in or from the workplace, which may cause sickness, impaired health and well-being, or significant discomfort among workers or among the citizens of the community.” This is the practice of assessment and control of environmental factors and stresses arising in and from workplace, which may cause injury, sickness, impaired health and well-being or significant discomfort and inefficiency among workers or among the citizens of the community.

It encompasses the study of:

- toxicology
- industrial Processes
- the chemical and physical behavior of air contaminants
- environmental sampling techniques and statistics
- the design and evaluation of ventilation system
- noise control
- radiation protection
- the health effects of occupation hazards

3.2 What is an Industrial Hygienist?

Industrial hygienists are scientists and engineers committed to protecting the health and safety of people in the workplace and the community. A professional industrial hygienist is a person possessing either a baccalaureate degree in engineering, chemistry, or physics or a baccalaureate degree in a closely related biological or physical science from an accredited college or university, who also has a minimum of three years of industrial hygiene experience. A completed doctoral in a related physical, biological or medical science or in related engineering can be substituted for two years of the three-year requirement. A completed master's degree in a related physical or biological science or in related engineering can be substituted for one year of the three-year requirement. Under no circumstances can more than two years of graduate training be applied toward the three-year period.

Occupation/Industrial hygienists use environmental monitoring and analytical methods to detect the extent of worker exposure and employ engineering, work practice controls, and other methods to control

potential health hazards. Occupation/Industrial hygienists must work with Occupational Health physicians to develop comprehensive occupational health programmes and with occupational and environmental epidemiologists to perform research on health effects. Industrial hygienists analyze, identify, and measure workplace hazards or stresses that can cause sickness, impaired health, or significant discomfort in workers through chemical, physical, ergonomic, or biological exposures. Two roles of the OSHA industrial hygienist are to spot those conditions and help eliminate or control them through appropriate measures.

3.3 History of Occupational/Industrial Hygiene

There has been an awareness of industrial hygiene since antiquity. The environment and its relation to workers' health was recognised as early as the fourth century BC when Hippocrates noted lead toxicity in the mining industry. In the first century AD, Pliny the Elder, a Roman scholar, perceived health risks to those working with zinc and sulfur. He devised a face mask made from an animal bladder to protect workers from exposure to dust and lead fumes. In the second century AD, the Greek physician, Galen, accurately described the pathology of lead poisoning and also recognised the hazardous exposures of copper miners to acid mists. In the Middle Ages, guilds worked at assisting sick workers and their families. In 1556, the German scholar, Agricola, advanced the science of industrial hygiene even further when, in his book De Re Metallica, he described the diseases of miners and prescribed preventive measures. The book included suggestions for mine ventilation and worker protection, discussed mining accidents, and described diseases associated with mining occupations such as silicosis.

Industrial hygiene gained further respectability in 1700 when Bernardo Ramazzini, known as the "father of industrial medicine," published in Italy the first comprehensive book on industrial medicine, De Morbis Artificum Diatriba (The Diseases of Workmen). The book contained accurate descriptions of the occupational diseases of most of the workers of his time. Ramazzini greatly affected the future of industrial hygiene because he asserted that occupational diseases should be studied in the work environment rather than in hospital wards. Industrial hygiene received another major boost in 1743 when Ulrich Ellenborg published a pamphlet on occupational diseases and injuries among gold miners. Ellenborg also wrote about the toxicity of carbon monoxide, mercury, lead, and nitric acid.

In England in the 18th century, Percival Pott, as a result of his findings on the insidious effects of soot on chimney sweepers, was a major force

in getting the British Parliament to pass the Chimney-Sweepers Act of 1788. The passage of the English Factory Acts beginning in 1833 marked the first effective legislative acts in the field of industrial safety. The Acts, however, were intended to provide compensation for accidents rather than to control their causes. Later, various other European nations developed workers' compensation acts, which stimulated the adoption of increased factory safety precautions and the establishment of medical services within industrial plants.

In the early 20th century in the U.S., Dr. Alice Hamilton led efforts to improve industrial hygiene. She observed industrial conditions first hand and startled mine owners, factory managers, and state officials with evidence that there was a correlation between worker illness and exposure to toxins. She also presented definitive proposals for eliminating unhealthful working conditions. At about the same time, U.S. federal and state agencies began investigating health conditions in industry. In 1908, public awareness of occupationally related diseases stimulated the passage of compensation acts for certain civil employees. States passed the first workers' compensation laws in 1911. And in 1913, the New York Department of Labor and the Ohio Department of Health established the first state industrial hygiene programs. All states enacted such legislation by 1948. In most states, there is some compensation coverage for workers contracting occupational diseases. Today, nearly every employer is required to implement the elements of an industrial hygiene and safety, occupational health, or hazard communication program and to be responsive to the Occupational Safety and Health Administration (OSHA) and its regulations.

3.4 Roles of Industrial/Occupational Hygienist

The goal of the industrial hygienist is to keep workers, their families, and the community healthy and safe. They play a vital part in ensuring that federal, state, and local laws and regulations are followed in the work environment.

Typical roles of the industrial hygienist include:

- Investigating and examining the workplace for hazards and potential dangers

- Making recommendations on improving the safety of workers and the surrounding community

- Conducting scientific research to provide data on possible harmful conditions in the workplace
- Developing techniques to anticipate and control potentially dangerous situations in the workplace and the community
- Training and educating the community about job-related risks
- Advising government officials and participating in the development of regulations to ensure the health and safety of workers and their families
- Ensuring that workers are properly following health and safety procedures

Industrial Hygienists Work with the Issues that Concern Us All

Industrial hygienists deal with the health and safety challenges facing people everywhere including:

- Indoor air quality (sick building syndrome, second-hand tobacco smoke)
- Evaluating and controlling environmental lead exposure
- Emergency response planning and community right-to-know
- Occupational disease (AIDS in the workplace, tuberculosis, silicosis)
- Potentially hazardous agents such as asbestos, pesticides, and radon gas
- Cumulative Trauma Disorders (repetitive stress injuries, carpal tunnel syndrome)
- Radiation (electromagnetic fields, microwaves)
- Reproductive health hazards in the workplace
- Setting limits on exposure to chemical and physical agents
- Detection and control of potential occupational hazards such as noise, radiation, and illumination
- Hazardous waste management

3.5 Excerpts from Case Study: Industrial Hygiene

Background Information

A large new Orlean hospital has been affected by Katrina disaster, which has contributed to the evacuation of staffs to Baton Rouge. Six (6) weeks after the effect, I have been mandated with responsibility of supervising a team that will return to the hospital since I am an Industrial Hygienist. This team will also be responsible for evaluating the situation and engaging in a plan to re-estaiblish basic medical needs for the staffs involved in the recovery initiative. While the team comprises various leaders of the hospital, the incident commander or

person in-charge of recovery is looking for guidance on safe entry, safe clean-up procedures, suitable PPE for all recovery employees, and a hazard assessment for the most crucial items. He also needs an assessment of operations that can contribute to acute or chronic health effects, diseases or illness. This process of supervising the team in the recovery effort and providing guidance to the Incident Commander will require the use of industrial hygiene concepts.

Suggestions and Recommendations to the Incident Commander

As previously mentioned, the Incident Commander is looking for guidance from the Industrial Hygienist regarding safe-entry, suitable PPE for all recovery staffs, safe clean-up processes, hazard assessment for critical items, and operation that cause health effects. The guidance is vital because such disaster are usually accompanied by septic system collapse, structural destruction, and chemical explosion. The first recommendation to the Incident Commander in handling the recovery and clean-up is to ensure that no one works alone. This helps to ensure that there is another person to rescue the other in case something happen during the clean-up or recovery process. Secondly, each of these workers should be adequately trained on important procedures to take extreme caution when entering the building. Third, they should wear robust shoes since cut feet is the most common injury in the aftermath of a natural disaster or incident. In addition, these individuals should be armed with flash lights and other types of lights when carrying out their operations. Fourth, the clean-up team should be granted HEPA rated respirators during their initial entry into the building. Finally, the windows, floors, doors and walls, should be critically assessed to ensure the safety of the team and experts before entry of the whole team. It is important for the Incident Commander to work with the organisation's managers and supervisors in conducting an assessment of specific conditions at the site and implement safety and health controls based on the OSHA standards (Occupational Safety and Health Administration, 2013).

4.0 CONCLUSION

We have learnt in this unit that industrial hygiene is a discipline that involved the assessment and control of occupational hazards which can impaired the health of workers or community members. This field involved the broad knowledge of toxicology, occupational safety and health, environmental monitoring and statistics; and knowledge of study. We have seen that there has been an awareness of industrial hygiene since antiquity; even before the modern man have knowledge of epidemiology and occupational health. The industrial hygienists play a crucial role in the occupational health and safety of workers and

members of the community. We can therefore conclude that industry hygiene is a vital tool in any occupational setting.

5.0 SUMMARY

In this unit, you have been acquainted with the practice of industrial hygiene in an occupational setting and who an industrial hygienist is. You have also learnt about the historical development of industrial hygiene as early as the fourth century BC when Hippocrate noted lead toxicity in the mining industry to the early 20th century, when the Occupational Safety and Health Administration (OSHA) and its regulations came to existence. We conclude in this Unit that the goal of the industrial hygienist is to keep workers, their families, and the community healthy and safe. They play a vital part in ensuring that federal, state, and local laws and regulations are followed in the work environment.

6.0 TUTOR-MARKED ASSIGNMENT

1. Outline and briefly explain the importance of an industrial hygiene in relation to its application in modern occupational setting.
2. Explain the statement: Industrial hygienists deal with issues that concern everyone.
3. Write an essay on the Occupational Safety and Health Administration (OSHA) and its regulations.
4. As an occupational hygienist, you are employed by a tobacco manufacturing industry. How would you investigate the workplace hazard and protect the workers from potential dangers?

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UNIT 3 WORKPLACE SAFETY

CONTENTS

1.0 INTRODUCTION

In the last unit, you learnt about industrial hygiene, history of industrial hygiene from antiquity and job descriptions of industrial hygienists. In this unit, we will learn about the definition and concept of workplace safety, measures that must be put in place to ensure occupational safety and health of workers and the importance of appropriate workplace safety measures by employers towards their workers.

2.0 OBJECTIVES

By the end of this unit, you will be able to:

- discuss the concept of workplace safety
- explain the various workplace safety measures
- discuss the benefits of workplace safety.

3.0 MAIN CONTENT

3.1 Concept of Workplace Safety

Workplace Safety, also commonly referred to as occupational health and safety (OHS), is a multidisciplinary field concerned with the safety, health, and welfare of people at work. The goals of workplace safety programs include fostering a safe and healthy work environment. OSH may also protect co-workers, family members, employers, customers,

and many others who might be affected by the workplace environment. A safe work environment is a productive one. No matter the size or type of the business, workplace safety procedures are a necessity for all staff. Safety measures protect employees as well as equipment and business property. Avoiding or minimising injuries and damage to equipment and facilities will result in fewer expenses and more profit for a business.

Workplace health and safety procedures are necessary for the well-being of both employers and employees. Violence in the workplace is an ever-growing concern in today's business community. According to the U.S. Occupational Safety and Health Administration (OSHA), "homicide is the fourth leading cause of fatal occupational injury in the United States." Diseases and other health concerns also affect a worker's ability to effectively perform his job duties. It is important for employers to take the necessary steps to protect employees from the health and safety concerns of today's corporate community.

In common-law jurisdictions, employers have a common law duty to take reasonable care of the safety of their employees. Statute law may in addition impose other general duties, introduce specific duties, and create government bodies with powers to regulate workplace safety issues: details of this vary from jurisdiction to jurisdiction.

3.2 Workplace Safety Measures

Worker safety is a primary focus in any industry. Workplace safety procedures are designed to keep employees, visitors and customers safe while helping to reduce the stress associated with the work area. Company management should take the time to develop safety procedures at work that get the entire staff involved in making company safety a priority. Occupational Safety Health Administration provides standards to assist employers in eliminating hazards that may cause injuries or fatalities. Some of the measures/guidelines to ensure workplace safety are:

3.2.1 Hazard Identification

Identifying workplace safety issues is the first step in protecting employees. Common work safety concerns can include ergonomics, presence of hazardous chemicals, mechanical problems, noise pollution, restricted visibility, dangers of falling and weather-related hazards. Issues with non-ergonomic equipment may cause human health problems, including sore backs and carpal tunnel syndrome. Chemicals can explode, causing burns, or pose the danger of poisoning. Mechanical

safety issues can occur related to the operation of any machine in the workplace. Noise and visibility issues can compromise an employee's hearing and sight. Falls resulting from poor housekeeping or negligence can cause serious injury and death; procedures should be in place to prevent them. Ice, snow and rain can create hazards of their own; employees need to be trained how to operate equipment safely when weather conditions are bad.

3.2.2 Workplace Safety Policies

Each business should have a safety policy in place, created either by management or in a joint effort between management and staff. Every employee has a role in carrying out the safety policies. A safety handbook should be created identifying safety issues and spelling out consequences of not following the appropriate safety procedures.

3.2.3 Safety Training

Training is necessary so that employees will know how to practice safety in the workplaces. Depending on the type of equipment used, the training may be required by a federal mandate. For example, any workplace that operates a forklift must provide training for employees for its safe operation. Training can come from outside experts hired to teach classes or employees specially trained to perform safety instruction.

3.2.4 Protective Equipment

Appropriate personal protective equipment (PPE) must be available to anyone who comes in contact with a potential work hazard. This can include hard hats, protective eyewear, earplugs, shoes, gloves and clothing. Even an office worker who delivers a message to a work area near a potential hazard must put on the appropriate PPE.

3.2.5 Provision of Ergonomic Workstation

Although sitting or standing in one place to perform job duties may not seem as if it is an exposure risk, the repetitive nature of some jobs can lead to serious musculoskeletal disorders (MSDs). In addition to the muscles, ligaments and tendons, the nerves and blood vessels are also affected by this type of injury. MSDs include carpal tunnel syndrome, arthritis, neck and spinal injuries and others.

An ergonomic workstation is particularly important in reducing the threat of repetitive motion injuries. The principles of ergonomics involve creating a work environment that is unique to the person who

must work in it. This may include a station with a desk chair, keyboard and computer screen that are at the right height for an individual office worker to prevent strain on the back, hips, knees, wrists and hands.

3.2.6 Reporting Process

One of the ways to help get employees and management involved together in the safety procedures of your company is to implement a reporting process. When employees see potential safety problems, they should be trained to avoid trying to handle the problems on their own. Employees should be aware of the safety reporting process, and report safety issues immediately. When the staff knows how to report safety concerns, it will keep everyone more vigilant on looking out for problems. This creates a culture of safety within the company that can help the company maintain a safe work environment.

3.2.7 Evacuation

When an emergency happens within your facility, such as a fire or explosion, it is important for everyone in the company to know the evacuation procedure. Develop an evacuation procedure that covers everyone in the company. Point out the closest emergency exit to each department, and develop a set of procedures for the safe evacuation of the building. Those procedures would include what personal items to bring when evacuating, the route each person should take and how to report to a member of the management team once an employee is outside the building. Post evacuation maps throughout the building, and check emergency exits regularly to make sure they remain accessible.

3.2.8 First Aid Kit

Well-stocked first aid kits should be a part of any company safety program. Place first aid kits in each work room, and have a small first aid kit in every manager's office. A first aid kit should contain sterilised bandages, medical adhesive tape, headache medication, antibacterial ointment, surgical gauze and over-the-counter pain medication. It should also include any site-specific emergency items, such as an eye wash for areas that use potent chemicals.

3.3 Importance/Benefits of Workplace Safety

1. Workplace safety results in fewer accidents, which results in fewer costs for worker’s compensation, less down time for employees, and less retraining time for workers otherwise needed to replace an injured worker.

2. Avoiding damage to equipment will result in fewer repair costs.

3. Worker performance is improved when workers know how to prevent injuries and have confidence in management's active role in protecting their safety.

4. Health and safety programs are an important part of preventing injury and illness in the workplace. Health programs help employers and employees understand the potential hazards they are exposed to on a daily basis.

5. Effective health and safety programs educate workers on the benefits of practicing proper workplace behaviors. For example, the “Safety Pays” program helps employers determine the cost workplace injuries and illness have on a company’s profit margin. When companies understand the impact injuries have on their bottom line, they are more inclined to implement programs to keep their workers healthy and safe.

6. Workplace health and safety practices are important because they help prevent inter-office violence and raise employee awareness of the potential dangers they face. Violent acts and behaviors of employees and other individuals within the workplace are cause for concern because they threaten a company’s overall well-being.

Companies must take an active approach in educating workers on the importance of practicing safe habits in order to maintain a healthy and safe working environment.

3.4 Case Study on Health and Safety Workplace

Ribbonwood and Arbuckle Ltd was established in 2000, with the company changing its name to RAL Logging Ltd in May 2011. During that time Director Danny Arbuckle owned and operated up to three forestry crews that specialised in logging in steep terrain. Following company restructure in May 2012, the company now only operates the one fully mechanised swing yarder hauler crew, RAL 86, which was the crew interviewed for this case study.

As part of their commitment to Health and Safety Rayonier place contractual obligations on contractors who, pre-contract, are required to confirm that they are working to health safety standards, are maintaining an effective health and safety management system, have the appropriate health and safety equipment and a good record of health and safety. The

contract that is signed between Rayonier and contractors has explicit health and safety requirements, including:

- compliance with health and safety legislation and codes of practice
- health and safety management system requirements including drug and alcohol management and associated testing and rehabilitation
- minimum standards of training and worker competency
- hazard identification and sharing of hazard information
- accident and incident reporting and investigation
- forest specific work rules (e.g., forestry road use, firearms)
- mobile plant fit for purpose
- attendance at safety training sessions.

Compared to other sectors that are involved with outside work, forestry has the highest fatality rate with around four people dying in forestry accidents each year. While about half of these happen outside commercial forests, most occur in the high risk activities of tree felling and breaking out. In addition to fatalities forestry has the highest rate of serious harm incidents with around 18 for every 1000 workers.

The company has developed a high media profile through winning regional and national awards for their approaches to and practices of health and safety. In 2007 they won Best Overall Contribution to Improving Workplace Health and Safety in the New Zealand Workplace Health & Safety Awards.

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4.0 CONCLUSION

Regardless of the type of work environment an employee spends time in, he or she may face exposure to various workplace hazards. They may be visible in nature, or they may involve airborne toxins or other hazards that are not readily visible. As stated, today's employers are required to

create a safe work environment free from hazards to the fullest degree possible, and a number of different laws exist to ensure this happens across all industries. Among employer obligations in regard to workplace exposure is the fact that business owners must, by law, inform employees of any existing known dangers. Often, this information comes in the form of a Material Safety Data Sheet (MSDS). The MSDS may contain a wealth of information, from the possible health concerns associated with a particular toxin to what employees should wear (for example, protective clothing or glasses) to minimise their risk of exposure. Employers are obligated to create hazard-free work spaces for their employees to the fullest extent possible. Any employer who fails to do so runs the risk of fines or lawsuits.

5.0 SUMMARY

In this unit, you have learnt that workplace safety involves provision of safe working environment for workers and ensuring that the working environment is congenial to the health of the workers. You have also learnt that there are various measures to be put in place to ensure workplace safety for employee viz: hazard identification, formulation of workplace safety policies, periodic safety training, provision of personal protective equipment (PPEs) and ergonomic workplace station, reporting process, evacuation and first aid kits.

Finally, we showed the various benefits attached to workplace safety if properly implemented. One of the aspects of maintaining a productive workplace is making sure that there is effective health, safety and security procedures in place. Effective procedures protect your employees, customers, guests and facilities from harm and damage. Review your health and safety procedures regularly with your management team to see if any changes need to be made to make the policies more effective.

6.0 TUTOR-MARKED ASSIGNMENT

1. Describe the importance of workplace safety in the context of occupational health.
2. List the objectives of workplace safety.
3. Briefly explain the terms:
   a. Hazard Identification, b. Ergonomic Workstation, c. Safety Training, d. Exposure and Employee Right, e. Toxic Labeling.

4. Some work environments, such as factories or food-production facilities, are more prone to damaging substances or toxins simply due to the nature of the business. Explain in details the workplace safety measures you will put in place.

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UNIT 4 TYPES AND APPLICATION OF SAFETY EQUIPMENT

CONTENTS

1.0 INTRODUCTION

The Occupational Safety and Health Administration (OSHA) require that employers protect their employees from workplace hazards that can cause injury. Controlling a hazard at its source is the best way to protect employees. Depending on the hazard or workplace conditions, OSHA recommends the use of engineering or work practice controls to manage or eliminate hazards to the greatest extent possible. When engineering, work practice and administrative controls are not feasible or do not provide sufficient protection, employers must provide personal protective equipment (PPE) to their employees and ensure its use.

Personal protective equipment, commonly referred to as “PPE”, is equipment worn to minimise exposure to a variety of hazards.

In this unit, you will learn about the definition of PPE, when to use PPE and suitability of PPEs. You will also be taken through information, instruction and training on PPEs use. Finally, this unit will end, with the various types of PPE, how to maintain and store PPE.

2.0 OBJECTIVES

By the end of this unit, you will be able to:

- define PPE
- discuss the suitability and when to use PPE
- provide information, instruction and training on the use of PPE
- discuss the various type of PPE and their relevance
- discuss the maintenance and storage of PPE.

3.0 MAIN CONTENT

3.1 What is Personal Protective Equipment (PPE)?

The term personal protective equipment, or simply PPE, refers to a large group of products designed to protect workers from workplace hazards. PPE is defined in the Personal Protective Equipment at Work Regulations as ‘all equipment (including clothing affording protection against the weather) which is intended to be worn or held by a person at work and which protects him against one or more risks to his health or safety’. PPE is used in environments in which all hazards have not been designed out of processes. A risk assessment should always be carried out before PPE is chosen and work commences.

Personal Protective Equipment, are the tools that ensure the basic health protection and safety of users. PPE is any device or appliance designed to be worn by an individual when exposed to one or more health and safety hazards. PPE includes all clothing and other work accessories designed to create a barrier against workplace hazards, and using PPE requires hazard awareness and training on the part of the user. Employees must be aware that the equipment does not eliminate the hazard; if the equipment fails, exposure will occur. To reduce the possibility of failure, equipment must be properly fitted and maintained in a clean and serviceable condition.

3.2 When to use PPE

PPE must always be regarded as a 'last resort' to protect against risks to safety and health. Engineering controls and safe systems of work must always be considered first. For example, it may be possible to do the job using methods that will not require the use of PPE. If this is not possible, more effective safeguards should be put in place. For example, fixed screens could be provided rather than individual eye protection.

There are a number of reasons why PPE must be considered as a 'last resort':

- PPE only protects the person wearing it, whereas measures controlling the risk at source protect everyone in the workplace.
- Theoretical maximum levels of protection are difficult to achieve and the actual level of protection is difficult to assess. Effective protection is only achieved by selecting suitable PPE and if it is correctly fitted, maintained and used.
- PPE may restrict the wearer to some extent by limiting mobility or visibility, or by requiring additional weight to be carried. Thus creating additional hazards.

3.3 Suitability of PPE

To be able to choose the right type of PPE, the hazards involved in the task or work environment must be considered carefully. PPE must also meet the needs of the individual.

The following factors should be considered when assessing the suitability of PPE:

- is the PPE appropriate for the risk involved and conditions at the place where exposure may occur? e.g. goggles are not suitable when full-face protection is required.
- does the PPE prevent or adequately control the risks involved without increasing the overall risk? e.g. gloves should not be worn when using a pillar drill, due to the increased risk of entanglement.
- can the PPE be adjusted to fit the wearer correctly? e.g. if a person wears glasses, ear defenders may not provide a proper seal to protect against noise hazards
- has the state of health of those using it been taken into account?
- what are the needs of the job and the demands it places on the wearer? How long will the PPE need to be worn? What are the requirements for visibility and communication?

- if more than one item of PPE is being worn, are they compatible? For example, does a particular type of respirator make it difficult for eye protection to fit properly?

3.4 Information and instruction on PPE use

Where PPE is provided, employees must be provided with adequate information, instruction and/or training on its use. The extent of information, instruction and/or training will vary with the complexity and performance of the kit. For example, a full Breathing Apparatus kit will require more training to use properly than a disposable face mask.

Information and instruction should cover:

- the risk(s) present and why the PPE is needed
- the operation (including demonstration), performance and limitations of the equipment
- use and storage (including how to put it on, how to adjust and remove it)
- any testing requirements before use
- any user maintenance that can be carried out (e.g. hygiene/cleaning procedures)
- factors that can affect the performance of the equipment (e.g. working conditions, personal factors, defects and damage)
- how to recognise defects in PPE, and arrangements for reporting them
- where to obtain replacement PPE.

In addition to initial training, refresher training may be required from time to time. Supervisor checks on the use of PPE may help determine when refresher training is required.

3.5 Training Employees in the Proper Use of PPE

Employers are required to train each employee who must use PPE. Employees must be trained to know at least the following:

- When PPE is necessary.
- What PPE is necessary?
- How to properly put on, take off, adjust and wear the PPE.
- The limitations of the PPE.
- Proper care, maintenance, useful life and disposal of PPE.

Employers should make sure that each employee demonstrates an understanding of the PPE training as well as the ability to properly wear and use PPE before they are allowed to perform work requiring the use of the PPE. If an employer believes that a previously trained employee is not demonstrating the proper understanding and skill level in the use of PPE, that employee should receive retraining. Other situations that require additional or retraining of employees include the following circumstances: changes in the workplace or in the type of required PPE that make prior training obsolete.

The employer must document the training of each employee required to wear or use PPE by preparing a certification containing the name of each employee trained, the date of training and a clear identification of the subject of the certification.

3.6 Duties of employees regarding PPE

The Personal Protective Equipment at Work Regulations place duties on employees to take reasonable steps to ensure that PPE provided is properly used.

The Regulations also place the following duties on employees:

- PPE must be worn and used in accordance with the instructions provided to them
- Employees must take all reasonable steps to ensure that PPE is returned to the accommodation provided for it after it has been used (unless the employee may take PPE away from the workplace e.g. footwear or clothing)
- PPE must be examined before use
- Any loss or obvious defect must be immediately reported to their supervisor
- Employees must take reasonable care for any PPE provided to them and not carry out any maintenance unless trained and authorised.

3.7 Types of PPE

3.7. 1 Eyes and Face Protection

Employees can be exposed to a large number of hazards that pose danger to their eyes and face. OSHA requires employers to ensure that employees have appropriate eye or face protection if they are exposed to eye or face hazards from flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, potentially infected material or potentially harmful light radiation.

Many occupational eye injuries occur because employees are not wearing any eye protection while others result from wearing improper or poorly fitting eye protection. Employers must be sure that their employees wear appropriate eye and face protection and that the selected form of protection is appropriate to the work being performed and properly fits each employee exposed to the hazard.

Prescription Lenses

Everyday use of prescription corrective lenses will not provide adequate protection against most occupational eye and face hazards, so employers must make sure that employees with corrective lenses either wear eye protection that incorporates the prescription into the design or wear additional eye protection over their prescription lenses. It is important to ensure that the protective eyewear does not disturb the proper positioning of the prescription lenses so that the employee's vision will not be inhibited or limited. Also, employees who wear contact lenses must wear eye or face PPE when working in hazardous conditions.

Eye Protection for Exposed Employees

OSHA suggests that eye protection be routinely considered for use by carpenters, electricians, machinists, mechanics, millwrights, plumbers and pipefitters, sheet metal employees and tinsmiths, assemblers, sanders, grinding machine operators, sawyers, welders, laborers, chemical process operators and handlers, and timber cutting and logging workers. Employers of employees in other job categories should decide whether there is a need for eye and face PPE through a hazard assessment.

Examples of potential eye or face injuries include:

- Dust, dirt, metal or wood chips entering the eye from activities such as chipping, grinding, sawing, hammering, the use of power tools or even strong wind forces.
- Chemical splashes from corrosive substances, hot liquids, solvents or other hazardous solutions.
- Objects swinging into the eye or face, such as tree limbs, chains, tools or ropes.
- Radiant energy from welding, harmful rays from the use of lasers or other radiant light (as well as heat, glare, sparks, splash and flying particles).

Types of Eye Protection

Selecting the most suitable eye and face protection for employees should take into consideration the following elements:

- Ability to protect against specific workplace hazards.
- Should fit properly and be reasonably comfortable to wear.
- Should provide unrestricted vision and movement.
- Should be durable and cleanable.

Should allow unrestricted functioning of any other required PPE. An employer may choose to provide one pair of protective eyewear for each position rather than individual eyewear for each employee. If this is done, the employer must make sure that employees disinfect shared protective eyewear after each use. Protective eyewear with corrective lenses may only be used by the employee for whom the corrective prescription was issued and may not be shared among employees.

Some of the most common types of eye and face protection include the following:

- **Safety spectacles.** These protective eyeglasses have safety frames constructed of metal or plastic and impact-resistant lenses. Side shields are available on some models.
- **Goggles.** These are tight-fitting eye protection that completely cover the eyes, eye sockets and the facial area immediately surrounding the eyes and provide protection from impact, dust and splashes. Some goggles will fit over corrective lenses.
- **Welding shields.** Constructed of vulcanised fiber or fiberglass and fitted with a filtered lens, welding shields protect eyes from burns caused by infrared or intense radiant light; they also protect both the eyes and face from flying sparks, metal spatter and slag chips produced during welding, brazing, soldering and cutting operations. OSHA requires filter lenses to have a shade number appropriate to protect against the specific hazards of the work being performed in order to protect against harmful light radiation.
- **Laser safety goggles.** These specialty goggles protect against intense concentrations of light produced by lasers. The type of laser safety goggles an employer chooses will depend upon the equipment and operating conditions in the workplace.
- **Face shields.** These transparent sheets of plastic extend from the eyebrows to below the chin and across the entire width of the

employee's head. Some are polarised for glare protection. Face shields protect against nuisance dusts and potential splashes or sprays of hazardous liquids but will not provide adequate protection against impact hazards. Face shields used in combination with goggles or safety spectacles will provide additional protection against impact hazards.

Each type of protective eyewear is designed to protect against specific hazards. Employers can identify the specific workplace hazards that threaten employees' eyes and faces by completing a hazard assessment as outlined in the earlier section.

3.7.2 Head Protection

Protecting employees from potential head is a key of any safety program. A head injury can impair an employee for life or it can be fatal. Wearing a safety helmet or hard hat is one of the easiest way to protect an employee's head from injury. Hard hats can protect employees from impact and penetration hazards as well as from electrical shock and burn hazards.

Employers must ensure that their employees wear head protection if any of the following apply:

- Objects might fall from above and strike them on the head;
- They might bump their heads against fixed objects, such as exposed pipes or beams; or
- There is a possibility of accidental head contact with electrical hazards.

Some examples of occupations in which employees should be required to wear head protection include construction workers, carpenters, electricians, linemen, plumbers and pipefitters, timber and log cutters, welders, among many others. Whenever there is a danger of objects falling from above, such as working below others who are using tools or working under a conveyor belt, head protection must be worn. Hard hats must be worn with the bill forward to protect employees properly.

In general, protective helmets or hard hats should do the following:

- Resist penetration by objects.
- Absorb the shock of a blow.
- Be water-resistant and slow burning.

- Have clear instructions explaining proper adjustment and replacement of the suspension and headband.

Hard hats must have a hard outer shell and a shock-absorbing lining that incorporates a headband and straps that suspend the shell from 1 to 1 1/4 inches (2.54 cm to 3.18 cm) away from the head. This type of design provides shock absorption during an impact and ventilation during normal wear.

Types of Hard Hats

There are many types of hard hats available in the marketplace today. In addition to selecting protective headgear that meets OHSA standard requirements, employers should ensure that employees wear hard hats that provide appropriate protection against potential workplace hazards. It is important for employers to understand all potential hazards when making this selection, including electrical hazards. This can be done through a comprehensive hazard analysis and an awareness of the different types of protective headgear available.

Hard hats are divided into three industrial classes:

- **Class A hard hats** provide impact and penetration resistance along with limited voltage protection (up to 2,200 volts).
- **Class B hard hats** provide the highest level of protection against electrical hazards, with high-voltage shock and burn protection (up to 20,000 volts). They also provide protection from impact and penetration hazards by flying/falling objects.
- **Class C hard hats** provide lightweight comfort and impact protection but offer no protection from electrical hazards.

Another class of protective headgear on the market is called a “bump hat,” designed for use in areas with low head clearance. They are recommended for areas where protection is needed from head bumps and lacerations. These are not designed to protect against falling or flying objects. It is essential to check the type of hard hat employees are using to ensure that the equipment provides appropriate protection. Each hat should bear a label inside the shell that lists the manufacturer and the class of the hat.

Size and Care Considerations

Head protection that is either too large or too small is inappropriate for use, even if it meets all other requirements. Protective headgear must fit appropriately on the body and for the head size of each individual. Periodic cleaning and inspection will extend the useful life of protective headgear. A daily inspection of the hard hat shell, suspension system and other accessories for holes, cracks, tears or other damage that might compromise the protective value of the hat is essential. Paints, paint thinners and some cleaning agents can weaken the shells of hard hats and may eliminate electrical resistance. Consult the helmet manufacturer for information on the effects of paint and cleaning materials on their hard hats. Never drill holes, paint or apply labels to protective headgear as this may reduce the integrity of the protection. Do not store protective headgear in direct sunlight, such as on the rear window shelf of a car, since sunlight and extreme heat can damage them.

3.7.3 Foot and Leg Protection

Employees who face possible foot or leg injuries from falling or rolling objects or from crushing or penetrating materials should wear protective footwear. Also, employees whose work involves exposure to hot substances or corrosive or poisonous materials must have protective gear to cover exposed body parts, including legs and feet. If an employee's feet may be exposed to electrical hazards, non-conductive footwear should be worn. On the other hand, workplace exposure to static electricity may necessitate the use of conductive footwear

Examples of situations in which an employee should wear foot and/or leg protection include:

- When heavy objects such as barrels or tools might roll onto or fall on the employee's feet;
- Working with sharp objects such as nails or spikes that could pierce the soles or uppers of ordinary shoes;
- Exposure to molten metal that might splash on feet or legs;
- Working on or around hot, wet or slippery surfaces; and
- Working when electrical hazards are present.

Foot and leg protection choices include the following:

- **Leggings** protect the lower legs and feet from heat hazards such as molten metal or welding sparks. Safety snaps allow leggings to be removed quickly.

- **Metatarsal guards** protect the instep area from impact and compression. Made of aluminum, steel, fiber or plastic, these guards may be strapped to the outside of shoes.
- **Toe guards** fit over the toes of regular shoes to protect the toes from impact and compression hazards. They may be made of steel, aluminum or plastic.
- **Combination foot and shin guards** protect the lower legs and feet, and may be used in combination with toe guards when greater protection is needed.
- **Safety shoes** have impact-resistant toes and heat-resistant soles that protect the feet against hot work surfaces common in roofing, paving and hot metal industries. The metal insoles of some safety shoes protect against puncture wounds. Safety shoes may also be designed to be electrically conductive to prevent the buildup of static electricity in areas with the potential for explosive atmospheres or nonconductive to protect employees from workplace electrical hazards.

Special Purpose Shoes

Electrically conductive shoes provide protection against the buildup of static electricity. Employees working in explosive and hazardous locations such as explosives manufacturing facilities or grain elevators must wear conductive shoes to reduce the risk of static electricity buildup on the body that could produce a spark and cause an explosion or fire. Foot powder should not be used in conjunction with protective conductive footwear because it provides insulation, reducing the conductive ability of the shoes. Silk, wool and nylon socks can produce static electricity and should not be worn with conductive footwear. Conductive shoes must be removed when the task requiring their use is completed. Note: Employees exposed to electrical hazards must never wear conductive shoes.

Electrical hazard, safety-toe shoes are nonconductive and will prevent the wearers' feet from completing an electrical circuit to the ground. These shoes can protect against open circuits of up to 600 volts in dry conditions and should be used in conjunction with other insulating equipment and additional precautions to reduce the risk of an employee becoming a path for hazardous electrical energy. The insulating protection of electrical hazard, safety-toe shoes may be compromised if the shoes become wet, the soles are worn through, metal particles become embedded in the sole or heel, or employees touch conductive, grounded items. Note: Nonconductive footwear must not be used in explosive or hazardous locations.

Foundry Shoes

In addition to insulating the feet from the extreme heat of molten metal, foundry shoes keep hot metal from lodging in shoe eyelets, tongues or other shoe parts. These snug-fitting leather or leather-substitute shoes have leather or rubber soles and rubber heels. All foundry shoes must have built-in safety toes.

Care of Protective Footwear

As with all protective equipment, safety footwear should be inspected prior to each use. Shoes and leggings should be checked for wear and tear at reasonable intervals. This includes looking for cracks or holes, separation of materials, broken buckles or laces. The soles of shoes should be checked for pieces of metal or other embedded items that could present electrical or tripping hazards. Employees should follow the manufacturers' recommendations for cleaning and maintenance of protective footwear.

3.7.4 Hand and Arm Protection

If a workplace hazard assessment reveals that employees face potential injury to hands and arms that cannot be eliminated through engineering and work practice controls, employers must ensure that employees wear appropriate protection. Potential hazards include skin absorption of harmful substances, chemical or thermal burns, electrical dangers, bruises, abrasions, cuts, punctures, fractures and amputations. Protective equipment includes gloves, finger guards and arm coverings or elbow-length gloves.

Employers should explore all possible engineering and work practice controls to eliminate hazards and use PPE to provide additional protection against hazards that cannot be completely eliminated through other means. For example, machine guards may eliminate a hazard. Installing a barrier to prevent employees from placing their hands at the point of contact between a table saw blade and the item being cut is another method.

Types of Protective Gloves

There are many types of gloves available today to protect against a wide variety of hazards. The nature of the hazard and the operation involved will affect the selection of gloves. The variety of potential occupational hand injuries makes selecting the right pair of gloves challenging. It is essential that employees use gloves specifically designed for the hazards and tasks found in their workplace because gloves designed for one

function may not protect against a different function even though they may appear to be an appropriate protective device.

The following are examples of some factors that may influence the selection of protective gloves for a workplace.

- Type of chemicals handled.
- Nature of contact (total immersion, splash, etc.).
- Duration of contact.
- Area requiring protection (hand only, forearm, arm).
- Grip requirements (dry, wet, oily).
- Thermal protection.
- Size and comfort.
- Abrasion/resistance requirements.

Gloves made from a wide variety of materials are designed for many types of workplace hazards. In general, gloves fall into four groups:

- Gloves made of leather, canvas or metal mesh;
- Fabric and coated fabric gloves;
- Chemical- and liquid-resistant gloves;
- Insulating rubber gloves

Leather, Canvas or Metal Mesh Gloves

Sturdy gloves made from metal mesh, leather or canvas provide protection against cuts and burns. Leather or canvass gloves also protect against sustained heat.

- **Leather gloves** protect against sparks, moderate heat, blows, chips and rough objects.
- **Aluminised gloves** provide reflective and insulating protection against heat and require an insert made of synthetic materials to protect against heat and cold.
- **Aramid fiber gloves** protect against heat and cold, are cut- and abrasive-resistant and wear well.
- **Synthetic gloves** of various materials offer protection against heat and cold, are cut- and abrasive-resistant and may withstand some diluted acids. These materials do not stand up against alkalis and solvents.

Fabric and Coated Fabric Gloves

Fabric and coated fabric gloves are made of cotton or other fabric to provide varying degrees of protection.

- **Fabric gloves** protect against dirt, slivers, chafing and abrasions. They do not provide sufficient protection for use with rough, sharp or heavy materials. Adding a plastic coating will strengthen some fabric gloves.
- **Coated fabric gloves** are normally made from cotton flannel with napping on one side. By coating the unnapped side with plastic, fabric gloves are transformed into general-purpose hand protection offering slip-resistant qualities. These gloves are used for tasks ranging from handling bricks and wire to chemical laboratory containers. When selecting gloves to protect against chemical exposure hazards, always check with the manufacturer or review the manufacturer's product literature to determine the gloves' effectiveness against specific workplace chemicals and conditions.

Chemical- and Liquid-Resistant Gloves

Chemical-resistant gloves are made with different kinds of rubber: natural, butyl, neoprene, nitrile and fluorocarbon (viton); or various kinds of plastic: polyvinyl chloride (PVC), polyvinyl alcohol and polyethylene. These materials can be blended or laminated for better performance. As a general rule, the thicker the glove material, the greater the chemical resistance but thick gloves may impair grip and dexterity, having a negative impact on safety.

Some examples of chemical-resistant gloves include:

- **Butyl gloves** are made of a synthetic rubber and protect against a wide variety of chemicals, such as peroxide, rocket fuels, highly corrosive acids (nitric acid, sulfuric acid, hydrofluoric acid and red-fuming nitric acid), strong bases, alcohols, aldehydes, ketones, esters and nitro compounds. Butyl gloves also resist oxidation, ozone corrosion and abrasion, and remain flexible at low temperatures. Butyl rubber does not perform well with aliphatic and aromatic hydrocarbons and halogenated solvents.
- **Natural (latex) rubber gloves** are comfortable to wear, which makes them a popular general-purpose glove. They feature outstanding tensile strength, elasticity and temperature resistance. In addition to resisting abrasions caused by grinding and polishing, these gloves protect employees' hands from most water solutions of acids, alkalis, salts and ketones. Latex gloves have caused allergic reactions in some individuals and may not be appropriate for all employees. Hypoallergenic gloves, glove liners and powderless gloves are possible alternatives for employees who are allergic to latex gloves.

- **Neoprene gloves** are made of synthetic rubber and offer good pliability, finger dexterity, high density and tear resistance. They protect against hydraulic fluids, gasoline, alcohols, organic acids and alkalis. They generally have chemical and wear resistance properties superior to those made of natural rubber.
- **Nitrile gloves** are made of a copolymer and provide protection from chlorinated solvents such as trichloroethylene and per-chloroethylene. Although intended for jobs requiring dexterity and sensitivity, nitrile gloves stand up to heavy use even after prolonged exposure to substances that cause other gloves to deteriorate. They offer protection when working with oils, greases, acids, caustics and alcohols but are generally not recommended for use with strong oxidizing agents, aromatic solvents, ketones and acetates.

Care of Protective Gloves

Protective gloves should be inspected before each use to ensure that they are not torn, punctured or made ineffective in any way. A visual inspection will help detect cuts or tears but a more thorough inspection by filling the gloves with water and tightly rolling the cuff towards the fingers will help reveal any pinhole leaks. Gloves that are discolored or stiff may also indicate deficiencies caused by excessive use or degradation from chemical exposure.

Any gloves with impaired protective ability should be discarded and replaced. Reuse of chemical-resistant gloves should be evaluated carefully, taking into consideration the absorptive qualities of the gloves. A decision to reuse chemically-exposed gloves should take into consideration the toxicity of the chemicals involved and factors such as duration of exposure, storage and temperature.

3.7.5 Body Protection

Employees who face possible bodily injury of any kind that cannot be eliminated through engineering, work practice or administrative controls, must wear appropriate body protection while performing their jobs. In addition to cuts and radiation, the following are examples of workplace hazards that could cause bodily injury:

- Temperature extremes;
- Hot splashes from molten metals and other hot liquids;
- Potential impacts from tools, machinery and materials;
- Hazardous chemicals.

Types of Body Protection

There are many varieties of protective clothing available for specific hazards. Employers are required to ensure that their employees wear personal protective equipment only for the parts of the body exposed to possible injury.

Types of body protection include:

- overalls, aprons and coveralls (protection against hazardous substances)
- laboratory coats
- surgical gowns
- clothing for cold, heat and bad weather
- clothing to protect against machinery, e.g. chainsaws
- high visibility clothing (e.g. jackets, vests)
- harnesses
- back supports
- life jackets
- full body suits.

If a hazard assessment indicates a need for full body protection against toxic substances or harmful physical agents, the clothing should be carefully inspected before each use, it must fit each employee properly and it must function properly and for the purpose for which it is intended.

Protective clothing comes in a variety of materials, each effective against particular hazards, such as:

- **Paper-like fiber** used for disposable suits provide protection against dust and splashes.
- **Treated wool and cotton** adapts well to changing temperatures, is comfortable, and fire-resistant and protects against dust, abrasions and rough and irritating surfaces.
- **Duck** is a closely woven cotton fabric that protects against cuts and bruises when handling heavy, sharp or rough materials.
- **Leather** is often used to protect against dry heat and flames.
- **Rubber, rubberised fabrics, neoprene and plastics** protect against certain chemicals and physical hazards. When chemical or physical hazards are present, check with the clothing manufacturer to ensure that the material selected will provide protection against the specific hazard.

3.7.6 Torso Protection

Many hazards can threaten the torso: heat, splashes from hot metals and liquids, impacts, cuts, acids, and radiation. A variety of protective clothing is available, including vests, jackets, aprons, coveralls, and full body suits. Fire retardant wool and specially treated cotton clothing items are comfortable, and they adapt well to a variety of workplace temperatures. Other types of protection include leather, rubberised fabrics, and disposable suits such as those made from tyvek.

3.7.7 Hearing Protection

Determining the need to provide hearing protection for employees can be challenging. Employee exposure to excessive noise depends upon a number of factors, including:

- The loudness of the noise as measured in decibels (dB).
- The duration of each employee's exposure to the noise.
- Whether employees move between work areas with different noise levels.
- Whether noise is generated from one or multiple sources.

Generally, the louder the noise, the shorter the exposure time before hearing protection is required. For instance, employees may be exposed to a noise level of 90 dB for 8 hours per day (unless they experience a Standard Threshold Shift) before hearing protection is required. On the other hand, if the noise level reaches 115 dB hearing protection is required if the anticipated exposure exceeds 15 minutes.

If engineering and work practice controls do not lower employee exposure to workplace noise to acceptable levels, employees must wear appropriate hearing protection. It is important to understand that hearing protectors reduce only the amount of noise that gets through to the ears. The amount of this reduction is referred to as attenuation, which differs according to the type of hearing protection used and how well it fits. Hearing protectors worn by employees must reduce an employee's noise exposure to within the acceptable limits. Occupational Noise Exposure, for detailed information on methods to estimate the attenuation effectiveness of hearing protectors based on the device's noise reduction rating (NRR). Manufacturers of hearing protection devices must display the device's NRR on the product packaging. If employees are exposed to occupational noise at or above 85 dB averaged over an eight-hour period, the employer is required to institute a hearing conservation program that includes regular testing of employees' hearing by qualified professionals.

Types of Hearing Protection

Some types of hearing protection include:

- **Single-use earplugs** are made of waxed cotton, foam, silicone rubber or fiberglass wool. They are self-forming and, when properly inserted, they work as well as most molded earplugs.
- **Pre-formed or molded earplugs** must be individually fitted by a professional and can be disposable or reusable. Reusable plugs should be cleaned after each use.
- **Earmuffs** require a perfect seal around the ear. Glasses, facial hair, long hair or facial movements such as chewing may reduce the protective value of earmuffs.
- **Semi-inserts** (also called canal-caps), which cover the entrance to the ear canal.

3.7.8 Respiratory Protection

These are devices that help to control the development of occupational diseases caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, and vapors.

There are two main types of respiratory protective equipment:

- respirators that filter contaminated air or clean it as it is breathed in
- respirators that supply clean air from an independent source.

Work with harmful dusts, fumes, vapours can require respiratory protective equipment. Tasks where respiratory protection may be required include; welding, work with harmful substances, work in areas where large amounts of nuisance dust is present, work that creates dust (e.g. disc cutters).

3.8 Maintaining PPE

An effective system of maintenance of PPE is essential to make sure the equipment continues to provide the degree of protection for which it is designed. Therefore, the manufacturer's maintenance schedule (including recommended replacement periods and shelf lives) must always be followed. Maintenance may include; cleaning, examination, replacement, repair and testing. The wearer may be able carry out simple maintenance (e.g. cleaning), but more intricate repairs must only be carried out by competent personnel. The costs associated with the maintenance of PPE are the responsibility of the employer.

3.9 Storage for PPE

Where PPE is provided, adequate storage facilities for PPE must be provided for when it is not in use, unless the employee may take PPE away from the workplace (e.g. footwear or clothing). Accommodation may be simple (e.g. pegs for waterproof clothing or safety helmets) and it need not be fixed (e.g. a case for safety glasses or a container in a vehicle). Storage should be adequate to protect the PPE from contamination, loss, damage, damp or sunlight. Where PPE may become contaminated during use, storage should be separate from any storage provided for ordinary clothing.

3.10 Provision and replacement of PPE

Some organisations and departments operate central stores that deal with the provision of PPE. In most cases, individual units/service areas are responsible for arranging the supply of required PPE to staff. Regardless of the arrangements for supply, it is a management responsibility to ensure the provision of correct PPE. When considering arrangements for providing replacement PPE it must be remembered that unless a task requiring PPE can be stopped, avoided or delayed until new PPE is obtained, replacement PPE must always be readily available.

3.11 Case Studies on Application and Use of PPE

Case Study 1: This matter of Marshall and Queensland Rehabilitation Services involved an Assistant in Nursing who sustained an injury whilst trying to transfer a patient. The plaintiff alleged that the defendant breached its duty of care including allegations that the employer had failed to provide adequate instruction, training and assistance to enable her to perform her duties safely. The employer was able to demonstrate that it had implemented control measures and training to address essentially what was the risk in this case of manual handling risks. The employer was able to show that the claimant was provided with instructions and training in manual handling tasks and the content of that training included patient transfers, how to roll a patient and the use of a sling and a hoist. Evidence that the plaintiff signed a manual handling competency form for that training was also submitted. Now as Terry was saying previously, the reinforcement and retraining and updating of training, so within 10 months of the initial training, further training instruction in manual handling was provided by a Physiotherapist and a further acknowledgement and competency form was signed by the plaintiff. The plaintiff had also received instruction in respect of the care of dementia patients and under cross examination she accepted that she received instruction that if a resident resisted the process of being rolled, she was to stop that procedure. The evidence provided by the employer

in that case was, was of an appropriate system of work and the court found in favour of the employer.

Case Study 2: Briefly, the plaintiff was employed as a Slaughterman for Queensland Abattoir Corporation. He was experienced, having worked for other abattoirs for 21 years. He cut his left wrist and hand with a knife. There were two aspects of the employer's operations which were an issue: whether the employer provided a safe system of work on the slaughter line and the supply of cut-resistant gloves to workers to minimise that very real risk of injury when performing the specific task. So briefly just looking at the facts, the plaintiff alleged his employer was negligent because they failed to provide him with cut-resistant gloves, failed to instruct him to wear gloves and provided – and failed to provide him with training on how to perform these duties wearing gloves. The employer counter argued – counter argued saying that the cut-resistant gloves were provided and it was the injured worker that was at fault, essentially a contributory negligence argument, for not wearing them. The evidence – the court proved that the cut-resistant gloves were available at the time of the worker's injury and if the worker had been wearing the glove it would have avoided the injury. However, further evidence established that the employer did not direct or insist that workers employed in the same area as the injured worker, actually wear cut-resistant gloves. Rather, they informed these workers that they didn't need to wear them while performing their duties, although it was compulsory for workers in other areas within the business to use them. The employer couldn't establish it had enforced the use of gloves. The evidence, was that they did not enforce the slaughterman wear cut-resistant gloves as they were resistant to change, they were not averse to taking industrial action and the employer was reluctant to carry out any action which might provoke industrial conflict and wanted to be seen as a considerate employer. The court found that the employer failed to provide a safe system of work and although the worker was supplied with cut-resistant gloves, he was not actually instructed or forced to wear them. So there was no contributory negligence found.

4.0 CONCLUSION

Employers are required to assess the workplace to determine if hazards that require the use of head, eye, face, hand, or foot protection are present or are likely to be present. If hazards or the likelihood of hazards are found, employers must select, and have affected employees use, properly fitted PPE suitable for protection from these hazards. Before doing work requiring the use of PPE, employees must be trained to know when PPE is necessary, what type is necessary, how it is to be

worn, and what its limitations are, as well as its proper care, maintenance, useful life, and disposal.

5.0 SUMMARY

In this unit, you have learnt that:

i. PPE is equipment worn to minimise exposure to a variety of hazards. They are intended to be worn or held by a person at work which protects them against one or more risks to their health and safety.
ii. PPE must always be regarded as a 'last resort' to protect against risks to safety and health. Engineering controls and safe systems of work must always be considered first.
iii. To be able to choose the right type of PPE, the hazards involved in the task or work environment must be considered carefully. PPE must also meet the needs of the individual.
iv. Where PPE is provided, employees must be provided with adequate information, instruction and/or training on its use. The extent of information, instruction and/or training will vary with the complexity and performance of the kit.
v. There are several PPE that offers protection to the delicate and vital body's organs such as the head, eyes and face, ear, body, torso, hand and arm etc. These include items as gloves, foot and eye protection, protective hearing devices (earplugs, muffs) hard hats, respirators and full body suits.
vi. Lastly, the provision, maintenance, storage and replacement of PPE are the responsibility of the employer.

6.0 TUTOR-MARKED ASSIGNMENT

1. Discuss in detail the term "PPE" and why it must be considered as a 'last resort' in occupation health and safety.
2. Explain lucidly the various factors to be considered when assessing the suitability of PPE
3. Write a short and concise note on the responsibilities of "employers" and "employees" as regarding PPE.
4. Discuss in detail the use of PPE in followings:
   - Ear protection
   - Eyes and face protection
   - Head protection
   - Nose protection
   - Hand and arms protection
   - Body protection
   - Tonsil protection.

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MODULE 3 HAZARD RECOGNITION, EVALUATION AND CONTROL

UNIT 1 SOURCES OF HAZARDS

CONTENTS

1.0 INTRODUCTION

In the last module we learnt about the concept and importance of workplace safety. Specifically, you learnt the importance of personal protective equipment (PPEs) in the protection of workers from environmental and occupational hazards. How the proper and prompt use of PPEs can safeguard and ensure the wellbeing of the workers. In this unit, you will learn about the definition, concept and sources of hazards in an occupational setting.

2.0 OBJECTIVES

At the end of this unit, you will be able to:

- explain the definition and concept of hazard
- classify hazards based on their sources
- discuss the status and marking of a hazard.

3.0 MAIN CONTENT

3.1 Definition and Concept of Hazards

A **hazard** is an agent which has the potential to cause harm to a vulnerable target. The terms "hazard" and "risk" are often used interchangeably. However, in terms of risk assessment, these are two very distinct terms. A hazard is any agent that can cause harm or damage to humans, property, or the environment. **Risk** is defined as the probability that exposure to a hazard will lead to a negative consequence, or more simply, a hazard poses no risk if there is no exposure to that hazard. Hazards can be dormant or potential, with only a theoretical probability of harm. An event that is caused by interaction with a hazard is called an **incident**. The likely severity of the undesirable consequences of an incident associated with a hazard, combined with the probability of this occurring, constitute the associated risk. If there is no possibility of a hazard contributing towards an incident, there is no risk.

Kates (1978) defines environmental hazard as "the threat potential posed to man or nature by events originating in, or transmitted by, the natural or built environment". This definition includes a broader range of hazards ranging from long term environmental deterioration such as acidification of soils and build-up of atmospheric carbon dioxide to communal and involuntary social hazards such as crime and terrorism to voluntary and personal hazards such as drug abuse and mountain climbing. Environmental hazards usually have defined or common characteristics including their tendency to be rapid onset events meaning they occur with a short warning time, they have a clear source of origin which is easily identified, impact will be swift and losses suffered quickly during or shortly after on-set of the event, risk of exposure is usually involuntary due to location or proximity of people to the hazard and the "disaster occurs with an intensity and scale that justifies an emergency response"

Hazards may be grouped according to their characteristics. These factors are related to geophysical events which are not process specific:

1. Areal extent of damage zone
2. Intensity of impact at a point
3. Duration of impact at a point
4. Rate of onset of the event
5. Predictability of the event

In defining hazard Keith Smith argues that what may be defined as hazard is only a hazard if there is the presence of humans to make it a hazard and that it is otherwise merely an event of interest. In this sense the environmental conditions we may consider hostile or hazardous can be seen as neutral in that it is our perception, human location and actions which identify resources and hazards within the range of natural events. In this regard human sensitivity to environmental hazards is a combination of both physical exposure (natural and/or technological events at a location related to their statistical variability) and human vulnerability (in regard to social and economic tolerance of the same location).

3.2 Classification of Hazards

Hazards can be classified as different types in several ways. One of these ways is by specifying the origin of the hazard. One key concept in identifying a hazard is the presence of stored energy that, when released, can cause damage. Stored energy can occur in many forms: chemical, mechanical, thermal, radioactive, electrical, etc. Another class of hazard does not involve release of stored energy; rather it involves the presence of hazardous situations. Examples include confined or limited egress spaces, oxygen-depleted atmospheres, awkward positions, repetitive motions, low-hanging or protruding objects, etc.

Hazards may also be classified as natural, anthropogenic, or technological. They may also be classified as health or safety hazards and by the populations that may be affected, and the severity of the associated risk. In most cases a hazard may affect a range of targets, and have little or no effect on others. Identification of hazards assumes that the potential targets are defined.

3.3 Origin/Sources of Hazards

3.3.1 Natural Hazards

Natural hazards may be defined as "extreme events that originate in the biosphere, hydrosphere, lithosphere or atmosphere "or" a potential threat to humans and their welfare" which include earthquake, landslide, hurricane and tsunamis.

Smith states that natural hazards are best seen in an ecological framework in order to distinguish between natural events and natural hazards. He says "natural hazards, therefore, result from the conflict of geophysical processes with people and they lie at the interface what has been called the natural events system and the human interface system." He says that "this interpretation of natural hazards gives humans a central role. Firstly, through location, because it is only when people and their possessions get in the way of natural processes that hazard exists."

A natural hazard can be considered as a geophysical event which when it occurs in extremes and a human factor is involved that may present a risk. In this context we can see that there may be an acceptable variation of magnitude which can vary from the estimated normal or average range with upper and lower limits or thresholds. In these extremes the natural occurrence may become an event that presents risk to the environment or people. Smith says "most social and economic activities are geared to some expectation of the 'average' conditions. As long as the variation of the environmental element remains fairly close to this expected performance, insignificant damage occurs and the element will be perceived as beneficial. However, when the variability exceeds some threshold beyond the normal band of tolerance, the same variable starts to impose a stress on society and become a hazard." Thus above average wind speeds resulting in a tropical depression or hurricane according to intensity measures on the Saffir–Simpson scale will provide an extreme natural event which may be considered a hazard.

Natural hazards such as earthquakes, floods, volcanoes and tsunami have threatened people, society, the natural environment, and the built environment, particularly more vulnerable people, throughout history, and in some cases, on a day-to-day basis. According to the Red Cross, each year 130,000 people are killed, 90,000 are injured and 140 million are affected by unique events known as natural disasters. Recent policy-oriented work into hazard management began with the work of Gilbert White, the first person to study engineering schemes as a means of mitigating flooding in the US. From 1935 to 1967, White and his colleagues led the research into flood defences, and further collaboration on investigation was undertaken at the University of Chicago.

In December 1989, after several years of preparation, the United Nations General Assembly adopted resolution 44/236 proclaiming the 1990s as the International Decade for Natural Disaster Reduction. The objective of that decade was stated in the annex of Resolution 44/236 as follows:

"…to reduce through concerted international action, especially in developing countries, the loss of life, property damage, and social and economic disruption caused by natural disasters, such as earthquakes, wind-storms, tsunamis, floods, landslides, volcanic eruptions, wildfire, grasshopper and locust infestations, drought and desertification and other calamities of natural origin."

Methods to reduce risk from natural hazards include construction of high-risk facilities away from areas with high risk, engineering redundancy, emergency reserve funds, purchasing relevant insurance, and the development of operational recovery plans.

3.3.2 Anthropogenic Hazards

These are hazards due to human behaviour and activities. The social, natural and built environment are not only at risk from geophysical hazards, but also from technological hazards including industrial explosions, release of chemical hazards and major accident hazards (MAHs). Technological and man-made hazards include explosions, release of toxic materials, episodes of severe contamination, structural collapses, and transportation, construction and manufacturing accidents, etc.

3.4 Status of a Hazard

Hazards are sometimes classified into three modes or statuses:

- **Dormant**—The situation environment is currently affected. For instance, a hillside may be unstable, with the potential for a landslide, but there is nothing below or on the hillside that could be affected.
- **Armed**—People, property, or environment is in potential harm's way.
- **Active**—A harmful incident involving the hazard has actually occurred. Often this is referred to not as an "active hazard" but as an accident, emergency, incident, or disaster.

3.5 Marking of Hazards

Hazard symbols or warning symbols are easily recognisable symbols designed to warn about hazardous materials, locations, or objects, The use of hazard symbols is often regulated by law and directed by standards organisations. Hazard symbols may appear with different colors, backgrounds, borders and supplemental

information in order to specify the type of hazard and the level of threat (for example, toxicity classes). Warning symbols are used in many places in lieu of or addition to written warnings as they are quickly recognised (faster than reading a written warning) and more universally understood, as the same symbol can be recognised as having the same meaning to speakers of different languages.

Figure 1: Skull and crossbones, a common symbol for poison and other sources of lethal danger (GHS hazard pictograms)

3.6 Case Study of Hazard Identification/Source

District Judge sets bigger fine for tripping hazards than for food hygiene offences saying that "The safety of employees is imperative." & the conditions were "An accident waiting to happen." An Environmental Health Officer from South Derbyshire District Council has prosecuted a restaurant proprietor after tripping hazards were found during a routine visit and again on enforcement re-visit. A very congested storeroom, which is unsuitable for purpose electrical cable laying across a step. An initial inspection by a local authority resulted in the service of Improvement Notice for tripping hazards in a restaurant storage area. The notice was subsequently complied with and the proprietor was given advice at that time about ensuring that the premises were kept free from such hazards. A subsequent visit undertaken by the EHO again revealed tripping hazards. Although no tripping accidents had occurred, the prosecution was taken after the previous advice was apparently ignored.

An electrical cable was seen trailing across a step. A storeroom, which had to be regularly accessed by staff to obtain items such as toilet paper and the highchair provided for customer use, was almost completely

obstructed and virtually inaccessible because of the clutter of things being haphazardly stored there. A prosecution for the tripping hazards was taken alongside various food hygiene offences. The proprietor pleaded guilty to not keeping floors free from articles which may cause a person to trip, contrary to Regulation 12(3) of the Workplace (Health, Safety and Welfare) Regulations 1992.

The case was heard by a District Judge who said that 'the safety of employees is imperative'. He said the tripping hazards, particularly the trailing cable, were 'an accident waiting to happen'. The proprietor was fined £1000 for this offence, compared to fines of £500 for non-compliance with Food Safety Improvement Notices and £250 for the food hygiene offences, showing the significance that the Judge gave to the tripping hazard. Full costs were also awarded to South Derbyshire District Council.

The problems in the storeroom were sorted out and the trailing cable was re-routed after the visit. The local authority's decision to take the prosecution was influenced by the impact that it would have on other duty holders through raising awareness of simple tripping hazards such as electrical cables and the importance of avoiding them.

4.0 CONCLUSION

A hazard is an agent that can cause harm or damage to humans, property, or the environment. Risk is the probability that exposure to a hazard will lead to a negative consequence, or more simply, a hazard poses no risk if there is no exposure to that hazard. A hazard may occur from natural events or anthropogenic sources. Identification of hazards assumes that the potential targets are defined, and is the first step in performing a risk assessment.

5.0 SUMMARY

In this unit, you have been acquainted with the definition and concept of hazards. You learnt that a hazard is an agent which has the potential to cause harm to a vulnerable target be it person, thing or place. Hazards can be classified in several ways viz: based on energy source (biological, chemical, mechanical, radioactive, physical, psychosocial, etc.); based on origin (natural and anthropogenic); and based on effect (health, safety, economic and environmental). The status of a hazard may be dormant, armed or active. The threats posed by a hazard are:

1. Hazards to people – death, injury, disease and stress
2. Hazards to goods – property damage and economic loss

3. Hazards to environment –loss of flora and fauna, pollution and loss of amenity[

To safe guard people in the environment or workers in occupational setting warning symbols are often put in designated places to warn about hazardous materials, locations, or objects. The use of hazard symbols is often regulated by law and directed by standards organisations. In the next unit, we shall discuss concisely on the various types of hazards found in occupational setting.

6.0 TUTOR-MARKED ASSIGNMENT

1. Write a short and concise note on the following terminologies:
   - Hazard
   - Risk
   - Vulnerability
   - Disaster
   - Incident
   - Natural environment
   - Built environment

2. Write an essay to illustrate a global disaster arising from:
   - natural hazard
   - anthropogenic hazard.

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UNIT 2 TYPES OF HAZARDS

CONTENTS

1.0 INTRODUCTION

Most workers are faced with a combination of these hazards at work. For example, it is not difficult to imagine a workplace where you are exposed to chemicals, unguarded and noisy machines, hot temperatures, slippery floors, etc. all at the same time. To be effective in recognising and evaluating on-the-job hazards and recommending controls, industrial hygienists must be familiar with the hazards' characteristics. Potential hazards can include air contaminants, and chemical, biological, physical, and ergonomic hazards. In this unit, you will be exposed to the ranges of hazards that exist in workplaces that workers are daily exposed to.

2.0 OBJECTIVES

At the end of this unit, you will be able to:

- recognised the various ranges of hazards that workers are exposed to in the workplace.
- discussed the potential health hazards in occupational exposure.

3.0 MAIN CONTENT

3.1 Ranges of Hazards

There are an unlimited number of hazards that can be found in almost any workplace. There are obvious unsafe working conditions, such as unguarded machinery, slippery floors or inadequate fire precautions, but there are also a number of categories of insidious hazards (that is, those hazards that are dangerous but which may not be obvious) including:

- chemical hazards, arising from liquids, solids, dusts, fumes, vapours and gases;
- physical hazards, such as noise, vibration, unsatisfactory lighting, radiation and extreme temperatures;
- biological hazards, such as bacteria, viruses, infectious waste and infestations;
- psychological hazards resulting from stress and strain;
- hazards associated with the non-application of ergonomic principles, for example badly designed machinery, mechanical devices and tools used by workers, improper seating and workstation design, or poorly designed work practices.

3.2 Potential Health Hazards

3.2.1 Air Contaminants

These are commonly classified as either particulate or gas and vapor contaminants. Themost common particulate contaminants include dusts, fumes, mists, aerosols, and fibers.

Dusts are solid particles generated by handling, crushing, grinding, colliding, exploding, and heating organic or inorganic materials such as rock, ore, metal, coal, wood, and grain.

Fumes are formed when material from a volatilised solid condenses in cool air. In most cases, the solid particles resulting from the condensation react with air to form an oxide.

The term **mist** is applied to liquid suspended in the atmosphere. Mists are generated by liquids condensing from a vapor back to a liquid or by a liquid being dispersed by splashing or atomizing. **Aerosols** are also a form of a mist characterised by highly respirable, minute liquid particles.

Fibers are solid particles whose length is several times greater than their diameter, such as asbestos.

Gases are formless fluids that expand to occupy the space or enclosure in which they are confined. They are atomic, diatomic, or molecular in nature as opposed to droplets or particles which are made up of millions of atoms or molecules. Through evaporation, liquids change into vapors and mix with the surrounding atmosphere. **Vapors** are the volatile form of substances that are normally in a solid or liquid state at room temperature and pressure. Vapors are gases in that true vapors are atomic or molecular in nature.

3.2.2 Chemical Hazards

Harmful chemical compounds in the form of solids, liquids, gases, mists, dusts, fumes, and vapors exert toxic effects by inhalation (breathing), absorption (through direct contact with the skin), or ingestion (eating or drinking). Airborne chemical hazards exist as concentrations of mists, vapors, gases, fumes, or solids. Some are toxic through inhalation and some of them irritate the skin on contact; some can be toxic by absorption through the skin or through ingestion, and some are corrosive to living tissue.

The degree of worker risk from exposure to any given substance depends on the nature and potency of the toxic effects and the magnitude and duration of exposure. Information on the risk to workers from chemical hazards can be obtained from the Material Safety Data Sheet (MSDS) that OSHA's Hazard Communication Standard requires be supplied by the manufacturer or importer to the purchaser of all hazardous materials. The MSDS is a summary of the important health, safety, and toxicological information on the chemical or the mixture's ingredients. Other provisions of the Hazard Communication Standard require that all containers of hazardous substances in the workplace have appropriate warning and identification labels.

3.2.3 Biological Hazards

These include bacteria, viruses, fungi, and other living organisms that can cause acute and chronic infections by entering the body either directly or through breaks in the skin. Occupations that deal with plants or animals or their products or with food and food processing may expose workers to biological hazards. Laboratory and medical personnel also can be exposed to biological hazards. Any occupations that result in contact with bodily fluids pose a risk to workers from biological hazards.

In occupations where animals are involved, biological hazards are dealt with by preventing and controlling diseases in the animal population as well as properly caring for and handling infected animals. Also, effective personal hygiene, particularly proper attention to minor cuts and scratches especially on the hands and forearms, helps keep worker risks to a minimum. In occupations where there is potential exposure to biological hazards, workers should practice proper personal hygiene, particularly hand washing. Hospitals should provide proper ventilation, proper personal protective equipment such as gloves and respirators, adequate infectious waste disposal systems, and appropriate controls including isolation in instances of particularly contagious diseases such as tuberculosis.

3.2.4 Physical Hazards

These include excessive levels of ionizing and non-ionizing electromagnetic radiation, noise, vibration, illumination, and temperature. In occupations where there is exposure to ionizing radiation, **time**, **distance**, and **shielding** are important tools in ensuring worker safety. Danger from radiation increases with the amount of time one is exposed to it; hence, the shorter the time of exposure the smaller the radiation danger.

Distance also is a valuable tool in controlling exposure to both ionizing and non-ionizing radiation. Radiation levels from some sources can be estimated by comparing the squares of the distances between the worker and the source. For example, at a reference point of 10 feet from a source, the radiation is 1/100 of the intensity at 1 foot from the source.

Shielding also is a way to protect against radiation. The greater the protective mass between a radioactive source and the worker, the lower the radiation exposure. In some instances, however, limiting exposure to or increasing distance from certain forms of non-ionizing radiation, such as lasers, is not effective. For example, an exposure to laser radiation that is faster than the blinking of an eye can be hazardous and would require workers to be miles from the laser source before being adequately protected. Shielding workers from this source can be an effective control method.

Noise, another significant physical hazard, can be controlled by various measures. Noise can be reduced by installing equipment and systems that have been engineered, designed, and built to operate quietly; by enclosing or shielding noisy equipment; by making certain that equipment is in good repair and properly maintained with all worn or unbalanced parts replaced; by mounting noisy equipment on special

mounts to reduce vibration; and by installing silencers, mufflers, or baffles. Substituting quiet work methods for noisy ones is another significant way to reduce noise-for example, welding parts rather than riveting them. Also, treating floors, ceilings, and walls with acoustical material can reduce reflected or reverberant noise. In addition, erecting sound barriers at adjacent work stations around noisy operations will reduce worker exposure to noise generated at adjacent work stations. It is also possible to reduce noise exposure by increasing the distance between the source and the receiver, by isolating workers in acoustical booths, limiting workers' exposure time to noise, and by providing hearing protection. OSHA requires that workers in noisy surroundings be periodically tested as a precaution against hearing loss. Another physical hazard, radiant heat exposure in factories such as steel mills, can be controlled by installing reflective shields and by providing protective clothing.

3.2.5 Ergonomic Hazards

The science of ergonomics studies and evaluates a full range of tasks including, but not limited to, lifting, holding, pushing, walking, and reaching. Many ergonomic problems result from technological changes such as increased assembly line speeds, adding specialised tasks, and increased repetition; some problems arise from poorly designed job tasks. Any of those conditions can cause ergonomic hazards such as excessive vibration and noise, eye strain, repetitive motion, and heavy lifting problems. Improperly designed tools or work areas also can be ergonomic hazards. Repetitive motions or repeated shocks over prolonged periods of time as in jobs involving sorting, assembling, and data entry can often cause irritation and inflammation of the tendon sheath of the hands and arms, a condition known as carpal tunnel syndrome.

Ergonomic hazards are avoided primarily by the effective design of a job or jobsite and by better designed tools or equipment that meet workers' needs in terms of physical environment and job tasks. Through thorough worksite analyses, employers can set up procedures to correct or control ergonomic hazards by using the appropriate engineering controls (e.g., designing or redesigning work stations, lighting, tools, and equipment); teaching correct work practices (e.g., proper lifting methods); employing proper administrative controls (e.g., shifting workers among several different tasks, reducing production demand, and increasing rest breaks); and, if necessary, providing and mandating personal protective equipment. Evaluating working conditions from an ergonomics standpoint involves looking at the total physiological and psychological demands of the job on the worker.

4.0 CONCLUSION

Workers do not create hazards — in many cases the hazards are built into the workplace. The trade union position on occupational health and safety is to ensure that work is made safer by modifying the workplace and any unsafe work processes. This means that the solution is to **remove the hazards,** not to try to get workers to adapt to unsafe conditions. Requiring workers to wear protective clothing which may not be suited or designed for the climate of your region is an example of forcing workers to adapt themselves to unsafe conditions, which is also shifting the responsibility from management to the worker.

It is important for unions to maintain this position because many employers blame workers when there is an accident, claiming that the workers were careless. This attitude implies that work can be made safer if workers change their behaviour or if employers only hire workers who never make mistakes. Everyone makes mistakes — it is human nature, but workers should not pay for mistakes with their lives. Accidents do not stop simply by making workers more safety conscious. Safety awareness may help but it does not remove unsafe work processes or conditions.

5.0 SUMMARY

In this unit, you have learnt that:

i. There is an unlimited number of hazards that can be found in almost every workplace. These include both obvious unsafe working conditions and insidious, less obvious hazards.
ii. Hazards in the workplace can be found in a variety of forms, including chemical, physical, biological, psychological, non-application of ergonomic principles, etc.
iii. Hazards often are built into the workplace. Therefore, trade unions must ensure that hazards are removed, rather than trying to get workers to adapt to unsafe conditions.
iv. The most effective accident and disease prevention begins when work processes are still in the design stage, when safe conditions can be built into the work process.

6.0 TUTOR-MARKED ASSIGNMENT

1. Describe extensively the health effects of exposure of workers to the following occupational hazards:
   - Noise from a heavy machine
   - Dust
   - Sulphuric acid mist
   - Allergens
   - Lifting of heavy loads
   - Mycotoxins

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UNIT 3 CONTROL OF HAZARDS

CONTENTS

1.0 INTRODUCTION

Occupational health problems arise largely from hazardous factors in the working environment. Since most hazardous conditions at work are in principle preventable, efforts should be concentrated on primary prevention at the workplace, as this offers the most cost-effective strategy for their elimination and control. The planning and design of workplaces should be aimed at establishing working environments that are conducive to physical, psychological and social well-being. This means taking all reasonable precautions to avoid occupational diseases and injuries. In this unit, you will be exposed to the various control measures against workplace hazards.

2.0 OBJECTIVES

At the end of this unit, you will be able to:

- mention the various ways of controlling occupational hazard
- explained the importance of each of the control measures.

3.0 MAIN CONTENT

3.1 Recognising and Controlling Hazards

Industrial hygienists recognise that engineering, work practice, and administrative controls are the primary means of reducing employee exposure to occupational hazards. Below are some of the control measures against exposure to physical, chemical and biological hazards:

3.1.1 Engineering control and housekeeping

Engineering control involves controlling the hazard at the source. The competent authority should ensure that exposure to hazardous substances (such as asbestos, for instance), is prevented or controlled by prescribing engineering controls and work practices which afford maximum protection to workers. One type of engineering control involves built-in protection as part of the work process concerned. These engineering controls should be built in during the design phase; they may be implemented later, but this tends to be more costly. Engineering controls may be more expensive to implement than methods which depend on continual vigilance or intervention by the worker, but they are safer. Examples include erecting guards around machines to prevent accidents or encasing a noise source with a muffler.

Another form of engineering control is the mechanisation process. This involves the use of a machine to do dangerous work rather than exposing a worker to the hazard. An example is the use of an automatic parts dipper on a vapour degreaser rather than having dipped parts into the tank by hand. Where the elimination of hazardous substances is not practicable in existing plants and processes, employers or managers should apply technical measures to control the hazard or risk by changing the process, so that the job is done in a completely different and safer way, or by enclosing the process completely to keep the hazard from reaching the worker. If the problems still cannot be solved by these methods, then methods such as local exhaust ventilation could be used to control the hazard.

These and other appropriate measures should be taken so that the exposure level is reduced to a level which, in the light of current knowledge, is not expected to damage the health of workers, even if they should go on being exposed at the same level for the duration of their working lives. Good work practices and working methods can ensure that hazardous materials are contained before they become a problem. Where complete containment has not been achieved, strict housekeeping and personal hygiene are absolutely essential to ensure

workplace and personal safety. In the presence of toxic chemicals, for instance, strict personal hygiene must always be observed so as to prevent local irritations or the absorption of such chemicals through the skin. Where hazardous substances such as lead dust in a storage battery plant or asbestos dust in brake shoe manufacture are involved, inadequate housekeeping can result in toxic materials circulating in the air. There are several ways of maintaining good housekeeping; for example:

- vacuuming is the best way of cleaning up dust, as dry sweeping often makes the problem worse by pushing dust particles back into the air; and
- regular and thorough maintenance of machines and equipment will reduce dust and fumes.

3.1.2 Substitution

Where necessary for the protection of workers, the competent authority should require the replacement of hazardous substances by substitute materials, in so far as this is possible. For example, in the case of asbestos or products containing asbestos, national laws or regulations must provide for its replacement, if technically practicable, by other materials and products, or for the use of alternative technology, scientifically evaluated by the competent authority as harmless or less harmful. The use of asbestos, or of certain types of asbestos, or of products containing asbestos, may be totally or partially prohibited in certain work processes. It is, however, necessary to ensure that the substitute is really safer.

3.1.3 Work practices and organisational methods

Where the evaluation of the working environment shows that elimination of risk and total enclosure of machinery are both impracticable, employers should reduce exposure to hazard as much as possible, through administrative or organisational measures, so as to:

- reduce the source of the hazard, so that risks are confined to certain areas where engineering control measures can be applied effectively;
- adopt adequate work practices and working-time arrangements so that workers' exposure to hazards is effectively controlled; and
- minimise the magnitude of exposure, the number of workers exposed and the duration of exposure, e.g. carry out noisy operations at night or during the weekend, when fewer workers are exposed.

3.1.4 Personal protective equipment

When none of the above approaches is feasible, or when the degree of safety achieved by them is considered inadequate, the only solution is to provide exposed persons with suitable personal protective equipment and protective clothing. This is the final line of defence and should be used only as a last resort, since it entails reliance on active cooperation and compliance by the workers. Moreover, such equipment may be heavy, cumbersome and uncomfortable, and may restrict movement.

Employers should consult workers or their representatives on suitable personal protective equipment and clothing, having regard to the type of work and the type and level of risks. Furthermore, when hazards cannot be otherwise prevented or controlled, employers should provide and maintain such equipment and clothing as are reasonably necessary, without cost to the workers. The employer should provide the workers with the appropriate means to enable them to use the individual protective equipment. Indeed, the employer has a duty to ensure its proper use. Protective equipment and clothing should comply with the standards set by the competent authority and take ergonomic principles into account. Workers have the obligation to make proper use of and take good care of the personal protective equipment and protective clothing provided for their use.

3.1.5 Technological change

Technological progress can play an important role in improving working conditions and job content, but it can also introduce new hazards. Great care should therefore be taken in both the choice and the international transfer of technology in order to avoid potential hazards and ensure that the technology is adapted to local conditions. Management should consult with workers' representatives whenever new technology is introduced.

The hazards associated with technologies (equipment, substances and processes) used at the work site must be identified and effective measures taken to eliminate or control them. This means that safety factors should be built in, and that working conditions, organisation and methods should be adapted to the characteristics and capacities of workers.

The introduction of new technology should be accompanied by adequate information and training. Furthermore, potentially dangerous machinery, equipment or substances should not be exported without adequate safeguards being put in place, including information on safe use in the

language of the importing country. It is the duty of the governments of importing countries to review national legislation to make sure that it includes provisions to stop the import of technology detrimental to occupational safety and health or working conditions.

3.1.6 Administrative controls

These include controlling employees' exposure by scheduling production and tasks, or both, in ways that minimise exposure levels. For example, the employer might schedule operations with the highest exposure potential during periods when the fewest employees are present.

3.1.7 Protection of the general environment

The importance of protecting workers, the general public and the environment from materials containing hazardous substances cannot be overemphasised. To this end, the competent authority should ensure that criteria consistent with national or international regulations regarding disposal of hazardous waste are established. Procedures to be followed in the disposal and treatment of hazardous waste products should also be established, with a view to ensuring the safety of workers, and the protection of the general public and the environment. Employers must therefore dispose of waste containing hazardous materials, such as asbestos, in a manner that does not pose a health risk to the workers concerned, including those handling the waste material, or to the general population. Furthermore, it is up to the competent authority and employers to take measures to prevent pollution of the general environment by dust or other pollutants released from the work site.

3.2 Case Study of Hazard Control –A Scenario in a Catering Industry

The problem

A female employee working in a school kitchen had developed signs of dermatitis. Both hands were affected and there were patches of broken and weeping skin. She could not continue to work and was forced to take sick leave.

It was considered that the dermatitis may have been caused by her daily routine involving food preparation, cooking, washing dishes and wiping down surfaces. Due to food hygiene requirements, she regularly washed her hands.

The problem appeared to have arisen even though they had the following control measures in place:

- wearing cotton liners under normal standard washing up gloves, of a rubber base;
- washing up water was no hotter than 50-60ºC;
- chemicals were being used according to policy;
- a sensible skin care regime was being adopted.

Solution

The employer investigated what else could be done to prevent the dermatitis. The investigation focused on finding out:

- if the detergent used was actually contributing to the dermatitis;
- if the glove being used may be contributing to the dermatitis;
- if the employee is allergic to any of the food ingredients.

The initial investigation was carried out with the help of a 'skin care questionnaire' but unfortunately they were still unable to identify the cause of the dermatitis. As an initial precautionary measure she was supplied with an alternative pair of nitrile reusable gloves but this did not lead to improvements. At this stage expert advice from the occupational health physician was sought resulting in patch testing for potential causative agents.

Outcome

Patch tests confirmed that the employee had sensitivity to plant materials, in particular to lettuce. It was also felt that the washing up detergent could have contributed to the sensitisation of her hands, as it found that she did not always wear gloves when wiping surfaces down using a cloth.

On her return to work the following procedures were put in place:

- her skin condition was closely monitored;
- all existing control measures remained in place, but she also avoided contact with lettuce in any way;
- she continued to use nitrile gloves for work activities;
- regular application of prescribed creams.

Benefits

- Work-related dermatitis was treated and further sickness absence avoided.
- Lessons learnt for dealing with future cases and less money spent on sick pay.
- Return to work policy ensured that the employee's skin was monitored very closely, reducing the likelihood of future problems.

This case demonstrates the importance of the combination of early identification, careful management of skin care, adequate control measures for reducing expenditure on medical referral costs and sickness absence. There was also a commitment on the employee's part, to work with the employer to protect her health and income

4.0 CONCLUSION

How particular occupational hazards are prevented depends on the nature of the various causal agents, their mode of action and the severity of the risk. This can be achieved in a number of ways: engineering control, design of safe work systems to minimise risks, substituting safer materials for hazardous substances, administrative or organisational methods, and use of personal protective equipment. In prescribing measures for the prevention and control of such hazards, the competent authority should take into consideration the most recent ILO codes of practice or guidelines.

5.0 SUMMARY

In this unit, you have learnt that:

i. Hazards can be controlled through various ways viz: engineering control, design of safe work systems to minimise risks, substituting safer materials for hazardous substances, administrative or organisational methods, and use of personal protective equipment.

ii. that workers must be provided with suitable protective equipment, clothing and other facilities where adequate protection against risk of accident or injury to health, including exposure to adverse conditions, cannot be ensured by other means

iii. the principles of the control of work hazards and work environment and how to select appropriate control measures and optimal use of available resources.

6.0 TUTOR-MARKED ASSIGNMENT

1. Discuss in details and state the importance of the following control measures to occupational hazards exposure in a tobacco manufacturing company:
   - Administrative control
   - Technological change
   - Personal Protective Equipment (PPEs)
   - Engineering control
   - Work practices and organisational methods

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MODULE 4 RISK MANAGEMENT FRAMEWORK

UNIT 1 EXPOSURE ROUTES AND ASSESSMENT

CONTENTS

1.0 INTRODUCTION

The principal routes of industrial exposure are dermal and inhalation. Occasionally toxic agents may be ingested, if food or drinking water is contaminated. Exposure to the skin often leads to localised effects known as “occupation dermatosis” caused by either irritating chemicals or allergenic chemicals. Such effects include scaling, eczema, acne, pigmentation changes, ulcers, and neoplasia. Some chemicals may also pass through the skin; these include aromatic amines such as aniline and solvents such as carbon tetrachloride and benzene. Toxic or potentially toxic agents may be inhaled into the respiratory tract where they may cause localised effects such as irritation (e.g., ammonia, chlorine gas), inflammation, necrosis, and cancer. Chemicals may also be absorbed by the lungs into the circulatory system, thereby leading to systemic toxicity (e.g., CO, lead). This unit looks at the principal routes by which a substance can enter the body; quantification of the contaminants; and

relevant statistics about the activities that can lead to an exposure known as exposure factors.

2.0 OBJECTIVES

At the end of this unit, you will be able to:

- distinguished between exposure assessment and exposure analysis
- explain the various routes of exposures to contaminants
- quantify the exposure of individuals or populations
- define an acceptable exposure for occupational environment.

3.0 MAIN CONTENT

3.1 Exposure Assessment

Exposure assessment is a branch of environmental science and occupational hygiene that focuses on the processes that take place at the interface between the environment containing the contaminant(s) of interest and the organism(s) being considered. These are the final steps in the path to release an environmental contaminant, through transport to its effect in a biological system. It tries to measure how much of a contaminant can be absorbed by an exposed target organism, in what form, at what rate and how much of the absorbed amount is actually available to produce a biological effect. Although the same general concepts apply to other organisms, the overwhelming majority of applications of exposure assessment are concerned with human health, making it an important tool in occupational health

Exposure assessment is the process of estimating or measuring the magnitude, frequency and duration of exposure to an agent, along with the number and characteristics of the population exposed. Ideally, it describes the sources, pathways, routes, and the uncertainties in the assessment. Exposure analysis is the science that describes how an individual or population comes in contact with a contaminant, including quantification of the amount of contact across space and time. 'Exposure assessment' and 'exposure analysis' are often used as synonyms in many practical contexts. Risk is a function of exposure and hazard. For example, even for an extremely toxic (high hazard) substance, the risk of an adverse outcome is unlikely if exposures are near zero. Conversely, a moderately toxic substance may present substantial risk if an individual or a population is highly exposed.

3.2 Routes of exposure

Contact between a contaminant and an organism can occur through any route. The possible routes of exposure are: inhalation, if the contaminant is present in the air, ingestion, through food, drinking or hand-to-mouth route, and dermal absorption, if the contaminant can be absorbed through the skin. Exposure to a contaminant can and does occur through multiple routes, simultaneously or at different times. In many cases the main route of exposure is not obvious and needs to be investigated carefully. For example, exposure to byproducts of water chlorination can obviously occur by drinking, but also through the skin, while swimming or washing, and even through inhalation from droplets aerosolised during a shower. The relative proportion of exposure from these different routes cannot be determined a priori.

3.2 Major Routes of Exposures to contaminants

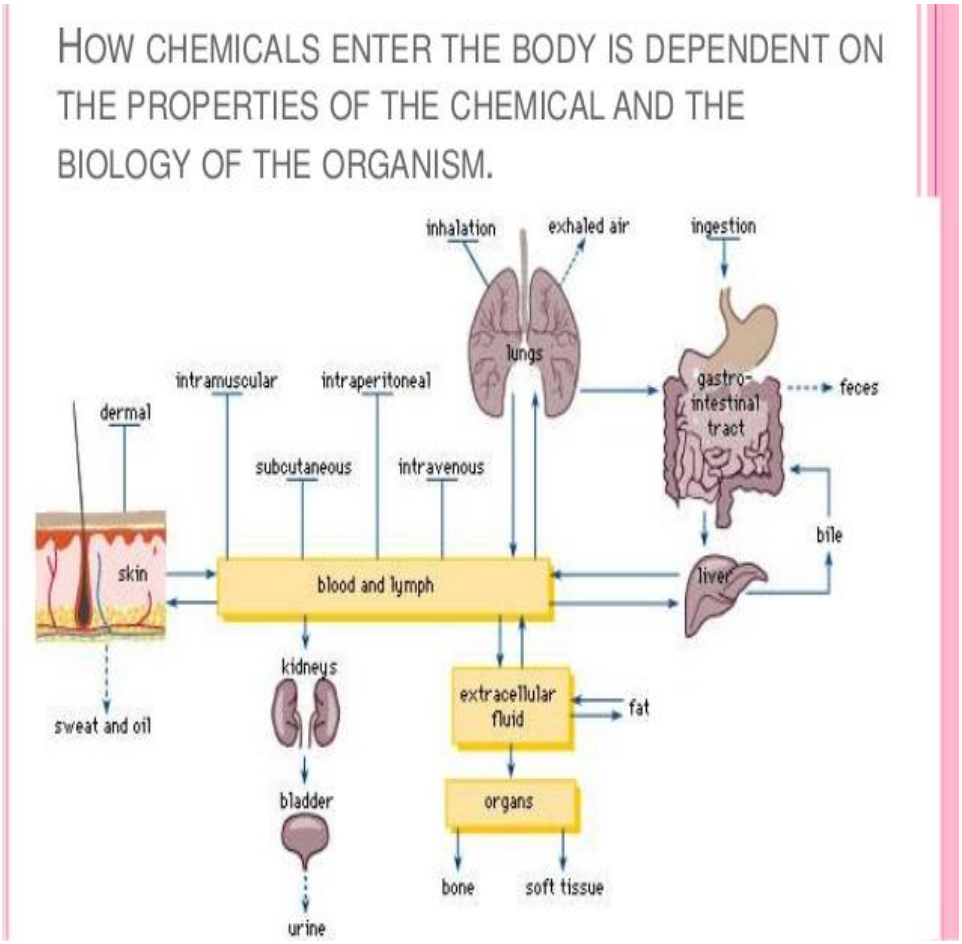

Figure 1: Showing the route of entry in the human body

3.3.1Inhalation

Inhalation is a major route of exposure that occurs when an individual breathes in polluted air which enters the respiratory tract. Identification of the pollutant uptake by the respiratory system can determine how the resulting exposure contributes to the dose. In this way, the mechanism of pollutant uptake by the respiratory system can be used to predict potential health impacts within the human population. Inhalation exposure is the concentration of the airborne pollutant in the air at the mouth and nose boundary. An assumption is that this concentration is inhaled by the person. The contact boundary, a particular nasal or oral region, is selected by the analyst. Intake dose is the mass of the pollutant that crosses the contact boundary and is inhaled by the individual. Some of this pollutant is exhaled, and the fraction that is absorbed by the respiratory system is known as the absorbed dose. A portion of the pollutant may also be expelled by sneezing, coughing, spitting, or swallowing. The remaining pollutant that is transported through the liquid layer, making contact with the respiratory tract tissues is the fraction of bioavailability, called the effective dose.

For most chemicals in the form of vapors, gases, mists, or particulates, inhalation is the major route of entry. Once inhaled, chemicals are either exhaled or deposited in the respiratory tract. If deposited, damage can occur through direct contact with tissue or the chemical may diffuse into the blood through the lung-blood interface. Upon contact with tissue in the upper respiratory tract or lungs, chemicals may cause health effects ranging from simple irritation to severe tissue destruction. Substances absorbed into the blood are circulated and distributed to organs that have an affinity for that particular chemical. Health effects can then occur in the organs, which are sensitive to the toxicant.

3.3.2 Topical Exposure (Skin or Eye absorption)

Topical exposure is a route by which substances can enter the body through the skin. Along with inhalation, ingestion and injection, dermal absorption is a route of exposure for toxic substances and route of administration for medication. Absorption of substances through the skin depends on a number of factors, the most important of which are concentration, duration of contact, solubility of medication, and physical condition of the skin and part of the body exposed. In Topical Exposure, the absorption is directly proportional with the lipid solubility and inversely proportional to the molecular weight.

Skin (percutaneous, dermal) absorption is a term that describes the transport of chemicals from the outer surface of the skin both into the skin and into circulation. Skin absorption relates to the degree of exposure to and possible effect of a substance which may enter the body through the skin. Human skin comes into contact with many agents intentionally and unintentionally. Skin absorption can occur from occupational, environmental, or consumer skin exposure to chemicals, cosmetics, or pharmaceutical products. Some chemicals can be absorbed in enough quantity to cause detrimental systemic effects. Skin disease (dermatitis) is considered one of the most common occupational diseases. In order to assess if a chemical can be a risk of either causing dermatitis or other more systemic effects and how that risk may be reduced one must know the extent to which it is absorbed, thus dermal exposure is a key aspect of human health risk assessment. Skin (dermal) contact can cause effects that are relatively innocuous such as redness or mild dermatitis; more severe effects include destruction of skin tissue or other debilitating conditions. Many chemicals can also cross the skin barrier and be absorbed into the blood system. Once absorbed, they may produce systemic damage to internal organs. The eyes are particularly sensitive to chemicals. Even a short exposure can cause severe effects to the eyes or the substance can be absorbed through the eyes and be transported to other parts of the body causing harmful effects.

Along with inhalation, ingestion and injection, dermal absorption is a route of exposure for bioactive substances including medications. Absorption of substances through the skin depends on a number of factors:

- Concentration
- Molecular Weight of the molecule
- Duration of contact
- Solubility of medication
- Physical condition of the skin
- Part of the body exposed including the amount of hair on the skin.

In general, the rate of absorption of chemicals through skin follows the following scheme from fastest to slowest: Scrotal > Forehead > Armpit≥ Scalp > Back = Abdomen > Palm = under surface of the foot.

To be absorbed through the skin, a chemical must pass through the epidermis, glands, or hair follicles. Sweat glands and hair follicles make

up about 0.1 to 1.0 percent of the total skin surface. Though small amounts of chemicals may enter the body rapidly through the glands or hair follicles, they are primarily absorbed through the epidermis. Chemicals must pass through the seven cell layers of epidermis before entering the dermis where they can enter the blood stream or lymph and circulate to other areas of the body. Toxins and toxicants can move through the layers by passive diffusion. The stratum corneum is the outermost layer of the epidermis and the rate-limiting barrier in absorption of an agent. Thus, how quickly something passes through this thicker outer layer determines the overall absorption. The stratum corneum is primarily composed of lipophilic cholesterol, cholesterol esters and ceramides. Thus lipid-soluble chemicals make it through the layer and into the circulation faster, however nearly all molecules penetrate it to some minimal degree.

3.3.3 Ingestion

Ingestion is the most common route of exposure to toxic chemicals. Most chemicals diffuse across the cell membrane in the non-ionised form, so that the degree to which the chemical is ionised is important′in determining whether a chemical is absorbed. Organic acids and bases dissociate into their ionised forms in response to the pH conditions of the environment. Organic acids are in their non- ionised form in an acidic environment (such as the stomach), and they thus tend to diffuse across a membrane, whereas organic bases are non-ionised and thus diffuse across a membrane in a basic environment (such as in the intestine). The pH on the mucosal surface of the small intestine is alkaline. Organic bases tend to be in the non-ionised, lipid-soluble form and thus in general are absorbed there. The pH of the stomach contents is in the range of 1 to 2 (strongly acidic), and weak organic acids tend to be in the non-ionised, lipid-soluble form. It might be expected that the poisons would be absorbed there, but, because the surface area of the stomach is much smaller than that of the small intestine, often the stomach contents (along with the poisons) are passed to the intestine before the chemicals are absorbed. The acidic environment of the stomach is the main reason for the poor absorption of organic bases in the stomach.

Absorption through the digestive tract is called ingestion. Ingestion can occur through eating or smoking with contaminated hands or in contaminated work areas. Ingestion of inhaled materials also occurs as a result of the natural cleaning action of the lungs. Material is removed from the lungs by cilial and is deposited in the throat to be swallowed. Chemicals that inadvertently get into the mouth and are swallowed do

not generally harm the gastrointestinal tract itself unless they are irritating or corrosive. Chemicals that are insoluble in the fluids of the gastrointestinal tract (stomach, small, and large intestines) are generally excreted. Others that are soluble are absorbed through the lining of the gastrointestinal tract. They are then transported by the blood to internal organs where they can cause damage.

3.3.4 Injection

Injection means introducing the material directly into the bloodstream. Injection may occur through mechanical injury from “sharps”. Accidental injection occurs mainly during the administration of drugs. Other injection may occur from the use of high pressure, air or liquid such as in spray painting, or from the rupture of high pressure lines. Substances may enter the body if the skin is penetrated or punctured by contaminated objects. Effects can then occur as the substance is circulated in the blood and deposited in target organs.

Injection it’s the only route in which the entire amount exposed is absorbed regardless of the chemical administered, because the chemical is introduced directly into the body. Chemicals may be injected

- intravenously (directly into a vein),
- intramuscularly (into a muscle),
- subcutaneously (under the skin),
- intraperitoneally (within the membrane lining the organs of the abdomen).

Because the blood is the vehicle of chemical distribution in the body, intravenous injection is the most rapid method of introducing a chemical into the body. The almost instantaneous distribution together with the irreversibility makes intravenous injection - a dangerous method of chemical exposure, with a fair chance of causing drug overdose if improperly administered.

3.4 Measurement of exposure

To quantify the exposure of particular individuals or populations two approaches are used, primarily based on practical considerations:

Direct approach

The direct approach measures the exposures to pollutants by monitoring the pollutant concentrations reaching the respondents. The pollutant concentrations are directly monitored on or within the person through point of contact, biological monitoring, or biomarkers. The point of

contact approach indicates the total concentration reaching the host, while biological monitoring and the use of biomarkers infer the dosage of the pollutant through the determination of the body burden. The respondents often record their daily activities and locations during the measurement of the pollutants to identify the potential sources, microenvironments, or human activities contributing the pollutant exposure. An advantage of the direct approach is that the exposures through multiple media (air, soil, water, food, etc.) are accounted for through one study technique. The disadvantages include the invasive nature of the data collection and associated costs. Point of contact is continuous measure of the contaminant reaching the target through all routes.

Biological monitoring is another approach to measuring exposure. This measures the amount of a pollutant within the body in various tissue media such adipose tissue, bone, or urine. Biological monitoring measures the body burden of a pollutant but not the source from whence it came. The substance measured may be either the contaminant itself or a biomarker which is specific to and indicative of an exposure to the contaminant.

Biomarkers of exposure assessment is a measure of the contaminant or other proportionally related variable in the body.

Air sampling measures the contaminant in the air as concentration units of ppmv (parts per million by volume), mg/m^3 (milligrams per cubic meter) or other mass per unit volume of air. Samples can be worn by workers or researchers to estimate concentrations found in the breathing zone (personal) or samples collected in general areas that can be used to estimate human exposure by integrating time and activity patterns. Validated and semi-validated air sampling methods are published by NIOSH, OSHA, ISO and other bodies.

Surface or dermal sampling measures of the contaminant on touchable surfaces or on skin. Concentrations are typically reported in mass per unit surface area such as $mg/100cm^2$. Validated and semi-validated air sampling methods are published by NIOSH, US EPA, OSHA, ISO and other bodies.

Indirect approach

The indirect approach measures the pollutant concentrations in various locations or during specific human activities to predict the exposure distributions within a population. The indirect approach focuses on the pollutant concentrations within microenvironments or activities rather than the concentrations directly reaching the respondents. The measured concentrations are correlated to large-scale activity pattern data, such as the National Human Activity Pattern Survey (NHAPS), to determine the predicted exposure by multiplying the pollutant concentrations by the time spent in each microenvironment or activity for by multiplying the pollutant concentrations and the contact rate with each media. The indirect approach or exposure modeling determines the estimated exposure distributions within a population rather than the direct exposure an individual has experienced. The advantage is that process is minimally invasive to the population and is associated with lower costs than the direct approach. A disadvantage of the approach is that the results were determined independently of any actual exposures, so the exposure distribution is open to errors from any inaccuracies in the assumptions made during the study, the time-activity data, or the measured pollutant concentrations.

In general, direct methods tend to be more accurate but more costly in terms of resources and demands placed on the subject being measured and may not always be feasible, especially for a population exposure study. Examples of direct methods include air sampling though a personal portable pump, split food samples, hand rinses, breath samples or blood samples. Examples of indirect methods include environmental water, air, dust, soil or consumer product sampling coupled with information such as activity/location diaries. Mathematical exposure models may also be used to explore hypothetical situations of exposure.

3.5 Exposure factors

Especially when determining the exposure of a population rather than individuals, indirect methods can often make use of relevant statistics about the activities that can lead to an exposure. These statistics are called exposure factors. They are generally drawn from the scientific literature or governmental statistics. For example, they may report information such as amount of different food eaten by specific populations, divided by location or age, breathing rates, time spent for different modes of commuting, showering or vacuuming, as well as information on types of residences. Such information can be combined with contaminant concentrations from ad-hoc studies or monitoring

network to produce estimates of the exposure in the population of interest. These are especially useful in establishing protective standards.

Exposure factor values can be used to obtain a range of exposure estimates such as average, high-end and bounding estimates. For example, to calculate the lifetime average daily dose one would use the equation below:

$$\text{LADD} = \frac{(\text{Contaminant Concentration})\,(\text{Intake Rate})\,(\text{Exposure Duration})}{(\text{Body Weight})(\text{Average Lifetime})}$$

All of the variables in the above equation, with the exception of contaminant concentration, are considered exposure factors. Each of the exposure factors involves humans, either in terms of their characteristics (e.g., body weight) or behaviors (e.g., amount of time spent in a specific location, which affects exposure duration). These characteristics and behaviors can carry a great deal of variability and uncertainty. In the case of lifetime average daily dose, variability pertains to the distribution and range of LADDs amongst individuals in the population. The uncertainty, on the other hand, refers to exposure analyst's lack of knowledge of the standard deviation, mean, and general shape when dealing with calculating LADD.

3.6 Defining acceptable exposure for occupational environment

Occupational exposure limits are based on available toxicology and epidemiology data to protect nearly all workers over a working lifetime. Exposure assessments in occupational settings are most often performed by occupational/industrial hygiene (OH/IH) professionals who gather "basic characterisation" consisting of all relevant information and data related to workers, agents of concern, materials, equipment and available exposure controls. The exposure assessment is initiated by selecting the appropriate exposure limit averaging time and "decision statistic" for the agent. Typically the statistic for deciding acceptable exposure is chosen to be the majority (90%, 95% or 99%) of all exposures to be below the selected occupational exposure limit. For retrospective exposure assessments performed in occupational environments, the "decision statistic" is typically a central tendency such as the arithmetic mean or geometric mean or median for each worker or group of workers. Methods for performing occupational exposure assessments can be found in "A Strategy for Assessing and Managing Occupational Exposures". Exposure assessment is a continuous process that is updated as new information and data become available.

4.0 CONCLUSION

Once the chemical is absorbed into the body, three other processes are possible: metabolism, storage, and excretion. Many chemicals are metabolised or transformed via chemical reactions in the body. In some cases, chemicals are distributed and stored in specific organs. Storage may reduce metabolism and therefore, increase the persistence of the chemicals in the body. The various excretory mechanisms (exhaled breath, perspiration, urine, feces, or detoxification) rid the body, over a period of time, of the chemical. For some chemicals elimination may be a matter of days or months; for others, the elimination rate is so low that they may persist in the body fora lifetime and cause deleterious effects.

5.0 SUMMARY

In this unit, you have learnt that:

i. exposure assessment is a branch of occupational hygiene that focuses on the processes that take place at the interface between the environment containing the contaminant(s) of interest and the organism(s) being considered.
ii. exposure analysis is the science that describes how an individual or population comes in contact with a contaminant, including quantification of the amount of contact across space and time
iii. exposure to a contaminant can and does occur through multiple routes, simultaneously or at different times. In many cases the main route of exposure is not obvious and needs to be investigated carefully.
iv. the main routes of exposure to contaminants include inhalation, ingestion, skin absorption and injection.
v. to quantify the exposure of particular individuals or populations two approaches are used, primarily based on practical considerations viz direct and indirect approach.

6.0 TUTOR-MARKED ASSIGNMENT

1. Distinguished in details the key differences between exposure assessment and exposure analysis.
1. Discuss succinctly the behaviour of contaminants through the various routes of entry:
   - Pulmonary route
   - Dermal route
   - Gastrointestinal route
   - Intravenous route
   - Intraperitoneal route
2. Discuss in detail the two approaches used to quantify exposure to contaminants in an individual.
3. Define “exposure factors” and state its importance in occupational health.

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UNIT 2 RISK ASSESSMENT AND COMMUNICATION

CONTENTS

1.0 INTRODUCTION

Risk assessment is a process that has been formalised to estimate the risk of adverse health effects caused by exposure to harmful chemicals and microorganisms. The goal is to express risk caused by exposure to a contaminant in terms of probability of illness or mortality. In this format such information can be better utilised by decision makers to determine the magnitude of the problem and weigh the costs and benefits of prevention or corrective action. The purpose of this unit is to provide a general background on the topic of risk analysis, and how it can be used in the problem solving process.

2.0 OBJECTIVES

At the end of this unit, you will be able to:

- state the concept and process of risk assessment
- establish dose-response effects for occupational hazards
- evaluate risk and take appropriate control measures to minimise adverse health. effects
- state the basic concept of risk communication in workplace.

3.0 MAIN CONTENT

3.1 Risk Identification

The purpose of the Risk Identification is to define the basic dimensions of the risk problem, and then to undertake a review of the potential risks. The Risk Identification step involves the gathering, organising, and appraisal of the scientific and technical information necessary to decide whether a particular environmental contaminant or occupational hazard is likely to constitute a significant hazard to human health. Therefore, all relevant information about a hazard should be assembled in a risk information library, which can be updated whenever necessary, as the risk management process continues.

3.2 Risk Assessment

Thus we can define **risk assessment** as the process of estimating both the probability that an event will occur and the probable magnitude of its adverse effects—economic, health safety–related, or ecological—over a specified period. For example, we might determine the probability that an atomic reactor will fail, and the probable effect of its sudden release of radioactive contents on the immediate area, in terms of injuries and property loss over a period of days. In addition, we might estimate the probable incidence of cancer in the community where the radioactivity was released over a period of years. Or, in yet another type of risk assessment, we might calculate the health risks associated with the presence of pathogens in drinking water or pesticides in food.

3.3 Process of Risk Assessment

The risk assessment process consists of four basic steps:

Hazard identification —Defining the hazard and nature of the harm; for example, identifying a chemical contaminant, such as lead or carbon tetrachloride, and documenting its toxic effects on human beings.

Exposure assessment—Determining the concentration of a contaminating agent in the environment and estimating its rate of intake in target organisms; for example, finding the concentration of aflatoxin (a fungal toxin) in peanut butter and determining the dose an ‘‘average’’ person would receive.

Dose–response assessment—Quantifying the adverse effects arising from exposure to a hazardous agent based on the degree of exposure. This assessment is usually expressed mathematically as a plot showing a response (i.e., mortality) in living organisms to increasing doses of the agent.

Risk characterisation—Estimating the potential impact of a hazard based on the severity of its effects and the amount of exposure.

3.4 Dose–Response Assessment

Contaminants are not equal in their capacity to cause adverse effects. To determine the capacity of agents to cause harm, we need quantitative toxicity data. Some toxicity data are derived from occupational, clinical, and epidemiological studies. Most toxicity data, however, come from animal experiments in which researchers expose laboratory animals, mostly mice and rats, to increasingly higher concentrations, or doses, and observe their corresponding effects. The result of these experiments is the dose–response relationship—a quantitative relationship that indicates the agent's degree of toxicity to exposed species. Dose is normalised as milligrams of substance or pathogen ingested, inhaled, or absorbed (in the case of chemicals) through the skin per kilogram of body weight per day (mg kg‑1 day‑1). Responses or effects can vary widely—from no observable effect, to temporary and reversible effects (e.g., enzyme depression caused by some pesticides or diarrhea caused by viruses), to permanent organ injury (e.g., liver and kidney damage caused by chlorinated solvents, heavy metals, or viruses), to chronic functional impairment (e.g., bronchitis or emphysema arising from smoke damage), to death. The goal of a dose–response assessment is to obtain a mathematical relationship between the amount (concentration)of a toxicant or microorganism to which a human being is exposed and the risk of an adverse outcome from that dose. The data resulting from experimental studies is presented as a dose–response curve. The abscissa describes the dose, whereas the ordinate measures the risk that some adverse health effect will occur. In the case of a pathogen, for instance, the ordinate may represent the risk of infection, and not necessarily illness.

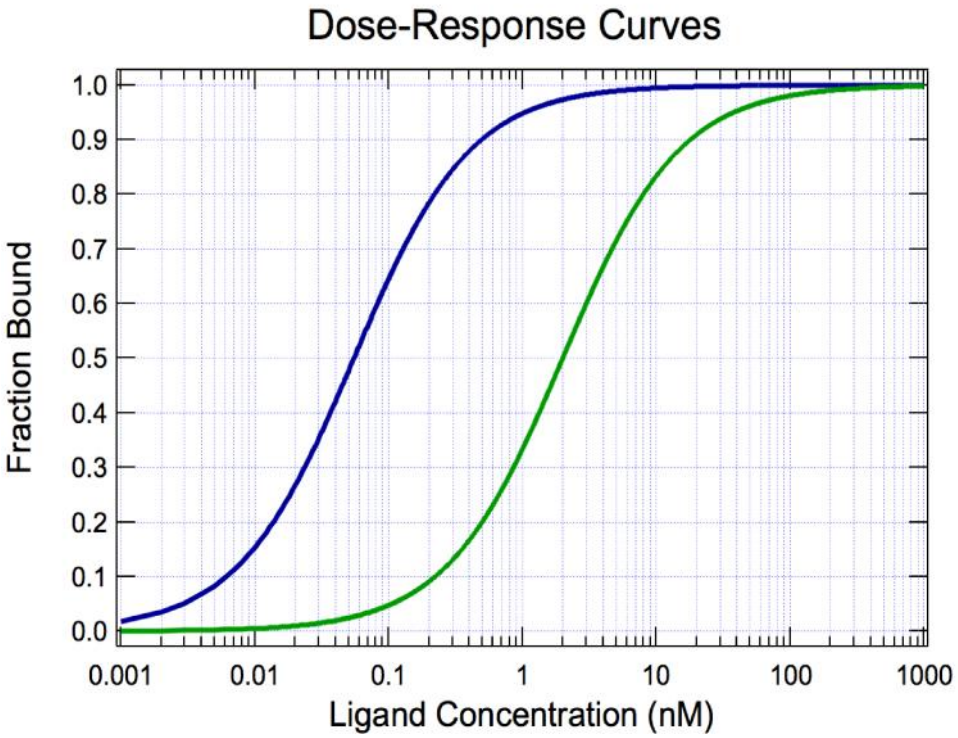

Figure 1: Dose-Response Curve

Dose–response curves are subject to controversy because their results change depending on the method chosen to extrapolate from—the high doses actually administered to laboratory test subjects to the low doses human beings are likely to receive in the course of everyday living. This controversy revolves around the choice of several mathematical models that have been proposed for extrapolation to low doses. Unfortunately, no model can be proved or disproved from the data, so there is no way to know which model is the most accurate. The choice of models is therefore strictly a policy decision, which is usually based on understandably conservative assumptions. Thus for noncarcinogenic chemical responses, the assumption is that some threshold exists below which there is no toxic response; that is, no adverse effects will occur below some very low dose (say, one in a million). Carcinogens, however, are considered nonthreshold—that is, the conservative assumption is that exposure to any amount of carcinogen creates some likelihood of cancer. This means that the only ‘‘safe’’ amount of carcinogen is zero, so the dose–response plot is required to go through the origin (0). There are many mathematical models to choose from, including the one-hit model, the multistage model, the multihit model, and the probit model.

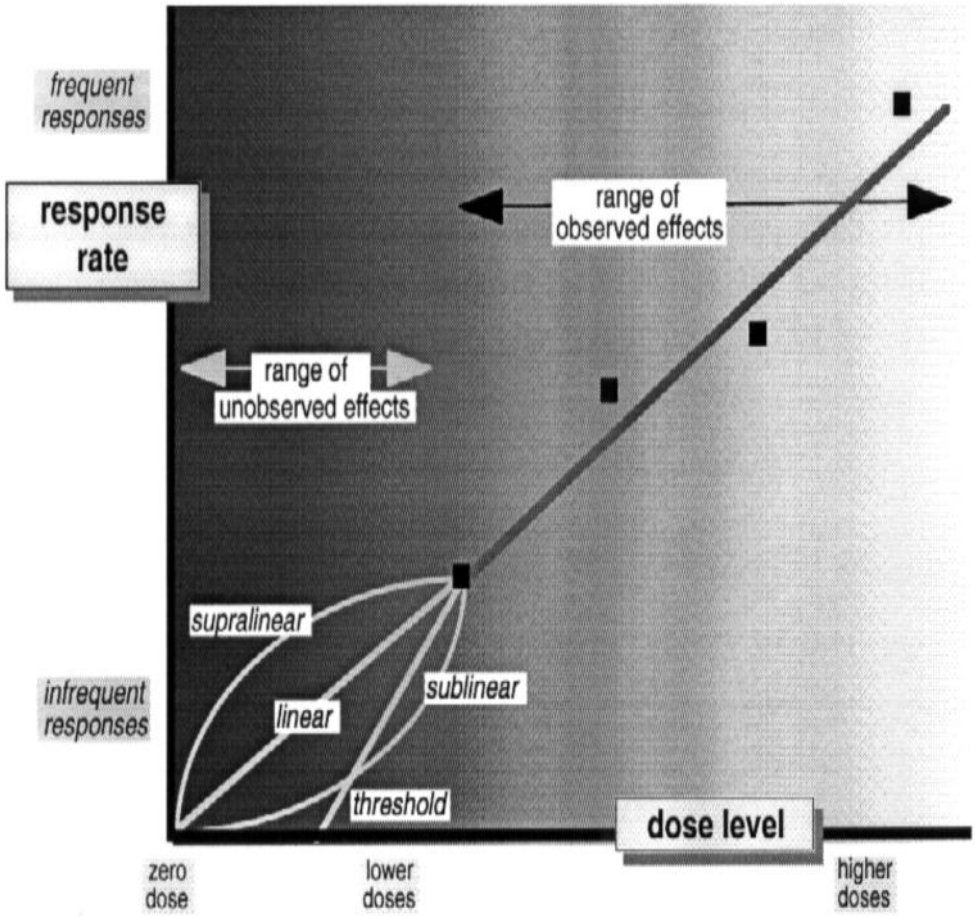

Figure 2: Low-dose Extrapolation the dose-response curve is visible in the 'range of observed effects', but needs extrapolation within the 'range of unobserved effects'.

The dose–response effects for noncarcinogens allow for the existence of thresholds; that is, a certain quantity of a substance or dose below which there is no observed adverse effect (NOAEL) by virtue of the body's natural repair and detoxifying capacity. The lowest dose administered that results in a response is given a special name: the lowest-observed-effect-level (LOEL). Examples of toxic substances that have thresholds are heavy metals. These thresholds are represented by the reference dose, or RfD, of a substance, which is the intake or dose of the substance per unit body weight per day (mg kg^{-1} day^{-1}) that is likely to pose no appreciable risk to human populations, including such sensitive groups as children. A dose– response plot for carcinogens therefore goes through this reference point.

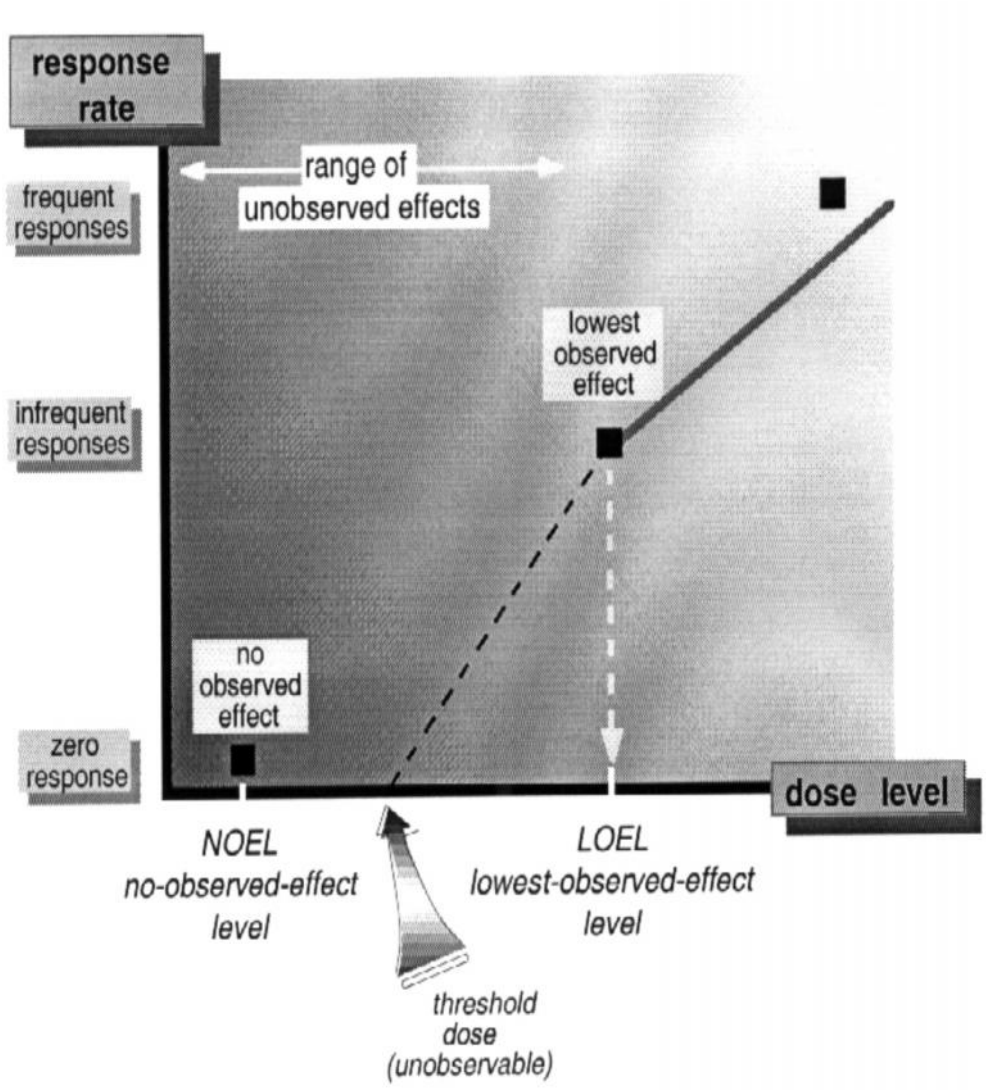

Figure 3: Estimation of a Toxicological Threshold for threshold-acting toxicants, the threshold dose cannot be exactly measured, but can be estimated by employing the NOEL and the LOEL in the dose-response curve

3.5 Risk Evaluation

The Risk Evaluation step examines the economic and social issues influencing the selection of control options intended to ensure acceptable levels of risk. These considerations deal extensively with individual and societal values, and thus they go far beyond the scientific notion of objective analysis of empirical. (measurable) physical quantities. Instead, risk evaluation techniques focus on the exploration of normative issues related to what ought to happen in a society that seeks to provide effective protection of the health its citizens in an equitable, but affordable, manner. Because it is so difficult for us as individuals to effectively control personal exposure to environmental

contaminants, we collectively depend to a great extent on societal safeguards. These may be either government environmental regulations that have the force of law, or private-sector guidelines that require voluntary adherence by corporate members of business organisations.

Two major classes of normative societal issues are considered in the Risk Evaluation step:

Economic Evaluation

Economic evaluation considers the projected costs of implementing an environmental improvement program, together with the corresponding benefits of expected future improvements in population health. This approach provides risk managers with the ability to evaluate and select the best available environmental control strategy from a range of proposed options. As the term suggests, economic evaluation involves the assigning of subjective values, usually expressed as money values, to quantify health benefits gained from the reduced incidence of disease (morbidity) and lessened risk of premature death (mortality). Several different types of economic analysis techniques can be used at the risk evaluation step. Among the methods most commonly used are the following analytical techniques:

1. Cost-Effectiveness Analysis
2. Benefit-Cost Analysis
3. Risk-Benefit Analysis
4. Socio-Economic Impact Analysis

Social Evaluation

The notion of acceptable risk concerning environmental hazards is a subjective value that is strongly influenced by societal norms and expectations about safety. Safety therefore does not denote the absence of risk, but rather the acceptability of risk under certain conditions defined by social influences. Acceptable risk is determined less by the objective level of risk than by the subjective risk tolerance of the exposed individual. There is an old saying in environmental risk management that. Perception is reality.. Despite the best efforts of scientists and economists to explain and defend the risk estimates and cost-benefit ratios that they have calculated, public acceptance of risk continues to be greatly influenced by factors unrelated to science or economics. Many of these factors are social factors, which include the following:

- risk perception
- anthropogenic hazard

- comparative risk
- risk equity

3.6 Risk Control

The Risk Control step focuses on choosing a particular course of preventive or remedial action from an array of possible control options, all of which are intended to reduce health risks through various strategies identified by the stakeholders and the risk management team. In contrast to the apparent objectivity of the previous analytical steps, the Risk Control step will need to consider a myriad of inherently subjective economic, social, and political issues, as well as carefully reviewing the critical scientific findings contained in the risk characterization report. Thus, it is important that Risk Control deliberations take place within an open and transparent participatory process that involves continual consultations with all stakeholder groups, as well as the general public, employing the full spectrum of available risk communication and consensus building tools.

3.7 Implementation and Monitoring

The Implementation and Monitoring step (also termed the Action step) refers to developing plans and taking actions necessary to communicate and implement the risk management decision. In the past, the action phase for stakeholders has focused primarily on complying with regulations. There has been a shift towards voluntary compliance and greater involvement of stakeholders in developing both risk management strategies and implementation plans. Involvement of stakeholders from the Initiation phase through to the Implementation and Monitoring phase of the process will result in risk management action plans that are implemented effectively, efficiently and flexibly. The plan should include:

- how and when the risk management strategy will be carried out
- the roles, responsibilities, and accountabilities of individuals and organisations
- plans for communication with and involvement of interested and affected parties
- criteria that will be used for monitoring and evaluation
- training requirements, staffing requirements, and financing requirements

Monitoring and review is an essential and integral step in the risk management process. Through monitoring, the actual impacts, benefits, and costs of a risk management strategy can be compared with estimates

made earlier in the risk management process. Ongoing review is essential to ensuring that changing circumstances do not change the risk priorities and that the management plan is relevant. Factors that may affect the likelihood and consequences of an outcome may change, as may the factors that affect the suitability or cost of the various risk management options.

The benefits of a Monitoring step in risk management include:

- the identification of new or changing risks;
- the accumulation of evidence to support assumptions and results of analyses;
- the development of a more accurate portrait of the risks; and
- reduction of costs associated with improper or redundant implementation of risk control measures

3.8 Risk Communication

Risk communication is defined as any two-way communication between stakeholders about the existence, nature, form, severity, or acceptability of risks. It is vitally important to understand the basic concepts of risk communication and to ensure that communication among stakeholders is integral to the risk management process. The focus of risk communication has evolved since the mid 1980.s, from concern about how best to inform the public about the technical aspects of risk assessments to a process of early and ongoing dialogue among stakeholders. While guidelines for risk communication have been prepared by various agencies, putting principles into practice is a long term process requiring considerable resources, time, and effort. The risks associated with ineffective risk communication include irreplaceable loss of management credibility, unnecessary and costly conflicts with government, difficult and expensive approval process for project sites, bitter and protracted debates and conflicts with stakeholders, diversion of management attention from important problems to less important problems, non-supportive and critical employees, and unnecessary human suffering due to high levels of anxiety and fear.

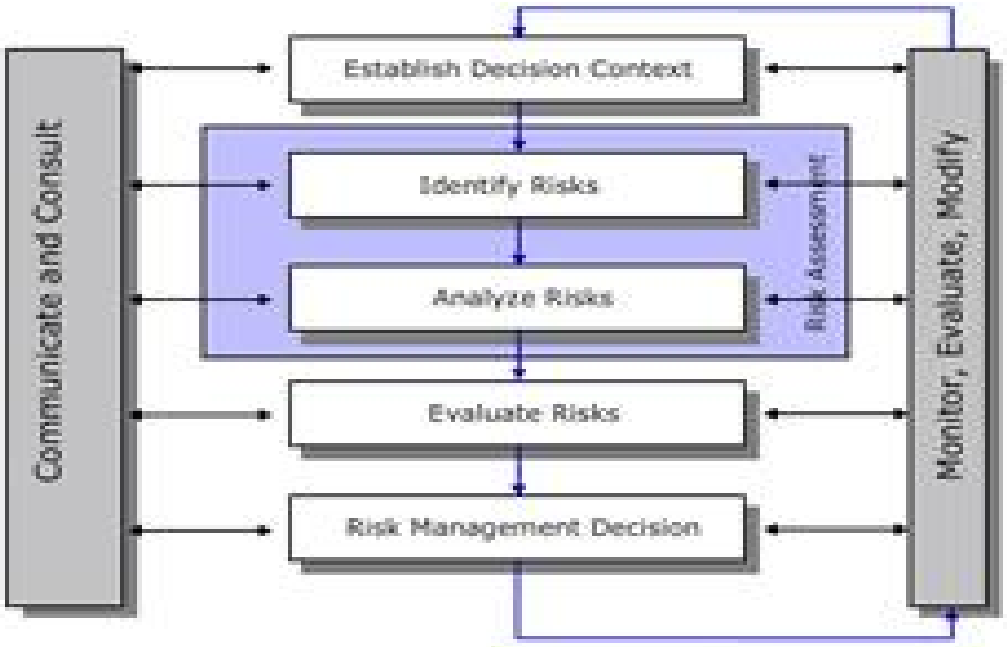

Figure 4: Steps in Risk Communication

3.9 Case Studies and Commentaries on Risk Assessment

CASE STUDY 1: Tributyltin Risk Management in the United States

R. J. Huggett and M. A. Unger, Virginia Institute of Marine Sciences

Tributyltin (TBT) is a chemical with a variety of biocidal applications, including use as an antifouling agent in boat paints (Blunden and Chapman, 1982). Biological effects of TBT on marine and estuarine organisms and the concentrations of TBT that induce them vary widely among species (Huggett et al., 1992). A water concentration of 1,000 ng/L (1 part per billion) is lethal to larvae of some species, and nonlethal effects have been observed at concentrations as low as 2 ng/L (2 parts per trillion, ppt). Both laboratory and field studies of toxicity were initially hampered by difficulties in measuring the low concentrations that were toxic to some organisms.

Adverse effects on nontarget organisms, including commercially valuable species of shellfish, were observed in Europe in the early 1980s (Alzieu, 1986; Abel et al., 1986). Abnormal shell growth was documented in Crassostrea gigas (European oyster) and linked through laboratory experiments to TBT leached from antifouling paints. That connection led to restrictive regulations in France (in 1982) and Great Britain (in 1985 and 1987). In the United States, concentrations exceeding those determined experimentally to be effective have been found in many areas, particularly in harbors with large marinas. Snails in

the vicinity of a marina on the York River, Virginia, were shown to have an abnormally high incidence of imposex (expression of male characteristics by female organisms), an effect previously observed under laboratory conditions in female European oysters, Ostrea edulis (Huggett et al., 1992). EPA began to assess effects of TBT in 1986, but has not yet issued any regulations. Meanwhile, restrictive actions have been taken by states and by the Congress.

A proposal by the U.S. Navy to use TBT paints on its entire fleet was prohibited by Congress in 1986, despite a Navy study that predicted no adverse environmental impact. Virginia enacted legislation and an emergency regulation in 1987, and Maryland, Michigan, and other states have since taken similar actions. Congress enacted national legislation restricting use of TBT paints in 1988. Those actions generally banned or restricted the use of TBT paints on small boats (less than 25 m long) and placed limits on leaching rates from paints used on larger vessels. Studies in Virginia had shown that most TBT releases were from small boats. Small-scale monitoring studies (e.g., in France and Virginia) have shown that the restrictions have been effective in reducing environmental concentrations and adverse impacts of TBT.

Risk management of TBT has been unusual in several ways. The initial basis for concern was field observation of adverse effects, not extrapolation from laboratory bioassays and field chemistry data. Risk assessment and risk management were conducted by state agencies and legislatures, rather than by EPA. Although the risk assessments were made without formalised methods, the results of the independent assessments were the same. Finally, TBT is the first compound banned by the Congress and the first regulated for environmental reasons alone.

Discussion

(Led by L. Barnthouse, Oak Ridge National Laboratory, and P. F. Seligman, Naval Ocean Systems Center)

The case study addressed, with differing completeness, each of the five recommended steps in risk assessment and management. Hazard identification included the observation of abnormalities in the field and the same effects in experimentally exposed animals. Dose-response identification included data both from the field (correlative) and from the laboratory (experimental). Exposure assessment was based on estimated use and release rates rather than on monitoring or modeling studies. Risk characterisation was only qualitative; it did not address such issues as the number and distribution of species that were vulnerable, or the degree of damage to the shellfish industry. Risk management actions were based on the demonstrable existence of

hazard, on societal concern for the vulnerable species, and on the ready availability of alternative antifouling agents.

Some workshop participants were critical of the risk assessment approach adopted by Congress and state regulatory agencies. No attempt was made to plan and execute a formal risk assessment. Risk identification was based primarily on data on nonnative species. The Eastern oyster and blue crab, the species putatively at greatest risk, have been found to be less sensitive. Regulatory responses were based on findings of high environmental concentrations of TBT in yacht harbors and marinas, rather than in ecologically important regions such as breeding grounds. The central issue is whether a safe loading capacity (environmental concentration) of TBT for nontarget organisms can be defined, given substantially reduced rates of input. Recent information on fate and persistence, chronic toxicity, and dose-response relationships could support a more quantitative risk assessment with the possibility of more or less stringent restrictions.

CASE STUDY 2: Ecological Risk Assessment for Terrestrial Wildlife Exposed to Agricultural Chemicals

R. J. Kendall, Clemson University

The science of ecological risk assessment for exposure of terrestrial wildlife to agricultural chemicals has advanced rapidly during the 1980s. EPA requires detailed assessments of the toxicity and environmental fate of chemicals proposed for agricultural use (EPA, 1982; Fite et al., 1988). Performance of an ecological risk assessment requires data from several disciplines: analytical toxicology, environmental chemistry, biochemical toxicology, ecotoxicology, and wildlife ecology.

Addressing the ecological risks associated with the use of an agricultural chemical involves a complex array of laboratory and field studies—in essence, a research program. This paper provides examples of integrated field and laboratory research programs, such as The Institute for Wildlife and Environmental Toxicology (TIWET) at Clemson University. Preliminary toxicological and biochemical evaluations include measurements of acute toxicity (LC_{50} and LD_{50}), toxicokinetics, and observations of wildlife in areas of field trials. Assessment of reproductive toxicity includes studies with various birds and other wildlife, particularly European starlings that nest at high densities in established nest boxes; these studies include measurements of embryo and nestling survival, post fledgling survival, behavior, diet, and residue chemistry (Kendall et al., 1989). Nonlethal assessment methods include measurement of plasma cholinesterase activity associated with organophosphate pesticide exposures (Hooper et al., 1989). A wide

variety of birds, mammals, and invertebrates have been used in these studies.

End points evaluated in wildlife toxicological studies include mortality, reproductive success, physiological and biochemical changes, enzyme impacts, immunological impairment, hormonal changes, mutagenesis and carcinogenesis, behavioral changes, and residues of parent compounds and metabolites (Kendall, 1992).

The paper includes a case history of a comparative evaluation of Carbofuran and Terbufos as granular insecticides for control of corn rootworms. Carbofuran has been responsible for many incidents of wildlife poisoning and is recognised as being very hazardous to wildlife. In contrast, although Terbufos is highly toxic to wildlife in laboratory studies, exposure of wildlife under field conditions appears generally to be relatively low, and widespread mortality is not evident. Field studies of Terbufos conducted by TIWET might be the only ones conducted to date that satisfy EPA's requirements for a Level 2 field study, a more quantitative assessment of the magnitude of the effects of a pesticide than the qualitative Level 1 studies. (Level 2 studies are performed when toxicity tests and use patterns suggest a detailed study is warranted.) Data generated in those studies support an ecological risk assessment for Terbufos that is reported in the paper. However, the research program on Terbufos represents many years of effort with integration of laboratory and field research to achieve a full-scale level 2 study in just one geographic area on one crop. Ecological modeling techniques will be needed to generalise the results to other chemicals or to other situations.

Discussion

(Led by B. Williams, Ecological Planning and Toxicology, Inc., and J. Gagne, American Cyanamid Company)

Dr. Williams noted that each step in ecological risk assessment is more complex and less understood than the corresponding step in human health risk assessment. Although hazard can be assumed when a toxic chemical is released, the species and populations at risk must first be defined. The appropriate selection of surrogate species for testing in the laboratory is usually unclear. Measurement of environmental concentrations is only the first step in exposure characterisation. Exposure assessment also requires consideration of foraging behavior, avoidance, and food-web considerations, as well as spatial and temporal variability. Risk characterisation involves comparison of exposure estimates with measures of hazard; this process might result in compounding of errors. Ecological risk assessments do not track

individuals over time and so do not accurately reflect population changes.

The activities presented in the case study have a large research component, which is focused on dose-response assessment and exposure assessment. One discussant characterised risk assessment, as presented in the case study, as a retrospective exercise based on focused characterisation of hazard and exposure in wildlife. Given the difficulties in conducting environmental risk assessments, the four-part paradigm might not be applicable at levels of organisation above that of the population.

4.0 CONCLUSION

Once the risks are characterised, various regulatory options are evaluated in a process called risk management, which includes consideration of social, political, and economic issues, as well as the engineering problems inherent in a proposed solution. One important component of risk management is risk communication, which is the interactive process of information and opinion exchange among individuals, groups, and institutions. To be effective, risk communication must provide a forum for balanced discussions of the nature of the risk, lending a perspective that allows the benefits of reducing the risk to be weighed against the costs. Risk assessment provides an effective framework for determining the relative urgency of problems and the allocation of resources to reduce risks. Using the results of risk analyses, we can target prevention, remediation, or control efforts toward areas, sources, or situations in which the greatest risk reductions can be achieved with the resources available. However, risk assessment is not an absolute procedure carried out in a vacuum; rather, it is an evaluative, multifaceted, comparative process. Thus to evaluate risk, we must inevitably compare one risk to a host of others. In fact, the comparison of potential risks associated with several problems or issues has developed into a subset of risk assessment called comparative risk assessment.

5.0 SUMMARY

In this unit, you have learnt that:

i. Risk Identification is the systematic ways of gathering, organising, and appraisal of the scientific and technical information necessary to decide whether a particular environmental contaminant or occupational hazard is likely to constitute a significant hazard to human health.

ii. risk assessment as the process of estimating both the probability that an event will occur and the probable magnitude of its adverse effects — economic, health safety–related, or ecological—over a specified period.

iii. the risk assessment process consists of four basic steps basically – hazard identification, exposure assessment, dose-response assessment and risk characterisation.

iv. dose–response assessment means quantitating the adverse effects arising from exposure to a hazardous agent based on the degree of exposure. This assessment is usually expressed mathematically as a plot showing a response (i.e., mortality) in living organisms to increasing doses of the agent.

v. risk evaluation techniques focus on the exploration of normative issues related to what ought to happen in a society that seeks to provide effective protection of the health its citizens in an equitable, but affordable, manner. The two major classes of normative societal issues are considered in the Risk Evaluation step are: economic and social evaluation.

vi. the Implementation and Monitoring step (also termed the Action step) refers to developing plans and taking actions necessary to communicate and implement the risk management decision.

vii. risk communication is the interactive process of information and opinion exchange among individuals, groups, and institutions. To be effective, risk communication must provide a forum for balanced discussions of the nature of the risk, lending a perspective that allows the benefits of reducing the risk to be weighed against the costs.

6.0 TUTOR-MARKED ASSIGNMENT

1. Explain the relevance of NOEL and the LOEL in the dose-response curve.
2. Discuss succinctly the tasks of risk communication in the risk management process.
3. Write a concise and short note on the followings:
   - Cost-Effectiveness Analysis
   - Risk-Benefit Analysis
   - Benefit-Cost Analysis
   - Risk Perception
   - Comparative Risk Assessment
   - Risk Equity
   - Socio-Economic Impact Analysis

7.0 REFERENCES/FURTHER READING

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UNIT 3 HEALTHY-WORKERS EFFECT

CONTENTS

1.0 INTRODUCTION

The Healthy Worker Effect (HWE) phenomenon has been under debate since a few years. Some epidemiologists consider HWE an ordinary method problem while others consider it a field of Science by itself. In this unit we shall explain various definitions of HWE with their historical background, necessary to understand the phenomena. This unit also deals with the HWE in occupational studies, and systematically presents the sources, components, magnitude, effect modifiers and strategies for reducing the HWE.

2.0 OBJECTIVES

At the end of this unit, you will be able to:

- discuss the concept and origin of Healthy Worker Effect (HWE).
- explain the various sources and components of the HWE.
- discuss the various factors affecting the HWE
- explain the strategies for reducing HWE.

3.0 MAIN CONTENT

3.1 Definitions

"HWE is a phenomenon initially observed in studies of occupational diseases: Workers usually exhibit lower overall death rates than the general population because the severely ill and chronically disabled are ordinarily excluded from employment" – Last, 1995. Another definition by McMichael (1976) who first gave it the name is: "HWE refers to the consistent tendency of the actively employed to have a more favorable mortality experience than the population at large." However, other occupational epidemiologists describe HWE as the reduction of mortality or morbidity of occupational cohorts when compared with the general population.

The healthy worker effect (HWE) is a term applied to the deficit of both morbidity and mortality ascribed to various employment-associated factors when workers and the general population are compared. First used by McMichael et al., (1976) the HWE reflects that an individual must be relatively healthy in order to be employable in a workforce, and both morbidity and mortality rates within the workforce are usually lower than in the general population. As a result, real excesses in both morbidity and mortality due to harmful exposures at work might be wholly or partially masked.

Although well-recognised, the HWE has been considered to be a poorly defined phenomenon and a popular but vague concept. To a certain extent, the above-stated criticisms are justifiable as neither rigorous definition of the HWE nor a consensus upon how to deal with the HWE have been available. Additionally, although years of effort by occupational epidemiologists have been devoted to reducing or even eliminating the HWE, it remains one of the most complex methodological difficulties in the study of occupational hazards and human health.

3.2 Historical Background

This phenomenon was first observed in 1885 when William Ogle found mortality rate dependent on difficulty of occupation; some occupations repel and some others attract workers. In other words, the more vigorous occupations had a relatively lower mortality rate when compared with the death rate in occupations of an easier character or among the unemployed. Doll and coworkers (1965) studied on gas workers exposed to carbonised coal. They measured standardised mortality rate (SMR i.e. mortality rates after eliminating possible effect of age differences in workers and general population) for groups of gas

workers with different kinds of exposure. SMR is less than 100 in unexposed workers. Almost 100 years later, in 1974, McMichael coined the term HWE to describe this phenomenon. A year later, Goldsmith (1975) pointed out that most industrially employed cohorts should be expected to have better life expectancy than unemployed persons. SMR close to unity (100) is used as an indication of absence or a low degree of HWE.

3.3 Sources of Healthy Worker Effect

The HWE has long been considered as a source of selection bias. It is true that there is a selection process of excluding unhealthy individuals from the workforce, and this selection process leads to a difference in health status between workers and the general population. From this perspective, in an industry free of significant life shortening hazards, both morbidity and mortality rates within the workforce of interest are likely to be lower than that in the general population. In addition to bias due to the selection process at employment, occupational studies of both morbidity and mortality, which compare workers and the general population, appear to be influenced by additional sources of biases. For example, healthier workers are more likely to stay in the workforce than those who are sick, which may also give rise to a healthier occupational cohort. From this perspective, the HWE can be viewed as a consequence of selecting an occupational cohort with a process based on health and/or survival effects.

This unit classifies the HWE and the other biases related to the comparison of workers and general population into selection bias, information bias, and confounding bias as addressed below.

3.3.1 Selection bias

Many investigators have suggested that incomplete follow-up of the section of workers who leave employment could be a source of the HWE. Such incomplete follow-up can be attributable to (1) good health required of workers for continued employment and (2) the tendency for those who develop diseases to leave their employment. Thus, if comparisons are made between workers who remain in employment during the time period of observation (i.e., active workers) and the genera] population, the HWE may arise.

In addition to incomplete follow-up, lower morbidity and mortality rates of workers could be simply a consequence of an improper local vs. national comparison. If the worker population belongs to a region with better health conditions than large geographic areas or a nation as a whole, then regional differences in the occurrence of a particular disease

may contribute to observed deficits of morbidity and mortality among workers. Such regional differences may result from dissimilar qualities of health and clinical care and/or local peculiarities in diagnostic criteria, and have little to do with the good health of workers.

3.3.2 Information bias

The comparison of both morbidity and mortality between workers and the general population might leave room for information bias. For example, the differences in both morbidity and mortality between an occupational cohort and the general population may arise from different criteria in the diagnosis of diseases, or from differences in the methods and quality of recording health outcomes between the two populations being compared. The difference in the mortality ascertainment may entail different degrees of misclassincation of diseases between populations. If the number of deaths among workers is under-ascertained, a study may report deficits in both morbidity and mortality among workers, and such deficits are unrelated to the selection process of an individual into the workforce.

3.3.3 Confounding bias

As mentioned earlier, many researchers consider the HWE to be a source of selection bias because it is a result of the selection process of relatively healthy individuals into industries. Such selection processes may have the following consequences. First, because people who are diagnosed with illnesses with a symptomatic prediagnostic phase are less likely to obtain employment, the selected workers may have a better-than-average health status. Second, employment regulations set by industries may restrict certain risk factors for diseases and causes of death. For example, some health-related behaviours such as smoking, are not allowed during the work hours, and some personal traits, such as obesity, may be thought unfit for particular labour forces by industry.

A study exemplified such phenomena by demonstrating a significant deficit in lung cancer mortality among petrochemical workers in which the authors hypothesised that since smoking was prohibited in the workplace, the proportion of smokers in that group of workers was smaller than in the general population. In addition to such selection processes, the differences in both morbidity and mortality between specific groups of workers and the general population may be attributed to non-comparability of socio-economic status. It has been suggested that once hired, workers in large industries may have greater access to medical services that protect them from diseases. Thus, the HWE may reflect the selection of workforces for study rather than selection of individuals into workforce.

3.4 Components of HWE

Healthy Hire Effect

Employers have the right to reject certain persons for employment because of physical disabilities, or poor general health. An employer will exclude those obviously at high risk. Person selection may also be influenced by habits and physical conditions such as weight, smoking, or alcoholism. This effect will vary according to the labor situation, i.e. during period of labor shortages less fit workers could be included in the labor force whereas during periods of labor surplus employers can be choosy.

Healthy Worker Survivor Effect

Workers who do not have strong motivation to work because of health problems do not present themselves for employment (self-selection). They generally change jobs frequently or retire early. They change their job for different reasons including ill health. The effect is reduced after 15 years of entry to the industry.

Time-since-hire

The length of time the population has been followed. HWE is a characteristic of actively employed workers. Incomplete follow-up of the out-migrating section of the cohort could result in failure to track every individual to determine his vital status. Reduction in health status could occur without any relation to exposure.

Monson (1986) divided the follow-up into two phases; a dynamic phase and a stable plateau. The dynamic phase is characterised by increased relative risk (RR) with years of follow-up. The RR becomes constant after some years of follow-up (plateau).

Beneficial Effect of Work

Improved access to healthcare, routine disease screening and physical exercise are the beneficial effects of work. While there is a wide agreement on the first three factors, there is debate on the extent of the beneficial effect. Doll (1965) considered low mortality a result of true benefit of work on health.

3.5 Factors Affecting HWE

In addition to the sources and components of the HWE, determining size and effect-modifiers of the HWE has been another challenge to researchers. Specifically, the HWE can be very serious in some studies,

but may be moderate in others. We summarised, in the following section, factors affecting the HWE.

Causes of death

Many investigators have argued that the HWE is of **l**ittle or no consequence in interpreting data on cancer mortality. The reason for this is that it is unlikely that factors predicting eventual cancer deaths would be presented at 20 years of age, when many people become employed, which may not be true for factors that predict other causes of death. In other words, most cancers are not associated with a prolonged period of ill-health that would affect employability for a long time before death occurred. Although the verification of this argument is almost unfeasible empirically, it is quite reasonable to conceptually be convinced that the influence of the HWE should be relatively moderate for mortality studies of diseases with an absence of a prolonged disabling illness preceding death such as cancer.

Demographic factors

Fox and Collier analysed data collected in a cohort study of all men ever exposed to vinyl chloride monomer in manufacturing processes in Great Britain. The results showed that the standardised mortality ratio (SMR) for all causes was lower for younger workers than that for older workers, even after adjustment for length of employment. This finding is contradictory to the common belief that older individuals seeking employment are healthier than individuals of the same age in the general population while it is not so obvious for younger people looking for employment Thus, if age at start of employment modified the size of the HWE, it would favour the older workers more than the younger workers.

However, it is again not possible to empirically verify the above stated argument. Even if the SMRs are found to be equal across the different age ranges, it provides no convincing evidence of equal operation of the HWE at different ages, and may only reflect the mix of possible different HWEs and different age-specific effects from occupational hazards. Additionally, Hernberg argued that the HWE would have greater influence on male workers than on female workers, since women are less likely to be rejected from the workforce for poor health status than men are.

Types of occupational cohort

Different workforces usually have different hiring policies with respect to physical fitness and/or certain health related behaviours, such as smoking. As a result, the HWE is likely to be different across industries. The HWE in the study of active employees can be even more serious since workers who remain in the workforce are generally healthier than those who are retired or disassociated from the workplace. Thus, the HWE would tend to be more observable for physically demanding occupations than for those with little need of physical labour.

The time elapse

Some studies have noted that SMRs were approaching one with increased time before follow-up and concluded that the advantage of a health selection process at the initial stage disappeared gradually. Thus, for older age groups, the proportion of healthy persons in the general population and that in the occupational cohort would become more and more alike. The decline of the HWE with time since first employment may be because the effect of selective exclusion from entry into work only operates during the period when an illness impairs employability. For example, a man who dies from chronic obstructive lung disease may have been too ill to obtain a job for 10 years before his death, but it is less likely to have restricted him from employment 40 years before his death. Breslow demonstrated this in a cohort of smelter workers by examining the joint effects of time of hire, birth place, years since employment and levels of arsenic exposure on the SMRs for respiratory cancer mortality. He noted that the change of SMR with time was largely determined by time of hiring. Additionally, one could also speculate that the advantageous health status of workers at the start of employment would decline with the passage of time because the advantages resulting from the selection process would gradually disappear as a result of physical and psychological work pressure.

With the exception of the above-stated argument for the increase of SMR with time, researchers have different viewpoints on the change of SMR. Firstly, it has been suggested that the comparison of two age-adjusted SMRs should not be allowed unless there is homogeneity across strata of ratios of mortality rates in cohort 1 and cohort 2 and in the general population. As time goes on, the age-specific mortality rate might change and the condition for comparing SMRs derived at two different points in time could be violated. Thus, the customary observation of the increase of SMR over time may not necessarily be due to the disappearance of HWE (or the increase in mortality risk), but is instead an artefact of SMR methodology. Secondly, researchers have argued that the increase of SMR for certain diseases with time may

simply be a consequence of accumulated hazardous exposures rather than the disappearance of the advantages of the selection process at employment.

3.6 Strategies for Reduction of Healthy Worker Effect

Among a variety of biases arising from the comparison between workers and the general population, the selection bias can be effectively minimised if studies include not only active workers but also pensioners and those who left work before retirement. Additionally, the information bias would be much less serious than the selection bias if an appropriate general population with comparably accurate information on both morbidity and mortality was identified. However, once the general population is used as a comparison population and the industry's recruitment of workers is based on health status or/and certain health-related behaviours, the confounding bias would invariably occur. The only way of adjusting for confounding bias is to conceive the baseline health status and risk factor distributions of the occupational cohort and of the general population, which is, unfortunately, unrealistic.

A number of strategies for minimizing the HWE have been frequently proposed. Nearly every strategy has its strengths and limitations and these are comprehensively summarised in the literature. Among the strategies, 'use external work comparison groups' and 'use internal comparison groups', in our view, are the most methodologically plausible. Ideally, we should identify a theoretically correct external comparison population, or a representative sample from it, which comprises other employed persons who have entered and remained in the workforce through an equivalent selection process. Moreover, the correct external population should consist of workers from certain occupations who are comparable with the index occupation in terms of extraneous effects on the outcomes of interest.

In addition to 'use external work comparison groups', researchers may consider another strategy that examines variation in the health outcome rate across a gradient of increasing exposure within the workforce, i.e., 'use internal comparison groups'. This strategy is justifiable in that employees from the same industry tend to experience a similar selection process, and they are likely to share a similar potential confounding effect. As a result, the presence of the HWE can be effectively controlled by comparing rates of the health outcomes of interest between individuals with high exposure and those with low or no exposure. The nested case-control study is equivalent, in the sense of selecting controls, to the use of internal comparison groups.

3.7 Case Study on HWE

Excerpt from Case Study - Quantification of the healthy worker effect: a nationwide cohort study among electricians in Denmark

Background

The healthy worker effect (HWE) is a well-known phenomenon. In this study we used the extensive registration of all Danish citens to describe the magnitude of HWE among all Danish electricians and evaluated strategies for minimizing HWE bias of the association between occupation and mortality.

Methods

All Danish male citizens aged 26-56 years in the period 1984-1992 were followed for three years in several registers. We evaluated HWE bias among electricians because they were unexposed to detrimental occupational exposures. We compared electricians to three reference groups (general population, construction industry and carpenters/bricklayers) and utilised analytical methods for minimizing HWE bias (lag time analyses, age-stratified analyses, marginal structural model and restriction to employed, newly employed or long-term workers).

Results

The mortality rate was higher among electricians, who the year following active employment received incapacity benefits or was on long-term sick leave. Electricians receiving incapacity benefits, on long-term sick leave, unemployed, or with increased comorbidity index had lower odds of re-employment. Electricians had lower mortality rate (rate ratio,0.60;95%CI,0.52-0.69) compared to the general population, while electricians leaving employment had increased mortality (1.90;1.50-2.40). Adjusting for several social events slightly attenuated the estimates, while the marginal structural model did not minimize bias. Electricians had the same mortality as the construction industry and carpenters/bricklayers. Mortality was comparable to the general population after three or more years of lag time.

Conclusions

In this nationwide study, employment as electricians had marked effect on mortality. Appropriate reference selection and lag time analyses minimised the HWE bias.

4.0 CONCLUSION

In summary, the HWE has not been sufficiently and systematically defined. Considering its multifaceted nature, it is very doubtful that such a crude term is useful at all. This unit also concludes that there is no particular comparison populations preferable in all aspects and careful interpretation of the results from the studies using different comparison populations are strongly recommended. We suggest that investigators should not focus on the term 'healthy worker effect' and should perhaps try to make comprehensible distinctions between the different underlying factors related to the comparison between workers and the general population. This approach would be, we believe, a better way of gaining insight into and handling HWE-related biases in occupational epidemiology.

5.0 SUMMARY

In this unit, you have learnt that:

i. HWE is a phenomenon initially observed in studies of occupational diseases in which workers usually exhibit lower overall mortality and morbidity rates than the general population because the severely ill and chronically disabled are ordinarily excluded from employment.
ii. The HWE has long been considered as a source of selection bias. It is true that there is a selection process of excluding unhealthy individuals from the workforce, and this selection process leads to a difference in health status between workers and the general population. These biases related to the comparison of workers and general population are divided into election bias, information bias, and confounding bias.
iii. The components of HWE include: healthy hire effect (employers have the right to reject certain persons for employment because of physical disabilities, or poor general health), healthy worker survivor effect (workers who do not have strong motivation to work because of health problems do not present themselves for employment (self-selection), time-since-hire (HWE is a characteristic of actively employed workers), and bemeficial effect of work(Improved access to healthcare, routine disease screening and physical exercise is the beneficial effect of work).
iv. Factors affecting the HWE includes: demographic factors, causes of death, types of occupational cohort, the time elapse, and time related factors (age at hire, age at risk and duration of employment).

v. HWE is caused by an inadequate reference group (i.e. comparison problem). If we find an ideal reference group, then HWE will not exist. It is a complex, problem creating bias comprising of several factors and may be modified by a number of factors. It is not possible to make generalisations in a particular case of HWE

6.0 TUTOR-MARKED ASSIGNMENT

1. Give an historical background of the origin of Healthy Worker Effect (HWE).
2. Give a concise explanation on the various factors affecting HWE with relevant illustration.
3. Discuss in detail the various sources of biases in HWE which make it one of the most complex methodological aspects in occupational studies which use the general population as the comparison group.
4. Discuss the behaviour of the Healthy Worker Effect.
5. Discuss succinctly the strategies for minimising or avoiding HWE.

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MODULE 5 CLINICAL OCCUPATIONAL HEALTH AND SAFETY

UNIT 1 OCCUPATIONAL AND OTHER WORK-RELATED DISEASES

CONTENTS

1.0 INTRODUCTION

In this unit, you will learn occupational diseases and work-related diseases that workers are exposed to. We shall also look into the characteristics of occupational diseases and work-related stress. A brief description of the various occupational diseases and work-related diseases shall be looked into. Finally, you will learn about the different mode of prevention against occupational diseases.

2.0 OBJECTIVES

By the end of this unit, you will be able to:

- distinguish between the term “occupational diseases” and “work-related” diseases.
- .describe the characteristics of occupational diseases and work-related diseases.
- describe the aetiology and behavior of different occupational diseases and work-related diseases.
- explain the various modes of prevention of occupational diseases.

3.0 MAIN CONTENT

3.1 Occupational Diseases - Definition

Occupational diseases are adverse health conditions in the human being, the occurrence or severity of which is related to exposure to factors on the job or in the work environment. Such factors can be:

- Physical: e.g. noise, heat, radiation
- Chemical: e.g. pesticides, solvents, heavy metals, dust
- Biological: e.g. tuberculosis, hepatitis B virus, HIV
- Ergonomic: e.g. improperly designed tools or work areas, repetitive motions
- Psychosocial stressors: e.g. lack of control over work, inadequate personal support
- Mechanical: these mainly cause work accidents and injuries rather than occupational diseases.

“Occupational diseases… stand at one end of the spectrum of work relatedness diseases where the relationship to specific causative factors at work has been fully established and the factors concerned can be identified, measured, and eventually controlled. At the other end [are] diseases [that] may have a weak, inconsistent, unclear relationship to working conditions; in the middle of the spectrum there is a possible causal relationship but the strength and magnitude of it may varies.”

3.2 Degree of Work-Relatedness

The degree of work-relatedness of a work-connected disease condition varies in different situations and determines whether a disease is considered an occupational disease, work-related disease or aggravation of a concurrent disease, e.g.

- A specific agent like lead or silica, which is present essentially in the workplace, causes a disease condition which cannot occur due to other causes; this is an occupational disease.

- Where an infection can occur at the workplace, an occupational disease can also be caused by a specific agent, such as tuberculosis among health care workers in a tuberculosis treatment centre. Of course infection can also occur in the general population under non-occupational conditions.

- Work-related diseases occur more frequently than occupational diseases. They are caused by interaction of several extrinsic risk factors and a number of intrinsic factor each of which may or may not operate in any individual case. Occupation hazards are among the risk factors which can contribute to the occurrence of work-related diseases. Examples are many and include:

  - behavioural responses
  - psychosomatic illness
  - hypertension
  - coronary heart disease
  - chronic non-specific respiratory disease
  - locomotor disorders

- Work conditions can aggravate pre-existing disease: hepatic dysfunction can be aggravated by exposure to certain chlorinated hydrocarbons; bronchial asthma can be aggravated by dust exposure and renal disease can be aggravated by inorganic mercury, cadmium and certain solvents.

- Exposure to combinations of occupational hazards may result in synergistic effects which are much more pronounced than effects of individual exposures simply added together.

- Individual susceptibility to the effects of some occupational exposures varies. Genetic factors are important determinants of individual susceptibility.

3.3 Characteristics of Occupational Diseases

The occupational cause of occupational disease is often overlooked by health care providers. This is due to several special characteristics of occupational disease that may obscure its occupational origin.

- The clinical and pathological presentation of most occupational diseases is identical to that of non occupational diseases; e.g. asthma (excessive airway narrowing in the lungs) due to airborne exposure to toluene diisocyanate is clinically indistinguishable from asthma due to other causes.

- Occupational diseases may occur after the termination of the exposure. An extreme example would be asbestos related-mesothelioma (a cancer affecting the lung and abdomen) which can occur 30 or 40 years after the exposure.

- The clinical manifestations of occupational diseases are related to the dose and timing of exposure; e.g. at very high airborne concentrations, elemental mercury is acutely toxic to the lungs and can cause pulmonary failure, while at lower level of exposure, elemental mercury has no pathologic effect on the lungs but can have chronic adverse effects on the central and peripheral nervous systems.

- Occupational factors can act in combination with non-occupational factors to produce disease; e.g. exposure to asbestos alone increases the risk of lung cancer five-fold; and the long-term smoking of cigarettes increases the risk of lung cancer between 50 and 70 fold.

3.2 Characteristics of Work-Related Stress

This category has certain characteristics that were identified and stated by a WHO Expert Committee as follows:

“Multifactorial diseases”, which may frequently be work-related, also occur among the general population, and working conditions and exposures need not to be risk factors in each case of any one disease. However, when such diseases affect the workers, they may be work-related in a number of ways: they may be partially caused by adverse working conditions; they may be aggravated, accelerated or exacerbated by workplace exposures; and they may impair working capacity. It is important to remember that personal characteristics, other environmental and sociocultural factors usually play a role as risk factors for these diseases.

Multifactorial “work-related” diseases are often more common than occupational diseases and therefore deserve adequate attention by the health care systems, which incorporates the occupational health services.

The work-related diseases which deserve particular attention are:

- behavioural and psychosomatic disorders.
- hypertension
- coronary heart disease
- peptic ulcers
- chronic non-specific respiratory disease
- locomotor disorder.

3.5 Aetiology of Common Occupational Diseases

3.5. 1 Pulmonary Dust Diseases

If the work place is dusty, dust will inevitably be inhaled. Dust particles below five microns in diameter are called respirable since they have the chance to penetrate to the alveoli. The respiratory tract has certain defense mechanisms against the dust but when the environment is very dusty a significant amount of dusts can be retained in the lungs.

Different kinds of dust have different effects:

- Soluble particles of toxic compounds reach the blood and causes poisoning, e.g. lead.
- Irritant dusts cause irritation of the upper respiratory tract and the lungs and certain metal fumes cause chemical pneumonia, e.g. cadmium, beryllium and manganese.
- Some others cause sensitisation resulting in asthma or extrinsic allergic alveolitis, e.g. some organic dust.
- Metal fumes fever is caused by inhalation of fumes of zinc and copper causing fever, body aches and chills for 1-2 days.
- Pneumonic anthrax is caused by inhalation of wool dust containing the spores.
- Benign pneumoconiosis which causes x-ray opacities (nodulation) without symptoms or disability is caused by inhalation iron, barium and tin dust.
- Byssinosis is caused by prolonged exposure (7-10 years) to cotton dust in the textile industry especially in the ginning, bale opening and carding. It is manifested by chest tightness on the first day following a weekend. Initially, the patient is free of

symptoms for the rest of the week. Chronic bronchitis, emphysema and disability are common complications.

- Pneumoconiosis is disabling pulmonary fibrosis that results from the inhalation of various inorganic dust, such as silica, asbestos, coal, talc, china clay, e.g. silicosis and asbestosis:

Silicosis: Silicosis result from the inhalation of respirable particles of free crystalline silica (SiO_2). Exposure occur in mining and quarrying operation, stone cutting and shaping, foundry operations, glass and ceramic manufacture, sandblasting and manufacturing of abrasive soaps. It takes many years to develop the disease (7-10 years, sometimes less) and this depends on the concentration of dust at workplace, its silica content, the particle size and individual susceptibility. The dust particles settle in the lungs and cause small nodules of fibrosis that progressively become numerous, enlarge and coalesce causing fibrosis and progressively loss of lung function and disability. The disease can be detected even before the symptoms appear by x-ray examination which shows numerous bilateral nodular shadows of different sizes or large masses of fibrosis.

Asbestosis: Asbestosis is caused by inhalation of asbestos fibres. It is a hydrated magnesium silicatewhich is resistant to heat and many chemicals. In addition to mining and extraction, exposure to asbestos occur in its use for insulation, in the making of asbestos cloth, in the manufacturing of asbestos cement pipe and other products, vinyl floor tiles and brake and cloth lining. Asbestos fibres, when inhaled, will cause diffuse interstitial fibrosis of the lung, pleural thickening and calcification. Bronchogenic carcinoma or pleural and peritoneal mesothelioma are known effects. The early symptoms include progressive dyspnoea on exertion, cough, expectoration, chest pain, cyanosis and clubbing of the fingers. The disease takes about seven years to develop and depends upon the dust concentration at the workplace. Early detection depends on symptoms and signs and the x-ray picture. Smoking increases the risk of developing lung cancer several folds.

3.5.2 Occupational Infections

Human diseases caused by work-associated exposure microbial agents, e.g. bacteria, viruses, rickettsia, fungi and parasites (helminthes, protozoa), are called occupational infections. An infection is described as occupational when some aspects of the work involves contact with a biologically active organism. Exposure occurs among health care workers in fever hospitals, laboratories and general hospitals; among

veterinarians and agricultural workers in animal husbandry and dairy farms and pet shops; and among sewerage workers, wool sorters and workers in the leather industry.

3.5.3 (Occupational) Pulmonary Tuberculosis

Health care workers in tuberculosis treatment centres, in laboratories and in veterinary clinics are particularly affected. The disease is caused by Mycobacterium tuberculosis (Koch's bacillus) and is transmitted occupationally by droplet infection, contact with infected material from humans (sputum) or animals. The organism can survive in dust and away from direct sunlight for many days and enters the body through the respiratory tract or abraded skin where it causes a skin ulcer.

The disease usually affects the lungs but can also affect the gastrointestinal tracts, bones, kidneys, meninges, pleural and peritoneum. Pulmonary tuberculosis is manifested by coughing, expectoration, haemoptysis, loss of weight, loss of appetite, night sweats and night fever. It can be diagnosed by chest X-ray and bacteriological examination of the sputum.

Workers should undergo a pre-placement examination and be tested with tuberculin and vaccinated with BCG if the tuberculin test is negative. Pre-placement and periodic X-rays should be taken. Health education and proper disposal of infected material should be observed.

3.5.4 Viral Hepatitis B and C

Health care workers who are likely to come into contact with the blood and body fluids of infected persons are at great risk of infection. An acute onset of hepatitis is the exception; more often there are vague general symptoms or none at all and the infection is discovered on routine serological examination. The disease may pass into chronic active hepatitis: liver cirrhosis, hepatic failure and liver carcinoma.

Because of the exposure to patients' body fluid via contaminated glassware and contaminated equipment, such as needles, which may provide an opportunity for contact with mucous membranes or parenteral inoculation, strict "infection control" procedures should be developed for situation where there are potential risks, such as phlebotomy, dentistry and haemodialysis. Workers at increased risk of hepatitis B infection should receive hepatitis B immunisation.

3.5.5 Occupational Dermatoses

Occupational dermatoses are the most common occupational diseases and are almost always preventable by a combination of environmental, personal and medical measures.

The skin can be affected by many factors:

- repeated many irritations may cause callosities and thickening of the skin
- various kinds of radiation
- tuberculosis and anthrax
- chemicals can cause irritation and sensitization

Types of occupational dermatosis:

- acute contact eczema due to irritation and sensitisation
- chronic contact eczema due to irritation and sensitisation
- chloracne (lubricating and cutting oils, tar and chlorinated naphthalenes)
- photosensitization (chemicals, drugs and plants)
- hypopigmentation and hyperpigmentation (dyes, heavy metals and chlorinated hydrocarbons)
- keratoses (ionizing radiation, ultraviolet radiation)
- Benign tumours and epitheliomas (UV, ionizing radiation, tar, soot, arsenic)
- ulcers (trauma, burns).

3.5.6 Occupational Cancer

The cause of cancer is still not completely understood. It has been observed however, through epidemiological studies that cancer of certain organs has been associated with certain exposures.

Occupational cancer is not different from other types of cancers in terms of presentation or histopathologic forms. A positive history of exposure to a carcinogenic agent can be obtained in occupational cancer. Examples of some carcinogenic agents and organs affected are listed below.

Carcinogenic Agent	Organ Affected
Arsenic	Skin and lung
Chromium compounds, hexavalents	Lung
Nickel	Lung and nasal sinus
Polycyclic Aromatic Hydrocarbons (PAH)	Skin
Coal tars	Skin, scrotum, lung, bladder
Benzol	Blood (leukaemia)
B-naphthalamine	Bladder
Ionizing radiation	Skin, bone, lung, blood (leukemia)
Asbestos	Lung, pleura, peritoneum

3.5.7 Reproductive Effects

Occupational exposure to certain chemicals or physical factors (like ionizing radiation) has been found to have certain effects on reproductive functions:

- dysfunction in males (sterility or defective spermatozoa) and females (anovulation, implantation defects in the uterus).
- increased in incidence of miscarriage, stillbirth and neonatal death.
- Induction of structural and functional defects in newborn babies.
- Induction of defects during the early postnatal developmental stage.

Exposure of either parent may lead to reproductive defects.

Chemicals which may have been associated with reproductive effects include:

- alcohols
- anaesthetic gases
- cadmium
- carbon disulfide
- lead

- manganese
- polyvinyl chloride.

3.6 Prevention of Occupational Diseases

Primary Prevention

Primary prevention is accomplished by reducing the risk of disease. In the occupational setting, this is most commonly done by reducing the magnitude of exposure to hazardous substances. As the dose is reduced, so is the risk of adverse health consequences. Such reductions are typically managed by industrial hygiene personnel and are best accomplished by changes in the production process or associated infrastructure, e.g. the substitution of a hazardous substance with a safer one, or enclosure or special ventilation of equipment or processes that liberate the airborne hazards. These are known as engineering controls.

Other methods of exposure reduction include the use of personal protective equipment and rotation of workers through areas in which hazards are present to reduce the dose to each worker (NB: this method does, however, increase the number of workers exposed to the hazard).

Secondary Prevention

This is accomplished by identifying health problems before they become clinically apparent (i.e. before the workers report feeling ill) and intervening to limit the adverse effects of the problem. This is also known as occupational disease surveillance. The underlying assumption is that such early detection will result in a more favourable outcome.

An example of secondary prevention is the measurement of blood lead levels in workers exposed to lead. An elevated blood lead level indicates a failure of primary prevention but can allow for corrective action before clinically apparent lead poisons occur. Corrective action would be to improve the primary prevention activities listed above.

Tertiary Prevention

This is accomplished by minimizing the adverse clinical effect on health of a disease or exposure. Typically, this is thought of as clinical occupation medicine. An example of tertiary prevention is the treatment of lead poisoning (headache, muscle and joint pain, abdominal pain, anaemia, kidney dysfunction) by administration of chelating medication. The goal is to limit symptoms and discomfort, minimise injury to the body and maximising functional capacity.

4.0 CONCLUSION

Occupational diseases are unique in the sense that the hazards that cause them are known even before the exposure of the workers takes place. This fact characterises occupational diseases as being entirely preventable; exposure can be controlled or preventable. The ideal situation of complete prevention of occupational diseases by controlling exposures however, does not occur in practice, and occupational diseases continue to occur.

To minimise the damages caused by occupational diseases, the best alternative is early detection of pathological changes at a stage when they are reversible. Certain occupational exposures cause early clinical, functional, biochemical, physiological or morphological changes which, when detected early enough, are reversible. There are many clinical, laboratory and other tests that have been developed to detect these early changes, each exposure having it specific test.

5.0 SUMMARY

In this unit, you have learnt that:

i. Occupational diseases are adverse health conditions in the human being, the occurrence or severity of which is related to exposure to factors on the job or in the work environment.

ii. work-related diseases are work-connected disease arising from exposure to working conditions or aggravated by working environment.

iii. the characteristics of occupational diseases are that they have identical clinical and pathological presentation with that of non occupational diseases; are related to the dose and timing of exposure; and may occur after the termination of the exposure

iv. occupational diseases include silicosis, asbestosis, occupational infections, occupational pulmonary tuberculosis, brucellosis, anthrax, viral hepatitis B and C, acquired immune deficiency syndrome (AIDS), occupational dermatoses, occupational cancer, reproductive effects, etc.

v. occupational diseases can be prevented through three methods: primary prevention (by reducing the risk of disease), secondary prevention (by identifying health problems before they become

clinically apparent) and tertiary prevention (by minimising the adverse clinical effect on health of a disease or exposure).

6.0 TUTOR-MARKED ASSIGNMENT

1. Distinguished in details the differences between occupational diseases and work-related diseases.
2. Discuss in detail the following preventive measures for occupational diseases:
   - Primary prevention
   - Secondary prevention
   - Tertiary prevention
3. Discuss in detail the aetiology, clinical manifestations and management of the following occupational diseases:
   - Occupational cancer
   - Silicosis
   - Occupational Pulmonary tuberculosis
   - Occupational asthma
   - Viral Hepatitis B and C
   - Occupational dermatoses
   - Acquired Immune Deficiency Syndrome (AIDS)
   - Occupational infections

1. Discuss succinctly the characteristics of the following:
   - Occupational diseases
   - Work-related diseases

2. List ten (10) examples of the following hazards and the occupational/work-related diseases that they caused.
   - Physical hazards
   - Chemical hazards
   - Biological hazards

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UNIT 2 SURVEILLANCE OF WORKERS' HEALTH (PRE- EMPLOYMENT AND PERIODIC MEDICAL EXAMINATIONS)

CONTENTS

1.0 INTRODUCTION

Since the consequences of occupational hazards may not become apparent for many years, it is important to identify potential dangers early before they result in incurable diseases. The methods for identifying occupational hazards and the health problems associated with them can be achieved broadly through environmental assessment, biological monitoring, medical surveillance and epidemiological approaches. This unit will expose you to the various medical examinations and health assessments that workers undergo in ideal occupational setting. You will also learn about the ethics and legal issues surrounding workers' health surveillance.

2.0 OBJECTIVES

By the end of this unit, you will be able to:

- mention the concept and factors behind workers' health surveillance.

- describe the various medical examinations and health assessments that workers need to undergo.
- describe the ethical and legal issues surrounding surveillance of workers' health.

3.0 MAIN CONTENT

3.1 General framework

The surveillance of workers' health entails medical examinations of workers to ensure that their state of health is compatible with their job assignment and that their occupational exposure to hazards does not have any detrimental effects on their health. Health examinations also help to identify conditions which may make a worker more susceptible to the effects of hazardous agents and to detect early signs of health impairment caused by them. Their main purpose is primary prevention of work-related injuries and diseases.

Surveillance should be carried out in consultation with the workers or their representatives, and should not result in any loss of earnings for them. Furthermore, medical examinations should be free of charge and, as far as possible, should take place during working hours.

Workers' health surveillance at national, industry and enterprise levels should be organised so as to take into account several factors, including:

- ❖ the need for a thorough investigation of all work-related factors;
- ❖ the nature of occupational hazards and risks in the workplace which may affect workers' health;
- ❖ the health requirements of the working population;
- ❖ the relevant laws and regulations and the available resources;
- ❖ the awareness of workers and employers of the functions and purposes of such surveillance; and
- ❖ the fact that surveillance is not a substitute for monitoring and control of the working environment.

3.2 Medical examinations, health assessments and biological tests

Workers who are or have been exposed to occupational hazards, such as asbestos, should be provided with such medical examinations as are necessary to supervise their health in relation to those occupational hazards, and to diagnose occupational diseases caused by exposure to them.

Surveillance of workers' health in the form of medical screening or periodic medical examinations to identify the effects of occupational hazards or diseases. It has been shown that special prescriptive surveys to detect ill health among the working population generally prove more rewarding in terms of avoiding or controlling hazards than a series of medical tests performed at a later stage to identify or confirm suspected occupational disease. Cases of occupational disease often remain "latent" (silent) among the labour force. As a condition slowly develops, workers adapt to it, and are often unwilling to report illness that may result in the loss of their jobs. Medical examinations of workers frequently reveal the existence of health hazards in the workplace, and in such cases the necessary environmental evaluation and control measures must be implemented. The importance of workers' health surveillance is clearly stated in paragraph 11 of the Occupational Health Services Recommendation, 1985 (No. 171), which provides as follows:

Surveillance of the workers' health should include, in the cases and under the conditions specified by the competent authority, all assessments necessary to protect the health of the workers, which may include:

(a) health assessment of workers before their assignment to specific tasks which may involve a danger to their health or that of others;
(b) health assessment at periodic intervals during employment which involves exposure to a particular hazard to health;
(c) health assessment on resumption of work after a prolonged absence for health reasons for the purpose of determining its possible occupational causes, of recommending appropriate action to protect the workers and of determining the worker's suitability for the job and needs for reassignment and rehabilitation;
(d) health assessment on and after the termination of assignments involving hazards which might cause or contribute to future health impairment.

3.2.1 Pre-Assignment Medical Examination

Pre-assignment medical examinations are carried out before the placement of workers in jobs or their assignment to specific tasks which may involve a danger to their health or that of others. The purpose of such an examination is to determine in what capacity the prospective employee can be utilised most efficiently without detriment to himself or herself or to fellow workers. The scope of pre-assignment medical examination is influenced by such factors as the nature and location of the industry, as well as by the availability of the services of physicians

and nurses. Regardless of the size of the enterprise, it is advisable to conduct such examinations for all prospective employees. In the case of young people, such pre-assignment medical examinations are prescribed by specific ILO Conventions.

The pre-assignment medical examination provides clinical information and laboratory data on the worker's health status at the moment of entering employment. It is also an important record for the worker's subsequent occupational history, as it provides a baseline for the evaluation of any changes in health status that may occur later on. The results of pre-assignment medical examinations should be used to help place workers in jobs which are compatible with the status of their health, and not to screen out workers. In some cases, prospective employees who are found to be HIV-positive may be refused employment on the basis of their health status, or those already in employment may be summarily dismissed. These practices should not be condoned.

3.2.2 Periodic Health Evaluations

Periodic health evaluations are performed at appropriate intervals during employment to determine whether the worker's health remains compatible with his or her job assignment and to detect any evidence of ill health attributed to employment. Their objectives include:

- identifying as early as possible any adverse health effects caused by work practices or exposure to hazards; and

- detecting possible hazards.

Changes in the body organs and systems affected by harmful agents can be detected during the periodic medical examination, usually performed after the worker has been employed long enough to have been exposed to any such hazards in the workplace. The worker may be physically fit, showing no signs of impairment and unaware of the fact that the substances he or she works with daily are slowly poisoning his or her system. The nature of the exposure and the expected biological response will determine the frequency with which the periodical medical examination is conducted. It could be as frequent as every one to three months, or it could be carried out at yearly intervals.

3.2.3 Return-To-Work Health Assessment

A **return-to-work health assessment** is required to determine whether a worker is fit to resume his or her duties after a prolonged absence for health reasons. Such an assessment might recommend appropriate actions to protect the worker against future exposure, or may identify a need for reassignment or special rehabilitation. A similar assessment is performed on a worker who changes job, with a view to certifying him or her fit for the new duties.

3.2.4 Post-Assignment Health Examination

Post-assignment health examinations are conducted after the termination of assignments involving hazards which could cause or contribute to future health impairment. The purpose is to make a final evaluation of workers' health and compare it with the results of previous medical examinations to see whether the job assignments have affected their health. In certain hazardous occupations, the competent authority should ensure that provision is made, in accordance with national law and practice, for appropriate medical examinations to continue to be available to workers after the termination of their assignment.

At the conclusion of a prescribed health assessment, workers should be informed in a clear and appropriate manner, by the attending physician, of the results of their medical examinations and receive individual advice concerning their health in relation to their work. When such reports are communicated to the employer, they should not contain any information of a medical nature. They should simply contain a conclusion about the fitness of the examined person for the proposed or held assignment and specify the kinds of jobs and conditions of work which he or she should not undertake, for medical reasons, either temporarily or permanently.

When continued assignment to work involving exposure to hazardous substances is found to be medically inadvisable, every effort, consistent with national conditions and practice, should be made to provide the workers concerned with other means of maintaining an income. Furthermore, national laws or regulations should provide for the compensation of workers who contract a disease or develop a functional impairment related to occupational exposure, in accordance with the Employment Injury Benefits Convention,1964 (No. 121).

It must be mentioned that there are limitations to medical examinations, especially in developing countries, where generally the provision and coverage of health services is poor and there are relatively very few doctors. In these conditions, the heavy workload and other limitations

often inhibit the thoroughness of medical examinations. Where workers are exposed to specific occupational hazards, special tests are needed. These should be carried out in addition to the health assessments described above. The surveillance of workers' health should thus include, where appropriate, any other examinations and investigations which may be necessary to detect exposure levels and early biological effects and responses.

The analysis of biological samples obtained from the exposed workers is one of the most useful means of assessing occupational exposure to a harmful material. This analysis may provide an indication of the amount of substance that has accumulated or is stored in the body, the amount circulating in the blood, or the amount being excreted. There are several valid and generally accepted methods of biological monitoring which allow for the early detection of the effects on workers' health of exposure to specific occupational hazards.

These can be used to identify workers who need a detailed medical examination, subject to the individual worker's consent. Urine, blood and saliva are the usual body fluids examined for evidence of past exposure to toxic(harmful) agents. Lead concentrations in the urine or blood have long been used as indices of lead exposure. Most biological monitoring measures are invasive procedures which may be undertaken only with legal permission. Moreover, many countries lack the laboratory facilities and other resources necessary to carry out such tests. Consequently, priority should be given to environmental criteria over biological criteria in setting exposure limits, even though biological monitoring has certain advantages over environmental sampling. Biological monitoring takes account of substances absorbed through the skin and gastrointestinal tract(stomach), and the effects of added stress (such as increased workload resulting in a higher respiration rate with increased intake of the air contaminant) will also be reflected in the analytical results. Furthermore, the total exposure (both on and off the job) to harmful materials will be accounted for. Biological monitoring should not, however, be a substitute for surveillance of the working environment and the assessment of individual exposures. In assessing the significance of the results of biological monitoring, values commonly found in the general public should be taken into account.

3.2.5 Sickness Absence Monitoring

The importance of keeping a record of absence from work because of sickness is well recognised in various countries. Monitoring sickness absence can help identify whether there is any relation between the reasons for ill health or absence and any health hazards which may be present at the workplace. Occupational health professionals should not,

however, be required by the employer to verify the reasons for absence from work. Their role is rather to provide advice on the health status of the workforce in the enterprise and on medical problems which affect attendance and fitness for work. Occupational health professionals should not become involved in the administrative management and control of sickness absence, but it is acceptable for them to provide advice on medical aspects of sickness cases, provided that medical confidentiality is respected.

3.3 Ethical and legal issues

The surveillance of workers' health should be based not only on sound technical practice, but on sound ethical practice as well. This requires that a number of conditions be met and workers' rights respected. In particular, workers subject to health monitoring and surveillance should have:

- the right to confidentiality of personal and medical information;
- the right to full and detailed explanations of the purposes and results of the monitoring and surveillance; and
- the right to refuse invasive medical procedures which infringe their corporeal integrity.

Conditions governing workers' health surveillance

- Provisions must be adopted to protect the privacy of workers and to ensure that health surveillance is not used for discriminatory purposes or in any other manner prejudicial to workers' interests.
- Each person who works in an occupational health service should be required to observe professional secrecy as regards both medical and technical information which may come to his or her knowledge in connection with the activities of the service, subject to such exceptions as may be provided for by national laws or regulations.
- Occupational health services should record data on workers' health in personal confidential health files which should also contain information on jobs held by workers, on exposure to occupational hazards involved in their work, and on the results of any assessments of workers' exposure to these hazards.
- Although the competent authority may have access to data resulting from the surveillance of the working environment, such data may only be communicated to others with the agreement of the employer and the workers or their representatives in the enterprise or the safety and health committee.

- Personal data relating to health assessments may be communicated to others only with the informed consent of the worker concerned.

3.4 Case Studies on Occupational Health Surveillance

Case study 1(400-1,400 employees): The interviews took place during the final year of a four-year greenfield construction site for the building of a Power Station where the client was closely involved on site. Interviewees were a client line manager, the site health and safety manager and a Registered General Nurse(RGN) with 5 years' experience in occupational health. The latter two were both employed by the main contractor. The full time RGN and retained occupational health physician were available to all site employees. All site employees completed a health assessment questionnaire at the start of their employment and any health concerns admitted were followed up. Pre-employment medicals and health surveillance were not undertaken for site employees. The site nurse suspected that the majority of subcontracted workers concealed information regarding their health to avoid questions raised about their fitness for work, despite confidentiality being assured. It was considered that her role was more reactive than proactive, i.e., workers visited her in the clinic for treatments. She did not attend health and safety meetings or accompany health and safety professionals on site walkabouts, although she felt that her role could be more proactive, e.g., she could advise on manual handling, sun protection, health risk assessment and check the welfare facilities (toilets, wash areas).

This site nurse thought that generally workers did not have an interest in health, e.g., protecting their skin from irritants, but that given time, encouragement and confidentiality workers would discuss their concerns. In support of this, it had been noticed that visits to the first aid facility by site managers, workers, etc. had increased and there was less stigma attached to them. Regarding the management of health, difficulties were expressed as being the high cost to the industry, overall monitoring and maintaining confidentiality. Finally, when asked for ideas concerning how the health of subcontractors could be managed, a form of 'swipe-card' system that workers carried, containing details of medicals, surveillance, work history, etc. was suggested.

Case study 3 (50-60 employees). The interviews took place halfway though a two-year, new process building construction project on the existing factory site where the client was in close contact. Interviewees were all employed by the main contractor and comprised a corporate

health and safety advisor, the site manager and the site safety advisor (with responsibility for health).
The client-run medical centre employed a full-time RGN and an occupational health physician one day a week for their own employees. However, this facility was only available to contractors for more serious accident injuries, which the trained first aiders on the construction site were unable to handle. Contractors were not encouraged to use the centre for other health reasons, medicals or health surveillance as this was not included in the project costs and would therefore be an additional expense for the client. Pre-employment questionnaires, medicals or health surveillance were not undertaken for workers on this construction site.

Once again the attitude of. workers to their health was felt to be poor, i.e., not interested in sun protection, skin care, good lifting practice, etc. It was thought unlikely that workers would take the initiative to arrange their own medical assessments/health surveillance with occupational health professionals. Although in one manager's experience, older, fit workers would be likely to have a medical, as it would be in their interest to prove their fitness for work. It was expressed that any health management system would be difficult to implement due to the suspicion that it would create regarding possible job loss: prospective employees may conceal information about their health in order to secure employment.

Once again the creation of a 'passport' system was cited as the way forward for the future management of health. For example, extending the 'Safety Passport Scheme' managed by the Engineering Construction Industry Training Board (ECITB) on behalf of clients, to all workers and to include health as well as safety training information.

4.0 CONCLUSION

Information about conditions in the working environment and the health of workers –which is necessary for planning, implementing and evaluating OSH programmes and policies – is gathered through ongoing, systematic surveillance. Different types of surveillance address the various aspects of work and health. Some activities focus principally on the health of workers themselves, while others explore the various factors in the work environment that may have negative impacts on health. Whatever the approach taken, researchers must meet minimum requirements with regard to workers’ sensitive health data.

5.0 SUMMARY

Workers' health surveillance entails procedures for the assessment of workers' health by means of detection and identification of any abnormalities. Such procedures may include biological monitoring, medical examinations, health assessment questionnaires, radiological examinations and reviews of workers' health records, among others.

6.0 TUTOR-MARKED ASSIGNMENT

1. List and explain the factors to be taken into consideration when organising workers' health surveillance at industrial and national level.
2. Explain the following terminologies lucidly:
   - Workers' health surveillance
   - Working environment surveillance
3. Discuss in detail the features and objectives of the followings:
   - Periodic health evaluations
   - Pre-Assignment medical examinations
   - Return-to-work health assessment
   - Post-Assignment health examinations
   - Sickness absence monitoring

4 Discuss in detail the ethical and legal issues surrounding the surveillance of workers' health.

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Notes

1. This chapter is based mainly on the Occupational Cancer Recommendation, 1974 (No. 147), the Occupational Safety and Health Convention, 1981 (No. 155), the Occupational Health Services Convention (No. 161), and Recommendation (No. 171), 1985, the Asbestos Convention, 1986 (No. 162), and the Chemicals Recommendation, 1990 (No. 177).

2. International Occupational Safety and Health Information Centre (CIS), chemical exposure limits database: http://www.ilo.org/public/english/protection/safework/cis/products/explim.htm.

UNIT 3 OCCUPATIONAL ACCIDENTS AND INJURIES IN THE WORKPLACE

CONTENTS

1.0 INTRODUCTION

In the last unit you learnt that surveillance of workers' health entails medical examinations of workers to ensure that their state of health is compatible with their job assignment and that their occupational exposure to hazards does not have any detrimental effects on their health. You also learnt about various activities that focus primarily on workers' health; and the ethical and legal issues surrounding workers' health surveillance. In this unit, you will learn about occupational accidents and injuries in the workplace. You shall also be exposed to the various factors responsible for occupation accidents and injuries; with a detail on how to record, investigate and report occupational accidents and injuries. Finally, this unit will discuss on the prevention and control of accidents in workplaces and make you acquainted with first aid techniques on several occupational injuries.

2.0 OBJECTIVES

At the end of this Unit, you will be able to:

- understand the importance of preventing accidents and injuries in the workplace and support safety professionals' efforts in this regards.
- participate in educating and training workers on prevention and control of injury and accident in workplace.
- keeps records and analyse data obtained.
- give advice on reducing morbidity, disability and mortality due to occupational accidents and trauma.
- be acquainted with first aid techniques and be able to provide emergency care in the workplace.

3.0 MAIN CONTENT

3.1 Definitions

Injury: a physical damage to the body tissues caused by an accident or by exposure to environmental stressors.

Wound: A break in the continuity of body tissue or opening in the skin. A wound may be an injury but not all injuries are wounds.

Accident: A sudden event that results in an undesired outcome such as property damage, bodily injury or death.

Occupational Accident: Accident occurring at the workplace which may cause damage to machinery, tools or people.

Occupational Injury: An injury that arises out of, and in the course of, employment.

Occupational Safety: Risk identification at the workplace and preventive measures taken to reduce or eliminate the hazard which may lead to accidents.

3.2 Classification of Types of Occupational Accidents

Types of Accident

- Fall or being struck by materials
- Striking against objects
- Being caught in, under or between object
- Over-exertion or strenuous movements
- Exposure to or contact with extreme temperature
- Exposure to or contact with electric current
- Exposure to or contact with harmful substances or radiation.
- Other types of accident

Agency

- Machine
- Means of transport and lifting equipment
- Other equipment
- Materials, substances and radiation
- Work Environment
- Other agencies not elsewhere classified
- Agencies not classified for lack of sufficient data

Nature of Injury

- Wound, Fracture and Dislocation
- Burns, Poisonings
- Diseases

Bodily Location of the Injury

- Head
- Trunk
- Upper extremities
- Lower extremities
- Body System

3.3 Causes of Occupational Accidents and Injuries

Human Factors

There are many varying human factors that have an effect on the accident-risk of the individual at certain times and in certain situations. Some of these factors are: age, experience, use of medicine or drugs, motivation, etc. But most human activity requires the avoidance of errors that could result in injuries or material damage. To avoid an accident an individual must observe and recognise danger, decide on a course of action and act sufficiently vigorously to avoid the danger.

The accident may occur if a hazard is not seen, recognised or understood as dangerous, or if one does not take responsibility for personal action, or if one does not know how to act or for other reasons does not decide to act. Even if the right decision is made, the muscular response may be incorrect, ineffectual or too slow.

Environmental Factors

These include both the outside agent of injury and other factors of the physical working environment: lighting, noise, temperature, etc.

A necessary factor of injury is contact with a harmful object, substance or energy. An injury may also be cause by a lack of energy, e.g. lack of oxygen in the environment. These injury agents are called hazards. If there is a hazard in the working environment there is always some possibility of accident. This is the reason why safety technology has the first priority in accident prevention. Hazards should be isolated or eliminated so that there is no risk of accident.

The injury agent, the kind and amount of hazardous energy, is the main determinant of the severity of injury. The following table illustrates some examples:

Select examples of overt and cumulative trauma commonly affecting occupational groups

Cause	Injury/Disorder	Affected Occupation
Overt trauma		
Mechanical energy	Lacerations	Sheet metals workers, butchers, press operators, sawyers, fabric cutter

	Fractures	Materials handlers, miners, construction workers.
	Contusions	Materials handlers, any worker exposed to low energy impacts.
	Amputation	Press operators, butchers, machine operators
	Crushing Injuries	Materials handlers, press operators, construction workers, rubber workers.
	Eyes injuries (struck by foreign objects)	Miners, grinders, saw mill operators, machine shop employers
	Strains or sprains (overt)	Materials handlers, miners, baggage handlers, mail handlers, construction workers
Thermal Energy	Burns	Foundry workers, smelters, welders, glass workers, laundry workers.
	Heat strain	Firefighters, steelworkers, smelter workers.
	Cold strain	Utility workers, lumberjacks, butchers
Chemical Energy (including acute toxicity)	Burns	Masons, Process workers, hazardous waste workers
	Asphyxiation, acute toxicity	Firefighters, confined space workers, hazardous waste

		workers
Electrical Energy	Electrocution, shocks and burns	Utility workers, construction workers, electricians, users of electric hand tools or machines
Nuclear Energy	Radiation burns, illness	Hospital workers, industrial radiographers, nuclear workers
Cumulative Trauma		
Heavy lifting, prolonged awkward posture	Back Pain	Materials handlers, sitting nurses, truck drivers, sewing machine operators
Frequent or repetitive hand motions with awkward posture	Upper extremity Cumulative trauma disorders (tendonitis, carpal tunnel syndrome, epicondylitis, degenerative joints disease	Assembly line workers; forceful garment workers; poultry, meat or fish processors; clerical workers; press operators; fruit pickers; musicians
Vibration	Raynaud syndrome	Lumberjacks, grinding machine operators, jackhammer operators

Organisational Factors

The social environment has a great effect on human performance. The safety management approach to accidents is that the immediate causes (unsafe conditions and unsafe acts) are the only symptoms of roots causes that exist in the management function. These may be errors in the areas of management policy, confusion of goals, staffing, housekeeping, responsibility, use of authority, line and staff relationships, accountability, rules, initiative, etc.

Controlling the frequency and severity of accident occurrence and controlling the quality and quantity of products have much in common. In many cases the same faulty practice is involved, leading to both accident occurrence and unsatisfactory production.

3.4 Recording and Investigating Accident and Injury

Companies and health workers need to record and investigate occupational accidents in order to:

- Identify the real causes of injury, property damages and near-misses
- develop effective methods of preventing future similar accidents
- meet legislative requirements

The accident or injury report should include the following information:

- circumstances of the accident
- cause of the accident.
- available data for accessing the cause of the accident and their effects on the person and the environment.
- emergency measures taken.
- steps to be taken in the future to avert further accidents.
  Accidents may be reported according to:

- cause of accident
- place of the accident
- type of injury
- personal characteristics such as age, sex and the level of education of the injured.
- time of the accident

The following point should be considered when developing an accident recording and investigation system:

- What reports are required?
- Who is responsible for conducting the investigation?
- Who do reports go to?
- What time-frame should be allowed to complete investigation?
- Are there follow-up procedures to ensure that report recommendations are implemented?
- Have the appropriate authorities been notified?
- What accidents will be recorded and investigated?
- Is a custom designed form needed?

- Are all injuries recorded in the recording system?
- What training will investigators need?
- Where will record of accidents and investigations be kept?
- Does regular analysis identify similar accidents recurring or other trends?

3.3 Accident Rates

Comparison of accidents between time-period, industries, occupations and countries can be made only if the industrial accident statistics are considered in conjunction with data, including employment, work hours, production, etc. For such purposes it is useful to calculate relative measures such as frequency, incidence and severity rates.

- ❖ frequency rate = total number of accident × 10^3 ÷ total number of work – hours worked
- ❖ incidence rate = total number of accident × 10^3 ÷ total number of workers exposed.

Two different severity indicators are recommended:

- ❖ the average number of days lost per accidents
- ❖ the number of days lost per day worked by persons exposed to risk, or, failing that, per person exposed to risks.

In some countries the severity rate is defined as the number of days lost per 1000 work-hours.

Death and permanent disabling injuries are dealth with separately from other accidents in statistics. It is also possible to convert them into lost working days, for example, so that death and total disabling permanent injury are equal to 6000 lost days.

3.6 Prevention and Control of Occupational Accidents and Injuries

The basic accident and injury prevention are as follows:

- ❖ Eliminate the hazard from the machine, method, material or facility structure.

- ❖ Control or contain the hazard, by enclosing or guarding it at its source or attaching an exhaust pipe to remove airborne hazards from the operator.

- Train operating personnel to be aware of the hazard or to follow safe job procedures to avoid it.

- Prescribe personal protective equipment for personnel to shield them from hazards.

- Provide advisory services on safety and health problems and other matters related to accident and injury prevention.

- Develop a centralised programme to control accidents and fire hazards.

- Keep informed of changes in legislation and safety codes and communicate such information to management.

- Develop and apply safety standards both for production facilities (equipment, tools, work methods and safeguarding) and for products, based on applicable legal and voluntary codes, rules and standards.

- Work closely with the engineering, industrial hygiene, medical and purchasing departments to ensure that only safe tools, equipment and supplies are purchased.

- Develop, plan and implement a safety and health inspection programme to be carried out by the operating supervisors and field safety personnel to identify potential hazards, both in the workplace and in the use of the company's products.

- Along with presentative from the engineering, operating and personnel, inspect all new equipment to ensure adequate health and safety safeguards.

- Guide operating supervision in accident investigation to determine the accident's cause and to prevent recurrence.

- Review non-disabling-injury accident reports on a sample basis to check the thoroughness of the accident investigation and corrective actions taken.

- Correct and analyse data on illness and accidents for the purpose of instituting corrective action and to determine accidents trends and provide targets for corrective actions.

- ❖ Ensure education and training of employees in general as well as specific health and safety principles and techniques.

- ❖ Maintain supervisory contacts for new instructions, follow-up and general health and safety motivation.

- ❖ Cooperate with industrial hygiene or environmental quality control personnel on industrial hygiene problems.

3.7 Importance of First Aid

First aid is the immediate care given to victims of accidents before trained medical workers arrive. Its goal is to stop and, if possible, reverse harm. It involves rapid and simple measures such as clearing the air passway, applying pressure to bleeding wounds or dousing chemical burns to eyes or skin. The critical factors which shapes first aid facilities in a workplace are work-specific risk and availability of definitive medical care, e.g. the care of a high-powered saw injury is obviously radically different from that of a chemical inhalation. First aid is a fluid concept not only in what must be done (how long, how complex) but in who can do it.

First aid personnel are persons on the spot, generally workers who are familiar with the specific conditions of work. They might not be medically qualified but they must be trained and prepared to perform very specific tasks. First aid personnel should be selected carefully, taken into account attributes such as reliability, motivation and the ability to cope with people in a crisis situation.

3.8 First Aid Techniques for Injuries in Workplace

Head Injuries

Crucial steps

1. Maintain an airway
2. Control bleeding
3. Protect against infection
4. Prevent further injury

Facial Injuries

Crucial steps

1. Check for obstructed airway as facial injuries may cause external bleeding resulting in blockage of airway. The bleeding from the oral cavity can be particularly heavy.
2. Control bleeding by realigning the jaw, i.e. by grasping the chin and pulling it straight out.
3. Maintain the airway by turning victim on his/her side.

Chest Injuries

Crucial steps

1. Seal the chest wound from the outside as quick as possible.
2. Never extract foreign objects from the chest wound.
3. Maintain airway.
4. Administer oxygen.
5. Apply mouth-to-mouth resuscitation and external heart massage if necessary.
6. Transport the patient in a sitting position unless he/she is in shock.

Abdominal Injuries

Crucial steps

1. Cover the wound with a sterile dressing; apply a compression binder to control haemorrahaging.
2. Look for any penetrating wounds and other symptoms such as vomiting, abdominal pain and tenderness.
3. Never attempt to replace protruding organs, cover them with sterile gauze and keep the cloth moist.
4. Place the patient in a semi-sitting position unless he/she is in shock.
5. Keep the patient warm with blanket.
6. Never give patient anything to drink or eat.

Eyes Injuries

Do not interfere with eyes injuries except in minor cases. Refer the victim to hospital immediately.
Crucial steps

1. Any chemical splash into the eye(s) must be considered a vision-threatening emergency. Forcibly keep the patient's eyelid open while irrigating with water for at least five minutes, then refer the patient to an ophthalmologist. Inform the ophthalmologist of the nature of the chemical contaminant,
2. Patch the injured eye lightly with a dry, sterile eye pad. If laceration of the eye is suspected, add a protective shield over the sterile eye pad.
3. Never put eye ointment in an eye to be seen by the ophthalmologist. The ointment makes clear visualizations of the retina very difficult.

Fractures

It is essential to remember the following:

1. Do not harm. Unwise attempts by the patient to continue to use a fractured extremity may cause laceration of the soft tissues and may lead to the broken bone penetrating the skin or to the onset of shock.
2. Protect and immobilise. Apply a splint to the fracture so the victim can be moved more comfortably and without causing any further injuries.

Crucial steps

1. Place the injured limb in as natural a position as possible before padding and splinting.
2. If the broken bone is not protruding above the skin, apply traction to overcome muscle and to straighten the limb with minimum pain. If the broken bone is protruding above the skin, do not apply traction to avoid contaminating deep tissues.
3. To control bleeding, apply gentle pressure by covering the wound with a sterile dressing and wrapping it with an elastic bandage.
4. Never attempt to set an open fracture. Apply the proper splint before moving the patient.

Thermal Injuries

Crucial steps

1. Prevent shock.
2. Do not attempt to remove patient's clothes except in the case of a chemical burn.

3. Wrap the patient in a clean sheet to prevent infection.
4. Maintain body temperature.
5. Neutralise the chemical agent if a neutraliser is available.
6. Determine what chemical agents has been the cause of the burns before transferring the patients to hospital.

Cold

Crucial steps

1. Immerse the affected part in water heated to about 40^{o}C and 42^{o}C.
2. Do not attempt to thaw the affected area.
3. Do not place the victim close to fire.
4. Do not massage the affected area.

Heat Stroke

Factors contributing to heat stroke are: workload, thermal environment, stress, non-acclimatisation, poor work conditions, overweight, unsuitable clothing, poor ventilation, dehydration or shortage of water, alcohol consumption, history of cardiovascular diseases or recent prickly heat.

Crucial steps

1. Confirmed suspected cases of heat stroke by measuring the body temperature. A person with a temperature between 40^{o}C and 43^{o}C would be considered a victim of heat stroke.

2. Sponge with cool water, wrap in cool sheets or towels or cool blow air over patients.

Shock

Shock means there is not enough blood circulating through the body. Symptoms of shock include: pale, cold and moist skin, shallowing breathing, bluish fingernails and lips, thirst and restlessness.
Crucial steps

1. Treat shock by removing the cause: stop bleeding, relieving the pain, splint the fracture.
2. Prevent infection and maintain body temperature.
3. Lay the patient flat.

4. Burn victims suffering from shock should be given liquids in small amounts.

3.9 Case Study on Workplace Injury and Accidents

CS1-Synopsis of Accident

Injured worker (IW) was tasked to fit up a vehicle's fuel tank in the workshop. While fitting up the tank, he was short of one grounding cable. Unable to find a terminal lug of correct size for the grounding cable, IW decided to use an existing lug of nearest size and enlarge its hole with a round file. After filing for 10mins without any progress, IW decided to use a bench drilling machine to enlarge the hole. IW used a self–gripping plier to hold the grounding cable. IW was wearing cotton gloves on both hands. During drilling, IW's left hand's glove was caught by the rotating drill bit, thereby resulted in his left thumb being severed.

CS1-Observations and Findings

Before the accident, IW's employer had only conducted induction briefing on generic safety and health rules to new employees, but not any job-specific RA and SWP related to their works. IW's employer had established RA and SWP for the workshop activities, including drilling task. However, IW was not aware of the RA & SWP. He had not been briefed about the hazards, risks and control measures of the bench drilling machine, which had been identified in RA and SWP. Most of the other engineers were also not aware of the RA and SWP in the workplace, and how the risks of injuries could be controlled or mitigated. At the time of the accident, the rotating spindle and chuck of the drilling machine were not securely guarded.

CS1-Lessons Learnt

- Employer should ensure secure guarding of the dangerous parts of machines in the workplace. The drilling machine's spindle and chuck should be securely guarded.
- Employer should ensure employees' awareness and knowledge of WSH hazards and control measures. There should be a proper communication or briefing of relevant RA and SWP to all personnel who are liable to be exposed to the risks posed by the work activities carried out in the workplace. The briefing on RA and SWP should be documented.
- Warning notices or signages, where reasonably practicable, should be clearly displayed at or near the machinery to warn of

the presence of dangerous part(s), and the ‘dos & don’ts’ for machinery safety.

4.0 CONCLUSION

An occupational injury is a physical damage to the body caused by an accident or by exposure to workplace hazards; while an occupational accident is a sudden event that results in an undesired outcome such as property damage, bodily injury or death. Many causative factors are responsible for injuries and accidents in workplace viz: human, environmental and organisational factors. It thus importance to records and investigates occupational accidents and injuries in order to identify the real causes and develop effective methods of preventing future similar event. Conclusively, workers must be train on how to administer first aid treatment in case of emergency or sudden occurrence of accident in a workshop.

5.0 SUMMARY

In this unit, you have learnt that:

i. An occupational injury is a physical damage to the body tissues caused by an accident or by exposure to workplace stressors; while an occupational accident is a sudden event occurring from workplace hazards that results in an undesired outcome such as bodily injury or death.

ii. Occupational accidents and injuries arises due to interplay of many factors in the workplace viz: human factors, environmental factors and organisational factors.

iii. It is imperative that companies and community health workers need to record and investigate occupational accidents in order to identify the actual causes of injury and near-misses; develop effective methods of preventing future similar accidents; and meet legislative requirements.

iv. Accident or injury report should vital information viz circumstances of the accident; cause of the accident; available data for accessing the cause of the accident; emergency measures taken and steps to be taken in the future to further avert further accidents.

v. The following prevention and control measures should be taken against occupational accidents and injuries: elimination of hazards from machine, method and facility; control or contain

hazards at point source; provide and train personnels on the use of PPEs; and provide advisory services on safety and health problems and other matters related to accident and injury prevention.

vi. First aid facility should be readily available in the workplace and personnels should be train on the administration of first aid treatment in case of emergency.

6.0 TUTOR-MARKED ASSIGNMENT

1. Explain the crucial steps to be follow in the administration of first aid treatment to workers affected by the followings:
   - Abdominal injuries
   - Heat stroke
   - Fracture of the spine and pelvis
   - Poisoning
   - Haemorrhage
   - Impaired breathing
2. For the purposes of accident prevention, investigations must be fact finding and not fault finding.

   Discuss the above mentioned statement in the light of the actual occupational accident recording and investigating system at the local and national level.
3. Discuss the method used in measuring accident or severity rate in Nigeria and also explain the indicators adopted.
4. As an industrial hygienist you are asked to record and investigate accidents and injuries in a coal mining industry.
   - What are the vital information your report should contain?
   - What are the points you would considered when developing the report?

- After your investigation, what are the preventive and control measures you would suggest to be put in place to prevent accidents and injuries in the mine.

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UNIT 4 WORKMAN COMPENSATION

CONTENTS

1.0 INTRODUCTION

In the last unit you learnt that Occupational accidents and injuries arise due to interplay of many factors in the workplace viz: human factors, environmental factors and organisational factors. You also learnt on how to record, investigate and report occupational accidents and injuries with their prevention and control techniques. In this unit, you will learn about workman compensation and also be introduced to workman compensation law. You will also be taken through the various forms of workers' compensation fraud by workers and employers. Finally, this unit will end with a review of the Nigeria's Employee Compensation Act.

2.0 OBJECTIVES

By the end of this unit, you will be able to:

- explain the concept of workman compensation.
- understand the features of workman compensation law and other labour laws.
- explain the various Workers' Compensation fraud.
- understand the key features of Nigeria's Employee Compensation Act.

3.0 MAIN CONTENT

3.1 Concept of Workman Compensation

4. **Workers' compensation** is a form of insurance providing wage replacement and medical benefits to employees injured in the course of employment in exchange for mandatory relinquishment of the employee's right to sue their employer for the tort of negligence. The trade-off between assured, limited coverage and lack of recourse outside the worker compensation system is known as "the compensation bargain". One of the problems that the compensation bargain solved is the problem of employers becoming insolvent as a result of high damage awards. The system of collective liability was created to prevent that, and thus to ensure security of compensation to the workers. Individual immunity is the necessary corollary to collective liability.

5. While plans differ among jurisdictions, provision can be made for weekly payments in place of wages (functioning in this case as a form of disability insurance), compensation for economic loss (past and future), reimbursement or payment of medical and like expenses (functioning in this case as a form of health insurance), and benefits payable to the dependents of workers killed during employment (functioning in this case as a form of life insurance).
6. General damage for pain and suffering, and punitive damages for employer negligence, are generally not available in workers' compensation plans, and negligence is generally not an issue in the case. These laws were first enacted in Europe and Oceania, with the United States following shortly thereafter.

3.2 Worker Compensation Law

7. Workers' compensation is insurance that provides cash benefits and/or medical care for workers who are injured or become ill as a direct result of their job.
8. Employers pay for this insurance, and shall not require the employee to contribute to the cost of compensation. Weekly cash benefits and medical care are paid by the employer's insurance carrier, as directed by the Workers' Compensation Board. The Workers' Compensation Board is a state agency that processes the claims. If Board intervention is necessary, it will determine whether that insurer will reimburse for cash benefits and/or medical care, and the amounts payable.

In a workers' compensation case, no one party is determined to be at fault. The amount that a claimant receives is not decreased by his/her carelessness, nor increased by an employer's fault. However, a worker loses his/her right to workers' compensation if the injury results solely from his or her intoxication from drugs or alcohol, or from the intent to injure him/herself or someone else.

A claim is paid if the employer or insurance carrier agrees that the injury or illness is work-related. If the employer or insurance carrier disputes the claim, no cash benefits are paid until the workers' compensation law judge decides who is right. If a worker is not receiving benefits because the employer or insurance carrier is arguing that the injury is not job-related, he or she may be eligible for disability benefits in the meantime. Any payments made under the Disability Program, however, will be subtracted from future workers' compensation awards.

If you can return to work but your injury prevents you from earning the same wages you once did, you may be entitled to a benefit that will make up two-thirds of the difference. You may also return to work in light or alternate duty before you are fully healed.

3.3 Other Forms of Labour Law

3.3.1 Common-law Remedies

Common law imposes obligations on employers to provide a safe workplace, provide safe tools, give warnings of dangers, provide adequate co-worker assistance (fit, trained, suitable "fellow servants") so that the worker is not overburdened, and promulgate and enforce safe work rules.

Claims under the common law for worker injury are limited by three defenses afforded employers:

- The Fellow Servant Doctrine is that employer can be held harmless to the extent that injury was caused in whole or in part by a peer of the injured worker.
- Contributory negligence allows an employer to be held harmless to the extent that the injured employee failed to use adequate precautions required by ordinary prudence.
- Assumption of risk allows an employer to be held harmless to the extent the injured employee voluntarily accepted the risks associated with the work.

3.3.2 Statutory Compensation Law

Workers' compensation statutes are intended to eliminate the need for litigation and the limitations of common law remedies by having employees give up the potential for pain- and suffering-related awards, in exchange for not being required to prove tort (legal fault) on the part of their employer. Designed to ensure employees who are injured or disabled on the job are not required to cover medical bills related to their on-the-job injury, the laws provide employees with monetary awards to cover loss of wages directly related to the accident as well as to compensate for permanent physical impairments.

The laws also provide benefits for dependents of those workers who are killed in work-related accidents or illnesses. Some laws also protect employers and fellow workers by limiting the amount an injured employee can recover from an employer and by eliminating the liability of co-workers in most accidents. US state statutes establish this framework for most employment. US federal statutes are limited to federal employees or to workers employed in some significant aspect of interstate commerce.

3.4 Workers' Compensation Fraud

Workers' compensation fraud can be committed by doctors, lawyers, employers, insurance company employees and claimants, and may occur in both the private and public sectors.

The topic of workers' compensation fraud is highly controversial, with claimant supporters arguing that fraud by claimants is rare—as low as one-third of one percent, others focusing on the widely reported National Insurance Crime Bureau statistic that workers' compensation fraud accounts for $7.2 billion in unnecessary costs, and government entities acknowledging that "there is no generally accepted method or standard for measuring the extent of workers' compensation fraud ... as a consequence, there are widely divergent opinions about the size of the problem and the relative importance of the issue."

According to the Coalition Against Insurance Fraud, tens of billions of dollars in false claims and unpaid premiums are stolen in the U.S. alone every year.

The most common forms of workers' compensation fraud by workers are:

1. Remote injury. Workers get injured away from work, but say they were hurt on the job so that their workers' compensation policy will cover the medical bills.
2. Inflating injuries. A worker has a fairly minor job injury, but lies about the magnitude of the injury in order to collect more workers' compensation money and stay away from work longer.
3. Faking injuries. Workers fabricate an injury that never took place, and claim it for workers' compensation benefits.
4. Old injury. A worker with an old injury that never quite healed claims it as a recent work injury in order to get medical care covered.
5. Malingering. A worker stays home by pretending the disability is ongoing when it is actually healed.
6. Failure to Disclose. A worker knowingly, or unknowingly, makes a false statement or representation about their injury.

The most common forms of workers' compensation fraud by employers are:

1. Underreporting payroll. An employer reports that workers are paid less than they actually are in order to lower their premiums.
2. Inflating experience. An employer claims workers are more experienced than they actually are in order to make them seem less risky and therefore less expensive to cover.
3. Evasion. An employer fails to obtain workers' compensation for their employees when it is required by law. Workers are often deceived into thinking they are covered when they are not.
4. Through the introduction of "opt-out plans" that are governed by the federal Employee Retirement Income Security Act, or ERISA, which is regulated by the Labor Department. The "opt-out plans" provide lower and fewer payments, make it more difficult to qualify for benefits, control access to doctors and limit independent appeals of benefits decisions.

3.5 Nigeria’s Employee Compensation Act

The Employee Compensation Act was an important piece of legislation passed in order to provide for employees who were injured, disabled, or died during the course of their employment. The Act replaced the Workmen’s Compensation Act.

Some of the key features of the law which Nigerians need to be aware of are:

1. The Law was established in order to provide an open and fair system of guaranteed and adequate compensation for employees or their dependants for any death, injury, disease or disability arising out of or in the course of employment.

2. The Law is applicable to all employers and employees in the public and private sectors throughout the Federal Republic of Nigeria.

3. The Nigeria Social Insurance Trust Fund Management Board is empowered to implement the Act and the Fund established under it.

4. In order to access compensation, the employee (or his/her dependents) must notify the employer of the injury/disabling occupational disease/death within 14 days of the occurrence. The information should include – name of the employee, time and place of the occurrence, and nature and cause of the disease or injury if known. Failure to provide the information required is a bar to a claim for compensation (subject to decision of the NSITF in certain circumstances.

5. The Employer must report this information to the NSITF Management Board within 7 days of receiving notification from the employee or his/her dependents. In the case of a death it must be reported immediately. Failure to make a report is an offence under the Employee Compensation Act.

6. An application for compensation must be made by the employee or his/her dependents within one year after the date of death, injury or disability arising from an occupational accident or disease, or else the claim will be refused (except if special circumstances for the delay existed).

7. Any employee who suffers any disabling injury out of or in the course of employment is entitled to compensation, whether or not it occurred in the workplace.

8. An employee is entitled to payment of compensation with respect to any accident sustained while on the way between the place of work and–
   - The employee's principal or secondary residence;
   - The place where the employee usually takes meals, or

- The place where he usually receives remuneration provided that the employer has prior notification of such place.

9. An employee is entitled to compensation for mental stress arising from an acute reaction to a sudden and unexpected traumatic event arising out of or in the course of
the employee's employment.

10. In the case of death of the employee, compensation is paid to the employee's widow(er) and/or child(ren) on a scale ranging from 30% - 90% monthly of the employee's remuneration depending on the circumstances of the dependents.

11. Every employer is to make a minimum monthly contribution of 1% of the total monthly payroll into the Employee Compensation Fund.

3.6 Case Studies: Worker's Compensation

Case One:

Worker injured discs in her back while working in an office environment. She received medical care including a back fusion surgery for which the insurance company paid. Worker was receiving weekly payments while out of work. The worker felt as though she was being treated fairly. When she finished her medical treatment the insurance company offered an amount for settlement of about $17,000.00 for her resulting disability. That amount just did not seem right.

She called for a free consultation with us. After hearing her story, it became clear that the insurance company was attempting to get the worker to settle for far less than she was entitled. In working as her advocate, we determined that the worker had been paid less per each week while out of work than what she was entitled to receive. Also, the doctor's impairment ratings (critical to a worker's compensation case) were inaccurate. We sat down with the doctor to determine the appropriate rating. The insurance company had not presented the appropriate questions to the doctor in obtaining the ratings. The insurance company was not advocating for the injured worker. In offering their original settlement amount, the insurance company did not appropriately consider the worker's continuing health care issues related to the work injury. They did not inform the worker of what all they had failed to consider. They were hoping that the worker's lack of understanding about the system would work in the insurance company's favor. The insurance company fought the injured worker's claim for

additional compensation all the way but in the end round up paying $130,000.00 to the injured worker. After paying the attorney's fee and costs, this worker increased her compensation dramatically over what she almost accepted from the "trusting" insurance company, and she continues her employment today.

Case Two: Robert Palamar v. Illinois State Toll Highway Authority, 12 WC 30587

Facts

The petitioner, a toll booth worker and former weightlifter, began to experience left shoulder pain a few years prior to 2010. An x-ray of the left shoulder taken in November of 2011 demonstrated mild arthritic changes about the glenohumeral joint with mild AC arthritis. A left shoulder MRI scan the same month revealed severe post-traumatic or osteoarthritic degenerative changes with marked chondromalacia, a small partial-thickness rotator cuff tear and mild bursitis. He subsequently underwent an injection into the shoulder.

On March 6, 2012, the petitioner returned to his shoulder physician, complaining of pain in the left shoulder and left knee, reporting that he had been involved in an altercation four days prior. The doctor diagnosed a left rotator cuff tear and opined that it was related to the petitioner's "active adult activities" and his duties working in a toll booth, specifically the extending of his arm up and above to tractor trailers and down to passenger cars. The doctor recommended conservative treatment, including physical therapy and injections.

Issues

- Did the petitioner sustain an accident arising out of and in the course of his employment on March 6, 2012?

- Did the petitioner provide timely notice of the alleged accident to his employer?

Outcome

The Arbitrator found that petitioner failed to prove that he sustained an accident arising out of and in the course of his employment on March 6, 2012. The Arbitrator pointed out the petitioner's extensive pre-existing history of left shoulder problems, for which he had received extensive treatment within less than a year prior to the alleged date of accident. The Arbitrator also viewed video evidence of the typical work activities of a toll booth collector and found that such activities did not constitute repetitive trauma, especially in light of the fact that most motorists in

fact extend their arms close enough to the toll booth such that little or no reaching out and up is required by the toll booth operator. The Arbitrator further found that the causation opinion of the treating physician was based on conjecture and speculation and thus of no probative value.

With regard to notice, the Arbitrator found that the petitioner failed to provide notice to the employer of his left shoulder injury within 45 days of March 6, 2012. The Arbitrator found it relevant that as a 20-year employee, the petitioner failed to prepare a written report of injury, as per the employer's protocol. A representative of the employer testified that she only became aware of an alleged shoulder injury in late 2012, following the filing of the Application for Adjustment of Claim on August 29, 2012.

Based on these findings, the Arbitrator denied the petitioner's claim for compensation and the claim was dismissed. The Arbitration Decision was affirmed and adopted by the Commission.

4.0 CONCLUSION

Workers' compensation makes it a liability for employers to provide financial and medical compensation to employees who suffer death or incapacity resulting from accident or injury in the workplace. However, both workers and their employers in private and public sector abuse this insurance policy by perpetuating all forms of fraudulent practices.

5.0 SUMMARY

In this unit, you have learnt that:

i. Workers' compensation is a form of insurance providing wage replacement and medical benefits to employees injured in the course of employment in exchange for mandatory relinquishment of the employee's right to sue their employer for the tort of negligence.
ii. In workers' compensation law, employers pay for this insurance, and shall not require the employee to contribute to the cost of compensation. In a workers' compensation case, no one party is determined to be at fault. However, a worker loses his/her right to workers' compensation if the injury results solely from intoxication, or from deliberate incurrment of injury.
iii. Worker compensation fraud arises, when workers are guilty of the followings: inflating/faking of injuries, malingering, and failure to disclose or report old/remote injury) or employers fail

to obtain workers' compensation for their employees when it is required by law.

iv. The Nigeria's Employee Compensation Act is an important piece of legislation passed in order to provide for Nigerian employees who were injured, disabled, or died during the course of their employment. This Act comprise of eleven (11) key features.

6.0 TUTOR-MARKED ASSIGNMENT

1. Write extensively on the history and features of the Worker Compensation Law of the following countries:
   - United States
   - Germany
   - Canada
   - Australia
   - Japan
   - New Zealand
   - United Kingdom
   - India
2. Discuss with relevant examples the workers' compensation fraud committed in any profession of your choice and how can be these corrected.
3. As an Occupational Health student, you are asked to review the Nigeria's Employee Compensation Act. Identify the lapses and provide measures to be taken to handle them.

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MODULE 6 LEGISLATION AND POLICIES OF OCCUPATIONAL HEALTH PRACTICE

UNIT 1 WORKPLACE HEALTH AUDIT

CONTENTS

1.0 INTRODUCTION

In the last unit you learnt that workers' compensation is a form of insurance providing financial and medical benefits to employees injured in the course of employment. You also learnt about workers' compensation law and other forms of labour law; worker compensation fraud and the Nigeria's Employee Compensation Act. In this unit, you will learn about the general framework of workplace health audit; purposes, objectives and steps involve in workplace safety audit. You will also be taken through the various strategies of workplace surveillance andthe responsibilities of staffs involve in surveillance of the workplace.

2.0 OBJECTIVES

At the end of this unit, you will be able to:

- explain the concept of workplace health audit
- state the purpose, objectives and steps involve in workplace safety audit
- discuss the procedures of workplace surveillance and responsibilities of staffs involved.

3.0 MAIN CONTENT

3.1 General framework

Workplace Health Audit: involves identification and assessment of environmental factors that may affect workers' health, such as the state of occupational hygiene and sanitation, organisation of work, personal protective equipment and control systems, and workers' exposure to hazardous substances. Such surveillance may focus on accident and disease prevention, ergonomics, occupational hygiene, organisation of work and psycho-social factors, among others (For more information, see ILO, 1999a.)

To ensure a healthy working environment there must be monitoring at the workplace. This involves systematic surveillance of the factors in the working environment and working practices which may affect workers' health, including sanitary installations, canteens and housing, where these facilities are provided by the employer, as well as ensuring the working environment complies with safety and health standards. Everyone associated with the workplace from the most junior worker right through to the employer should be actively involved in the surveillance of the working environment. Basic surveillance is carried out by simple observation, and every worker, from shop floor to senior administration, should be trained to identify those factors (potential or actual) which may affect workers' health. Such training is necessary to enable the worker to report immediately to his or her direct supervisor any situation which can reasonably be thought to present an imminent and serious danger to life or health. In such a situation, the employer cannot require the worker to return to work until any necessary remedial action is taken.

Simple observation (a walk-through survey) of work processes and the working environment is the first step in any surveillance. Such observation may be sufficient in some cases to detect a lack of adequate control measures and exposure of workers to risk. An evaluation based on this type of observation may justify the recommendation of control

measures without the need for any more sophisticated determination of the level of exposure. Repeat visits to the workplace and walk-through observation are also necessary to provide an assurance that no deterioration has occurred at workplaces initially evaluated as satisfactory. Information from surveillance of the working environment should be combined with other data, such as epidemiological research or exposure limits, to assess occupational health risks.

3.2 Internal Vs External Audit

Internal	External
➢ Value in improving the bottom line of the business. ➢ Based on the effectiveness of processes in the safety management system. ➢ Identify gaps and creates opportunities for improvement. ➢ Cost avoidance.	➢ Conformance to applicable regulations and standards.

3.3 Purpose of a Workplace Safety Audit

The primary purpose of a safety internal audit is to verify that an organisation has a safety management system in place that meets the stated requirements. The following steps are involved in an internal safety audit:

- Comparing documentation.
- Reviewing records.
- Evaluating safety activities (state and federal requirements).
- Verification of conformance.

3.4 Objectives of the Workplace Safety Audit

The objectives of conducting a safety audit are to:

1. Verify conformance to applicable regulations and standards.
2. Verify conformance to documented procedures.
3. Verify effectiveness of safety processes in the system.
4. Identify opportunities to improve the safety system.

3.5 Safety Audit Preparation

The following steps are involved in a safety audit preparation. These include:

Step 1: Define and understand the scope of the audit

Step 2: Review applicable standards and regulations

Step 3: Prepare process models

Step 4: Review applicable documentation

Step 5: Review previous audits

Step 6: Create an effective checklist

Step 7: Perform a pre-audit meeting

3.6 Surveillance of the Working Environment

3.6.1 Monitoring of exposure

There may be special health hazards which require particular monitoring. Where this is the case, surveillance programmes should include the monitoring of workers' exposure to such hazards. The main objectives of such monitoring are to:

- identify real hazards;
- determine the level of workers' exposure to harmful agents;
- prove compliance with regulatory requirements;
- assess the need for control measures; and
- ensure the efficiency of control measures in use.

The above objectives can be achieved by carrying out occupational health surveys in addition to routine monitoring programmes.

Occupational health surveys are defined as investigations of environmental conditions in the workplace, conducted primarily to determine the nature and extent of any condition that may adversely affect the well-being of people working there. Such surveys are necessary to develop the engineering and medical control measures needed to eliminate or avoid harmful situations.

There are two types of occupational health survey:

- the walk-through survey, which is made for the purpose of selecting any locations in the plant where workers are exposed to hazards, so that this exposure can then be evaluated by analytical studies in order to determine whether additional control is necessary; and

- the comprehensive occupational health survey, which involves the use of sophisticated monitoring equipment and entails detailed planning and execution.

In a situation where workers are exposed to hazardous substances, for example airborne toxic chemicals, the employer should:

- limit exposure to such substances so as to protect the health of workers; and
- assess, monitor and record the concentration of substances at the workplace.

Monitoring should be performed and assessed by trained and experienced people, in accordance with recognised and scientifically accepted methods. The monitoring strategy should assess both the current situation and the possible effect of technological changes or control measures.

3.6.2 Occupational exposure limits (OELs)

One of the responsibilities of the competent authority is to establish the criteria for determining the degree of exposure to hazardous substances or agents, and where appropriate to specify levels as indicators for surveillance of the working environment, with a view to implementing the technical preventive measures required. Furthermore, the competent authority is required to prescribe limits for the exposure of workers to hazardous substances, for example solvent vapours, or asbestos. Exposure limits exist also in respect of physical hazards such as noise, radiation, heat and cold. Such exposure limits or criteria for determining the degree of exposure must be not only fixed but periodically reviewed and updated in the light of technological progress and advances in

technological and scientific knowledge. The ILO International Occupational Safety and Health Information Centre (CIS) compiles and maintains a database of the OELs for chemicals from many countries, and makes it available on its Internet site.

The OELs are usually expressed as time-weighted average concentrations over an eight- or sometimes 12-hour shift and, where necessary, short-term peak concentrations. In practice, the concentration of air pollutants cannot be measured at all workstations and at all times. A limited number of representative air samples are usually taken in order to estimate the average concentration of the pollutants in the workplace. This concentration can then be compared with the exposure limit. The sampling site and duration should be selected so as to ensure that the results are representative. The sampling should be carried out at fixed sites (area sampling) or at the breathing zone of the worker (personal sampling). Unless self-reading instruments are used, the samples will have to be analysed later by appropriate methods.

3.6.3 Record-keeping

The results of workplace monitoring should be collected and presented in a standardised way. Employers should keep the records of the monitoring of exposure for the period determined by the competent authority. This is to enable the assessment of any possible relation between later health impairment and exposure. For example, in cases of exposure to silica, coal, asbestos or carcinogenic substances, it may be necessary to keep records for several decades. Arrangements should also be made by the competent authority to conserve the records in an archive, so that they remain available even if an enterprise should close down. Records should include all relevant data, such as details of the site, product, manufacturer and methods of use, including whether personal protective clothing or equipment was available and whether it was actually worn. Workers and their representatives and the competent authority should have access to the monitoring records

3.7 Responsibilities of staff involved in the surveillance of the working environment

Staffs involved in the surveillance of the working environment are responsible for:

- conducting surveys of the working environment;
- interpreting the data gathered during the survey;
- keeping records;
- preparing appropriate control measures;
- preparing adequate warnings;

- suggesting precautions where dangers exist;
- advising management on industrial hygiene;
- educating workers and the community at large on basic occupational safety and health;
- conducting epidemiological studies to uncover the presence of occupation-related illness and injury.

4.0 CONCLUSION

The primary purpose of a workplace health audit is to verify that an organisation has a safety management system in place that ensures the wellbeing of the workers or the working environment support health of the staffs. This strategy involved routine monitoring and record keeping of exposure to occupational hazards; combined with other data, such as epidemiological research or exposure limits, to assess occupational health risks. The surveillance of the working environment should be carried out in liaison with other technical services in the enterprise, and in cooperation with the workers concerned and with their representatives in the enterprise or, where such a body exists, the safety and health committee. The evaluation of pollution levels and workers' exposure requires specialist knowledge. Such evaluation should therefore be carried out by, or in close cooperation with, an experienced industrial hygienist.

5.0 SUMMARY

Workplace Health Auditentails procedures for identification and assessment of environmental factors that may affect workers' health, and workers' exposure to hazardous substances in the working environment. Such surveillance may focus on accident and disease prevention, ergonomics, occupational hygiene, organisation of work and psycho-social factors, among others.The procedures usually employ include monitoring of exposure, record-keeping of exposure, and epidemiological research to establish occupational exposure limits (OELs).The objectives of a workplace safety audit are: to verify that the working environment and practices conform to standard regulations and standards, verify the effectiveness of the safety processes present in the workplace and identify opportunities to improve the safety system. The safety of the workplace is the responsibilities of both workers and management.

6.0 TUTOR-MARKED ASSIGNMENT

1. List and discuss the tactics to be employed while performing a safety audit. Also discuss the challenges with auditing safety practices.
2. Describe process models use in safety audit preparation.
3. Discuss in detail the features and objectives of the followings:
   - Initial audit
   - Follow-up audit
   - Unannounced verification visit
4. Discuss in detail the precautionary principle, derived from Principle 15 of the 1992 Rio Declaration onEnvironment and Development. Also state its relevance in the workplace health audit.

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UNIT 2 OCCUPATIONAL HEALTH POLICY

CONTENTS

1.0 INTRODUCTION

In the last unit you learnt that workplace health audit involves identification and assessment of environmental factors that may affect workers' health, such as the state of occupational hygiene and sanitation, organisation of work, personal protective equipment and control systems, and workers' exposure to hazardous substances. You were also taught the purpose, objectives and strategies involved in workplace safety audit. In this unit, you will learn about the aims and principles behind occupational safety and health (OSH). You shall also be make to understand the key features and objectives of a national OSH policy. Finally, this unit will discuss on the strategies focus on in a national OSH policy.

2.0 OBJECTIVES

By the end of this unit, you will be able to:

- discuss the general aims and principles behind occupational safety and health (OSH)
- describe the key features of a national OSH policy
- discuss the objectives of OSH policy review
- explain the strategies of a national OSH policy instrument.

3.0 MAIN CONTENT

3.1 General Aims and Principles

The promotion of occupational safety and health, as part of an overall improvement in working conditions, represents an important strategy, not only to ensure the well-being of workers but also to contribute positively to productivity. Healthy workers are more likely to be better motivated, enjoy greater job satisfaction and contribute to better-quality products and services, thereby enhancing the overall quality of life of individuals and society. The health, safety and well-being of working people are thus prerequisites for improvements in quality and productivity, and are of the utmost importance for equitable and sustainable socio-economic development.

In order to ensure that satisfactory and durable results are achieved in the field of occupational safety and health, each country should put in place a coherent national policy. Such a policy should be aimed at promoting and advancing at all levels the right of workers to a safe and healthy working environment; at assessing and combating at source occupational risks or hazards; and at developinga national preventive safety and health culture that includes information, consultation and training. By striving to minimise the causes of hazards in the working environment, the policy will reduce the costs of work-related injury and disease, contribute to the improvement of working conditions and the working environment, and improve productivity. The articulation of such a policy will reaffirm a government's commitment to the cause of a safe working environment and enable it to comply with its moral and international obligations.

3.2 Policy formulation and review

In order to ensure that a national OSH policy is comprehensive, measures should be taken to ensure tripartite participation, which is to say participation by government, employers' and workers' organisations, in its formulation, practical implementation and review. There must be coherence in terms of policy content, as well as during implementation. Although the substance and approach of these policies can vary according to national conditions and practice, there are nevertheless some basic features that are generally desirable: these are summarised in Appendix 1.

It should also be borne in mind that if a policy is to be successfully implemented, local conditions and practices must be taken into account when the policy is being formulated.

Appenix 1: Key features of a national policy on occupational safety and health

- The formulation of the policy should reflect tripartite participation, i.e. there should be inputs from employers' and workers' organisations as well as from government and others involved in the area of occupational safety and health.

- The policy should be consistent with national development objectives and policies as a whole.

- The policy should promote the right of workers to decent, safe and healthy working conditions and environment.

- The policy should include ways of promoting adequate public awareness and eliciting political endorsement at the highest level of government.

- The policy should promote the development of a national preventive safety and health culture that includes information, consultation and training.

- The policy should include a plan for mobilising the necessary institutional and financial resources.

- Coordination among all concerned institutions should be fostered as an inherent element of the policy.

- All available means of action should be used consistently.

- The policy should encourage voluntary compliance at enterprise level.

- The policy should be reviewed regularly.

Improving occupational safety and health is a dynamic process and the objectives are long-term. The implementation of any well-thought-out programme may thus be expected to extend over several years. Significant developments or phenomena need to be identified, and the necessary action taken by government as well as within enterprises to avoid possible disasters.

Because the occupational safety and health situation evolves, the policy itself should be reviewed at appropriate intervals. This review may be an overall assessment of the policy or else focus on particular areas. The objectives of a policy review are to:

- identify major problems;
- devise effective methods of dealing with them;
- formulate and establish priorities for action; and
- evaluate the results.

The nature and extent of OSH problems vary from country to country, resulting in part from differences in the level of economic development, and in technological and social conditions. For example, while a developing country may be grappling with the basic OSH hazards related to agriculture, an industrialised country may be confronted by hazards resulting from an advanced technology such as the production of nanomaterials or from new patterns of work organisation leading to stress. Similarly, within countries the incidence of work-related accidents and diseases, including fatal ones, is higher in certain occupations and sectors than in others. Consequently, national policies should establish priorities for action with regard to the specific problems faced within the country concerned. Such priorities may also vary according to other factors including the severity or extent of the particular problems, the available means of action, the economic situation of the country, sector or enterprise in question, the effects of changing technology and social conditions. It should, however, be stressed that adverse socio-economic conditions must not be used as a pretext for inaction.

3.3 Policy Instruments

Given the complexity and extent of occupational safety and health problems, and the many sources of occupational hazards and work-related diseases, no single intervention would be sufficient in itself to constitute an effective OSH programme. In order to have an impact, action has to proceed at various levels. The practical measures adopted may vary, depending on the degree of technological, economic and social development of the country concerned, and the type and extent of the resources available. It is possible, however, to give a broad outline of the essential components of a national policy.

In general, a national occupational safety and health policy should provide detailed strategies in the following areas, which will be discussed below:

- national laws, labour codes and regulations;
- role and obligations of the competent authority;
- policy coordination; and
- education and training.

3.3.1 National laws, labour codes and regulations

Appropriate legislation and regulations, together with adequate means of enforcement, are key policy instruments for the protection of workers. They form a basis for efforts to improve working conditions and the working environment. The inspection mechanism should make use, among otherthings, of a workers' health surveillance system, which may be run by the government, the community or the enterprise.

Labour legislation lays down minimum standards which are compulsory and applicable to everyone. As employers and plant managers have to fulfil these stipulations by adopting appropriate techniques, and as the efficacy of safety measures ultimately rests on their application by workers, it is imperative that representative organisations of employers and workers be consulted at the various stages in the preparation of laws and regulations.

It has been recognised, in countries with good safety records, that it is more effective to stipulate the duties of those with primary responsibility for OSH measures in general terms, rather than to attempt to regulate a multitude of hazards in minute detail. This approach is important because technology is developing at an increasingly rapid pace, and it often proves difficult for the legislation to keep abreast of progress. More recent legislation has therefore avoided setting out detailed requirements, but rather has defined general objectives in broad terms.

The trend in major industrialised countries is to restrict the number of statutory instruments and to promote the publication by government agencies or specialised professional bodies of directives, codes of practice and voluntary standards, which are more flexible and can be updated more easily. This approach fosters prevention but does not in any way preclude the enactment of specific regulations where strict measures are required to control serious occupational hazards.

Standards, specifications and codes of practice issued by national standards organisations or professional or specialised institutions are generally not binding, but in some cases they have been given the force of law by the competent authority. This practice, which is more common in countries where such organisations and institutions are public bodies rather than private concerns, considerably lightens the legislator's task,

but it may increase the burden on the OSH administrators unless they can rely on approved bodies or institutions for the application and monitoring of these standards and specifications.

3.3.2 Role and obligations of the competent authority

The formulation of a national OSH policy should reflect the respective functions and responsibilities of public authorities, employers, workers and others, and should recognise the complementary character of those responsibilities. Having said that, is the responsibility of the national designated competent authority to identify the major problems and draw up a realistic policy, taking into account the resources and means available. In doing so, the competent authority must set priorities on the basis of the urgency and importance of the problems to be overcome in that particular country.

In order to give effect to OSH policy, and taking account of the available technical means of action, the competent authority or authorities in each country will need to:

- review from time to time the OSH legislation and any other related provisions issued or approved, e.g. regulations or codes of practice, in the light of experience and advances in science and technology;

- issue or approve regulations, codes of practice or other suitable provisions on occupational safety and health, taking account of the links existing between safety and health on the one hand, and hours of work and rest breaks, on the other;

- undertake or promote studies and research to identify hazards and find means of overcoming them;

- provide specific measures to prevent catastrophes, ensuring that action is coordinated and coherent at all levels, with particular attention to areas of potentially high risk for workers and the population at large;

- provide information and advice, in an appropriate manner, to employers and workers, and promote or facilitate cooperation between them and their organisations, with a view to eliminating hazards or reducing them as far as practicable;

- ensure that national laws and regulations, and other approved provisions (for example, guidelines developed by national

organisations), are clear, consistent and comprehensive, and reflect national conditions; and

- verify that national legislation takes into account the applicable provisions of international labour standards, especially Conventions Nos. 155 and 161 and their accompanying Recommendations.

With regard to ensuring that the policy is implemented within enterprises, the competent authority or authorities should:

- set the conditions governing the design, construction and layout of undertakings with a view to avoiding or minimising hazards;
- ensure that hazards are avoided or controlled when operations begin, or when major alterations or changes are made;
- verify the safety of technical equipment used at work;
- see to it that the procedures defined by the competent authority are enforced;
- identify work processes, substances and agents which are to be prohibited, limited or made subject to authorisation or control, taking into consideration the possibility of simultaneous exposure to several substances or agents;
- establish and apply procedures for the notification of occupational accidents and diseases by employers and, when appropriate, insurance institutions and others directly concerned, and produce annual statistics on occupational accidents and diseases;
- hold inquiries in cases of accidents, diseases or any other injuries which arise in the course of or in connection with work and appear to reflect a serious situation;
- publish information on measures taken in pursuance of the national OSH policy, and on accidents, diseases and injuries which arise in the course of or in connection with work; and
- introduce or extend systems to examine chemical, physical and biological agents, and ergonomics and psycho-social factors, with a view to assessing the risk to the health of workers, in so far as is practicable in current national conditions.

3.3.3 Policy coordination

In order to ensure coherence in formulating and applying the national OSH policy, there must be coordination between the various authorities and bodies designated to implement the policy. There should also be close cooperation between public authorities, representative employers' and workers' organisations, and any other concerned bodies, with a view to making arrangements that are appropriate to national conditions and practice. Such arrangements might include the establishment of a central body to take overall responsibility for implementation of policy measures.

The main purposes of these joint efforts should be to:

- fulfil the requirements regarding policy formulation, implementation and periodic review;

- coordinate efforts to carry out the functions assigned to the competent authority;

- coordinate related activities that are undertaken nationally, regionally or locally by public authorities, employers and their organisations, workers' organisations and representatives, and other individuals or bodies concerned; and

- promote the exchange of views, information and experience nationwide, within particular industries, or in specific branches of economic activity.

If the goals of OSH policy are to be achieved, employers and workers must be continuously involved in its implementation and review. National tripartite seminars can be an effective means of associating employers and workers in the policy-making process. The consensus developed by such seminars increases the commitment to implement the agreed measures.

3.3.4 Education and training

Education and training provide individuals with the basic theoretical and practical knowledge required to carry out their trade or occupation successfully and to fit into the working environment. Because of the importance of occupational safety and health, measures should be taken to include these subjects in education and training at all levels in all trades and professions, including higher technical, medical and professional education. OSH training should meet the needs of all

workers, and should be promoted in a manner that is appropriate to national conditions and practice.

The idea is to incorporate OSH principles related to the student's needs into the teaching of all trades and professions. It is therefore important to ensure that OSH matters are integrated in the curricula and teaching materials of trades and occupations at a level in line with the future functions and responsibilities of the people being taught. In general, individuals have great difficulty in modifying acquired habits or abandoning ingrained actions and reflexes. Schooling or apprenticeship should therefore inculcate safe working methods and behavior at an early stage, so that they are followed throughout working life.

Vocational training, whether in the enterprise or at school, often leaves workers poorly prepared to deal with the hazards of their trade. Where they have learnt to work with defective or badly guarded machines and tools, it would be surprising if they were later to be much concerned about safety. If, on leaving school, they are unaware of the importance of good personal hygiene, they are scarcely likely to practise it in the workshop. If people are to be taught how to earn their living, they should also be taught how to protect their lives.
The need to give appropriate training in occupational safety and health to workers and their representatives in the enterprise should thus be stressed as a fundamental element of OSH policy, and should be stated explicitly in the policy document. Workers should be provided with adequate training in terms of the technical level of their activity and the nature of their responsibilities. Employers should also learn how to gain the confidence of their workers and motivate them; this aspect is as important as the technical content of training.

The need to train labour inspectors, OSH specialists and others directly concerned with the improvement of working conditions and the working environment cannot be overemphasised and should be reflected in the policy document. The training should take into account the increasing complexity of work processes, often brought about by the introduction of new or advanced technology, and the need for more effective methods of analysis to identify and measure hazards, as well as action to protect workers against them.

Employers' and workers' organisations should take positive action to carry out training and information programmes with a view to preventing potential occupational hazards in the working environment, and to controlling and protecting against existing risks such as those due to air pollution, noise and vibration. The public authorities have the responsibility to promote training and to act as a catalyst by providing

resources and specialised personnel where necessary. Such support is essential in developing countries.

Initial training, even under the best of conditions, cannot cover all foreseeable and unforeseeable situations. Consequently, occupational safety and health training is a long-term task, and one that is never completely finished.

4.0 CONCLUSION

Occupational safety and health policy represents the foundation from which occupational safety and health goals and objectives, performance measures and other system components are developed. It should be concise, easily understood, approved by the highest level of management and known by all employees in the organisation. In order to ensure that satisfactory and durable results are achieved in the field of occupational safety and health, each country should put in place a coherent national policy. Such a policy should be aimed at promoting and advancing at all levels the right of workers to a safe and healthy working environment; at assessing and combating at source occupational risks or hazards; and at developing a national preventive safety and health culture that includes information, consultation and training.

5.0 SUMMARY

In this unit, you have learnt that:

i. An Occupational safety and health policy represents the foundation from which occupational safety and health goals and objectives, performance measures and other system components are developed. It should also be borne in mind that if a policy is to be successfully implemented, local conditions and practices must be taken into account when the policy is being formulated.

ii. In order to ensure that a national OSH policy is comprehensive, measures should be taken to ensure tripartite participation, which is to say participation by government, employers' and workers' organisations, in its formulation, practical implementation and review. There must be coherence in terms of policy content, as well as during implementation.

iii. Because the occupational safety and health situation evolves, the policy itself should be reviewed at appropriate intervals. This

review may be an overall assessment of the policy or else focus on particular areas.

iv. Consequently, national policies should establish priorities for action with regard to the specific problems faced within the country concerned. Such priorities may vary according to factors such as the severity of problems, the available means of action, the economy of the country, sector or enterprise in question, the effects of changing technology and social conditions.

v. In general, a national occupational safety and health policy should provide detailed strategies in the following areas: national laws, labour codes and regulations; role and obligations of the competent authority;policy coordination; andeducation and training.

6.0 TUTOR-MARKED ASSIGNMENT

1. Explain the key features of a national policy on occupational safety and healthestablished in the following:
   - in a developed country in Europe
   - in a developing nation.
2. Describe a national OSH system modelled from provisions in ILO OSH instruments.
3. Discuss succinctly the strategies provide by a national OSH policy with respect to the following areas:
   - policy coordination
   - education and training
   - national laws, labour codes and regulations
   - role and obligations of competent authority

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UNIT 3 OCCUPATIONAL HEALTH CODE OF CONDUCT

CONTENTS

1.0 INTRODUCTION

The International Code of Ethics for Occupational Health Professionals published by the International Commission on Occupational Health (ICOH) presents the ethical principles essential in occupational health. The Code is intended to guide all professionals who carry out occupational health activities and to set a generally valid reference level in their performance. There is a wide range of duties, obligations and responsibilities as well as complex relationships among those concerned and involved in occupational safety and health matters. In general, obligations and responsibilities are defined by statutory regulations. This unit will look at the history of the development of occupational health ethics; basic principles and values of ethics on which the International Code of Ethics for Occupational Health Professionals is based; the duties and obligations of occupational health professionals; and conditions of execution of the functions of occupational health.

2.0 OBJECTIVES

At the end of this Unit, you will be able to:

- understand the historical development of the International Code of Ethics for Occupational Health Professionals.
- understand the principles of ethics and values of the International Code of Ethics for Occupational Health Professionals.
- explain the duties and obligations of occupational health professionals.
- discuss the conditions of Execution of the Functions of Occupational Health Professionals.

3.0 MAIN CONTENT

3.1 Historical Development of the International Code of Ethics for Occupational Health Professionals

The International Code of Ethics for Occupational Health Professionals published by the International Commission on Occupational Health (ICOH) presents the ethical principles essential in occupational health. The Code is intended to guide all professionals who carry out occupational health activities and to set a generally valid reference level in their performance. The preparation of an International Code of Ethics for Occupational HealthProfessionals was discussed by the Board of the ICOH in Sydney in 1987. A draft was distributed to the Board members in Montreal and was subject to a process of consultations at the end of 1990 and at the beginning of 1991. The 1992 Code of Ethics for Occupational Health Professionals was approved by the Board of the ICOH on 29 November 1991 and published in English and French in 1992, reprinted in 1994 and 1996 and translated into eight languages.

This International Code of Ethics was first published in 1992 in English and French with the approval of the Board of ICOH. The 1992 Code of Ethics set out basic principles and practical guidelines. In consideration of the changing environment where occupational health is practiced and of the need to provide guidance on particular aspects of the professional conduct, the Code was revised in 2002. The current Code corresponds to this 2002 edition. The ICOH Code of Ethics is broadly accepted serving as a standard for evaluating professional conduct in occupational health. In some countries, the Code is incorporated in the national law. In 2010, the United Nations Medical Directors Working Group agreed to advise that any UN organisational statements of ethics in

occupational health matters should be guided by, and consistent with the ICOH Code of Ethics. It is encouraging that the ICOH Code of Ethics is widely referred to in occupational health and related fields.

In its introduction, the Code highlights three basic principles: serving the health and social well-being of workers; integrity and impartiality in professional conduct; and full professional independence. An emphasis is placed on a proper preventive action at work based on the advisory roles of occupational health professionals. It is hoped that the Code is acknowledged in a reassured manner as a standard for defining and evaluating professional conduct in occupational health. During the triennium 2009-2011, the review of the International Code of Ethics has been conducted involving many ICOH members. The review is aimed at enhancing the ethical awareness and updating the Code with adding supplementary provisions reflecting recent developments. The review activities by the Code Review Group were presented at the ICOH Midterm Meeting in Milan in early 2011. Subsequently, the initial review draft was distributed to the officers of ICOH Scientific Committees and National Secretaries for their comment. Based on the feedback from many members, the review results were presented later in 2011. The results demonstrated the adequacy of retaining the current structure and the basic principles and the need tostrengthen the provisions relating to workplace action, privacy of health data and conditions for execution of professional functions. It is now proposed to update the Code, with minimal revisions, with a view to reinforcing the professional conduct in occupational health in diversifying work situations. Views and comments about updating the Code are therefore highly welcome.

3.2 Basic Principles

The following three paragraphs summarise the principles of ethics and values on which is based the International Code of Ethics for Occupational Health Professionals.

The purpose of occupational health is to serve the health and social well-being of the workers individually and collectively. Occupational health practice must be performed according to the highest professional standards and ethical principles. Occupational health professionals must contribute to environmental and community health.

The duties of occupational health professionals include protecting the life and the health of the worker, respecting human dignity and promoting the highest ethical principles in occupational health policies

and programmes. Integrity in professional conduct, impartiality and the protection of the confidentiality of health data and of the privacy of workers are part of these duties.

Occupational health professionals are experts who must enjoy full professional independence in the execution of their functions. They must acquire and maintain the competence necessary for their duties and require conditions which allow them to carry out their tasks according to good practice and professional ethics.

3.3 Duties and obligations of occupational health professionals

1. Aims and Advisory Role

The primary aim of occupational health practice is to safeguard and promote the health of workers, to promote a safe and healthy working environment, to protect the working capacity of workers and their access to employment. In pursuing this aim, occupational health professionals must use validated methods of risk evaluation, propose effective preventive measures and follow up their implementation. The occupational health professionals must provide competent and honest advice to the employers on fulfilling their responsibility in the field of occupational safety and health as well as to the workers on the protection and promotion of their health in relation to work. The occupational health professionals should maintain direct contact with safety and health committees, where they exist.

2. Knowledge and Expertise

Occupational health professionals must continuously strive to be familiar with the work and the working environment as well as to develop their competence and to remain well informed in scientific and technical knowledge, occupational hazards and the most efficient means to eliminate or to minimise the relevant risks. As the emphasis must be on primary prevention defined in terms of policies, design, choice of clean technologies, engineering control measures and adapting work organisation and workplaces to workers, occupational health professionals must regularly and routinely, whenever possible, visit the workplaces and consult the workers and the management on the work that is performed.

3. Development of a Policy and Programme

The occupational health professionals must advise the management and the workers on factors at work which may affect workers' health. The risk assessment of occupational hazards must lead to the establishment of an occupational safety and health policy and of a programme of prevention adapted to the needs of undertakings and workplaces. The occupational health professionals must propose such a policy and programme on the basis of scientific and technical knowledge currently available as well as of their knowledge of the work organisation and environment. Occupational health professionals must ensure that they possess the required skill or secure the necessary expertise in order to provide advice on programmes of prevention which should include, as appropriate, measures for monitoring and management of occupational safety and health hazards and, in case of failure.

4. Emphasis on Prevention and on a Prompt Action

Special consideration should be given to the rapid application of simple preventive measures which are technically sound and easily implemented. Further evaluation must check whether these measures are effective or if a more complete solution must be sought. When doubts exist about the severity of an occupational hazard, prudent precautionary action must be considered immediately and taken as appropriate. When there are uncertainties or differing opinions concerning nature of the hazards or the risks involved, occupational health professionals must be transparent in their assessment with respect to all concerned, avoid ambiguity in communicating their opinion and consult other professionals as necessary.

5. Follow-Up on Remedial Actions

In the case of refusal or of unwillingness to take adequate steps to remove an undue risk or to remedy a situation which presents evidence of danger to health or safety, the occupational health professionals must make, as rapidly as possible, their concern clear, in writing, to the appropriate senior management executive, stressing the need for taking into account scientific knowledge and for applying relevant health protection standards, including exposure limits, and recalling the obligation of the employer to apply laws and regulations and to protect the health of workers in their employment. The workers concerned and their representatives in the enterprise should be informed and the competent authority should be contacted, whenever necessary.

6. Safety and Health Information

Occupational health professionals must contribute to the information for workers on occupational hazards to which they may be exposed in an objective and understandable manner which does not conceal any fact and emphasises the preventive measures. The occupational health professionals must co-operate with the employer, the workers and their representatives to ensure adequate information and training on health and safety to the management personnel and workers. Occupational health professionals must provide appropriate information to the employers, workers and their representatives about the level of scientific certainty or uncertainty of known and suspected occupational hazards at the workplace.

7. Commercial Secrets

Occupational health professionals are obliged not to reveal industrial or commercial secrets of which they may become aware in the exercise of their activities. However, they must not withhold information which is necessary to protect the safety and health of workers or of the community. When needed, the occupational health professionals must consult the competent authority in charge of supervising the implementation of the relevant legislation.

8. Health Surveillance

The occupational health objectives, methods and procedures of health surveillance must be clearly defined with priority given to adaptation of workplaces to workers who must receive information in this respect. The relevance and validity of these methods and procedures must be assessed. The surveillance must be carried out with the informed consent of the workers. The potentially positive and negative consequences of participation in screening and health surveillance programmes should be discussed as part of the consent process. The health surveillance must be performed by an occupational health professional approved by the competent authority.

9. Information to the Employer

The results of the examinations prescribed by national laws or regulations must only be conveyed to management in terms of fitness for the envisaged work or of limitations necessary from a medical point of view in the assignment of tasks or in the exposure to occupational hazards, with the emphasis put on proposals to adapt the tasks and working conditions to the abilities of the worker. General information on work fitness or in relation to health or the potential or probable health

effects of work hazards, may be provided with the informed consent of the worker concerned, in so far as this is necessary to guarantee the protection of the worker's health.

10. Protection of Communityand Environment

Occupational health professionals must be aware of their role in relation to the protection of the community and of the environment. With a view to contributing to environmental and public health; occupational health professionals must initiate and participate, as appropriate, in identifying, assessing, advertising and advising for the purpose of prevention on occupational and environmental hazards arising or which may result from operations or processes in the enterprise.

3.4 Conditions of Execution of the Functions of Occupational Health Professionals

1. Competence, Integrity and Impartiality

Occupational health professionals must always act, as a matter of prime concern, in the interest of the health and safety of the workers. Occupational health professionals must base their judgements on scientific knowledge and technical competence and call upon specialised expert advice as necessary. Occupational health professionals must refrain from any judgement, advice or activity which may endanger the trust in their integrity and impartiality.

2. Professional Independence

Occupational health professionals must seek and maintain full professional independence and observe the rules of confidentiality in the execution of their functions. Occupational health professionals must under no circumstances allow their judgement and statements to be influenced by any conflict of interest, in particular when advising the employer, the workers or their representatives in the undertaking on occupational hazards and situations which present evidence of danger to health or safety.

3. Equity, Non-Discrimination and Communication

The occupational health professionals must build a relationship of trust, confidence and equity with the people to whom they provide occupational health services. All workers should be treated in an equitable manner, without any form of discrimination as regards their condition, their convictions or the reason which led to the consultation

of the occupational health professionals. Occupational health professionals must establish and maintain clear channels of communication among themselves, the senior management responsible for decisions at the highest level about the conditions and the organisation of work and the working environment in the undertaking, and with the workers' representatives.

4. Medical Confidentiality

Individual medical data and the results of medical investigations must be recorded in confidential medical files which must be kept secured under the responsibility of the occupational health physician or the occupational health nurse. Access to medical files, their transmission and their release are governed by national laws or regulations on medical data where they exist and relevant national codes of ethics for health professionals and medical practitioners. The information contained in these files must only be used for occupational health purposes.

5. Collective Health Data

When there is no possibility of individual identification, information on aggregate health data on groups of workers may be disclosed to management and workers' representatives in the undertaking or to safety and health committees, where they exist, in order to help them in their duties to protect the health and safety of exposed groups of workers. Occupational injuries and work-related diseases must be reported to the competent authority according to national laws and regulations.

6. Promoting Ethics and Professional Auditing

Occupational health professionals must seek the support and co-operation of employers, workers and their organisations, as well as of the competent authorities, for implementing the highest standards of ethics in occupational health practice. Occupational health professionals must institute a programme of professional audit of their activities to ensure that appropriate standards have been set, that they are being met and that deficiencies, if any, are detected and corrected and that steps are taken to ensure continuous improvement of professional performance.

7. Clause on Ethics in Contracts of Employment

Occupational health professionals must request that a clause on ethics be incorporated in their contract of employment. This clause on ethics should include, in particular, their right to apply professional standards,

guidelines and codes of ethics. Occupational health professionals must not accept conditions of occupational health practice which do not allow for performance of their functions according to the desired professional standards and principles of ethics. Contracts of employment should contain guidance on the legal, contractual and ethical aspects and on management of conflict, access to records and confidentiality in particular. Occupational health professionals must ensure that their contract of employment or service does not contain provisions which could limit their professional independence. In case of doubt about the terms of the contract legal advice must be sought and the competent authority must be consulted as appropriate.

8. Records

Occupational health professionals must keep good records with the appropriate degree of confidentiality for the purpose of identifying occupational health problems in the enterprise. Such records include data relating to the surveillance of the working environment, personal data such as the employment history and occupational health data such as the history of occupational exposure, results of personal monitoring of exposure to occupational hazards and fitness certificates. Workers must be given access to the data relating to the surveillance of the working environment and to their own occupational health records.

4.0 CONCLUSION

The International Code of Ethics for Occupational Health Professionals is relevant to many professional groups carrying out tasks and having responsibilities in enterprises as well as in the private and public sectors concerning safety, hygiene, health and the environment in relation to work. The term occupational health professionals category is for the purpose of this Code defined as a broadly target group whose common vocation is a professional commitment in pursuing an occupational health agenda. The scope of this Code covers activities of occupational health professionals both when they are acting in individual capacity and as part of organisations and undertakings providing services to clients and customers. The Code applies to occupational health professionals and occupational health services regardless of whether they operate in a free market context subject to competition or within the framework of public sector health services.

5.0 SUMMARY

In this unit, you have learnt that:

i. The International Code of Ethics for Occupational Health Professionals published by the International Commission on Occupational Health (ICOH) presents the ethical principles essential in occupational health. The Code is intended to guide all professionals who carry out occupational health activities and to set a generally valid reference level in their performance. This International Code of Ethics was first published in 1992 in English and French with the approval of the Board of ICOH.

ii. the 1992 International Code of Ethics laid down general principles of ethics in occupational health. These are still valid but need to be updated and rephrased to reinforce their relevance in the changing environment where occupational health is practiced.

iii. the Code highlights three basic principles: serving the health and social well-being of workers; integrity and impartiality in professional conduct; and full professional independence.

iv. there is a wide range of duties, obligations and responsibilities as well as complex relationships among those concerned and involved in occupational safety and health matters. In general, obligations and responsibilities are defined by statutory regulations. Each employer has the responsibility for the health and safety of the workers in his or her employment. Each profession has its responsibilities which are related to the nature of its duties.

v. some of the conditions of execution of the functions of occupational health professionals and the conditions of operation of occupational health services are often defined in statutory regulations, such as regular planning and reviewing of activities and continuous consultation with workers and management.

6.0 TUTOR-MARKED ASSIGNMENT

1. Discuss the aims of occupational health practice as outline by the ILO/WHO Joint Committee on Occupational Health in 1995.

2. Discuss the duties and obligations of Occupational Health Professionals with regard to the followings:
   - danger to a third party
   - biological monitoring and investigations
   - health promotion
   - contribution to scientific knowledge
   - information to the worker

3. Explain the execution of the functions of occupational health professionals with respect to the followings:
   - relationship with health professionals
   - combating abuses
   - relationship with social partners

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UNIT 4 GUIDE TO OCCUPATIONAL HEALTH PRACTICE

CONTENTS

1.0 INTRODUCTION

In the last unit you learnt that the International Code of Ethics for Occupational Health Professionals presents the ethical principles essential in occupational health. The Code highlights three basic principles: serving the health and social well-being of workers; integrity and impartiality in professional conduct; and full professional independence. In this unit, you will learn about guide to occupational health practice. You shall also learn about the organisation of the guide and their various components.

2.0 OBJECTIVES

By the end of this unit, you will be able to:

- expalin the organisational sections of guide to occupational health practice
- describe the key features of the “essential elements” and “optional elements” in the guide
- apply this guide to real life occupational health practice.

3.0 MAIN CONTENT

3.1 Organisation of the Guide

This guide is divided into two sections: “Essential Elements” and “Optional Elements.” The Essential Elements encourage analysis and comparison of organisations, currently a problem in evaluating OHS

performance. These Essential Elements are applicable to all sectors and categories, including but not limited to manufacturing, distribution, and medical care, non-governmental organisations (NGOs), consulting and government. Organisations that combine safety, health (industrial hygiene), and environmental elements in the same section of the sustainability reporting will find the metrics applicable.

The "Optional Elements" are recommended, but not required for meeting the intent of this Guide. However, they are recommended as important information which will strengthen the reader's ability to judge the quality of OHS efforts for the reporting entity. The reporter is encouraged to include as many of these Optional Elements of information as possible. There are six optional categories, which include OHS targets, capital investments, worker involvement, training, risks and additional metrics.

The scope of the Guide is workplace health and safety reporting for sites owned by or operated for the organisation. Reporting should represent the overall organisation at the highest administrative level and not be concerned with minor differences in individual operating units (e.g., headquarters and not individual sites). Where operational standards are significantly different from corporate standards, however, these should be reported separately or explained. Organisations should consider workplace health and safety as material to their stakeholders. Every organisation should consider itself within the scope and materiality of these guidelines

3.2 Essential Elements

DESCRIPTIVE REPORTING REQUIREMENTS
The Introduction and Summary of Key Points

The beginning of your OHS report should include an introduction and summary of key points, providing the reader with an overview of your OHS programs and key performance measures. This might include information on both performance against established continual improvement targets and a brief description of any new targets as applicable.

Organisational Structure and Reporting Relationships

The report should include information on the organisational structure and reporting relationships for the central or corporate OHS function(s), whether on an indirect or direct basis. It should include:

- OHS staffing levels
- A general description of reporting relationship, including which department the OHS function reports to (e.g., legal, operations, supply chain, human resources, financial, and the position to whom it reports directly (an officer of the company such as the CEO or President, Director of a department), and
- Whether a member of the organisation's Board of Directors has direct oversight responsibility for the OHS function.

If the organisational designation includes other functions such as environment, quality and security, etc., these should be noted.

The Scope of the OHS Programs

This section should describe the OHS program's scope of coverage and should include all organisational sites, facilities, business units, business operations, suppliers, and contractors. The report should note any limitations or exclusions, including any subsidiaries, joint ventures (or other partnerships), and recent acquisitions or divestments. If this information is already presented in other areas of the sustainability reporting, it does not need to be repeated in this section.

OHS Policy or Codes of Conduct

The section should provide a description or summary of the top-level OHS policy and/or codes of conduct (e.g., Corporate OSH policy statement or Vendor Code of Conduct), indicating whether the policy and codes are applicable to the entire organisation. Policies and codes unique to particular operating divisions or business units should also be identified. It is not necessary to describe multiple policies or codes of conduct, which can be listed with an internet or other reference source.

OHS Management Systems

This section of the report should describe the organisation's OHS management system. This could be a proprietary approach or the use of a nationally or internationally recognised standard or guideline. Examples of national guidelines include:

- The United States Occupational Safety and Health Administration (OSHA) Voluntary Protection Program (VPP)
- The US ANSI/AIHA/ASSE Z10-2012 Occupational Health & Safety Management Systems standard, and
- The Canadian version, CAN/CSA-Z1000-14 - Occupational health and safety management

Examples of internationally recognised programs include:

- The OHSAS 18001 Occupational Health and Safety Management standard
- The forthcoming **ISO/DIS 45001** Occupational health and safety management systems standard, and
- The ILO's Guidelines on Occupational Safety and Health Management Systems

If the organisation utilises:

- A nationally/internationally recognised management system, identify the system used.
- A custom management system, describe the key components of the system and indicate whether it meets nationally/internationally recognised standards.

If the management system has been registered or certified by a third party auditor, the date of certification or registration should be provided in general, but not for each site. If some sites are not registered or certified, this should be noted as well. This can be expressed as a percentage of accredited sites or as the actual numbers for each category.

OHS Program and Performance Auditing

This section should detail the organisation's approach to OHS auditing with regard to the OHS program itself and its performance. For the purposes of this reporting guideline, auditing is limited to inspections or audits to determine the organisation's compliance with internal and/or mandated standards or regulations. The inspections or audits would be performed by individuals with no connection to the operation in question, whether they are the organisation's employees or external consultants. The scope of this reporting requirement does not include routine internal inspections.

OHS Performance Reporting

This section covers the organisation's OHS performance metrics. As noted before (and if not already identified), the scope of the performance reporting should be identified first. Specific exclusions or adjustments (acquisitions and divestments, etc.) should be noted as well.

3.3 Occupational Safety and Health (OSH) Performance Metrics

To advance the standardisation of sustainability reporting practices in occupational health, the following minimum performance reporting requirements are recommended:

1. Lost-time injury and illness frequency rate, lost-time injury and illness severity rate, and number of fatalities (all employees/workers – 5 year period).

2. Lost-time injury and illness frequency rate, lost-time injury and illness severity rate, and number of fatalities (all contractors – 5 year period).

3. % of owned or leased manufacturing, production, or warehousing facilities that have implemented an OHS management system that meets nationally or internationally recognised standard or guideline.

4. % of owned or leased manufacturing, production, or warehousing facilities that have had their OHS management systems audited.

5. % of direct/first tier suppliers' facilities that were audited for compliance with OHS standards.

Definitions:

Employee/worker – A person who is subject to the control of the organisation's management for the performance of work duties, including contract workers and temporary workers.

Contractor – External person(s) providing services to an organisation at a workplace in accordance with agreed specifications, terms and conditions.

Lost-time injury or illness – A nonfatal occupational injury or illness that causes a loss of time from work beyond the day or shift it occurred.

Lost-time injury and illness rate – The number of lost-time injuries and illnesses per million hours worked, calculated using this formula: (Number of lost-time injuries and illnesses x 1,000,000)/Total hours worked in accounting period.

Lost-time injury and illness severity rate – The number of days away from work due to workplace injury or illness per one million man hours

worked, calculated using this equation: (# of work days lost x 1,000,000)/Total hours worked.

OHS standards – Standards required by contract with the supplier, pursuant to an agreed upon Supplier Code of Conduct, or by relevant local law or regulation.

3.4 Optional Elements

OHS Targets
Metrics that provide performance against continual improvement goals or targets (e.g., reduce lost time injuries by 20% over 3 years).

OHS Involvement in Capital Investments
Describe the programs and approaches that assure OHS oversight of capital investments. This would include capital investments for new construction or equipment, process redesign, expansion, modernisation, etc. The trigger points (e.g., by process or type of equipment or corporate costs that would initiate OHS oversight) should also be described.

Some organisations use third party OHS assessments and/or acceptance testing for capital investments. If these are used, they should be described. This includes due diligence as it pertains to OHS, but not environmental due diligence for property acquisitions.

Worker Involvement

Worker involvement is a critical aspect of effective OHS programs. This includes worker participation in areas such as OHS committees, union OHS representation, joint inspections and investigations, job safety analyses, risk assessments and other areas such as kaizen teams and strike teams. If the type and level of worker participation varies significantly by geography and/or operating divisions, this should be summarised as well, identifying the differences (for example, German-style “works councils” may not have equivalents in other countries).

OHS Training
Another important aspect of OHS management is the nature and extent of training. Legally-mandated training can be included but should be identified as such. This should also include OHS training for all levels, including contractors and any others who are pertinent. This may be reported as, for example, OHS training hours per thousand hours worked.

OHS Risks

The report should provide a description of the strategic risk management process that the organisation uses to identify and manage key health and safety risks. Following this description, the organisation should list the key OHS risks that result from the process and how they are being mitigated. For organisations that have integrated or unrelated operations, these OHS risks may be summarised by category of operations within the same organisation. Only the most significant risks should be included in this section of the report and should reflect the risks common to the organisation's industry (e.g., hospitals and infectious disease, back injuries, etc.).

Other Descriptive Items, Including Additional Metrics

This section includes any additional information that would help the reader better understand the OHS program. It could include special programs such as safety fairs, special campaigns, community programs and awards and recognitions programs. Wellness and return to work programs may also be noted where appropriate.

Other optional elements include third party manufacturing metrics for the lost time injury and illness rates, the severity rate and the fatality rate. It may also be desirable to include a statement on the percentage of total manufacturing at the third party manufacturing site which is done solely for the reporting company (provides relevance for the reported metrics). These may include other indicative or predictive performance metrics that are relevant (e.g., workers exposed above recommended exposures but with safety equipment, safety culture indicators, behavioral safety observations, workers at risk, etc.).

4.0 CONCLUSION

The corporate reporting landscape has dramatically changed over the last several years. Investors and other key stakeholders are demanding more and better information on corporate performance. These developments have important implications for occupational health and safety (OHS) reporting. The Center for Safety and Health Sustainability is committed to helping your organisation negotiate these changes and meet the widening needs of investors and stakeholders. It is with this end in mind that CSHS has launched an initiative to standardize OHS reporting. CSHS views this campaign as a critical step in improving OHS performance and, ultimately, preventing worker injuries, illnesses, and fatalities.

5.0 SUMMARY

In this unit, you have learnt that:

i. occupational health guide is divided into two sections: “Essential Elements” and “Optional Elements.” The scope of the Guide is to ensure sustainability in workplace health and safety reporting for organisation.

ii. the Essential Elements encourage analysis and comparison of organisations, currently a problem in evaluating OHS performance. These Essential Elements are applicable to all sectors and categories.

iii. the “Optional Elements” are recommended, but not required for meeting the intent of this Guide. However, they are recommended as important information which will strengthen the reader’s ability to judge the quality of OHS efforts for the reporting entity. There are six optional categories, which include OHS targets, capital investments, worker involvement, training, risks and additional metrics.

iv. to advance the standardisation of sustainability reporting practices in occupational health, the following minimum performance reporting requirements are recommended: Lost-time injury and illness frequency rate, lost-time injury and illness severity rate, and number of fatalities (of all employees/workers and contractors).

6.0 TUTOR-MARKED ASSIGNMENT

1. Discuss how you would use the OSH performance metrics to assess workplace safety and health.
2. Explain the relevances of the followings in Occupational Safety and Health (OSH) reporting:
   - Essential elements
   - Optional elements.
3. Discuss the role of sustainability in occupational health practice guide.

7.0 REFERENCES/FURTHER READING

Center for Safety and Health Sustainability (2016). CSHS Best Practice Guide for Occupational Health and Safety in Sustainability Reportings.www.centershs.org

Code of practice on the protection of workers' personal data, ILO, Geneva, 1997.

Professional practice and ethics for occupational health nurses, in "A guide to an occupational health service: A handbook for employers and nurses". Published for the Royal College of Nursing by Scutari Projects, London. 2nd edition, 1991.