CHAPTER

1

Introduction to Occupational Health

The modern industrial operations present many hazards to the health of the workers. It is an established fact that there is no occupation which does not have any hazard. However, it is also true that there is no effective way of cure available for many of the occupational diseases. But there is a rosy part also that most of the occupational diseases are preventable. Preventive medicine and occupational health have the same aim—"the prevention of disease and promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations", the levels of application of preventive measures are the same—"health promotion, specific protection (primary prevention), early diagnosis and treatment (secondary prevention)" and disability limitation and rehabilitation (tertiary prevention)', and the tools are the same—"epidemiological approach, statistics, health screening, health education". Occupational health, therefore, is the application of preventive medicine in all places of employment. It is a division of general medicine which is devoted to the prevention of occupational disease and injury and to the promotion of health of people at work.

Occupational health should aim at 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 departure from 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 the worker in an environment adapted to his physiological and psychological capabilities and, to summarize, the adaptation of work to man and of each man to his work. Today's concept of occupational health has greatly been changed from earlier concept of 'industrial health'. Now, it is changing to 'environmental health', as we all are concerned about the ecological problems arising from rapid industrialization, urbanization, use of complex processes and hazardous chemicals in industries.

One of the declared aims of occupational health is to provide a safe occupational environment in order to safeguard the health of the workers and to step up industrial production and development. *Occupational environment* is the sum of external conditions and influences prevailed at the place of work which have direct and/or indirect effects on the health of working population. If occupational environment is polluted, it will affect the health of working population and will cause occupational disease or hazard. The disease which arises out of or in course of occupation is known as *occupational disease* (Fig. 1.1).

Categories of occupational disease syndromes: The World Health Organization

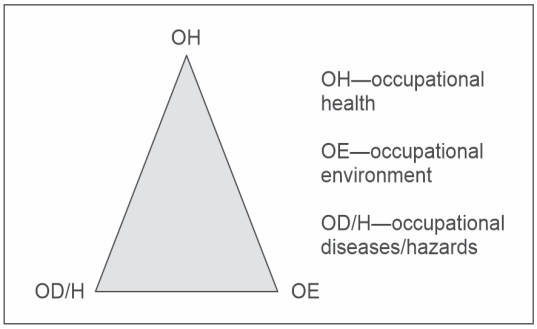

Fig. 1.1: Triangle of inter-relation between OH, OE and OD/H

(WHO) has proposed that there are at least four categories of occupational disease syndromes:

1. Disease that is only occupational in origin, like pneumoconiosis.
2. Diseases in which occupation is one of the causal factors, like bronchogenic carcinoma.
3. Diseases in which the occupation is a contributing factor in complex situations, like chronic bronchitis.
4. Diseases in which the occupation may aggravate a preexisting condition, like occupational asthma.

There is a growing awareness that improved working conditions and working environment are a positive contribution to the national development and is a necessity in the achievement of sustainable development. But despite the efforts of all concerned, the incidence of diseases is still too high and the workplace remains hazardous. Hazards related to the use of chemicals are widespread and according to the statistics, 2 out of every 3 workers worldwide are exposed to them. It shows how important it is to multiply our efforts to protect working people and the environment against these hazards. Prevention is the treatment of choice in case of occupational health hazards to save lives of workmen and economic losses in industries as well as for the excellence in industrial development. The ILO and WHO estimate that 1.9 million people died due to occupational risk factors globally in the year 2016. Of these work-related deaths, diseases accounted for 81%, while injuries comprised 19%. These are WHO/ILO joint estimates of the work-related burden of disease (Fig. 1.2).

Ergonomics is now a well recognized discipline and constitutes an integral part of any advanced occupational health service. The term 'ergonomics' is derived from the Greek words '*ergon*' meaning 'work' and '*nomos*' meaning 'law'. Training in ergonomics involves designing of machine, tools, equipment and manufacturing process, lay-out of the places of work, methods of work and environment in order to achieve greater efficiency of both man and machine. The objective of ergonomics is 'to achieve the best

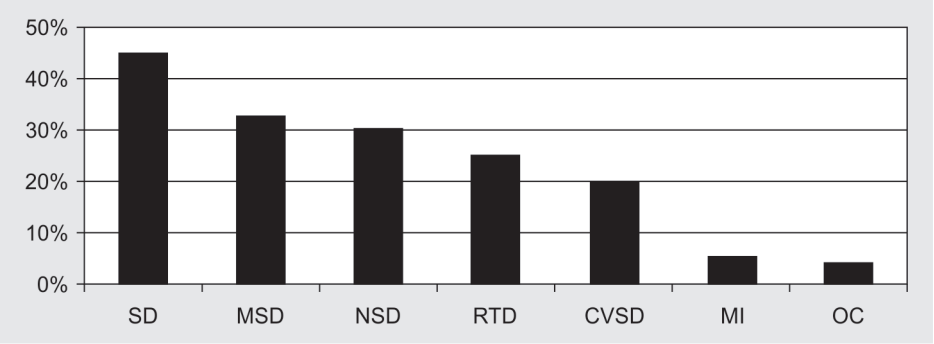

Fig. 1.2: SD: Skin diseases; MSD: Musculoskeletal diseases; NSD: Nervous system diseases; RTD: Respiratory tract diseases; CVSD: Cardiovascular system diseases; MI: Mental illness; OC: Occupational cancer (etiological fraction of occupational diseases: WHO/ILO joint study report)

mutual adjustment of man and his work, for the improvement of human efficiency and well-being'. The application of ergonomics has made a significant contribution to reduce industrial accidents and to improve the overall health and efficiency of the workers. Ergonomical hazards include improperly designed tools, equipment or work areas; unusual and unnecessary lifting or reaching; poor visual conditions; excessive vibration; or repeated forceful motions in awkward postures. These factors may be responsible for fatigue, stress, and strain, as well as cumulative trauma disorders and other musculoskeletal injuries. They may also predispose workers to harm from other safety hazards.

The workers may be exposed to five types of hazards, depending upon their occupations:

1. **Physical hazard:** This is due to the interaction between workers and physical agents. An agent is defined as a substance (living or non-living) or a force (tangible or intangible) and the excessive presence or relative lack of which may initiate or perpetuate a disease process. Physical agents are heat, cold, noise, vibration, ionizing radiation, non-ionizing radiation, light, barometric pressure, electricity, ultrasonography (USG), electromagnetic fields (EMF), and moisture.
2. **Chemical hazard:** This is due to the interaction between workers and chemical agents (Fig. 1.3). Chemical hazards are due to excessive airborne concentration of vapors, gases, or aerosols in the form of dusts, fumes, or mists. These may present an inhalation hazard; some may act as skin irritants or be toxic by absorption through the gastrointestinal tract.
3. **Biological hazard:** This is due to the interaction between workers and biological agents like bacteria, virus, fungus, and insects. These hazards may be produced by handling and processing biological specimens, plants, or animals and by improper removal of waste or sewage; inadequate food handling procedures; and deficiencies in personal hygiene, sanitation, and housekeeping

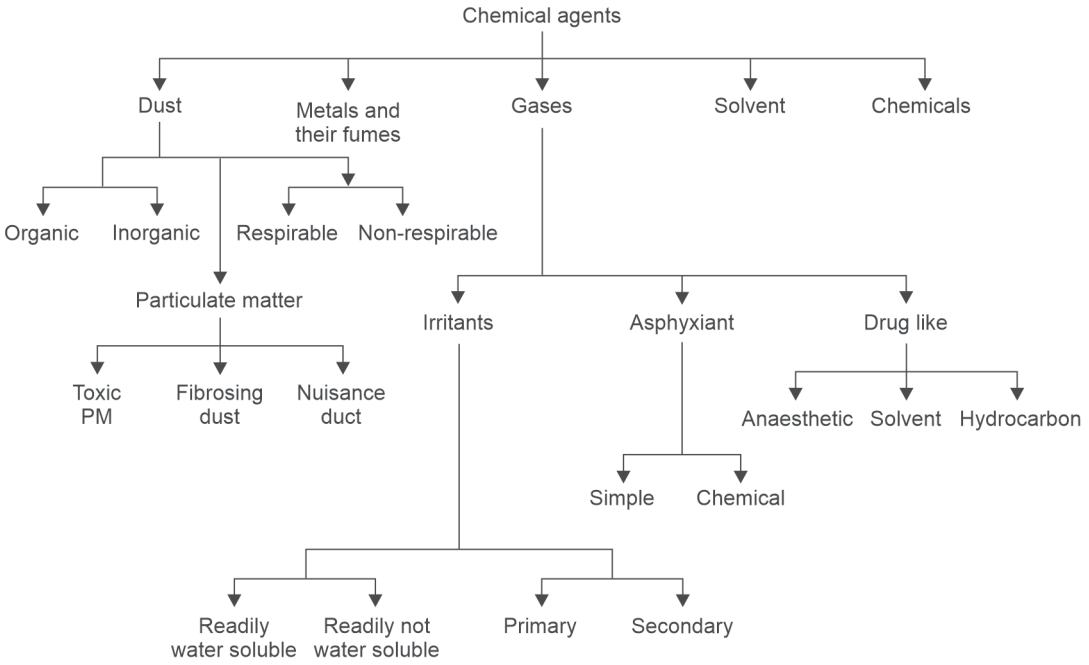

Fig. 1.3: Chemical agents

procedures. Occupational biohazards may act as infectious, allergenic, toxic, or carcinogenic agents in humans; but most agents defined as 'occupational biohazards' belong to the following groups:

a. Microorganisms such as viruses, bacteria, and fungi that are defined usually as single species causing infections or allergenic diseases. These include hepatitis B, HIV, brucellosis and other nonzoonotic species, as well as gram-negative bacteria that posses endotoxic or allergenic properties.
b. Arthropods comprising species that may attack and bite or sting workers causing adverse skin effects. Parasites like schistosomas are also the source of some diseases for agricultural workers.
c. Allergens and toxins derived from higher plants that may, on skin contact, cause dermatitis, or by inhalation cause rhinitis or occupational asthma.
d. Protein allergens of domestic or laboratory animals that are present in urine, feces, saliva, hair, dander, and feathers, or in particles of ground tissues that become airborne.

4. **Mechanical hazard:** This is due to the interaction between workers and machine, tools, housekeeping, etc. Examples, accident, injuries and cumulative trauma disorders. Factors responsible for mechanical hazard are: Environmental factors (heat, noise, vibration, machine without any guard) and human factor. Human factor may be of physical (colour blindness, deafness), physiological (age, sex, experience, shift work) and psychological, etc.
5. **Psychosocial hazard:** This is a hazard that affects the mental well-being or mental health of the worker by overwhelming individual coping mechanisms and impacting the workers' ability to work in a healthy and safe manner. Effects may be of two types: Psychological (behavioural changes) and psychosomatic (systemic changes).

Eye Injuries

The eye injuries account for about 5% of all industrial injuries. They are caused due to:

Flying objects	80%
Tools or parts of machines	8%
Splashes or liquids	7%
Explosive	2.5%
Falls	2%
Infections	0.5%

The WHO Global Strategy on Occupational Health for all (1996–2001) has the following objectives:

1. Strengthening of international and national policies for health at work and developing the necessary policy tools.
2. Development of a healthy work environment.
3. Development of healthy work practices and promotion of health at work.
4. Strengthening of occupational health care system.
5. Establishment of appropriate support services for occupational health.
6. Development of occupational health standards based on scientific risk assessment.
7. Development of human resource for occupational health.
8. Establishment of registration and data systems, development of information services for experts, effective transmission of data and raising of public awareness through public information.
9. Strengthening of research.
10. Development of collaboration on occupational health with other organizations.

Occupational Health in 21st Century

Liberalization and globalization of economy are posing a number of challenges in occu-

pational safety and health front mainly in developing countries like India:

1. With a new and sophisticated technology and newer work methods, system and processes, occupational health of workers has come under severe stress.
2. Pollution to the environment, as more hazardous industries are being set up in the country giving rise to accident, occupational diseases and catastrophic risks.

Strategies and approaches to address challenges of 21st century on health front:

1. Engineering approach towards safer processes, integrated system approach and better occupational environment.
2. Medical approach towards identifying the health risks and their prevention.
3. Ergonomical intervention technique.
4. Use of information technology for mass awareness and education.
5. Suitable human resource development (HRD) Strategies.
6. Formulation of comprehensive national policy on safety, health and environment.
7. Integration of occupational health with primary healthcare in the country.
8. Integration of health and safety management system with quality assurance system.
9. Application of total quality management (TQM) principles to occupational health management system.
10. Development of national network on occupational health.

Principles of Ethics of Occupational Health Professionals

Who is an occupational health physician? An occupational health physician is a general medical practitioner who has completed a specialization/residency period in occupational medicine and health, and is certified to work in this field. Occupational physicians are engaged in prevention (pre-employment medical examinations), diagnosis (biological monitoring and periodical examinations) as well as in taking care and rehabilitating workers who have been either injured in work accidents or have become ill due to various occupational diseases.

International Code of Ethics for Occupational Health Professionals prepared by the International Commission on Occupational Health (ICOH) has the following principles of ethics:

1. Occupational health practice must be performed according to the highest professional standards and ethical principles. Occupational health professionals must serve the health and social well-being of the workers, individually and collectively. They also contribute to environmental and community health.
2. The obligations of occupational health professionals include dignity and promoting the highest ethical principles in occupational health policies and programme. Integrity in professional conduct, impartially and the protection of the confidentiality of health data and of the privacy of workers are part of the obligations.
3. 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.

Health of Working Population

Majority of physicians who practice occupational medicine work with knowledge gained by self-study, attending of short-term courses, and practice experience. Here are those who contend that a lack of training in occupational medicine accounts for the failure to diagnose occupational diseases and eventually to compensate workers. Moreover, the long latency periods of many occupational diseases present a causation dilemma for

physicians. Another important contributing cause is the limited information available to physicians. Although interest in occupational medicine is increasing all over the world. Occupational health nurses expanded their roles in many industries over the past few years, with increased involvement in health promotion, management and regulatory issues affecting the workplace. Their roles continue to expand with increased prominence on cost-effective policies and disability management.

The global epidemic of occupational injury and disease is aggravated by the rapid transfer of even more hazardous industries to industrializing countries. The opportunities for improvements in occupational health presented by globalization are out-weighted by the shift in the health costs to workers with high-risk jobs, and this shift primarily affects migrant workers, women, children, and workers with temporary employment. The ILO reports that occupational health and safety laws cover only 10% of the population in developing countries and those laws omit many major hazardous industries and occupations, including agriculture, fishing, forestry; small scale enterprises in industrialized countries lack appropriate occupational health regulations and protective or control measures. Throughout the world, small scale enterprises do not provide basic occupational health services and other primary medical care. Moreover, many small factories are located at the center of or near residential areas. Small scale industrial hazards threaten the health of workers' families and adjacent community.

Effects of Work on Health

Work can affect health in several ways:

1. Occupational exposure may be a direct cause of ill health, for example, exposure to hydrogen cyanide gas encountered by firefighters during their work can cause cyanide poisoning.
2. Occupational exposure, while not necessarily being the sole factor causing disease and be one of a number of contributory causes. Cigarette smoking multiplies the risk for lung cancer if there is exposure to asbestos fibres or radon gas. Each of these can cause lung cancer independently, but a worker who smokes, lives in a high radon environment radon or is exposed to asbestos from work activities has a much increased risk of lung cancer. Another example is that of exposure to carbon monoxide which can result from smoking, following exposure to methylene chloride (used as a paint stripper), and working in an enclosed space like garage which is heated by a gas-fire heater, and has a car engine running. All these factors act independently to increase blood carboxyhaemoglobin, but when several of these sources of carbon monoxide are present together, there is an elevated risk of carbon monoxide poisoning.
3. The nature of job may worsen preexisting nonoccupational disease. Hairdressing producer or working in kitchen can result in a worsening of endogenous eczema.
4. The occupational environment may give easy access to potentially harmful materials, increasing the risk of their abuse. Adverse health effects resulting from availability to toxic agents are effects of anaesthetic gases in anaesthetists or other healthcare staffs or suicide in farm workers using pesticides.

Effects of Health on Work

Following a period of sickness absence, it is in a patient's and society's interest to encourage return to work. Many people with some impairment of function either seek work or seek to remain at work. This may affect his work by the following ways:

1. The patient's condition may limit, reduce or prevent him performing the job

effectively. Example: The musculoskeletal conditions that reduce mobility or diminish manipulative ability.
2. The patient's condition might be made worse by the job (excessive physical exertion in some cardiorespiratory conditions).
3. The patient's condition is likely to make it unsafe to do the job (liability to sudden loss of consciousness while working alone and at height).
4. The patient's condition is likely to make it unsafe for third parties, such as co-workers, visitors or members of the public. For example, a bus or train driver who is prone to episode of unconsciousness with no warning symptoms may cause an accident affecting other crew members, passengers and public.
5. The patient's condition might make it unsafe for the community (for consumer of a product, if a food-handler transmits infection).

Duties and Obligations of Occupational Health Professionals

In general, a physician is expected to cure diseases and injuries, thereby healing the patient, to prevent illness and to promote health, a state of well-being. The field of action of occupational physicians is somewhat wider. Involvement of workers in attempts to improve working conditions, the environmental conditions of the workplace, and the health of the enterprise and of the workforce itself have become essential elements. Occupational physicians advise management on issue of occupational hygiene, which includes the physical environment as well as the psychosocial climate in an enterprise. They assist in the adjustment of the work to the workers and of the workers to their work by an application of medical and behavioral sciences, ergonomics, selection of workers, and other methods. In that way, occupational physicians contribute to the quality of the person–work relationship, and worker–organization relationship, in close cooperation with other departments in a firm. The prevention of occupational diseases, monitoring potential adverse influences in the working environment, and monitoring exposed workers, is the direct responsibility of occupational physicians. Depending on the prevailing conditions, they may be involved in promoting the safety of the work environment with regard to potential injuries resulting from unsafe conditions and unsafe acts. Through epidemiological research, they may identify pathogenic conditions in the work environment and assist in removing these, thus preventing illness. With regards to the contagious diseases, they may organize immunization campaigns and isolate or remove sources of contagion, thus reducing the incidence of such diseases. All this can be summarized as activities aimed at preventing disease, or reducing its incidence, severity, or duration.

Duties and obligations of occupational health professionals:

1. *Ethics:* The first area the occupational health physician needs to clarify the ethics of his or her relationship to the patient's employer. Occupational physicians customarily practice as company doctors employed by corporations, as consultants of corporations, or as private practitioners works for no other purpose than the benefit of the patients. Usually, the code of ethics stresses that (a) the highest priority is to be given to the health and safety of the individual patient, (b) the physician must practice on a scientific basis, with objectivity and integrity, (c) the physician must give an honest opinion and avoid having his or her medical judgment influenced by any conflict of interest.
2. *Reporting health risk*: Disclosure of the health risks may take the form of patient's counseling, communicating findings to companies and government agencies, and publishing pertinent cases and findings in

scientific journals. Disclosures to the patient should be made on the basis of medical fact and not on social and political suppositions.

3. *Confidentiality*: Inappropriate release of medical information can have serious adverse consequences on the job security, so the physician should be sure of his position both legally and ethically when he does pledge himself.
4. *Determining persons' employability*: The examination content performed at the time of employment, includes:
   a. Medical history.
   b. An employment history to determine possible previous hazardous exposures.
   c. A physical examination that is an organ inventory and appraisal of function.
   d. Laboratory test procedure as indicated by previous and present health status and exposure content in the position.
   e. Radiographic examinations as indicated by the history or other evaluation findings.
   f. A recommendation, including individualized work restriction, and suggested accommodations, which is forwarded to the hiring authority, free of any diagnostic information and used exclusively as an aid in placement.
5. *Visiting the workplace*: Plant visits by the occupational health physician to the worker's place of employment are encouraged and necessary to get knowledge of work conditions and job requirement in the first-hand basis.
6. *Treating the injured/ill workers*: Occupational health professionals play an important role in prevention, recognition and treatment of injuries and illness. Workmen's Compensation Act/Law places the occupational physician in a critically important role. The physician must determine that an injury or illness is caused by work, diagnose it, prescribe care, and assess the extent of impairment and the ability of the worker to resume work.
7. *Surveillance examination*: In order to determine the work-relatedness of an employee's health problem or to monitor the occurrence of work-related health problems among a group of employees, the occupational health physician may call upon to perform surveillance examinations. These examinations require that the physician knowledge about what type and amount of exposure may have occurred and what the specific and non-specific bodily effects are produced by the substances upon exposure. The purpose of this examination is to determine potentially harmful effects, both acute and chronic, from exposure to specific substances and environmental conditions. If harmful conditions are discovered, the physician should not suppress this finding or let political or social pressures influence his or her medical decisions.
8. *Referring the patient:* Referring the patient to the referral centre.
9. *Follow-up of remedial action*.
10. *Screening for substances of abuse and combating abuses.*
11. *Advisory role* on *occupational health.*
12. *Compliance of the principles of occupational health services, i.e. preventive, promotive, adaptation, protective, cure and rehabilitation and primary health care principles.*
13. *Development of health policy and programme.*
14. *Emphasis on prevention and on a prompt action.*
15. *Conducting medical examinations*.
16. *Healthcare activities for workers and their families*.
17. *Disaster management activities*.
18. *Coordination with external agencies.*

19. *Coordination with other internal divisions.*
20. *To provide information to the worker.*
21. *To provide information to the employer.*
22. *Communication to third party.*
23. *Conducting training/awareness programme on occupational health.*
24. *Notification of notifiable occupational diseases.*
25. *To conduct biological monitoring and investigations.*
26. *To conduct health promotion activities.*
27. *Protection of community and environment.*
28. *To conduct work environment monitoring.*
29. *Contribution of scientific knowledge.*
30. *Competence, integrity and impartiality.*
31. *Professional independence.*
32. *Collection of health data.*
33. *Statistical monitoring.*
34. *Medical records keeping.*
35. *Relationship with social partners.*
36. *Promoting ethics and professional audit.*
37. *Medicolegal activity.*
38. *Professional independence.*
39. *Providing health education and counseling*: Every time an applicant or employee visits a physician or nurse, there is some health education and/or counseling given. Medical departments in industry provide an ideal opportunity for these services, which constitute an asset for the employees and for the employer as well. Both physicians and nurses in industry play an important role in guiding employees to the proper healthcare resources. An almost equally important role is played when the need is for counseling rather than pills or surgery. The education and counseling functions are often overlooked when assessing the costs and benefits of occupational health programs because of the difficulties in determining the units of service that can be defined. This is unfortunate because experience and common sense indicate that these activities are among the most valuable to both employees and employer.
40. *To take part in research.*

PREVENTION OF OCCUPATIONAL HEALTH HAZARDS

The various measures for the prevention of occupational diseases may be grouped under four heads: Medical measures, engineering measures, statutory or legislation measures and administrative measures.

Medical Measures

1. *Pre-employment medical examination*: It is done at the time of employment and includes the worker's family, occupational and social history, thorough physical, biological and radiological examinations. The purpose of this examination is to place the right person in the right job and to preserve the data for further comparison.

Hazards	*Undesirable condition*
a. Lead	Anaemia, hypertension, nephritis, peptic ulcer.
b. Dyes	Skin, bladder and kidney diseases, asthma, pre-cancerous lesion.

2. *Periodic medical examination*: The slow development of some occupational diseases is very often, leads to their non-recognition in the early stages and this is harmful to the worker. Therefore, for early diagnosis of occupational diseases periodic medical examination is essential. The frequency and content of periodic medical examination will depend upon the type of occupational exposure. Ordinarily, workers are examined once in a year. But in certain occupational exposure like lead, toxic dyes, and radium exposures monthly or six monthly examinations are indicated. Sometimes, even daily examination may be needed when irritant chemical like dichromates are handled.

3. *Pre-placement medical examination*: This medical examination is done when the worker is shifted from one hazardous area to another hazardous area within the same factory.
4. *Fitness-for-duty examination*: A fitness-for-duty examination is essentially the same evaluation and follows the same rules as a pre-placement examination. The only difference is that a fitness-for-duty examination determines whether a previously hired employee who was able to perform the essential functions of the job is still able to perform these essential functions safely. Ideally, a fitness-for-duty evaluation will determine whether an employee is able to perform his or her duties in a safe and effective manner. It is also designed to help the employee to obtain appropriate treatment or reasonable accommodations so that employee may continue his or her current occupation successfully. The employer may request a fitness-for-duty evaluation once the employee's own physician returns the employee to work to ensure that the employee can do his or her job functions safely without endangering himself, herself or others.
5. *Pre-retirement medical examination*: It is done to the workers before the retirement to see the health condition at the time of retirement and these records are to be preserved in some occupations, like asbestos and silica prone industries.
6. *Special medical examination*: This medical examination is done in case of long standing absent.
7. *Medical and healthcare services*: Principles of occupational health service (OHS):
    a. *Preventive*: Preventing occupational health hazards at work.
    b. *Health promotion*: Promoting physical, mental and social well-being of workers.
    c. *Protective*: Protecting workers' health against hazards at work.
    d. *Adaptation*: Adopting work and work environment to the capabilities of the workers.
    e. *Cure and rehabilitation*: Curing and rehabilitating occupational accidental injuries, occupational and work-related diseases.
    f. *Primary healthcare*: To provide primary healthcare to the workers and their families.
8. *First-aid centre or ambulance room*: The ambulance room should be separated from the rest of the factory and shall be used only for the purpose of first-aid treatment and rest. According to the Occupational Safety, Health and Working Condition Code, 2020 (Chapter-VI)—ambulance room in every factory, mine, building or other construction work wherein more than five hundred workers are ordinarily employed.
9. *First-aid box*: Every factory be provided and maintained so as to be readily accessible during all working hours first-aid boxes or cupboards equipped with the prescribed contents, and the number of such boxes or cupboards to be provided and maintained shall not be less than one for every one hundred and fifty workers ordinarily employed at any one time in the factory (Section 45 of Factories Act, 1948: First-aid Appliances). According to the Occupational Safety, Health and Working Condition Code, 2020 (Chapter-VI)—adequate first-aid boxes or cupboards with contents readily accessible during all working hours.
10. *Industrial hospital*: As a referral centre.
11. *ESI scheme*: Employees State Insurance (ESI) is a self-financing social security and health insurance scheme for Indian workers.
12. *Notification of notifiable occupational diseases*: National Law and Regulations (according to the Occupational Safety, Health and Working Condition Code, 2020) require the notification of some

cases and suspected cases of occupational diseases and these occupational diseases are called notifiable occupational diseases. These diseases are recognized internationally for the purpose of workmen's compensation. The main purpose of notification in industry is to initiate measure for prevention and protection and ensuring their effective application and to investigate the working condition and other circumstances which have caused or suspected to have caused occupational diseases. There is a list of 29 diseases included as notifiable occupational diseases as per Schedule III and Section 12 of this Code and recognized for the purpose of workmen's compensation as per the Workmen's Compensation Act, 1923. According to this OSH&WC, 2020, Section 12(1) where any worker in an establishment contacts any disease specified in the Schedule III, the employer of the establishment shall send notice thereof to such authorities, and in such forms and within such time, as may be prescribed by the appropriate government.

13. *Supervision of work environment*: The clinician often can best understand the potential contribution of workplace exposures to the patient's illness by visiting the workplace. The information that may be obtained during a site visit includes a detailed description of the work process, prior results of industrial hygiene sampling and medical surveillance, list of toxic or hazardous materials used and most important, a guided tour of the work site with a focus on the specific work areas where the patient has been working.
14. *To supervise/acquaintance with*: Physical, chemical, biological, mechanical and psychosocial hazards.
15. *To study occupational physiology*: Fatigue and weight carried.
16. *To supervise night-work and shift work.*
17. *To advise on matter connected with health and welfare*.
18. *Maintenance and analysis of records*.
19. *Health education and counseling*.

Engineering Measures

1. *Design of building*: Measures for the prevention of occupational disease should commence in the blue-print stage. The type of floor, wall, height, ceiling, roof, doors, windows, cubic space, and colour should receive attention.
2. *Good housekeeping*: It covers general cleanliness, ventilation, lighting, washing, food arrangements and general maintenance. It is a fundamental requirement for the control of occupational diseases.
3. *General ventilation*: There should be efficient exhaust ventilation in the room where dust, gas, and fumes are generated to decrease the air-borne contaminants.
4. *Mechanization*: The plant should be mechanized to the fullest possible extent to reduce the hazard of contact with harmful substances.
5. *Substitution*: Defined the replacement of a harmful material by a harmless one or one of lesser toxicity. Example: Zinc or iron-based paints in place of lead-based paints and acetone or toluene can be used in place of benzene.
6. *Dust control*: It can be controlled at the point of origin by water spray (wet method or hydroblasting).
7. *Enclosure*: Enclosure on the harmful materials and processes will prevent the escape of dust and fumes into the factory atmosphere.
8. *Isolation*: Sometimes, it may be necessary to isolate the offensive process in a separate building so that workers could not directly connected with the operation and not exposed to the hazards.
9. *Local exhaust ventilation*: By providing local exhaust ventilation, dusts, fumes

and other injurious substances can be trapped and extracted 'at source' before they escape into the factory atmosphere. The heart of local exhaust ventilation is the hood which is placed as near as possible to the point of origin of the dust or fumes. In this way, the breathing zone of workers may be kept free of dangerous dust and poisonous fumes.

10. *Protection devices*: To provide respiratory and non-respiratory personal protective equipment (PPE).
11. *Environmental monitoring*: To maintain safe work environment.
12. *Statistical monitoring*: It comprises the review at regular intervals of collected data on the health and environmental exposure of occupational group.
13. *Research*: It can provide a better understanding of the industrial health problems. There are two kinds of research: Pure research and research for improvement of or in connection with a manufacturing product.

Statutory/Legislation Measures

To comply (in India) some main code/act like:

1. Occupational Safety, Health and Working Condition (OSH&WC) Code, 2020.
2. The ESI Act, 1948.
3. The Workmen's Compensation Act, 1923.

Administrative Measures

Examples are:

Acclimatization: It is done to the workers who are going to absorb in heat prone areas.

Change of job: Shifting of the workers from noisy area to non-noisy area who are suffering from initial stage of noise induced hearing loss (NIHL).

Occupational Health and Productivity

Employee health and its effect on productivity are emerging as a critical focus for businesses and occupational health. Employers are realizing that the direct costs of insurance premiums are not what affect the bottom line. The indirect costs of absenteeism and 'presenteeism' (lessened job performance owing to chronic health problems) are also significant drain on company resources. Companies are recognizing that employees are their most important asset and often are not replaced easily. A healthy workforce is now seen as essential to long-term productivity. Companies, traditionally believed that high performance was linked primarily to cognitive abilities. However, recent research demonstrates that in order to sustain business growth, employers must be aware of the effect of human health on performance. Employees must have optimal health to maintain optimal productivity. Healthcare is not only a cost, but it is also an investment in the economic health of the company. Healthcare costs need to be targeted toward interventions that lessen health risks, decrease the incidence of new diseases, and mitigate the impact of chronic diseases on workers. Measuring the effect of health on productivity is an emerging field. Occupational physicians and nurses understand the workplace and have substantial expertise in disability management. They understand the barriers that may occur before returning an employee back to work and the issues that may delay recovery or affect performance. Occupational physicians and nurses already play roles in workers' compensation disability management, decreasing workers' compensation costs and promoting an early safe return to work. An occupational health specialist is the key player in an integrated health management system. This system should encompass medical programmes including return to work, reliance on evidence-based medicine protocol, treating minor non-work-related illness, and using employee assistance programmes. There needs to be an internal process to change the work culture to one of total wellness and prevention, including workers' training, the development of information systems to track

and report trends, and data analysis to identify areas for opportunity. By using a health and productivity questionnaire, the occupational health professional is able to analyse the health needs of a company. The medical department will know which chronic diseases affect their workplace and to what extent. The physician or nurse will be able to prioritize the programmes and determine what consulting and case-management systems will benefit the company most. Working with benefits and human resources, the physician or nurse can help the company to determine which health benefits need strengthening and what services should change based on the chronic health conditions and the medical risk factors of their specific workforce.

Implementation of National Policy for Excellence in Safety, Health and Environment (SHE) Management for Industrial Development in India

Industrialization is a global phenomenon and India is no exception and it is very much needed for economic growth and to face the global challenges. With rapid technological advances in industrial process, newer types of dangers to the life are being increasingly introduced. The management has to play prime role to resolve these issues and restore values through following definite objectives:

1. To fulfill the commitment towards constitutional requirement.
2. To comply the statutory requirement.
3. To run the organization smoothly.
4. To maximization the profit.
5. To render accident/illness free service.
6. To improve its employees.
7. To create new employment opportunities.
8. To serve the society.
9. To enrich the nation.

The constitutional requirement for the management of the industry is to implement the concerned articles of 'Directive Principles of State Policy' like:

Article 39: Directs for securing the health and strength of employees, men and women, that the tender age of children is not abused, and citizens are not forced by economic necessity to enter avocations unsuited to their age or strength.

Article 43A: States that the government shall take steps, by suitable legislation or in any other way to secure the participation of employee in the management of undertakings, establishments or other organizations.

Article 24: Directs for ensuring that no child below 14 years is employed to work in any factory or mine or engaged in any other hazardous employment.

On the basis of these directive principles and international instruments, the Government of India declared National Policy on 'Safety, Health and Environment at Workplace' duly approved by the Union Cabinet on 20th February, 2009 in New Delhi, during Indian Labour Conference.

Goal of the National Policy

1. Framing a statutory framework on SHE (Safety, Health & Environment).
2. Developing research and development capability.
3. Improving data collection system on work-related injuries and diseases.
4. Developing and mobilizing required technical OSHE manpower.
5. OSHE as integral component in every operation and in other relevant national policy.

Objectives of National Policy

1. Continuous reduction in the incidence of work-related fatal and non-fatal injuries, occupational diseases.
2. Improve coverage of work-related injuries, fatalities and diseases and provide for a more comprehensive database.
3. Continuous enhancement of community awareness.

4. Continuous increase in community expectation of workplace health and safety standard.
5. Improving SHE at workplace by creation of 'Green jobs'.

Action Programme

1. Enforcement by the State Enforcement Authority.
2. National standard by BIS and other concern authority.
3. Compliance of Safety Statutes and Standards by the industry.
4. Awareness programme by the Government, Industries and OSH stakeholders.
5. Research and development by all concerned.
6. Data collection and formation of DATA BANK.
7. Review of OSH status through audits, studies and surveys.
8. Review/update SHE policies at workplace.

Accident scenario in industries in India

Type of accident	*Year*				
	2007	*2008*	*2009*	*2010*	*2011*
Fatal	1464	1369	1509	1459	1433
Non-fatal	32526	32570	31584	30046	28402

(Standard Reference Note-2016: DGFASLI)

Industrial Safety, Health and Hygiene

The principles, which need to state the basic philosophy that will guide future efforts in safety, may include something similar to the following:

1. Safety must be at least equal to all other business activities.
2. Management must demonstrate a clear commitment to safety.
3. Safety improvement requires continuous change.
4. Management must provide the resources for continuous improvement.

Resources provided by management may include, but are not limited to the following:

1. Safety and health team.
2. Training and education materials, including instructors.
3. Time for training and education.
4. Personal protective equipment.
5. Technology review for training needs.
6. Funds to correct recognized hazards.

Some basic ingredients are needed for the development of an effective safety and health plan for continuous improvement. Safety and health programs may vary as to the implementation of each ingredient, but programs should include:

1. Defined objectives, goals, and measurements.
2. Organizational commitment.
3. Evaluation of hazards and the causes of hazards.
4. Facility and equipment design.
5. Effective communication, training, and educational programs.
6. Corrective action programs and performance audit.

Some of the methods that can be used to review the workplace for existing hazards:

1. Utilizing safety and health professionals for periodic audits.
2. Training everyone to recognize known hazards.
3. Performing periodic inspections of equipment and work areas.
4. Performing process analyses for potential problems.
5. Investigating all accidents with potential to cause accidents.
6. Organizing committees to review specific problems.

Industrial hygiene is devoted to the anticipation, recognition, evaluation, and control of environmental factors or stresses arising in or from the workplace, which can cause sickness, impaired health and well-being, or

significant discomfort among workers or among citizens of the community. The role of industrial hygienist in the work setting is to provide expertise in identifying health hazards, using accepted instrumentation and methodologies to evaluate their magnitude and to provide advice on implementation of control measures. One aspect of that role is to provide information to the occupational health practitioners on the hazards posed by work processes. An effective industrial hygiene program must be proactive in recognizing potential hazards and setting up sound programs that reduce exposure hazards.

Travel Medicine

Emporiatics or travel medicine has become a particular interest for specialists in infectious diseases, tropical medicine and public health. It is an important aspect of occupational health for two large groups of workers: People who must travel and people who manage and operate the conveyances and accommodations that travelers use. The objectives of an organized medical operation for travel and travel-related work are to (a) preserve the health and safety of the traveler/worker, (b) optimize the traveler's/worker's capacity to carry out their assignments, (c) protect the health and safety of the traveler's/worker's colleagues and the people of the host countries. Rapid travel through several time zones causes the disruption of disposition and daily activities that have become a condition known as 'jet lag'. Symptoms of jet lag are most prominent and prevalent following long overnight flights in any direction. Most international travelers experience time asynchrony in appetite, bowel function, and alertness for several days despite assuming local diurnal activity. Having a successful overseas experience is not automatic. Failure to complete an overseas assignment is more often due to cultural shock than physical illness. The *cultural shock syndrome* is the product of the multiple adjustments a visitor or expatriate must make during the early weeks and months of an overseas journey or tour of duty. Establishing immunity to infectious disease is one of the most important components of preparation for travel and Covid-19 is the recent example.

Occupational Health Policy

Example of a manufacturing industry:

Objectives

The manufacturing process of the company being a complex activity, the company recognizes that the company has a moral, economic, social and legal obligation to prevent hazards, provide healthy working environment and guard against all possible hazards and risks. The company, therefore, adopts and promulgates the policy set out below for the purpose of creating and maintaining a safe and healthy working environment.

Occupational Health Service

1. Company will establish occupational health service (OHS) centres in all its manufacturing units including captive mines to promote and maintain the physical, mental and social well-being of all the employees.
2. The company will establish a model referral centre for occupational health service for the industry.
3. Occupational health service at the unit level will function under medical department.
4. Occupational health service in all units shall be equipped to detect and prevent occupational/work-related diseases and to offer effective emergency and injury care at work.
5. Occupational health service at unit level shall employ any of or all the specialties of occupational medicine, occupational hygiene, occupational physiology and ergonomics, occupational psychology,

occupational health nursing, health education, biochemistry and toxicology, health information system, epidemiology and research depending on the needs of the unit in which they are housed, as approved by the management.

6. The occupational health service centre will be headed by the occupational physician who will be totally responsible for organizing various functions and comprehensive occupational health programmes as decided from time to time.
7. Occupational health service centres will have sufficient and adequate facilities (by way of qualified specialists, equipment, reference books and journals) to perform their above functions effectively.
8. OHS centres will have standard facilities for clinic-pathological tests and biological monitoring. All the OHS centres shall follow the same standardized procedures and will have close liaison with the main hospital and laboratories of the plant.
9. OHS shall arrange to provide adequate number of first aid boxes with approved contents on the shop floor. These boxes shall be maintained and kept under the charge of trained and competent first-aiders. Inspection of such boxes shall be carried out by OHS staff regularly from time to time.
10. OHS shall develop health education training packages including use of personal protective equipment for all employees and impart training accordingly.
11. OHS centres will play a vital role in suitably redeploying or rehabilitating an employee; if it is found that he/she is incapacitated due to an accidental injury, occupational disease or otherwise.
12. OHS centre will take special care of women employees working in hazardous areas or handling toxic substances which may cause danger or interfere with pregnancy/child-bearing/reproductive system.
13. The occupational physician will advise on suitability of the various personal protective equipment. While recommending, he will consider all factors relating to health, anthropometric measurements, comfort and other ergonomic aspects of relevance.
14. The head of the medical department at unit level would ensure rendering immediate medical care wherever so indicated and get the occupational and environmental health hazards analyzed with a view to advice the chief executive of the plant/unit for adopting preventive/corrective/containment measures.
15. All OHS units of the company will also cater to the emergency medical care as outlined in the disaster management plan. It will be well-equipped with medicines, dressings, injections and such other medical equipments to meet the emergency.
16. Key personnel with assigned specific functions will be identified and a chart indicating this displayed prominently. The OHS staff will also participate in mock-drills organized for the purpose.
17. The occupational physician will be a member of medical board and safety and health oriented committees.

Medical Examination

1. Every employee of the company at the time of recruitment will be subjected to pre-employment medical examination and would be recruited only when he/she has been declared medically fit by the competent medical authority.
2. Every employee, so declared medically fit would conform to the medical fitness norms in accordance with the rules and standards prescribed by the company.
3. All the employees, particularly above 40 years of age may be subjected to periodical medical examination in addition to the statutory requirements.
4. The company will ensure that uniform standards and procedures are followed in

all OHS with regard to medical screening for all employees at induction, during employment and at pre-retirement. This may be reviewed from time to time.

5. All health screening examinations will aim at evaluating general as well as occupational health status of employees. These examinations will include screening and diagnostic tests as may be deemed necessary from the occupational exposure point of view.
6. All medical records of the employees will be preserved in OHS centres and treated as confidential documents but accessible to respective employees. Computerized health information system shall be adopted wherever possible. The health records will be so designed to meet the statutory requirements.

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