OCCUPATIONAL HEALTH & MEDICAL EXAMINATION OF EMPLOYEES

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"What is Your Occupation?" - Dr. Bernardino Ramazzini

A 35-year-old man was visiting the hospital with complaints of pain, redness, dryness and burning of eyes. He gave history of similar complaints 4-5 times in last one year for which he had visited the hospital.

The patient was a "toddy tapper". Lime is added to the sap to prevent it from fermenting. The worker's eyes were exposed to lime due to nature of his work. If during the initial visit, if the doctor asked this patient, one simple question; **"What exactly is the nature of your work?"** the doctor would have arrived at an accurate diagnosis. Simple instructions to avoid exposure of eyes to lime would have prevented the recurrence.

Dr. Bernardino Ramazzini, a 16th Century Italian physician asked this million-dollar question to his patients. He also urged his colleague doctors to ask this question.

History of Occupational Health

That exposure to hazards at workplace can adversely affect the health was known for more that 2000 years. Hippocrates known as "father of Medicine" was first to recognize toxic effects of lead in fourth century B.C. Ping, a roman scholar in first century A.D. described a protective mask made from bladder which was used by workers in dusty trade. Dr. Ramazzini in his book "De MORBIS ARTIFICIUM DIATRIBA" written in 1700 A.D. accurately described occupational diseases due to many types of jobs such as chemist, metal diggers, cobblers, bakers, wool workers, brick makers and many more. First legislation "The health and moral of Apprentices Act, 1802" related to OHS was passed in United Kingdom. Many enlightened individuals have contributed to our knowledge of the subject.

What is Occupational Health?

World Health Organization definition states "Health is a complete state of physical, mental and social well-being and not merely absence of disease or infirmity".

In line with the above, Occupational Health may be defined as "Promotion and Maintenance of the Highest Degree of Physical, Mental and Social Well-being of Employees in All Occupations at All Locations".

What is Occupational Disease?

International Labor Organization definition says "Occupational disease" covers any disease contracted as a result of an exposure to risk factors arising from work activity. There are certain diseases are categorized as Notifiable diseases under the Factories Act,1948 and the Building and Other Construction Workers' (Regulation of Employment and Conditions of Service) Central Rules, 1998. The management has to report any notifiable diseases detected at the worksite to authority. The list of Notifiable disease are follows:

List of notifiable diseases in SCHEDULE III under the sections 89 and 90 of the Factories Act,1948

1. Lead poisoning, including poisoning by any preparation or compound of lead or their sequelae.
2. Lead tetra-ethyl poisoning.
3. Phosphorus poisoning or its sequelae.
4. Mercury poisoning or its sequelae.
5. Manganese poisoning or its sequelae.
6. Arsenic poisoning or its sequelae.
7. Poisoning by nitrous fumes.
8. Carbon bisulphide poisoning.
9. Benzene poisoning, including poisoning by any of its homologues, their nitro or amido derivatives or its sequelae.
10. Chrome ulceration or its sequelae.
11. Anthrax.
12. Silicosis.
13. Poisoning by halogens or halogen derivatives of the hydrocarbons of the aliphatic series.
14. Pathological manifestations due to—
    (a) radium or other radio-active substances;
    (b) X-rays.
15. Primary epitheliomatous cancer of the skin
16. Toxic anaemia.
17. Toxic jaundice due to poisonous substances.
18. Oil acne or dermatitis due to mineral oils and compounds containing mineral oil base.
19. Byssinosis.
20. Asbestosis.
21. Occupational or contact dermatitis caused by direct contract with chemicals and paints. These are of two types, that is, primary irritants and allergy sensitizers.
22. Noise induced hearing loss (exposure to high noise levels).
23. Beryllium poisoning.
24. Carbon monoxide.
25. Coal miners' pneumoconiosis.
26. Phosgene poisoning.
27. Occupational cancer.

28. Isocyanates poisoning.
29. Taxic nephritis.

List of Notifiable Occupational Diseases in SCHEDULE II under the RULE 230 (A) of the Building and Other Construction Workers' (Regulation of Employment and Conditions of Service) Central Rules, 1998

1. Occupational dermatitis.
2. Occupational cancer.
3. Asbestosis.
4. Silicosis.
5. Lead poisoning including poisoning by any preparation or compound of lead or their sequelae.
6. Benzene poisoning, including poisoning by any of its homologues, their nitro or amino derivatives or its sequelae.
7. Occupational asthma.
8. Pesticide poisoning.
9. Carbon monoxide poisoning.
10. Toxic jaundice.
11. Toxic anaemia.
12. Compressed air illness (Caissons disease).
13. Noise induced hearing loss.
14. Isocyanates poisoning.
15. Toxic nephritis.

What are the characteristics of Occupational Diseases?

- They take a long time to develop (except effects of poisoning at high concentrations)
- The exposed employees do not have any symptoms initially
- Most of the occupational diseases are not curable once permanent damage has taken place
- Most of the occupational diseases are preventable
- Many times, it is difficult to establish an occupation as a cause

There is no occupation without a hazard. But we can say on the positive note that it is possible to prevent occupational diseases because the hazards can be identified or known, can be measured and mitigation measures can be implemented. Some of the known occupational diseases include pneumoconiosis, occupational dermatitis, noise induced hearing loss, occupational cancers etc.

What are various Occupational Hazards?

Employees are exposed to hazards at workplace. They can be classified as physical, chemical, biological, mechanical, ergonomic and psycho-social. It will be beyond scope of this article to discuss every hazard and its health effect in detail. Hence, an overview is given below.

A. Physical Hazards

Physical hazards include heat, cold, noise, vibration, atmospheric pressure, illumination, non-ionizing radiation and ionizing radiation. Exposure to physical hazards can be easily measured and controlled.

Table 1: Summary of Physical Hazards

S.No.	Hazard	Health Effects	Mitigation Measures
1	Heat	• Prickly heat • Physical fatigue • Heat cramps • Heat exhaustion • Heat syncope • Heat stroke	• Monitoring by Wet Bulb Globe Temperature index • Proper ventilation • Shelters • Work Rest cycle • Proper clothing • Adequate safe drinking water • Training of supervisors to identify early symptoms of heat stress
2	Cold	• Trench foot • Frost bite • Hypothermia	• Temperature monitoring • Shelters • Work Rest cycle • Proper clothing • Training of supervisors to identify early symptoms of frost bite and hypothermia

S.No.	Hazard	Health Effects	Mitigation Measures
3	Noise	• Temporary hearing loss • Permanent hearing loss (NIHL) • Non-auditory effects such as fatigue, stress like response, interference with communication	• Engineering measures such as isolation of process, shields, machine maintenance, proper base fixing etc. • PPEs such ear plugs, earmuffs • Periodic audiometry
4	Illumination Insufficient or excessive light	• Eye strain • Fatigue • Headache • Stress • Accidents • Lower productivity	• Illumination monitoring • Legal compliance • Appropriate lighting system • Measures to reduce glare • Eye check-up
5	Vibration	• Musculoskeletal diseases • Joint problems • White fingers (in localized exposure)	• Vibration measurement • Proper fixing of seat • Cushioning • Work rest cycle • Anti-vibration gloves
6	Ionizing Radiation	• Cancer • Genetic damage • Foetal malformations • Skin ulcers	• Engineering measures • Radiation measurement • TLD badges for personal monitoring • Regular health-check-ups
7	Non-ionizing Radiation	• Arc eyes • Cataracts	• Engineering measures • PPEs
8	High Altitude	• Acute mountain sickness • High altitude pulmonary (Lung) oedema • High altitude cerebral (Brain) pulmonary oedema	• Medical examination • Training • Acclimatization • Oxygen supplementation
9	Deep sea diving	• Barometric trauma • Decompression sickness • Osteonecrosis	• Medical examination • Training • Gradual ascent • Supervision

B. Chemical Hazards

It has been estimated that more than 80000 chemicals are in use today in industries and commerce. Workers can be exposed to chemicals in various forms such as dust, powder, liquid, gas, aerosol, mist, fumes and smoke. The chemicals enter the body through inhalation, ingestion and skin absorption. Inhalation is the most common source of exposure as lung surface area is about 100 cubic m.

As can be seen from table II, all organs and body systems can be affected to various degrees. The adverse effects are dependent on properties of the chemical, concentration, particle size (in case of dusts), duration of exposure, severity of exposure and individual susceptibility. Acute exposure is easily identified, diagnosed and treated. However, it is important to identify chronic health effects (Due to exposure of low concentrations over a long period of time).

Table II – Summary of Chemical hazards

S.No.	Target Organ	Mechanism	Health Effects	Mitigation Measures
1	Skin	Direct exposure of skin to various chemicals	• Chemical Burns (Due to exposure due to high concentrations) • Occupational dermatitis • Oil acne • Skin cancer	• Engineering measure • Appropriate PPEs • Barrier cream • Hand washing • Training
2	Lungs	Inhalation of dusts, aerosols, fumes, smoke	• Acute effects due to exposure to high concentrations e.g. chlorine, ammonia • Pneumoconiosis e.g. silica, coal dust, cotton, asbestos • Lung cancer e.g. asbestosis, chromium • Occupational asthma • Lung tissue inflammation	• Occupational hygiene studies to asses exposure • Engineering measures • General and local exhaust ventilation • Respiratory PPEs • Training • Periodic medical examination
3	Brain, Liver, Kidney, Heart, Bones, Endocrine system, Reproductive system, Genes	Entry of chemicals into blood stream through inhalation, ingestion and skin absorption	• Genetic damage • Structural damage • Functional damage • Cancer • Effect on developing foetus	• Occupational hygiene studies to asses exposure • Engineering measures • Appropriate PPEs • Training • Periodic medical examination

C. Biological Hazards

The biological hazard means exposure to living organisms such as bacteria, viruses, fungi, parasites etc. These microorganisms can enter the blood stream through inhalation, ingestion and broken skin. Animal bites such as snake, scorpion, insects, wild animals etc. maybe also considered as biological hazard if it occurs in course of the job requirement. Food safety in the canteen and cafeteria at workplace is also important as lack of it may expose the worker to food and water borne infections.

The most common occupations where employees face biological hazards are farming, construction, health care, slaughterhouses, animal labs, sewage cleaning, etc. The health effects of the entry of germs in the body are varied and depend on the virulence of the organism, dose, vaccination status, nutritional status and immunity of the person.

Some of the infections that can be attributed to workplace are anthrax, tetanus, brucellosis, Hepatitis-B, leptospirosis, SARS, Orf, Q fever and many others. It may be noted that these diseases occur in general population but more chances of exposure at workplace due to the inherent risk increases the chances of infection.

The preventive measures include engineering measures (if applicable e.g. automation in slaughter houses and sewage cleaning), appropriate PPEs, training and awareness, regular cleaning and housekeeping, provision of safe drinking water, handwashing facilities and suitable vaccination (e.g. tetanus, hepatitis-B, H1N1 influenza, Anthrax).

D. Mechanical Hazards

The hazards include potential accident hazards at workplace such as moving parts of machinery, vehicular accidents, slips and trips, electrical shock, fall from height, fall of heavy object, collapse of structure etc. They are in domain of safety professionals, engineers and operation team. Hence, they are not discussed here in detail.

E. Ergonomic Hazards

As more and more automation and mechanisation are being implemented in industries and workplaces, the incidence of physical and chemical hazards is coming down to some extent especially in organized sector. Musculo-skeletal problems are on the rise. The constant use of electronic gadgets such as computers, laptops, mobile phones, gaming consoles, iPod etc. are significantly contributing to the problem.

ILO Definition says "Ergonomics is application of Human Biological sciences along with Engineering sciences to achieve the optimum mutual adjustment of man and his work". It is a very complex science which involves application of various disciplines such as Anthropometry, Biomechanics, Mechanical engineering, Industrial engineering, Industrial design, Kinesiology, Physiology and last but not the least Psychology. It involves adjustment of man to machine, man to work process and man to work environment.

Table III - Summary of Ergonomic hazards

Mechanism	Health Effects	Mitigation Measures
• Repetitive work • Use of Force e.g. lifting, pulling and pushing • Awkward Postures • Static Posture e.g. prolonged standing or sitting • Contact Stress • Environment such as temperature, noise, • Psycho Social e.g. boredom, anxiety, depression, poor job satisfaction	• Musculo-skeletal disorders such as affection of bones, joints, muscles, ligaments, tendons • Affection of peripheral nerves • Psychological effects • Accident potential • Low productivity • Fatigue – Physical and Mental	• Good Design of workplace, work process and work environment considering potential ergonomic hazards • Application of ergonomic rules • Regular ergonomic evaluation • Engineering measures such as automation, mechanical lifting of weights etc. • Job rotations and work rest cycles • Employee awareness training • Training of supervisors to identify ergonomic hazard • Prompt Referral of employee who exhibits early symptoms to the doctor

It may be noted that development of ergonomic injury depends on nature of mechanism of injury, duration of exposure, severity of exposure, individual susceptibility and general physical fitness of the worker.

Psycho-social Hazards

A sound body in a sound mind is extremely important for employee well-being, safety and productivity. Mental Health of an employee and her/his behaviour is influenced by genetics, nutrition, upbringing, experiences in early childhood, societal culture, ethnic culture, attitude and socio-economic issues. Problems and stress at workplace can significantly contribute to the mental health status of the employee. Unfortunately, the awareness of mental health issues in general population as well as all stake holders at workplace are low.

Table IV - Summary of Psycho-Social Hazards

Psychological Hazard	Adverse Health Effects	General Mitigation Measures
• Failure to adapt • Sexual harassment • Lack of job satisfaction • Low wages • Poor interpersonal interaction • Deprivation of family life	• Stress • Addictions (Though many times tension is just an excuse used for alcohol or tobacco abuse) • Exposure to sexually Transmitted Diseases • Malnutrition	• Inclusion of psychological hazards in HIRA document • Awareness training for all • Training of supervisors to identify early symptoms • Zero tolerance for alcohol or tobacco use at workplace

Table IV - Summary of Psycho-Social Hazards

Psychological Hazard	Adverse Health Effects	General Mitigation Measures
• Inability to deal with new technology • Frequent job rotations • Job insecurity • Changing job locations • Responsibility but no authority P.S. This list is indicative and not exhaustive. The readers may add many more conditions depending on their experience	• Increased accident potential • Sickness absenteeism	• Grievance Redressal Mechanisms at workplace • Counselling facilities • Sexual Harassment committee P.S. Unlike other workplace hazards, psycho-social hazards are not easily measurable, and results of mitigation measures may not always be measurable and predictable

What are the measures for prevention of Occupational Diseases?

Prevention of occupational diseases is multi-task effort involving senior management, operations, safety personnel, environment department, HR, Occupational health physician and medical staff, union representatives, government officials and last but not the least workers themselves.

Table V - Summary of Measures to control occupational risk exposure

Psychological Hazard	Adverse Health Effects	Adverse Health Effects	General Mitigation Measures
• Design of Workplace • Design of Safe work Procedures • HIRA (Hazard Identification and Risk Assessment) document • Application of Ergonomics Principles • Control of hazard at source • Isolation of process • General Ventilation • Illumination • Repair & Maintenance of Equipment • Environmental sanitation	• Periodic Occupational hygiene studies • MSDS • Risk communication • Washing Facilities • Safe drinking water • Nutritious food • Personal Protective Equipment • Statistical Monitoring • Research • Good Housekeeping • Training • Work Rest cycle • Safety audits • Family planning • Grievance redressal mechanism • Signages, warnings	• Pre-employment Examination • Periodic Examination • Biological Monitoring • Medical & Health Care Services • Immunization • Counselling Services • Notification • Documentation & Research • Health Education **It is extremely important the doctor is trained in occupational health**	• Maintaining legal register • Compliance of various safety and OH related provisions in various acts such Factory Act, Mining Act, BOCW Act, E.S.I.S. Act etc.

Medical Examination (Called Medical Surveillance as well)

Health is not valued till sickness comes. – Thomas Fuller

Medical examinations are one of the important components of medical measures. It must be noted that the medical examination conducted as per occupational health principles is different from general medical check-up. These check-ups are not for general fitness but for specific fitness for the job. These are also done to comply with statutory requirement as outlined in the factory act, Mines Act, BOCW act, new OHS labour code etc.

What are the general Principles of Medical surveillance?

- It is not a general check-up
- Occupational risk exposure assessment is the determinant and not mere exposure to a hazard

- Components of medical examinations viz. medical history taking, physical examination and investigations are in line with assessed occupational risk exposure
- The tests will be different for trades in the organization
- Legal provisions should be considered
- Unnecessary tests should be avoided
- Objective of these medical examinations are to determine fitness of the employee for specific job
- To determine that current medical condition of employee does not pose a threat to herself/himself and other employees
- Due to high incidence of diabetes mellitus and high blood pressure in Indian population, blood pressure examination and blood sugar check-up should be included in the medical surveillance for early detection of these silent killers

What are the different determinants for Occupational Risk Profiling and Medical Examination?

"Risk comes from not knowing what you are doing" – Warren Buffet

Various tools and information are available to determine the occupational risk profile and medical tests to be conducted. They many include

- Work Processes & Workflow
- Process safety analysis
- HAZOP and similar studies
- Job safety analysis
- Hazard Identification and Risk Analysis results
- Industrial hygiene studies - Personal as well as Environmental - Time Weighted Average data
- Target organ damage data as per Material Safety Data sheets for all raw, intermediate and final products and toxicity studies
- Accident and injury pattern analysis
- Availability of biological markers in body fluids e.g. urine
- Availability of PPEs
- Trend analysis
- Morbidity patterns (Sickness data analysis)
- Statutory and legal requirements
- Any other relevant information

Occupational risk exposure is jointly determined by team consisting of safety professional, industrial hygienist, production team, occupational health physician and other relevant stakeholders based on the above data. Once the employees are classified in SEGs (Similarly Exposed Groups), site occupational health physician will determine what tests are to be done for each employee.

What are the different categories of Medical Surveillance?

Table VI – Categories of Medical Surveillance

Category	When It Is Done	Why it is done
Pre-employment	Before the employee joins the organization	• To assess the physical and mental capability of the employee for the specific job • To document base line health data • To recruit a fit and productive employee • To reduce the economic burden on the organization • To comply with legal provisions
Periodic	• At regular intervals during employment • Generally, once a year • Additionally, as prescribed by the law	• For early diagnosis of Occupational diseases • Removal from further exposure if needed • Early changes may be reversible and progression of disease may be halted • Disability limitation with timely intervention • Trend analysis in different SEGs • To comply with legal provisions • Early diagnosis of non-occupational diseases

Category	When It Is Done	Why it is done
Pre-placement	When the job and risk profile is changes due job change within the organization	• To assess the physical and mental capability of the employee for the changed job • To comply with legal provisions if necessary
Per exposure	When the employee is exposed to any chemical or hazard due to accident	• For early detection and medical management of adverse effects of such exposure • To assess the fitness of employee to return to the job
Per request	When requested by supervisor or employee	• To assess the current medical condition of employee • To assess the fitness of employee to return to the job • To recommend temporary or long-term job change if necessary
Return to Work	When the employee returns to work after a prolonged injury or illness	• To assess the current medical condition of employee • To ensure that the injury or the prolonged illness has not hampered employee's ability to carry of the job assigned. • To recommend temporary or long-term job change if necessary
Exit	When the employee leaves the organization	• To assess the current medical condition of employee • To ensure that the health of the employee is not adversely affected due to employment risk exposure

What are some practical examples of tests conducted in medical surveillance?

- Pulmonary function tests in employees exposed to dusts toxic to lungs
- Audiometry in employees exposed to high noise or ototoxic chemicals
- Liver function tests in employees exposed to hepatotoxic chemicals
- Hearing and vision testing (including peripheral vision) testing in employees driving powered industrial vehicles such as forklift
- Hearing and vison testing (including depth perception) for overhead crane operators
- Targeted examination of Musculo-skeletal system of employees exposed to ergonomic risk
- Radiation exposure testing (quarterly) in employees exposed to ionizing radiation
- Height pass and vertigo test in employees working at height
- Stool examination and appropriate vaccination for food handlers
- Urinary phenol testing in employees exposed to benzene
- Examination of nasal septum in employees exposed to chronic chromium exposure

Take Home Message

- Employees are exposed to hazards at workplace thus having adverse effects on their health
- Most of the occupational diseases are not curable but are preventable
- Most of the occupational hazards can be identified, measured and controlled
- Often chronic health hazards are neglected and not suitably identified
- Controlling and minimizing occupational risk exposure include engineering measures, administrative measures, medical measures and legal measures
- Doctor trained in Occupational health, trained medical staff and medical measures play a vital role
- Medical surveillance is a vital tool of early detection and management of occupational diseases
- Medical surveillance tests are specific to occupational risk profile and not for a general check-up
- The basic objective of medical surveillance to determine fitness of employee for the specific job and early diagnosis of occupational diseases
- Effective implementation of Occupational Health management system makes a good business sense in terms of safety, productivity, cost reduction and legal compliance

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